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

Rexroth Bosch Group

Rexroth IndraDyn A Series Asynchronous Motors MAD/MAF

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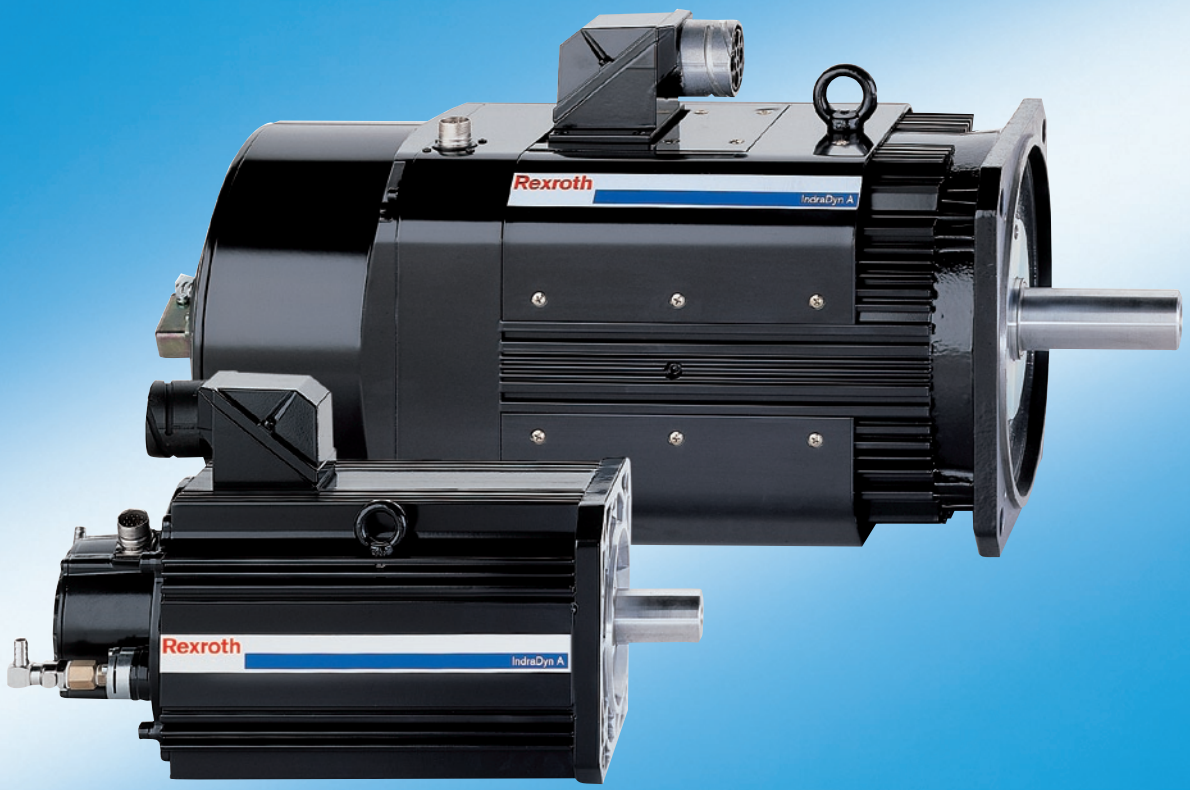
Edition 03

Project Planning Manual



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This documentation

- explains product features and applications, technical data as well as conditions and limits for operation.
- provides guidelines for product selection, application, handling and operation.

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Note

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1 Introduction to the Product

The Rexroth motor generation **IndraDyn A** consists of asynchronous box motors with squirrel-cage rotor; it is available as

MAD series with surface ventilation by solidly connected fan unit.

Fig. 1-1: Exemplary illustration MAD130

MAF series with liquid cooling.

Fig. 1-2: Exemplary illustration MAF130

IndraDyn A motors have compact dimensions and can be used as main and servo drives for all rotary driving.

The optimized design with safety class IP65 for motor and fan allows for operation in adverse conditions. Easy-to-service construction reduces maintenance frequency and allows maintenance during operation.

Furthermore, IndraDyn A motors with **ATEX design** can be used in hazardous areas under certain preconditions. Note, however, that the ATEX motors themselves are not certified as explosion-protected parts but only prepared for acceptance as part of an overall system. For more information, please observe the notes in Chapter 13 "ATEX Notes".

Combined with digital control devices from the IndraDrive, this results in intelligent drive solutions with a high power density and open functions.

1.1 About this Documentation

Document Structure

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

Sect.	Title	Contents	
1	Introduction	Introduction to the product and notes	
2	Important Instructions on Use	**Important safety notes**	
3	Safety		
4	Technical Data	Product description	for planners and designers
5	Dimension Sheets		
6	Type Codes		
7	Accessories	Practice	
8	Connection Techniques		
9	Application Notes		
10	Handling & Transport		for operating and maintenance personnel
11	Installation		
12	Operation		
13	ATEX Notes	Product description	for planners and designers
14	Service and Support	Additional information	
15	Index		

Fig. 1-3: Chapter structure

Additional documentation

To project the drive-systems of the IndraDyn A motor type series, you may need additional documentation depending on the devices used in your case. Rexroth has made the entire product documentation available on DVD in PDF format or in the Internet under www.boschrexroth.com/BrcDoku/ (one-time registration required). You will not need all the documentation included on the DVD to project a system.

Note: All documentation on the DVD are also available in a printed version. You can order the required product documentation via your Rexroth sales office.

MNR	Title / description
R911306531	-Produktdocumentation Electric Drives and Controls Version **xx** [1)] DOK-GENERL-DRIVE*CONTR-GN**xx**-D0-V0G7
1) The index (e.g. ..**02**-...) identifies the version of the DVD.	

Fig. 1-4: Additional documentation

Additional Components

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

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

Feedback

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

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

Please send your remarks to:

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Standards

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

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2 Important directions for use

2.1 Appropriate use

Introduction

Bosch Rexroth products represent state-of-the-art developments and manufacturing. They are 100% tested prior to delivery to ensure operating safety and reliability.

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

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

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

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

Areas of use and application

Asynchronous motors of the IndraDyn A line made by Bosch Rexroth are designed to be used as rotary main-spindle and servo-drive motors.

Typical applications are in:

- machine tools,
- printing and paper processing machines,
- packaging and foodstuff machines and
- metal-forming machine tools.

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

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

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

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

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

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

2.2 Inappropriate use

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

IndraDyn A motors may not be used if

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

3 Safety Instructions for Electric Drives and Controls

3.1 General Information

Using the Safety Instructions and Passing them on to Others

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

If the device is resold, rented and/or passed on to others in any other form, then these safety instructions must be delivered with the device.

WARNING

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

Instructions for Use

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

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this device.
- Only assign trained and qualified persons to work with electrical installations:
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.

- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded.
  Safety-relevant are all such applications which can cause danger to persons and material damage.
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturer must

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

  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

Explanation of Warning Symbols and Degrees of Hazard Seriousness

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

Warning symbol with signal word	Degree of hazard seriousness according to ANSI Z 535
 **DANGER**	Death or severe bodily harm will occur.
 **WARNING**	Death or severe bodily harm may occur.
 **CAUTION**	Bodily harm or material damage may occur.

Fig. 3-1: Hazard classification (according to ANSI Z 535)

Hazards by Improper Use

DANGER

High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!

DANGER

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

WARNING

High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!

WARNING

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

CAUTION

Hot surfaces on device housing! Danger of injury! Danger of burns!

CAUTION

Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting, or improper handling of pressurized lines!

CAUTION

Risk of injury by improper handling of batteries!

3.2 Instructions with Regard to Specific Dangers

Protection Against Contact with Electrical Parts

Note: This section only concerns devices and drive components with voltages of more than 50 Volt.

Contact with parts conducting voltages above 50 Volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the devices conduct dangerous voltage.

DANGER

High electrical voltage! Danger to life, electric shock and severe bodily injury!

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

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

⇒ Before switching on the device, the equipment grounding conductor must have been non-detachably connected to all electrical equipment in accordance with the connection diagram.

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

⇒ Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.

⇒ With electrical drive and filter components, observe the following:

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

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

⇒ Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.

⇒ A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.

⇒ Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

European countries: according to EN 50178/ 1998, section 5.3.2.3.

USA: See National Electrical Code (NEC), National Electrical Manufacturers' Association (NEMA), as well as local engineering regulations. The operator must observe all the above regulations at any time.

With electrical drive and filter components, observe the following:

DANGER

High housing voltage and large leakage current! Risk of death or bodily injury by electric shock!

⇒ Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.

⇒ The equipment grounding conductor of the electrical equipment and the units must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.

⇒ Over the total length, use copper wire of a cross section of a minimum of 10 mm^2 for this equipment grounding connection!

⇒ Before start-up, also in trial runs, always attach the equipment grounding conductor or connect with the ground wire. Otherwise, high voltages may occur at the housing causing electric shock.

Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 5 and 50 Volt at Rexroth products are protective extra-low voltage systems which are provided with touch guard according to the product standards.

WARNING

High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!

⇒ To all connections and terminals with voltages between 0 and 50 Volt, only devices, electrical components, and conductors may be connected which are equipped with a PELV (Protective Extra-Low Voltage) system.

⇒ Connect only voltages and circuits which are safely isolated from dangerous voltages. Safe isolation is achieved for example by isolating transformers, safe optocouplers or battery operation without mains connection.

Protection Against Dangerous Movements

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

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

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

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

DANGER

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

⇒ For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.

They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage:

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

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

⇒ Fences and coverings must be strong enough to resist maximum possible momentum.

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

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

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

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

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

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

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

⇒ Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.

WARNING

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

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

⇒ If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The interference immunity of present or future implanted heart pacemakers differs greatly, so that no general rules can be given.

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

Protection Against Contact with Hot Parts

CAUTION

Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!

⇒ Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!

⇒ Do not touch housing surfaces of motors! Danger of burns!

⇒ According to operating conditions, temperatures can be **higher than 60 °C, 140 °F** during or after operation.

⇒ Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes**! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.

⇒ After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.

⇒ Wear safety gloves or do not work at hot surfaces.

⇒ For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

Protection During Handling and Mounting

In unfavorable conditions, handling and assembling certain parts and components in an improper way can cause injuries.

CAUTION

Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!

- ⇒ Observe the general construction and safety regulations on handling and assembly.
- ⇒ Use suitable devices for assembly and transport.
- ⇒ Avoid jamming and bruising by appropriate measures.
- ⇒ Always use suitable tools. Use special tools if specified.
- ⇒ Use lifting equipment and tools in the correct manner.
- ⇒ If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- ⇒ Do not stand under hanging loads.
- ⇒ Immediately clean up any spilled liquids because of the danger of skidding.

Battery Safety

Batteries consist of active chemicals enclosed in a solid housing. Therefore, improper handling can cause injury or damages.

CAUTION

Risk of injury by improper handling!

- ⇒ Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- ⇒ Do not recharge the batteries as this may cause leakage or explosion.
- ⇒ Do not throw batteries into open flames.
- ⇒ Do not dismantle batteries.
- ⇒ Do not damage electrical parts installed in the devices.

Note: Environmental protection and disposal! The batteries installed in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separate from other waste. Observe the local regulations in the country of assembly.

Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors cooled with liquid and compressed air, as well as drive controllers, can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids, and cooling lubricating agents. In these cases, improper handling of external supply systems, supply lines, or connections can cause injuries or damages.

CAUTION

Risk of injury by improper handling of pressurized lines!

⇒ Do not attempt to disconnect, open, or cut pressurized lines (risk of explosion).

⇒ Observe the respective manufacturer's operating instructions.

⇒ Before dismounting lines, relieve pressure and empty medium.

⇒ Use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).

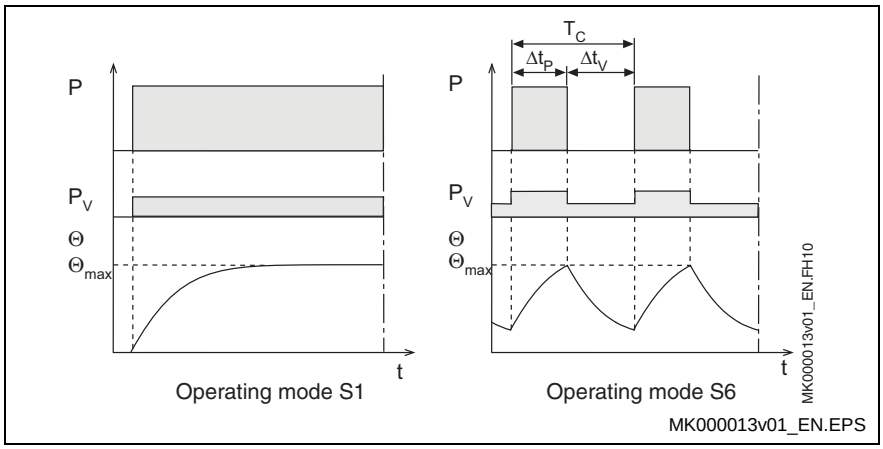
⇒ Immediately clean up any spilled liquids from the floor.

Note: Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separate from other waste. Observe the local regulations in the country of assembly.

4 Technical Data

4.1 Operating Modes

Bosch Rexroth motors are documented according to the test criteria and measuring methods of EN 60034-1. Stated technical data refer to operating modes S1 (continuous operation) and S6 (periodic operation), each with surface cooling through direct-connected fan units or liquid cooling.



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

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

ON Time

Operating mode S6 is supplemented by specification of the ON time (ED) in %. The operating time is calculated as follows:

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

ED:	Cyclic duration factor in %
T_C:	Cycle time
$Δt_P$:	Operating time with constant load

Fig. 4-2: Cyclic duration factor

4.2 Operating Behavior

In the following, parameters and characteristic curves of the IndraDyn A series and specifications of the motor data sheet are explained.

Parameters

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

Rated performance P_N Mechanical power output of the motor while running at the rated speed and rated torque. Unit = kilowatts (kW).

Rated current I_N Phase current of the motor while running at the rated speed and rated torque, specified as a root-mean-squared value in amps (A).

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

Maximum torque M_{max} Maximum torque that can be output at peak current I_{max} , given in Newton-meters (Nm).

⇒ The maximum torque that can be attained depends on the drive control device used. Only the specified maximum torque M_{max} in the selection lists is binding.

Maximum output P_{max} Maximum power output of the motor at $540V_{DC}$, given in kilowatts (kW).

⇒ The maximum output that can be attained depends on the drive controller that is used and on the power supply. Only the maximum output specified in the selection data is binding.

Maximum current I_{max} Maximum short-term branch current of the motor permitted without damaging the winding, given as a root-mean-square value in amperes (A).

⇒ To avoid a thermal overload when operating the motor with external controllers, note that the current is to be reduced after 400 ms to 2.2x the rated current and that I_{max} may be reapplied only if the winding temperature is in the permitted range if the degree of relief of the motor permits this.

Maximum speed n_{max} The maximum permissible speed of the motor in (min^{-1}) in dependence on the bearing type according to type code. Usually, the maximum speed is limited by mechanical factors as e.g. centrifugal forces, bearing strain, or use of a holding brake.

Torque constant in nominal point K_{M_N} at 20° C Ratio of torque increase to motor torque-forming current. Unit = Nm/A. Valid up to rated current I_N.

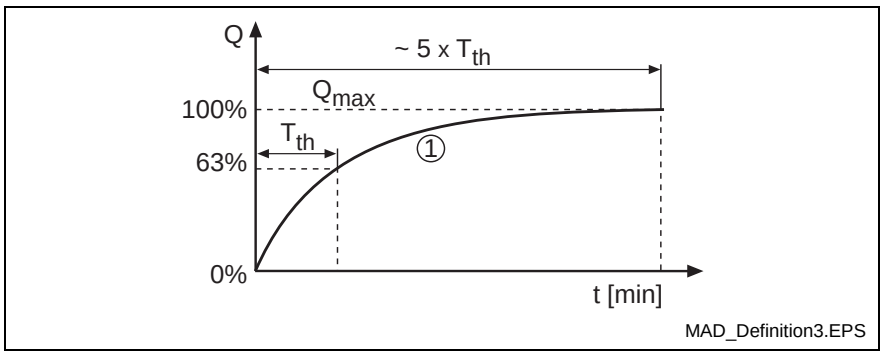
Discharge capacity C_{ab} Capacity of short-circuited power connections U, V, W against the motor housing. Unit = nF.

Power wire cross-section A Rated for cable assemblies with current carrying capacity according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at 40°C ambient temperature. The power wire cross section in (mm^2) can deviate depending on the selected type of connection - plug or terminal box. Therefore, when selecting the appropriate power cable, pay attention to the information in Chapter 8 ”Connection Techniques” and to the documentation ”Rexroth Connection Cable” (MNR R911282688).

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

Motor mass m Mass of the motor in standard version, without holding brake, specified in kilograms (kg).

Thermal time constant T_{th} Duration of the temperature rise to 63% of the final temperature of the motor under load with rated torque in S1 operation and surface ventilation by direct-connected fan units.



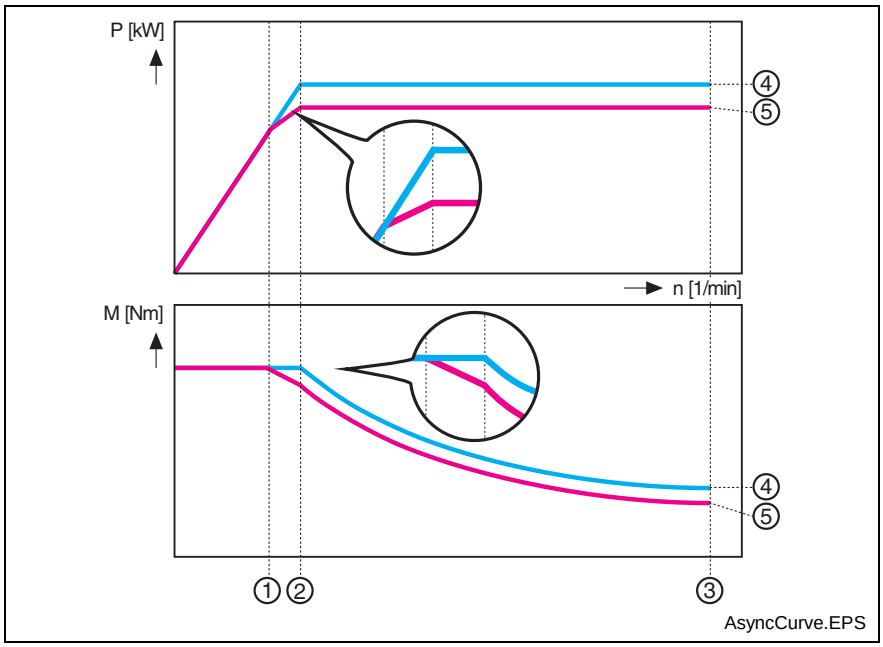
(1): Curve of the motor temperature over time
T_{th}: Thermal time constant

Fig. 4-3: Thermal time constant

Cycle time T_C Duration of the cycle in S6 operating mode until the thermally steady-state condition is reached when the maximum temperature equals the end temperature in S1 operation (see Fig. 4-1).

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

Characteristic Curve



P: mechanical output in kilowatts [kW]
M: torque available on the output shaft, in Newton meters [Nm]
n: motor speed, in revolutions per minute [min^{-1}]
(1): key speed (n_1 in data sheet)
(2): rated speed (n_N)
(3): max. torque (n_{max})
(4): characteristic curve without de-rating
(5): characteristic curve with de-rating

Fig. 4-4: IndraDyn A sample characteristic curves

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

Explanation:

(1) Key speed

Start of a drop in speed and power before reaching the rated speed n_N. This behavior is called **de-rating** and occurs only with some versions of motor windings. Without de-rating, the key speed equals the rated speed.

Until the key speed is reached, continuous current at standstill I_1 applies (root-mean-square value). **With no de-rating, the continuous current at standstill equals the rated current I_N.**

Until the key speed is reached, continuous torque at standstill M_1 is available for S1 operation. **Without de-rating, the continuous torque at standstill equals rated torque M_N.**

With an effective de-rating, torque is reduced when the key speed is reached. Fig. 4-4 shows to characteristics curves starting at the key speed.

(2) Rated speed

Without de-rating effect, induction motors provide a constant torque up to the rated speed (rated torque); starting at the rated speed, constant **rated power P_N** is available.

(3) Maximum speed

The speed limit up to which a motor can be safely operated. This is usually limited by the mechanical construction (bearing) or by using a holding brake.

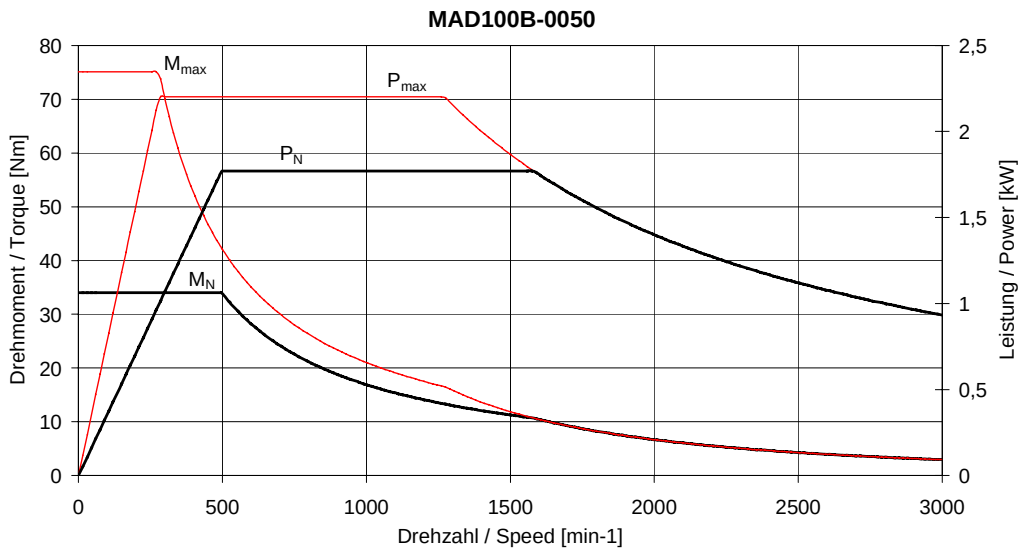
4.3 Data Sheet MAD100B

Description		Symbol	Unit	MAD100B				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	34	31	30	28	25
Rated power		P_N	kW	1.8	3.2	4.7	5.9	6.5
Rated current		I_N	A	5.3	8.9	12.9	14.6	16.2
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	75	75	68	66	61
Maximum output		P_{max}	kW	3.7	6.6	9	12.1	13.3
Maximum current		I_{max}	A	10.2	18	23.5	28.9	28.3
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	9000		
	R	n_{max}	rpm	3000	6000	6300		
	V	n_{max}	rpm	not available				
	H	n_{max}	rpm	3000	6000	9000	11000 [7])	
Continuous torque at standstill		M_{n1}	Nm	34	34	31	30	28
Continuous current at standstill		I_{n1}	A	5.3	9.4	12.5	15.3	16.2
Torque constant at 20° C		K_{M_N}	Nm/A	7.66	4.31	3.03	2.41	2.11
Thermal time constant		T_{th}	min	30				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	6	5.7	6	6	6
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	1	1	1	1.5	2.5
Moment of inertia [3])		J_{rot}	kgm²	0.019				
Mass [4])		m	kg	43				
Sound pressure level [5])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**		
Transmittable torque		M_4	Nm	30		24		
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	0.9		1.1		
Moment of inertia		J_{Br}	kgm²	0.00056				
Max. permissible braking energy		W_{max}	Ws	20000				
Disconnection time		t_2	ms	50		90		
Connection time		t_1	ms	42		30		
Maximum speed brake		n_{Br_max}	rpm	10000		10000		
Mass		m	kg	2		1.6		
Fan				**Axial fan**				
Air current				B → A, blowing				
Connection voltage		U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz				
Power consumption		S_N	VA	83 100				
Fan flow [6])		I_N	A	0.12				
Medium air voltage		V	m³/h	230				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
[7]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-5: Data sheet MAD100B

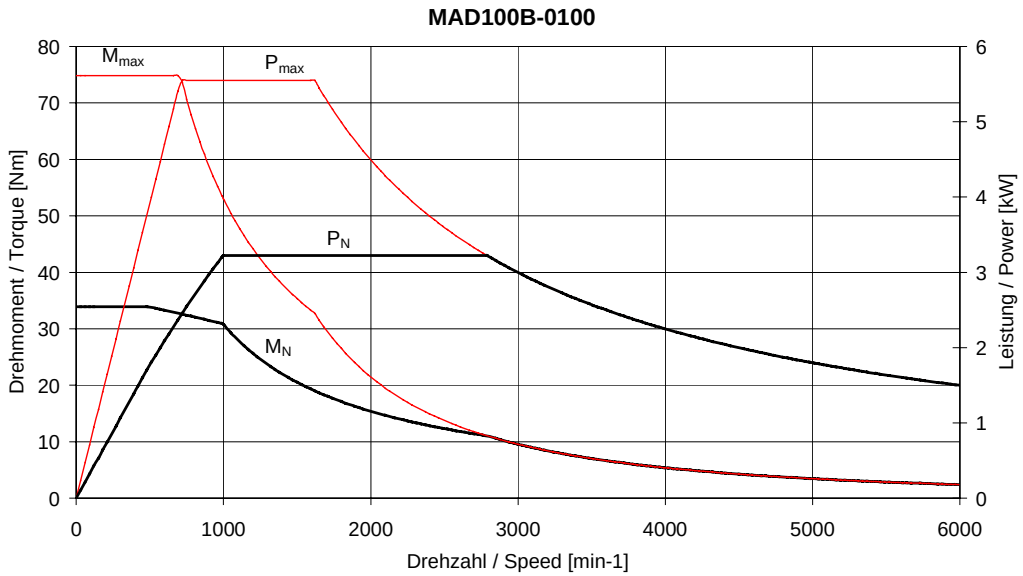
Characteristic Curves of MAD100B Motors



Mit Regelgerät HMS01.1N-W0020 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0020 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100B-0050.WMF

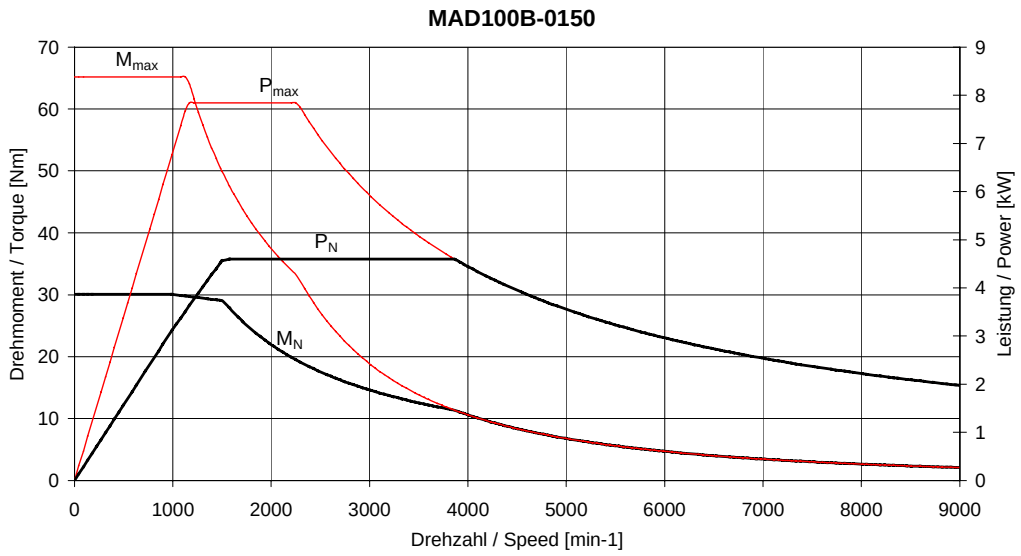
Fig. 4-6: Characteristic curve of MAD100B-0050 motors



Mit Regelgerät HMS01.1N-W0020 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0020 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100B-0100.WMF

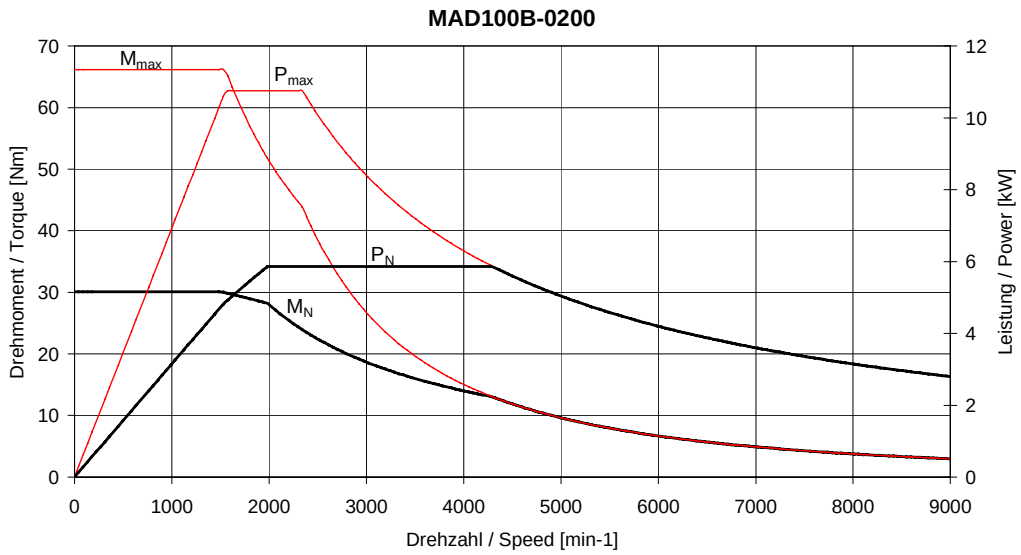
Fig. 4-7: Characteristic curve of MAD100B-0100 motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100B-0150.WMF

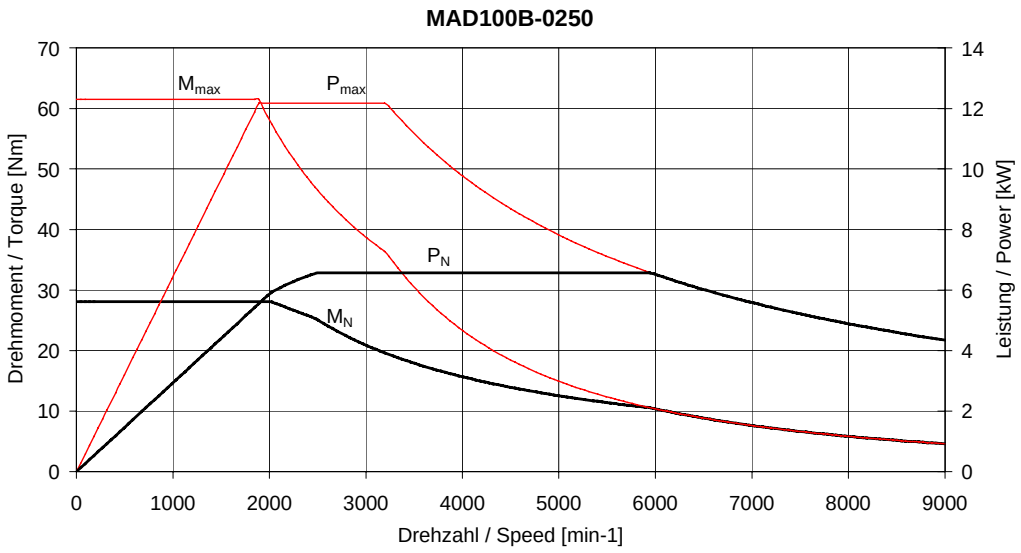
Fig. 4-8: Characteristic curve of MAD100B-0150 motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100B-0200.WMF

Fig. 4-9: Characteristic curve of MAD100B-0200 motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100B-0250.WMF

Fig. 4-10: Characteristic curve of MAD100B-0250 motors

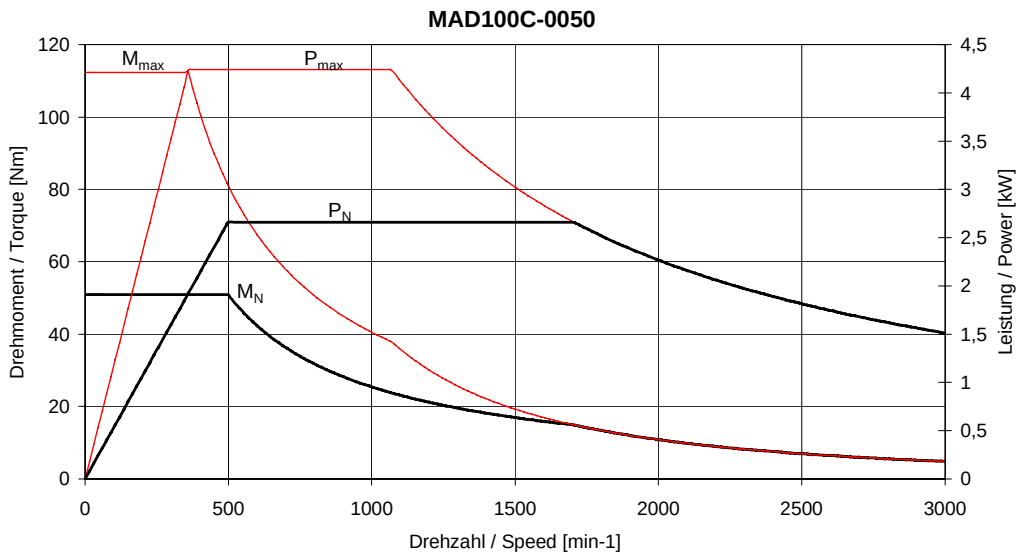
4.4 Data Sheet MAD100C

Description		Symbol	Unit	MAD100C				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	51	50	48	45	40
Rated power		P_N	kW	2.7	5.2	7.5	9.4	10.5
Rated current		I_N	A	8.2	13.2	19.7	25.7	27.8
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	112	119	110	105	99
Maximum output		P_{max}	kW	5.5	10.6	15.4	19.3	21.5
Maximum current		I_{max}	A	15.9	25.4	39	47.3	44.9
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	9000		
	R	n_{max}	rpm	3000	6000	6300		
	V	n_{max}	rpm	not available				
	H	n_{max}	rpm	3000	6000	9000	11000 [7])	
Continuous torque at standstill		M_{n1}	Nm	51	54	50	48	45
Continuous current at standstill		I_{n1}	A	8.2	13.8	20.3	26.7	27.8
Torque constant at 20° C		K_{M_N}	Nm/A	7.4	4.94	2.94	2.41	2.23
Thermal time constant		T_{th}	min	30				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	9	8.5	8.13	8.5	8.5
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	1	1.5	2.5	4	4
Moment of inertia [3])		J_{rot}	kgm²	0.0284				
Mass [4])		m	kg	59				
Sound pressure level [5])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**		
Transmittable torque		M_4	Nm	30		24		
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	0.9		1.1		
Moment of inertia		J_{Br}	kgm²	0.00056				
Max. permissible braking energy		W_{max}	Ws	20000				
Disconnection time		t_2	ms	50		90		
Connection time		t_1	ms	42		30		
Maximum speed brake		n_{Br_max}	rpm	10000		10000		
Mass		m	kg	2		1.6		
Fan				**Axial fan**				
Air current				B → A, blowing				
Connection voltage		U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz				
Power consumption		S_N	VA	83 100				
Fan flow [6])		I_N	A	0.12				
Medium air voltage		V	m³/h	230				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
[7]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-11: Data sheet MAD100C

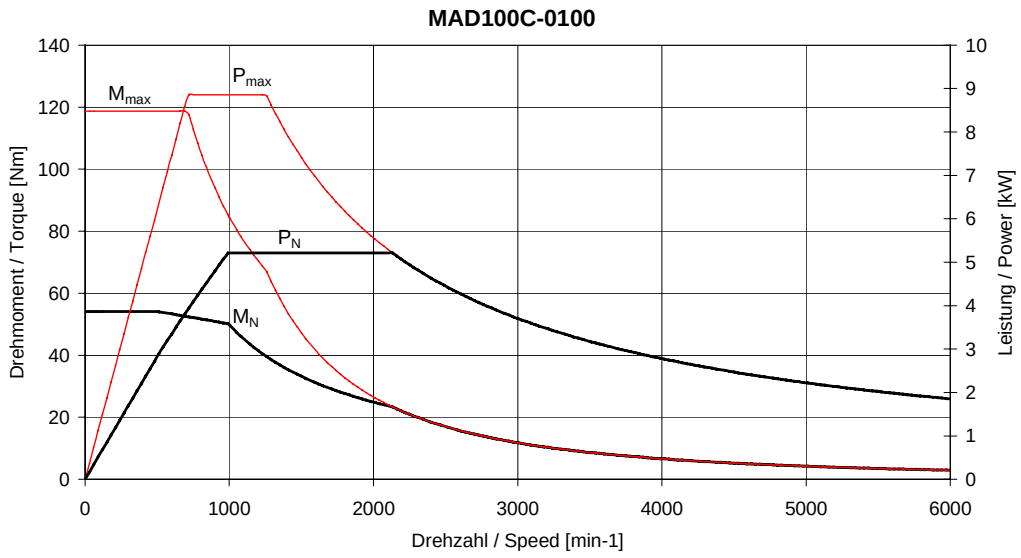
Characteristic Curves of MAD100C Motors



Mit Regelgerät HMS01.1N-W0020 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0020 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100C-0050.WMF

Fig. 4-12: Characteristic curve of MAD100C-0050 motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100C-0100.WMF

Fig. 4-13: Characteristic curve of MAD100C-0100 motors

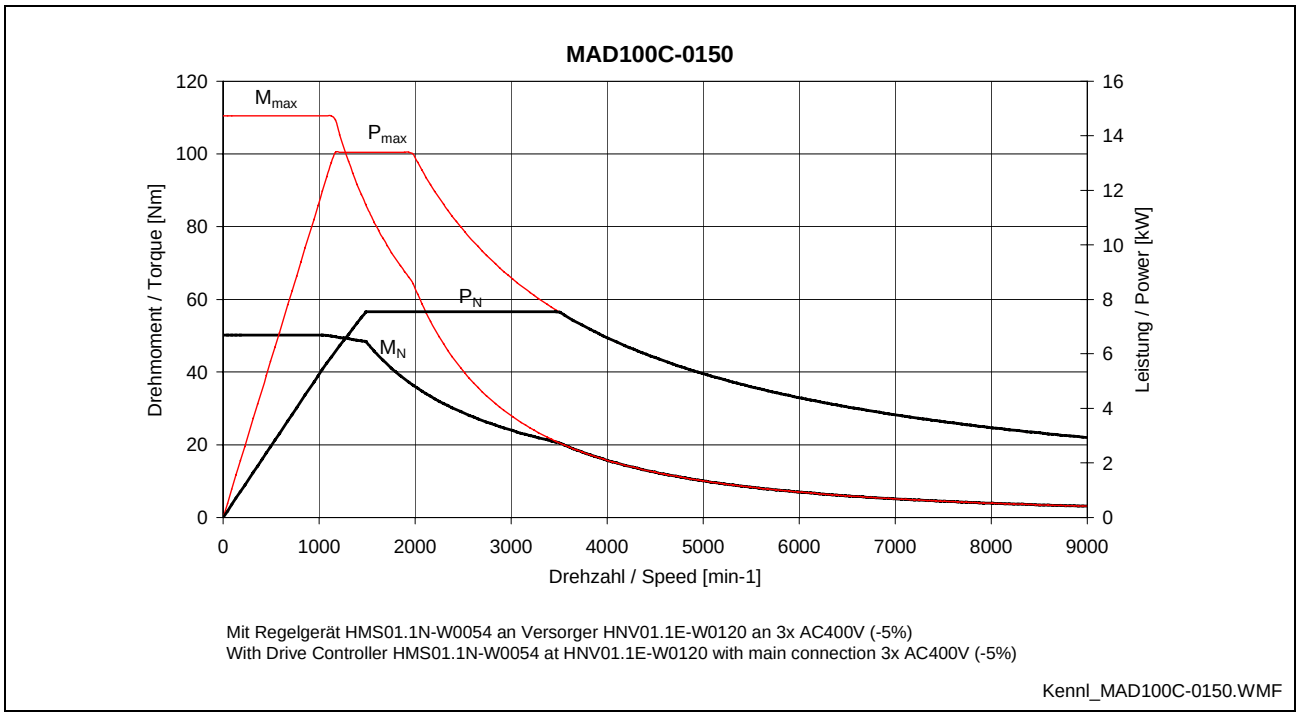


Fig. 4-14: Characteristic curve of MAD100C-0150 motors

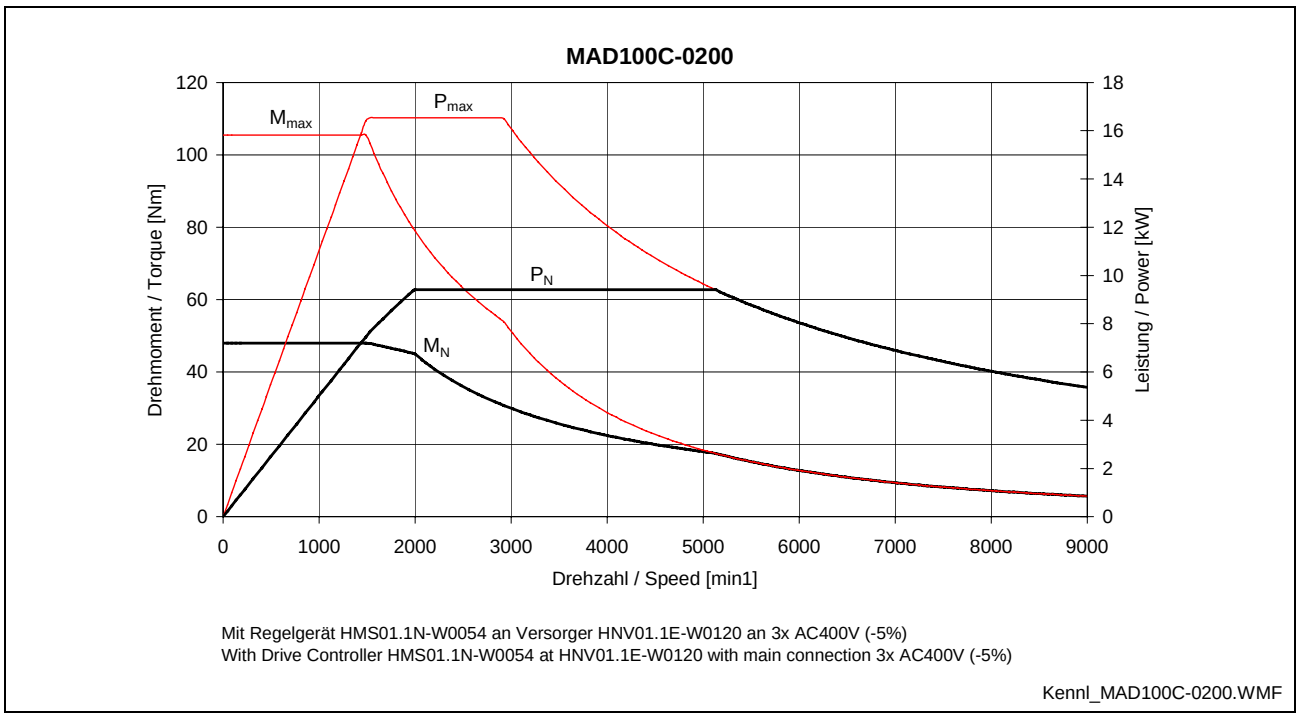
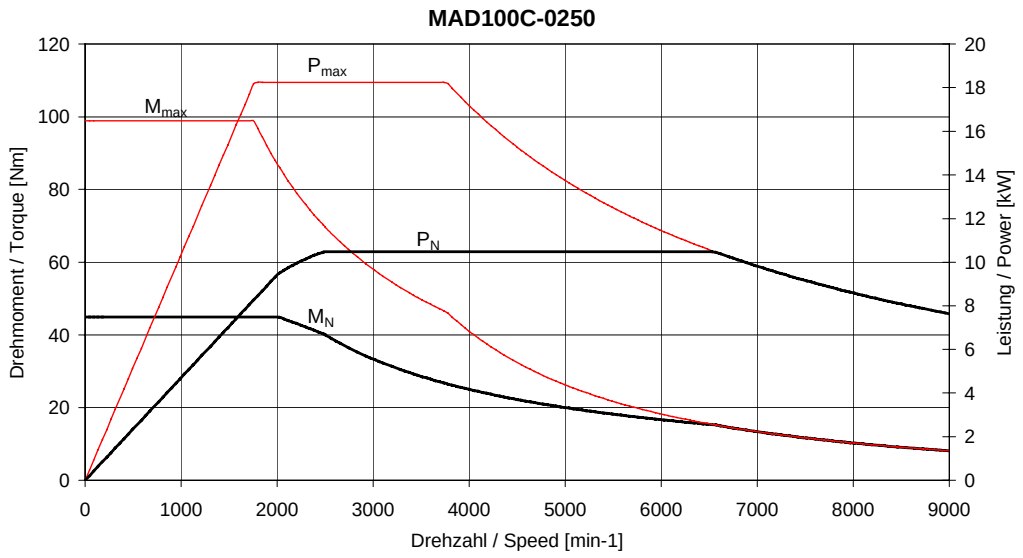


Fig. 4-15: Characteristic curve of MAD100C-0200 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100C-0250.WMF

Fig. 4-16: Characteristic curve of MAD100C-0250 motors

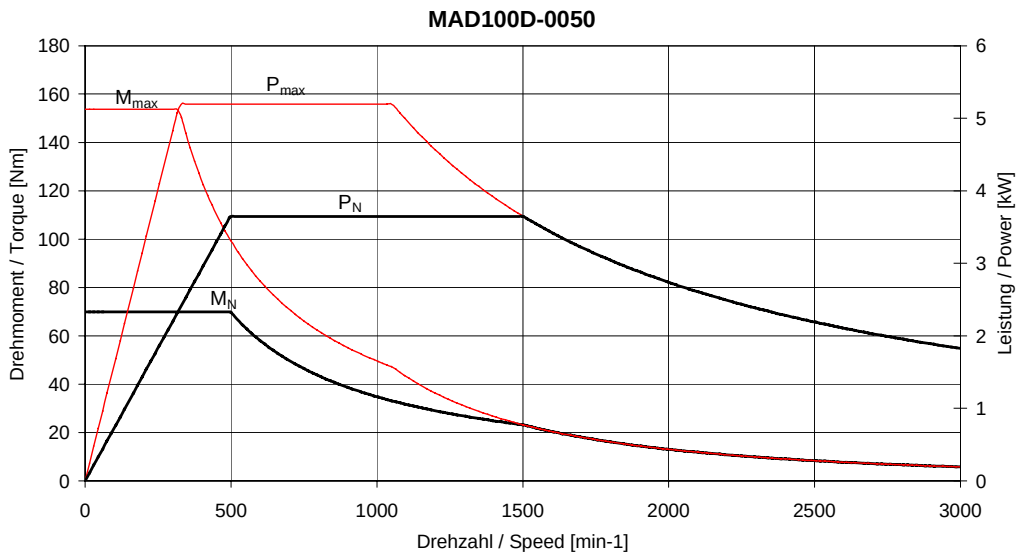
4.5 Data Sheet MAD100D

Description	Symbol	Unit	MAD100D				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_N	Nm	70	64	59	54	50
Rated power	P_N	kW	3.7	6.7	9.3	11.3	13.1
Rated current	I_N	A	10.1	19.3	25.6	27.2	32.4
Rated speed	n_N	rpm	500	1000	1500	2000	2500
Key speed	n_1	rpm	500	500	1000	1500	2000
Maximum torque	M_{max}	Nm	154	146	141	130	119
Maximum output	P_{max}	kW	7.6	13.7	19.1	23.2	26.9
Maximum current	I_{max}	A	19.1	34.3	47.6	52.7	64
Maximum speed with bearing… N	n_{max}	rpm	3000	6000	9000		
Maximum speed with bearing… R	n_{max}	rpm	3000	6000	6300		
Maximum speed with bearing… V	n_{max}	rpm	not available				
Maximum speed with bearing… H	n_{max}	rpm	3000	6000	9000	11000 [7])	
Continuous torque at standstill	M_{n1}	Nm	70	70	64	59	54
Continuous current at standstill	I_{n1}	A	10.1	20.4	26.8	28.7	34.7
Torque constant at 20° C	K_{M_N}	Nm/A	8.52	4.5	3.19	2.62	2.04
Thermal time constant	T_{th}	min	30				
Duty cycle time (S6-44%)	T_C	min	10				
Discharge capacity	C_{ab}	nF	11	11	10.2	11.5	11.9
Number of pole pairs	p		3				
Power wire cross-section [2])	A	mm²	1	2.5	4	4	6
Moment of inertia [3])	J_{rot}	kgm²	0.0392				
Mass [4])	m	kg	72				
Sound pressure level [5])	L_P	dB(A)	70 (+3)				
Ambient temperature in operation	T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1			F				
Motor protection class			IP65				
Holding brake (optional)			**Electrically clamping**		**Electrically releasing**		
Transmittable torque	M_4	Nm	30		24		
Connection voltage	U_{Br}	V	DC 24 ± 10 %				
Rated current	I_{Br}	A	0.9		1.1		
Moment of inertia	J_{Br}	kgm²	0.00056				
Max. permissible braking energy	W_{max}	Ws	20000				
Disconnection time	t_2	ms	50		90		
Connection time	t_1	ms	42		30		
Maximum speed brake	n_{Br_max}	rpm	10000		10000		
Mass	m	kg	2		1.6		
Fan			**Axial fan**				
Air current			B → A, blowing				
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz				
Power consumption	S_N	VA	83 100				
Fan flow [6])	I_N	A	0.12				
Medium air voltage	V	m³/h	230				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
[7]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-17: Data sheet MAD100D

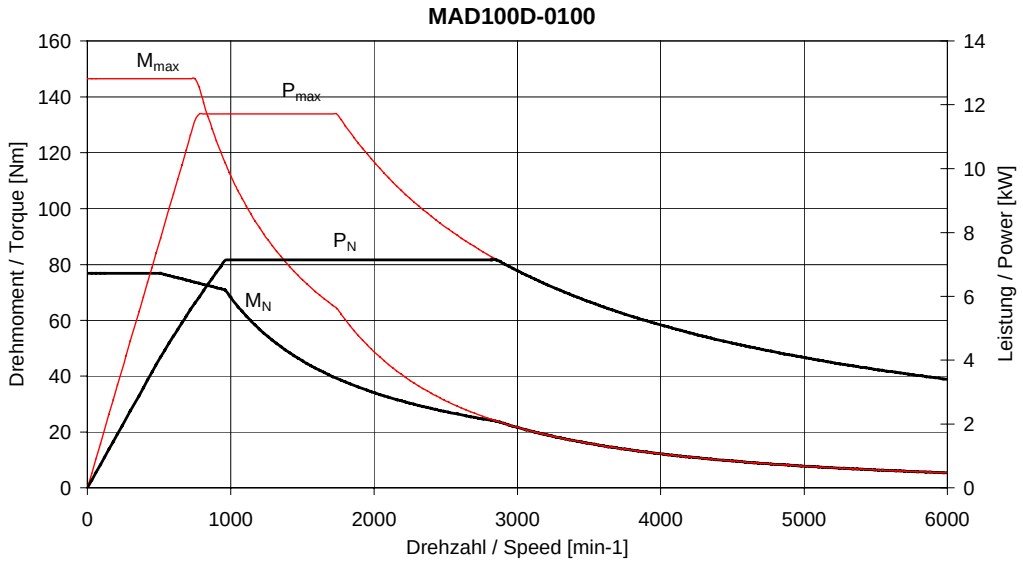
Characteristic Curves of MAD100D Motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100D-0050.WMF

Fig. 4-18: Characteristic curve of MAD100D-0050 motor



Mit Regelgerät HMS01.1N-W0054 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100D-0100.WMF

Fig. 4-19: Characteristic curve of MAD100D-0100 motors

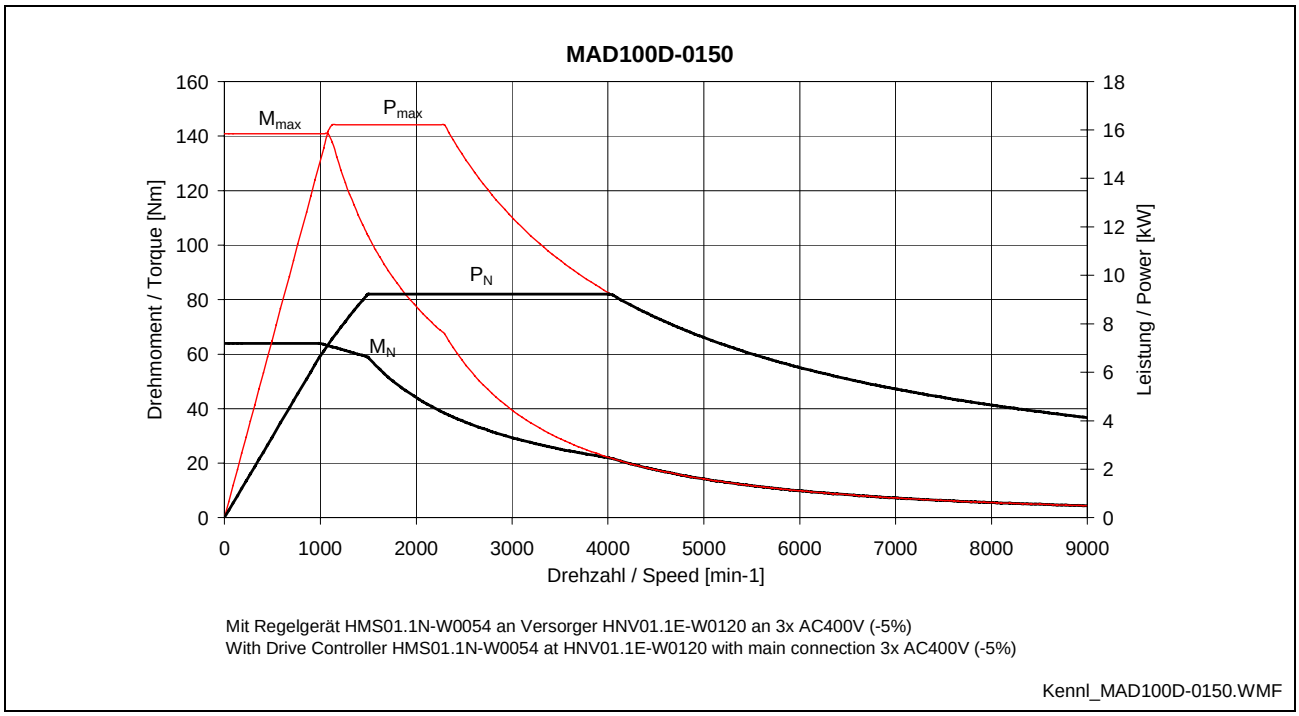


Fig. 4-20: Characteristic curve of MAD100D-0150 motors

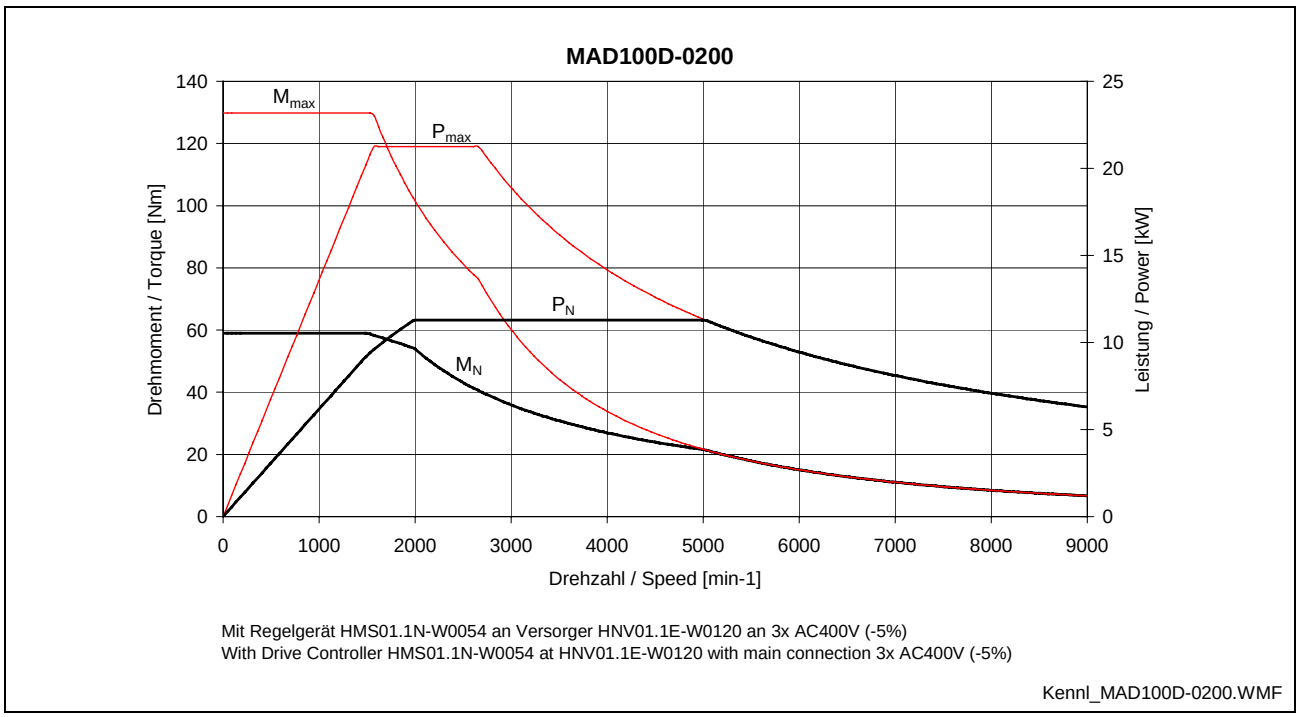
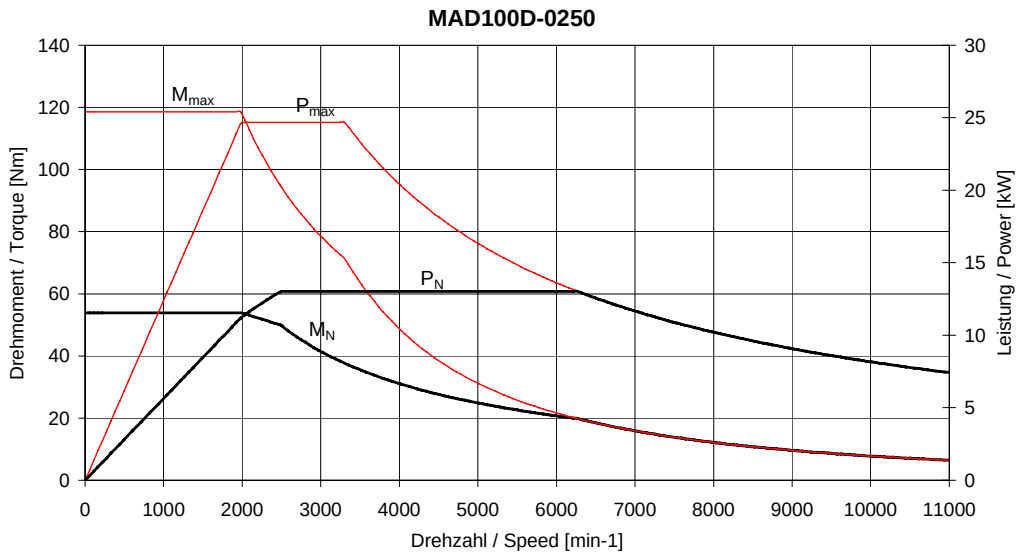


Fig. 4-21: Characteristic curve of MAD100D-0200 motors



Mit Regelgerät HMS01.1N-W0070 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD100D-0250.WMF

Fig. 4-22: Characteristic curve of MAD100D-0250 motors

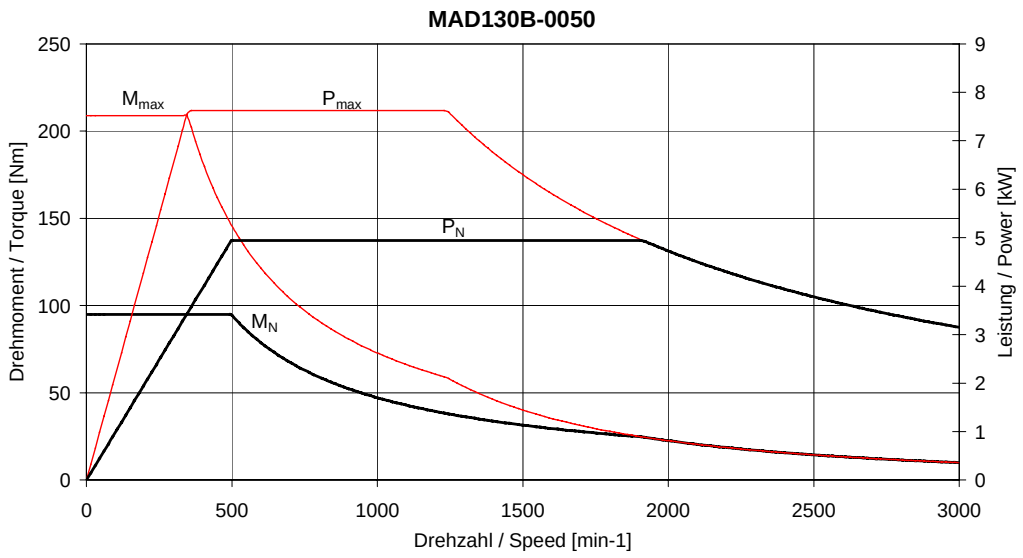
4.6 Data Sheet MAD130B

Description	Symbol	Unit	MAD130B				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_N	Nm	95	100	85	80	75
Rated power	P_N	kW	5	10.5	13.3	16.8	19.6
Rated current	I_N	A	12.8	26.9	34.9	43	47.2
Rated speed	n_N	rpm	500	1000	1500	2000	2500
Key speed	n_1	rpm	500	500	1000	1500	2000
Maximum torque	M_{max}	Nm	209	230	200	187	176
Maximum output	P_{max}	kW	10.3	21.5	27.4	34.4	40.2
Maximum current	I_{max}	A	25.4	53.7	71	80.7	83.3
Maximum speed with bearing… N	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing… R	n_{max}	rpm	3000	5250			
Maximum speed with bearing… V	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing… H	n_{max}	rpm	3000	6000	9000 [7])	10000 [7])	
Continuous torque at standstill	M_{n1}	Nm	95	110	95	85	80
Continuous current at standstill	I_{n1}	A	12.8	28.7	37.4	44.5	47.7
Torque constant at 20° C	K_{M_N}	Nm/A	8.49	4.79	3.08	2.47	2.15
Thermal time constant	T_{th}	min	45				
Duty cycle time (S6-44%)	T_C	min	10	6.4	10	10	5
Discharge capacity	C_{ab}	nF	16	15.8	15.8	16.1	17.3
Number of pole pairs	p		3				
Power wire cross-section [2])	A	mm²	1	4	6	10	10
Moment of inertia [3])	J_{rot}	kgm²	0.084				
Mass [4])	m	kg	100				
Sound pressure level [5])	L_P	dB(A)	70 (+3)				
Ambient temperature in operation	T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1			F				
Motor protection class			IP65				
Holding brake (optional)			**Electrically clamping**		**Electrically releasing**		
Transmittable torque	M_4	Nm	100		80		
Connection voltage	U_{Br}	V	DC 24 ± 10 %				
Rated current	I_{Br}	A	1.5		1.6		
Moment of inertia	J_{Br}	kgm²	0.002				
Max. permissible braking energy	W_{max}	Ws	30000				
Disconnection time	t_2	ms	65		140		
Connection time	t_1	ms	110		50		
Maximum speed brake	n_{Br_max}	rpm	8000		8000		
Mass	m	kg	8				
Fan			**Axial fan**				
Air current			B → A, blowing				
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz				
Power consumption	S_N	VA	139 208				
Fan flow [6])	I_N	A	0.20 .... 0.25				
Medium air voltage	V	m³/h	1000				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
[7]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-23: Data sheet MAD130B

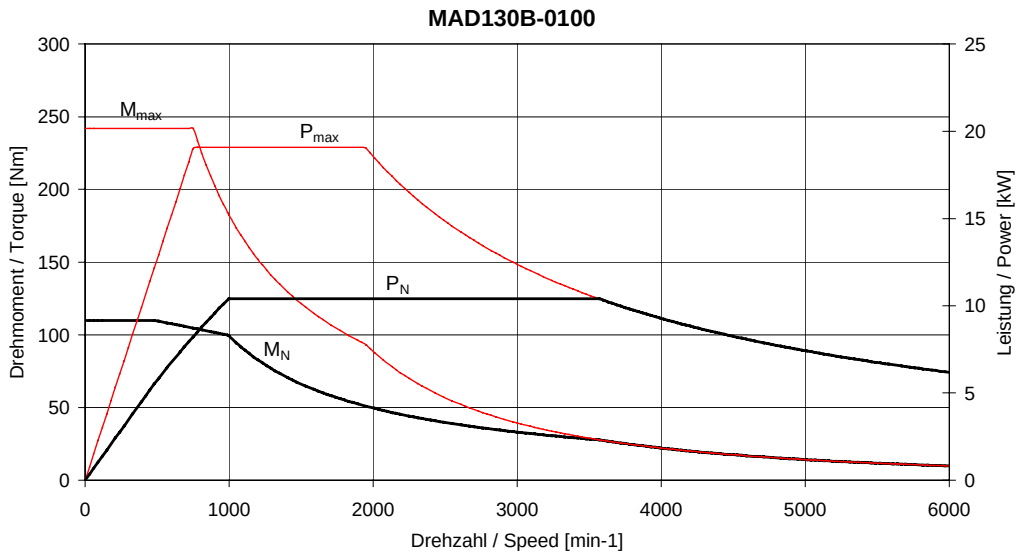
Characteristic Curves of MAD130B Motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130B-0050.WMF

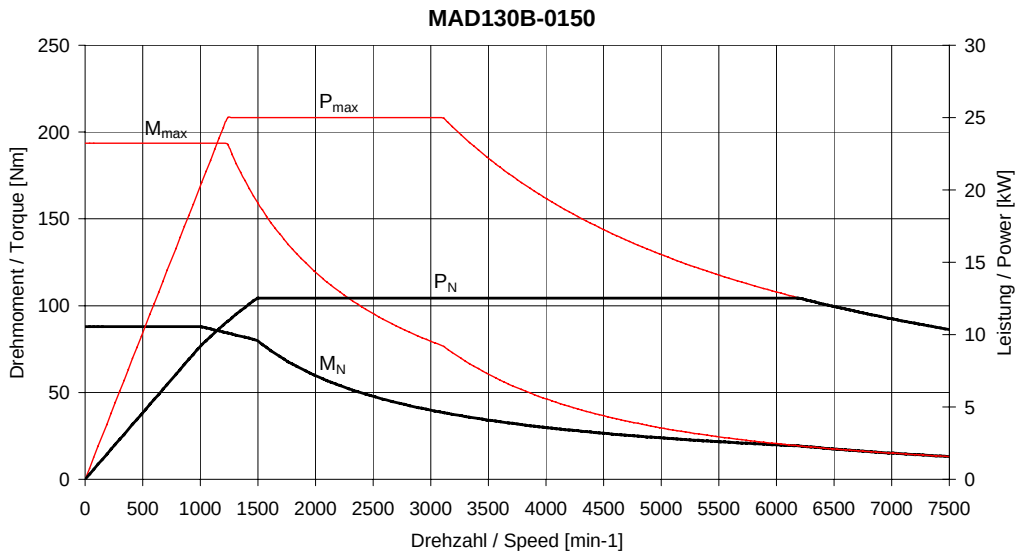
Fig. 4-24: Characteristic curve of MAD130B-0050 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130B-0100.WMF

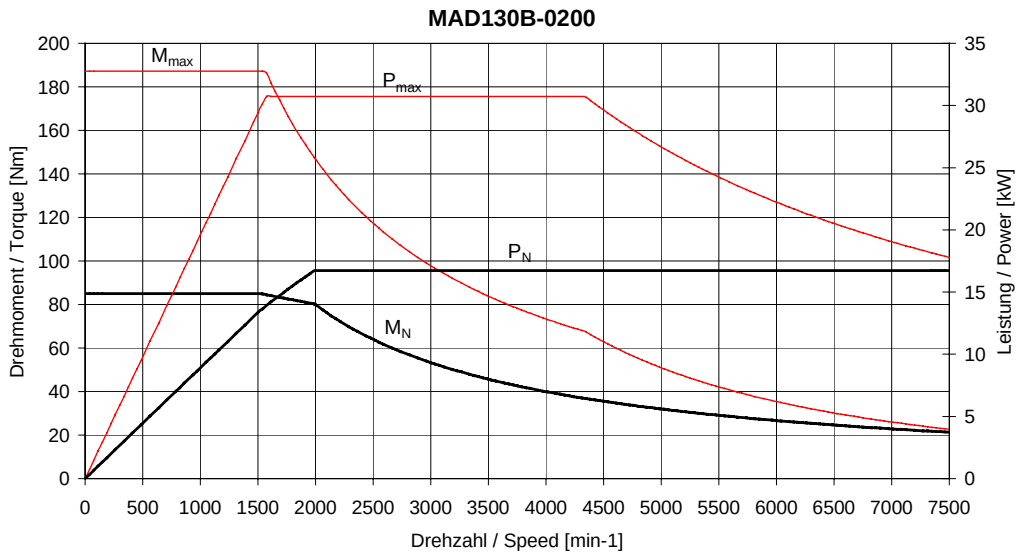
Fig. 4-25: Characteristic curve of MAD130B-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130B-0150.WMF

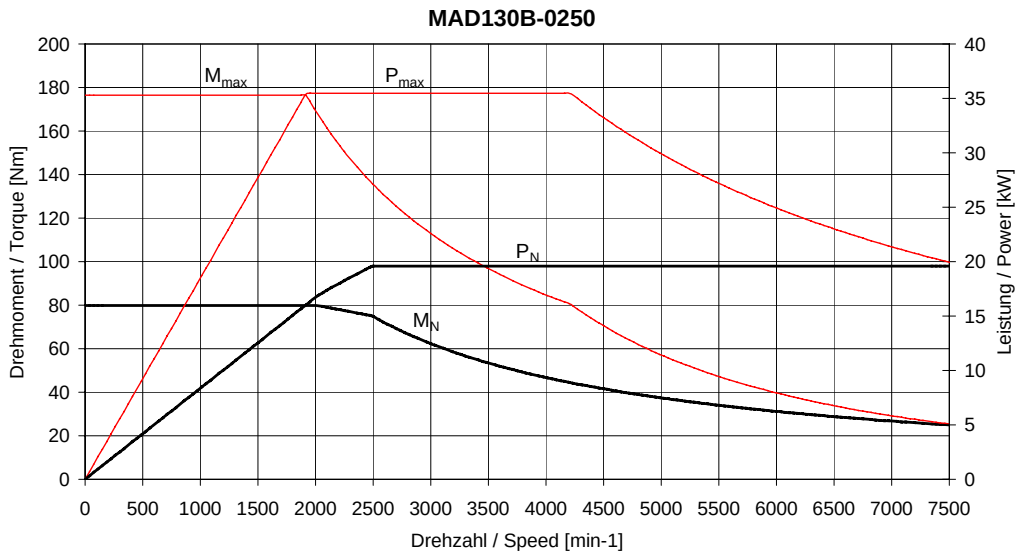
Fig. 4-26: Characteristic curve of MAD130B-0150 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130B-0200.WMF

Fig. 4-27: Characteristic curve of MAD130B-0200 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130B-0250.WMF

Fig. 4-28: Characteristic curve of MAD130B-0250 motors

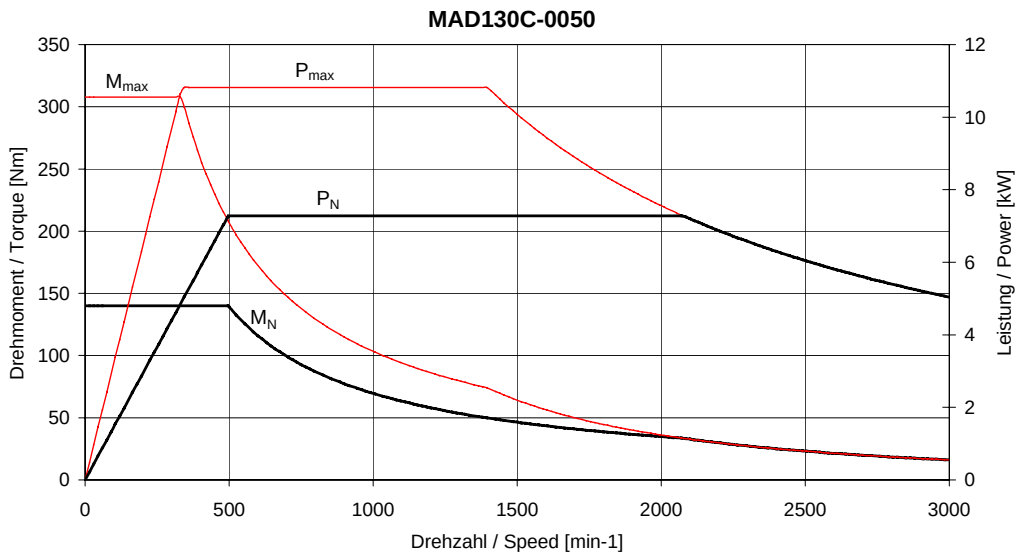
4.7 Data Sheet MAD130C

Description	Symbol	Unit	MAD130C				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_N	Nm	140	125	117	110	100
Rated power	P_N	kW	7.3	13.1	18.4	23	26.2
Rated current	I_N	A	19.7	36.2	48.9	57	62
Rated speed	n_N	rpm	500	1000	1500	2000	2500
Key speed	n_1	rpm	500	500	1000	1500	2000
Maximum torque	M_{max}	Nm	308	305	275	253	250
Maximum output	P_{max}	kW	15	26.9	37.7	47.2	53.7
Maximum current	I_{max}		35.3	74.3	93.3	106.7	114.9
Maximum speed with bearing… N	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing… R	n_{max}	rpm	3000	5250			
Maximum speed with bearing… V	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing… H	n_{max}	rpm	3000	6000	9000 [7])	10000 [7])	
Continuous torque at standstill	M_{n1}	Nm	140	140	125	115	110
Continuous current at standstill	I_{n1}	A	19.7	39.2	51.0	59.6	67
Torque constant at 20° C	K_{M_N}	Nm/A	9.31	4.33	3.1	2.64	2.1
Thermal time constant	T_{th}	min	50				
Duty cycle time (S6-44%)	T_C	min	10				
Discharge capacity	C_{ab}	nF	20	20	20.5	19.3	20
Number of pole pairs	p		3				
Power wire cross-section [2])	A	mm²	2.5	6	10	16	16
Moment of inertia [3])	J_{rot}	kgm²	0.108				
Mass [4])	m	kg	122				
Sound pressure level [5])	L_P	dB(A)	70 (+3)				
Ambient temperature in operation	T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1			F				
Motor protection class			IP65				
Holding brake (optional)			**Electrically clamping**		**Electrically releasing**		
Transmittable torque	M_4	Nm	100		80		
Connection voltage	U_{Br}	V	DC 24 ± 10 %				
Rated current	I_{Br}	A	1.5		1.6		
Moment of inertia	J_{Br}	kgm²	0.002				
Max. permissible braking energy	W_{max}	Ws	30000				
Disconnection time	t_2	ms	65		140		
Connection time	t_1	ms	110		50		
Maximum speed brake	n_{Br_max}	rpm	8000		8000		
Mass	m	kg	8				
Fan			**Axial fan**				
Air current			B → A, blowing				
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz				
Power consumption	S_N	VA	139 208				
Fan flow [6])	I_N	A	0.20 .... 0.25				
Medium air voltage	V	m³/h	1000				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
[7]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-29: Data Sheet MAD130C

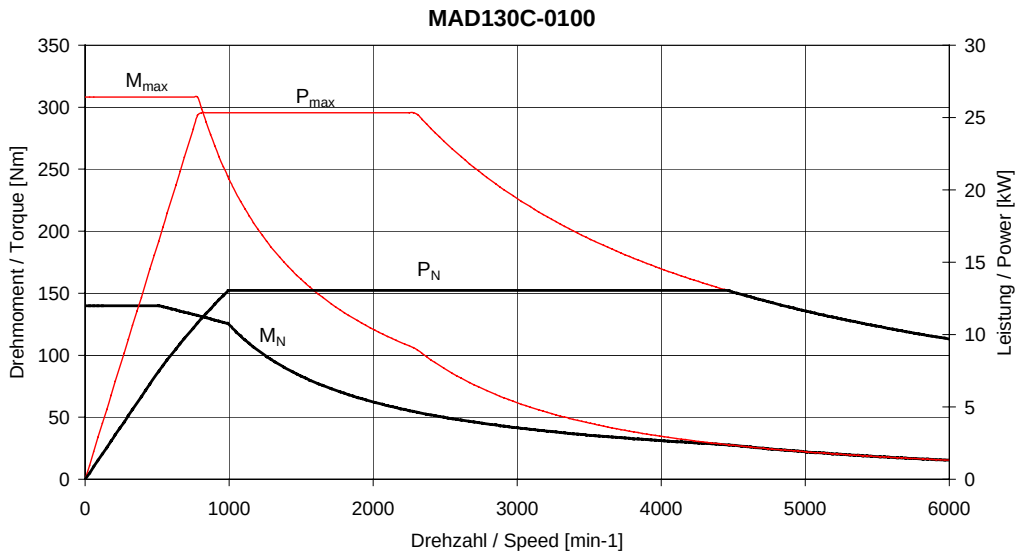
Characteristic Curves of MAD130C Motors



Mit Regelgerät HMS01.1N-W0070 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130C-0050.WMF

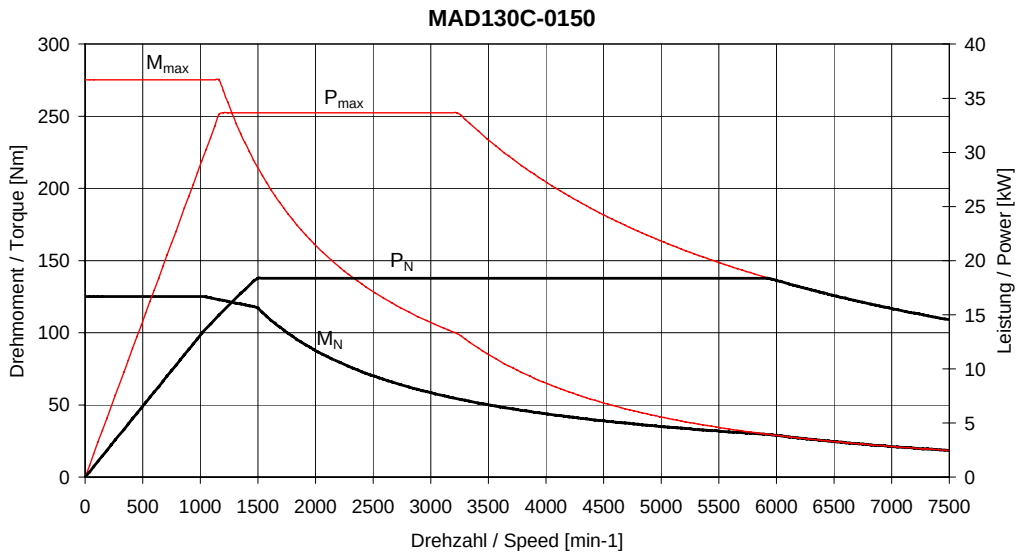
Fig. 4-30: Characteristic curve of MAD130C-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130C-0100.WMF

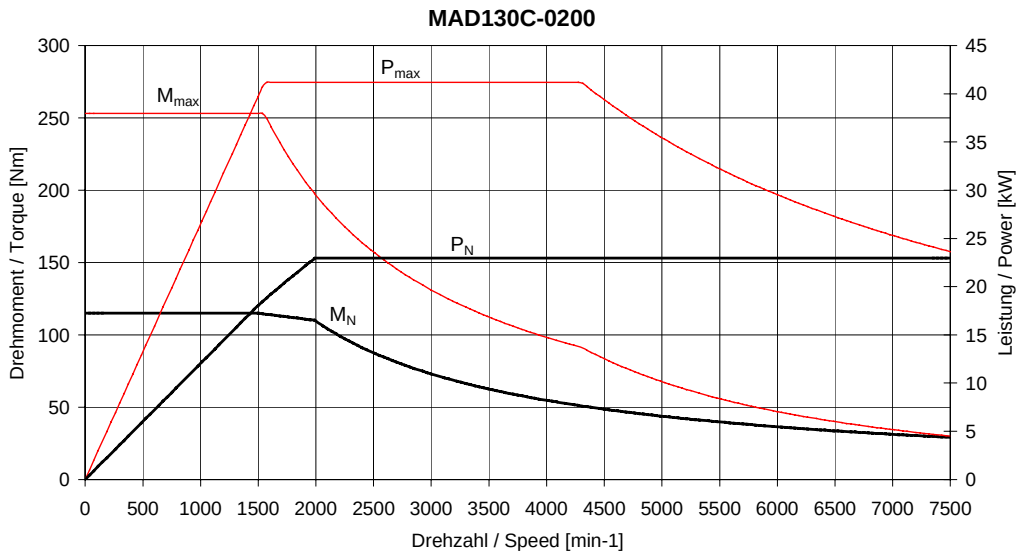
Fig. 4-31: Characteristic curve of MAD130C-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130C-0150.WMF

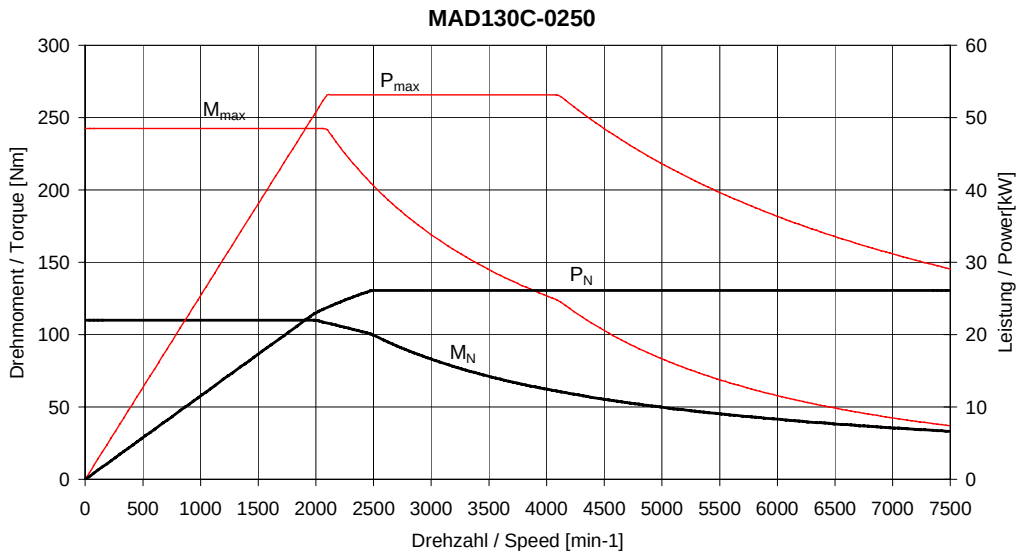
Fig. 4-32: Characteristic curve of MAD130C-0150 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130C-0200.WMF

Fig. 4-33: Characteristic curve of MAD130C-0200 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130C-0250.WMF

Fig. 4-34: Characteristic curve of MAD130C-0250 motors

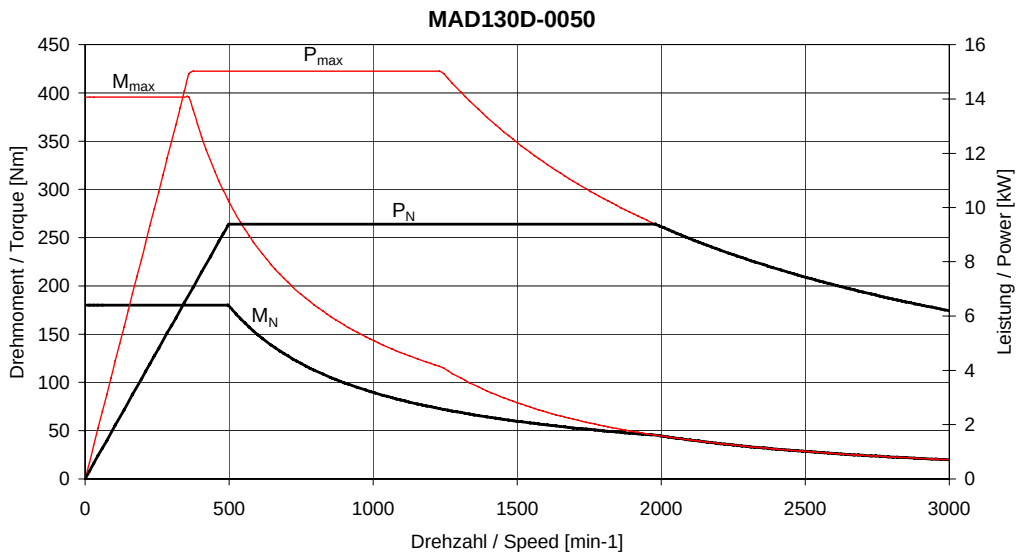
4.8 Data Sheet MAD130D

Description		Symbol	Unit	MAD130D				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	180	170	155	150	120
Rated power		P_N	kW	9.4	17.8	24.3	31.4	31.4
Rated current		I_N	A	24.2	43.7	61.5	71.3	72
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	396	418	375	341	310
Maximum output		P_{max}	kW	19.3	36.5	49.8	64.4	64.4
Maximum current		I_{max}	A	47	93.4	123	137	123.4
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	7500		
	R	n_{max}	rpm	3000	5250			
	V	n_{max}	rpm	3000	6000	7500		
	H	n_{max}	rpm	3000	6000	9000 [7])	10000 [7])	
Continuous torque at standstill		M_{n1}	Nm	180	190	170	155	130
Continuous current at standstill		I_{n1}	A	24.2	47.8	64.1	72.8	75.4
Torque constant at 20° C		K_{M_N}	Nm/A	8.75	4.72	3.09	2.62	2.69
Thermal time constant		T_{th}	min	45				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	27.5	27.3	30.5	27.5	26.4
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	4	10	16	16	25
Moment of inertia [3])		J_{rot}	kgm²	0.164				
Mass [4])		m	kg	165				
Sound pressure level [5])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**		
Transmittable torque		M_4	Nm	100		80		
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	1.5		1.6		
Moment of inertia		J_{Br}	kgm²	0.002				
Max. permissible braking energy		W_{max}	Ws	30000				
Disconnection time		t_2	ms	65		140		
Connection time		t_1	ms	110		50		
Maximum speed brake		n_{Br_max}	rpm	8000		8000		
Mass		m	kg	8				
Fan				**Axial fan**				
Air current				B → A, blowing				
Connection voltage		U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz				
Power consumption		S_N	VA	139 208				
Fan flow [6])		I_N	A	0.20 .... 0.25				
Medium air voltage		V	m³/h	1000				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
[7]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-35: Data Sheet MAD130D

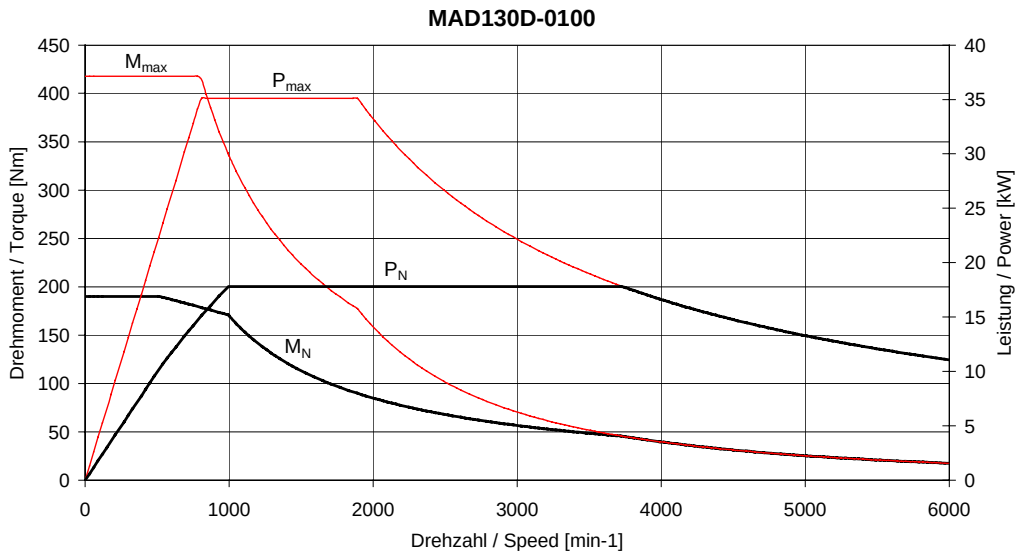
Characteristic Curves of MAD130D Motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130D-0050.WMF

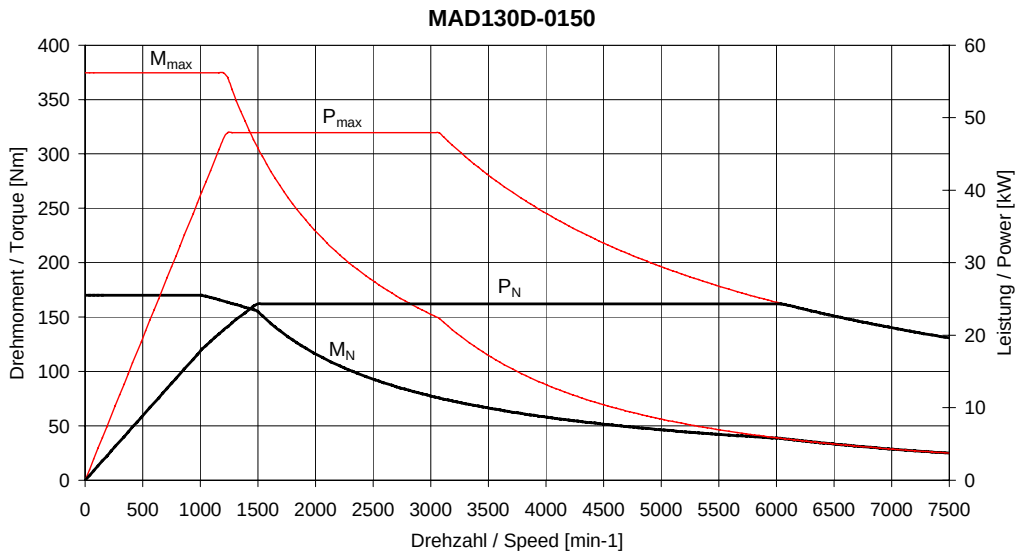
Fig. 4-36: Characteristic curve of MAD130D-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130D-0100.WMF

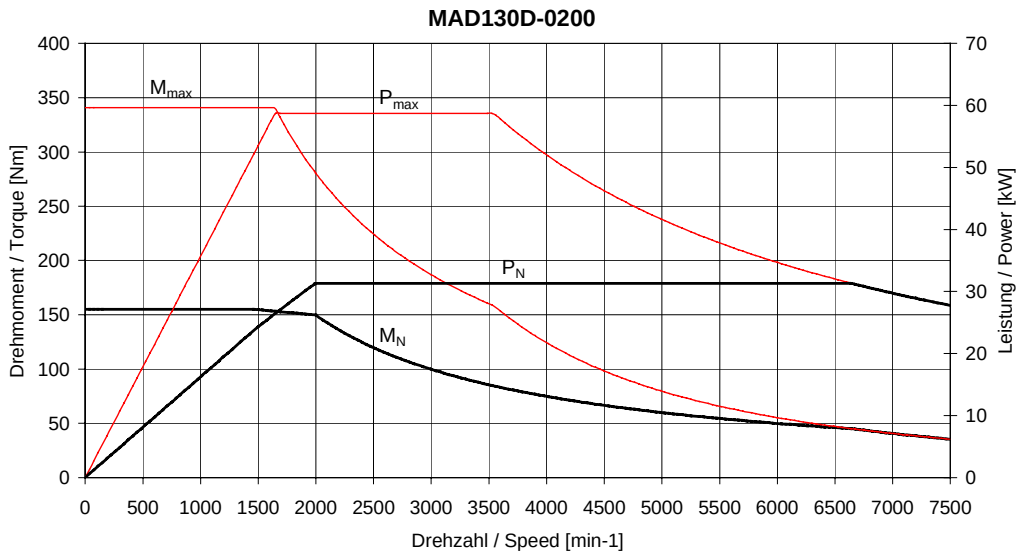
Fig. 4-37: Characteristic curve of MAD130D-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130D-0150.WMF

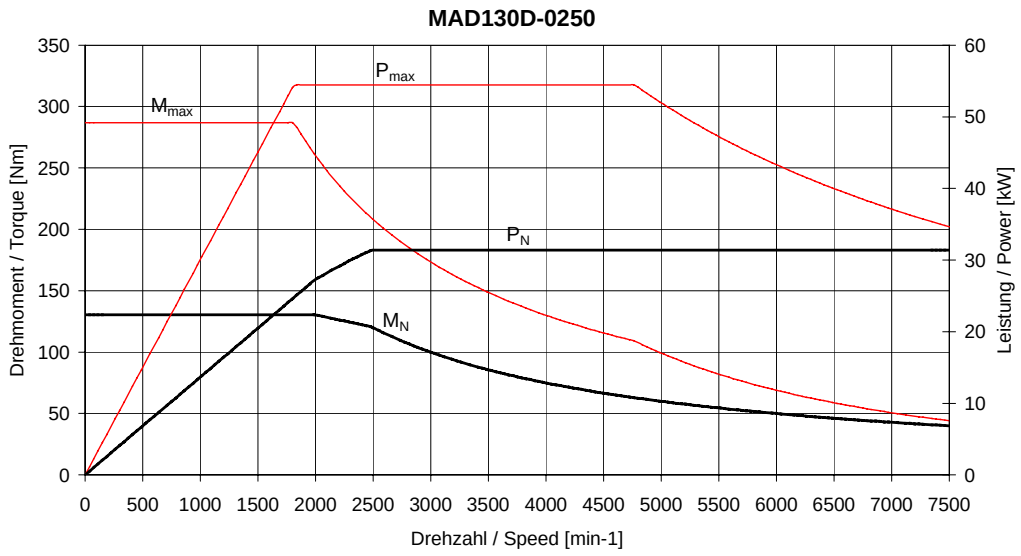
Fig. 4-38: Characteristic curve of MAD130D-0150 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130D-0200.WMF

Fig. 4-39: Characteristic curve of MAD130D-0200 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD130D-0250.WMF

Fig. 4-40: Characteristic curve of MAD130D-0250 motors

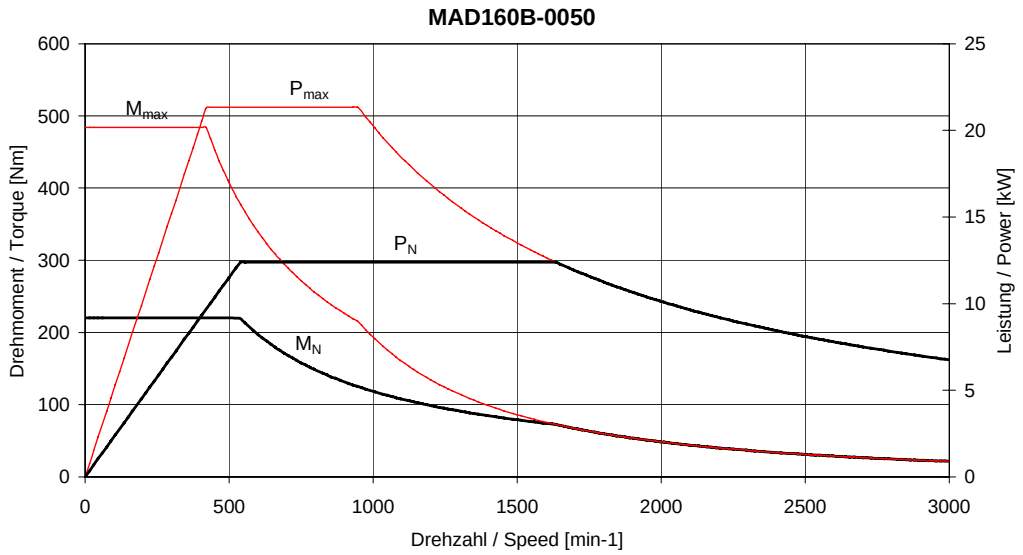
4.9 Data Sheet MAD160B

Description	Symbol	Unit	MAD160B			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_N	Nm	220	200	190	160
Rated power	P_N	kW	11.5	20.9	29.8	33.5
Rated current	I_N	A	26.1	43.5	61.6	75.8
Rated speed	n_N	rpm	500	1000	1500	2000
Key speed	n_1	rpm	500	500	1000	1500
Maximum torque	M_{max}	Nm	484	461	440	375
Maximum output	P_{max}	kW	23.6	42.9	61.2	68.7
Maximum current	I_{max}	A	51.7	87.5	132.2	157.4
Maximum speed with bearing… N	n_{max}	rpm	3000	6000		
Maximum speed with bearing… R	n_{max}	rpm	3000	4200		
Maximum speed with bearing… V	n_{max}	rpm	3000	6000		
Maximum speed with bearing… H	n_{max}	rpm	8000 [7)]			
Continuous torque at standstill	M_{n1}	Nm	220	210	200	170
Continuous current at standstill	I_{n1}	A	26.1	45	64	80.9
Torque constant at 20° C	K_{M_N}	Nm/A	10.96	5.47	3.37	2.54
Thermal time constant	T_{th}	min	60			
Duty cycle time (S6-44%)	T_C	min	10			
Discharge capacity	C_{ab}	nF	35	35	35	34.4
Number of pole pairs	p		2			
Power wire cross-section [2)]	A	mm²	4	10	16	25
Moment of inertia [3)]	J_{rot}	kgm²	0.25			
Mass [4)]	m	kg	201			
Sound pressure level [5)]	L_P	dB(A)	75 (+3)			
Ambient temperature in operation	T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1			F			
Motor protection class			IP65			
Holding brake (optional)			**Electrically clamping**	**Electrically releasing**	**Electrically releasing - reinforced**	
Transmittable torque	M_4	Nm	100		240	
Connection voltage	U_{Br}	V	DC 24 ± 10 %			
Rated current	I_{Br}	A	1.8	2.0	1.87	
Moment of inertia	J_{Br}	kgm²	0.0065		0.0188	
Max. permissible braking energy	W_{max}	Ws	40000		70000	
Disconnection time	t_2	ms	100	190	300	
Connection time	t_1	ms	85	12	30	
Maximum speed brake	n_{Br_max}	rpm	8000	8000	6000	
Mass	m	kg	20		25	
Fan			**Axial fan**			
Air current			B → A, blowing			
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz			
Power consumption	S_N	VA	132 175			
Fan flow [6)]	I_N	A	0.19 .... 0.21			
Medium air voltage	V	m³/h	1000			

[1)] Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2)] Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3)] Value without holding brake.
[4)] Value without holding brake, with fan.
[5)] At 1m distance, with PWM = 4 kHz
[6)] With I_N + 20% and higher, fans should be monitored.
[7)] Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-41: Data sheet MAD160B

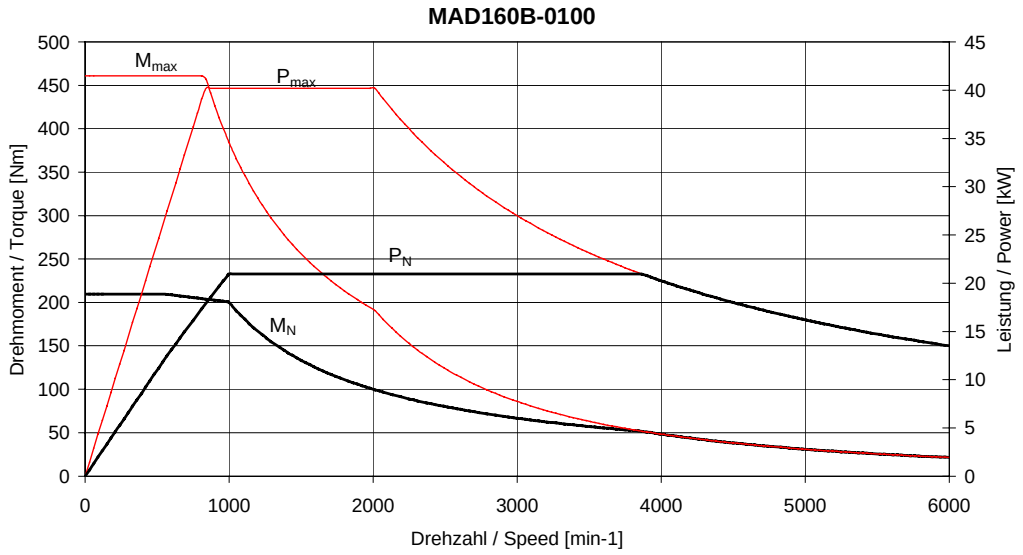
Characteristic Curves of MAD160B Motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160B-0050.WMF

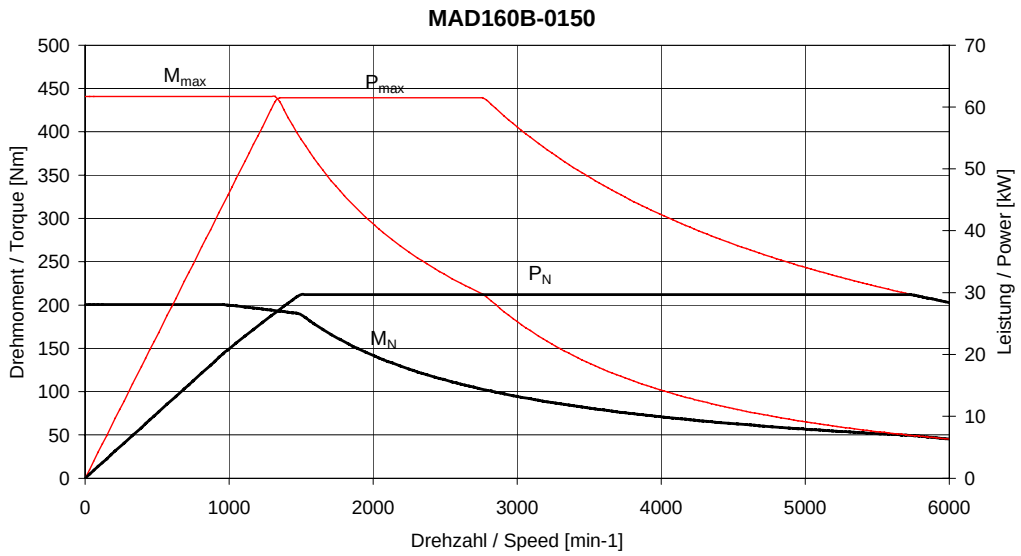
Fig. 4-42: Characteristic curve of MAD160B-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160B-0100.WMF

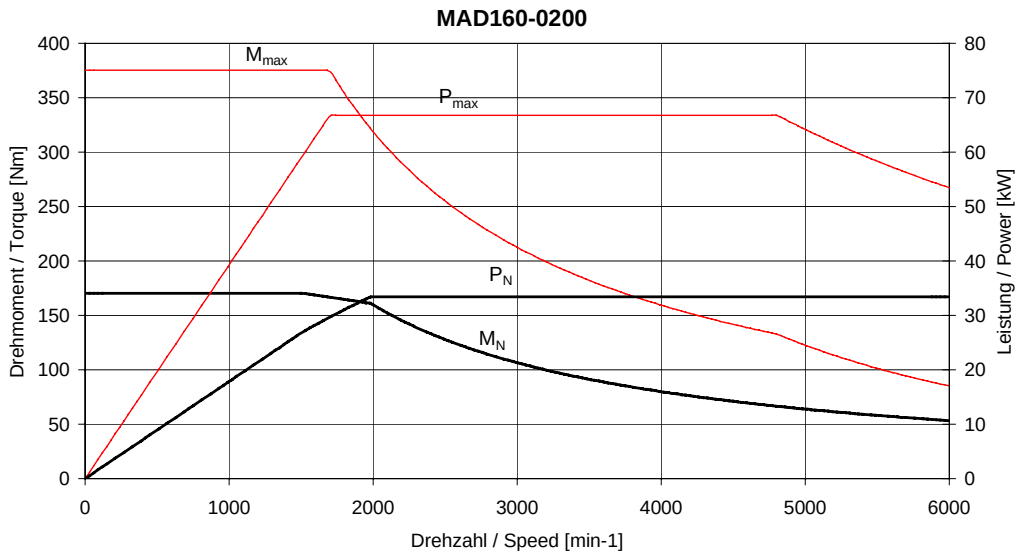
Fig. 4-43: Characteristic curve of MAD160B-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160B-0150.WMF

Fig. 4-44: Characteristic curve of MAD160B-0150 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160B-0200.WMF

Fig. 4-45: Characteristic curve of MAD160B-0200 motors

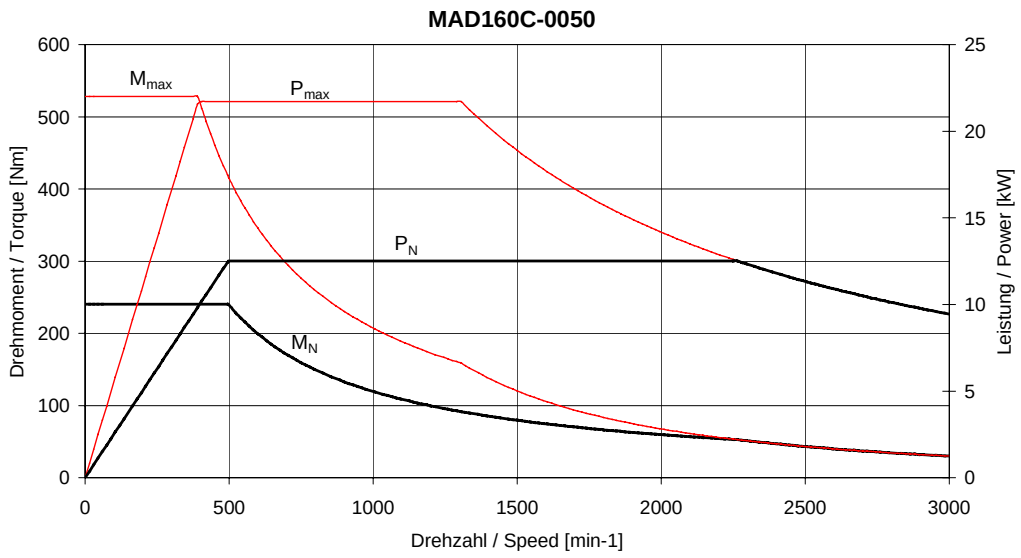
4.10 Data Sheet MAD160C

Description	Symbol	Unit	MAD160C			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_N	Nm	240	225	215	210
Rated power	P_N	kW	12.6	23.6	33.8	44
Rated current	I_N	A	27.6	52.9	75.3	93.9
Rated speed	n_N	rpm	500	1000	1500	2000
Key speed	n_1	rpm	500	500	1000	1500
Maximum torque	M_{max}	Nm	528	527	496	494
Maximum output	P_{max}	kW	25.8	48.4	69.3	90.2
Maximum current	I_{max}	A	54.8	112.3	152.6	182.4
Maximum speed with bearing… N	n_{max}	rpm	3000	6000		
Maximum speed with bearing… R	n_{max}	rpm	3000	4200		
Maximum speed with bearing… V	n_{max}	rpm	3000	6000		
Maximum speed with bearing… H	n_{max}	rpm	8000 [7)]			
Continuous torque at standstill	M_{n1}	Nm	240	240	225	225
Continuous current at standstill	I_{n1}	A	27.6	55.7	77.8	93.9
Torque constant at 20° C	K_{M_N}	Nm/A	9.95	4.83	3.36	2.63
Thermal time constant	T_{th}	min	70			
Duty cycle time (S6-44%)	T_C	min	10			
Discharge capacity	C_{ab}	nF	28	24.4	27.2	32.3
Number of pole pairs	p		2			
Power wire cross-section [2)]	A	mm²	6	16	25	25
Moment of inertia [3)]	J_{rot}	kgm²	0.311			
Mass [4)]	m	kg	238			
Sound pressure level [5)]	L_P	dB(A)	75 (+3)			
Ambient temperature in operation	T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1			F			
Motor protection class			IP65			
Holding brake (optional)			**Electrically clamping**	**Electrically releasing**	**Electrically releasing - reinforced**	
Transmittable torque	M_4	Nm	100		240	
Connection voltage	U_{Br}	V	DC 24 ± 10 %			
Rated current	I_{Br}	A	1.8	2.0	1.87	
Moment of inertia	J_{Br}	kgm²	0.0065		0.0188	
Max. permissible braking energy	W_{max}	Ws	40000		70000	
Disconnection time	t_2	ms	100	190	300	
Connection time	t_1	ms	85	12	30	
Maximum speed brake	n_{Br_max}	rpm	8000	8000	6000	
Mass	m	kg	20		25	
Fan			**Axial fan**			
Air current			B → A, blowing			
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz			
Power consumption	S_N	VA	132 175			
Fan flow [6)]	I_N	A	0.19 .... 0.21			
Medium air voltage	V	m³/h	1000			

[1)] Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2)] Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3)] Value without holding brake.
[4)] Value without holding brake, with fan.
[5)] At 1m distance, with PWM = 4 kHz
[6)] With I_N + 20% and higher, fans should be monitored.
[7)] Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-46: Data sheet MAD160C

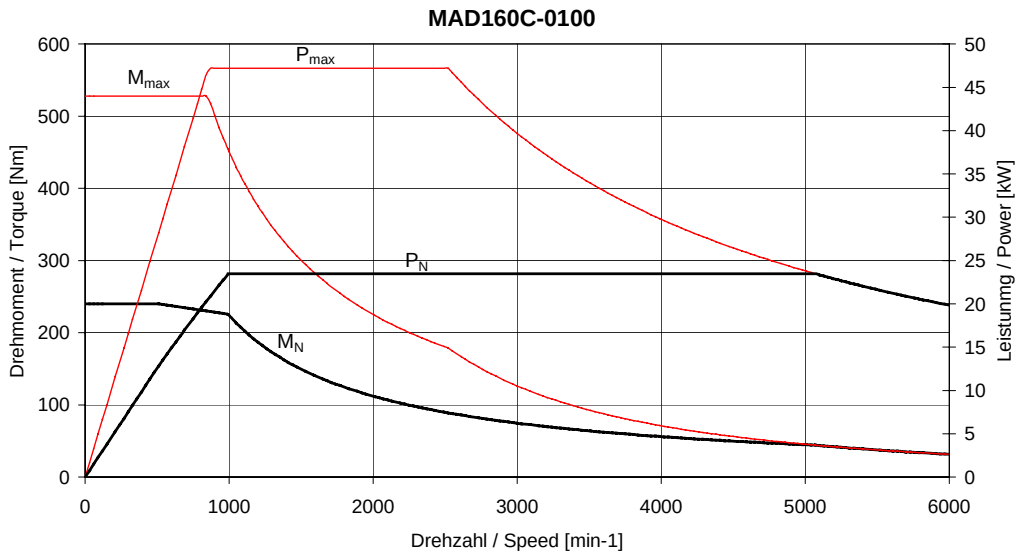
Characteristic Curves of MAD160C Motors



Mit Regelgerät HMS01.1N-W0070 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160C-0050.WMF

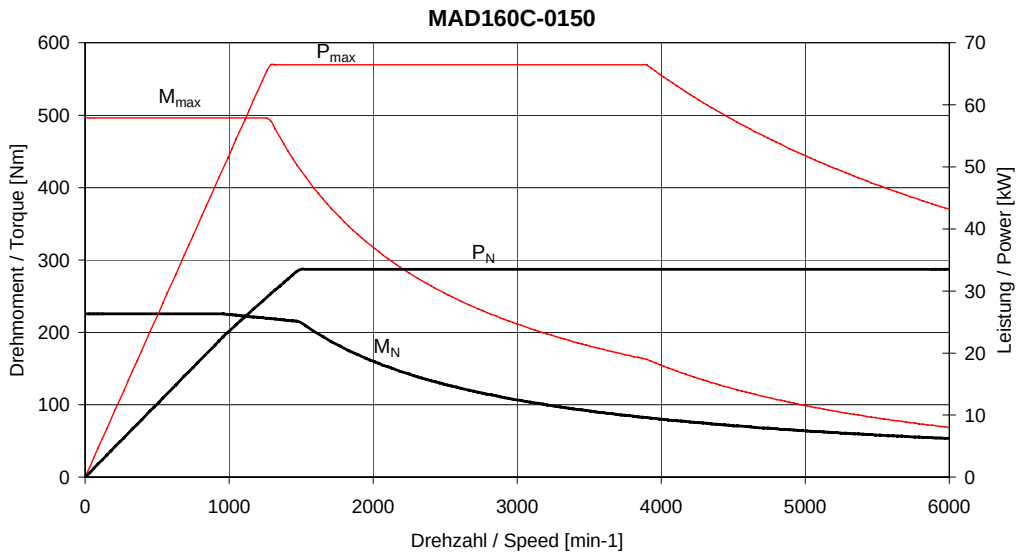
Fig. 4-47: Characteristic curve of MAD160C-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160C-0100.WMF

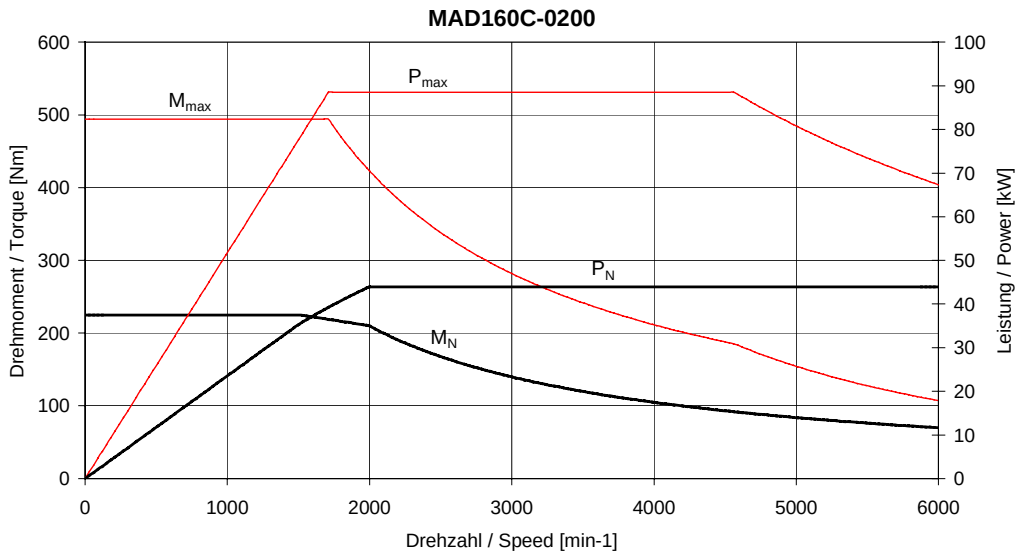
Fig. 4-48: Characteristic curve of MAD160C-0100 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160C-0150.WMF

Fig. 4-49: Characteristic curve of MAD160C-0150 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD160C-0200.WMF

Fig. 4-50: Characteristic curve of MAD160C-0200 motors

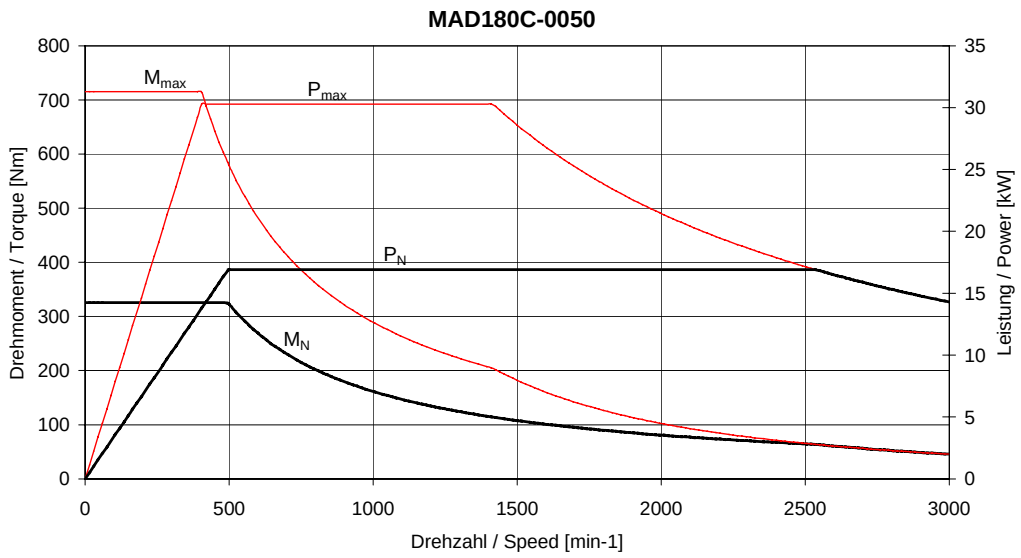
4.11 Data Sheet MAD180C

Description	Symbol	Unit	MAD180C			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_N	Nm	325	300	270	250
Rated power	P_N	kW	17	31.4	42.4	52.4
Rated current	I_N	A	38.2	69	88.6	104.6
Rated speed	n_N	rpm	500	1000	1500	2000
Key speed	n_1	rpm	500	500	1000	1500
Maximum torque	M_{max}	Nm	715	620	681	594
Maximum output	P_{max}	kW	34.9	64.4	86.9	107.4
Maximum current	I_{max}	A	76.6	147.5	230.3	207.3
Maximum speed with bearing… N	n_{max}	rpm	3000	6000		
Maximum speed with bearing… R	n_{max}	rpm	3000	4200		
Maximum speed with bearing… V	n_{max}	rpm	3000	6000		
Maximum speed with bearing… H	n_{max}	rpm	not available			
Continuous torque at standstill	M_{n1}	Nm	325	330	300	270
Continuous current at standstill	I_{n1}	A	38.2	75	116.2	110
Torque constant at 20° C	K_{M_N}	Nm/A	10	5.19	3.25	3.01
Thermal time constant	T_{th}	min	45			
Duty cycle time (S6-44%)	T_C	min	10			
Discharge capacity	C_{ab}	nF	29.2	25.2	30	31.6
Number of pole pairs	p		2			
Power wire cross-section [2])	A	mm²	10	25	35	35
Moment of inertia [3])	J_{rot}	kgm²	0.458			
Mass [4])	m	kg	334			
Sound pressure level [5])	L_P	dB(A)	78 (+3)			
Ambient temperature in operation	T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1			F			
Motor protection class			IP65			
Holding brake (optional)			**Electrically clamping**		**Electrically releasing**	
Transmittable torque	M_4	Nm	300		240	
Connection voltage	U_{Br}	V	DC 24 ± 10 %			
Rated current	I_{Br}	A	2		1.87	
Moment of inertia	J_{Br}	kgm²	0.0188			
Max. permissible braking energy	W_{max}	Ws	70000			
Disconnection time	t_2	ms	90		300	
Connection time	t_1	ms	150		30	
Mass	m	kg	25			
Fan			**Axial fan**			
Air current			B → A, blowing			
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz			
Power consumption	S_N	VA	242 382			
Fan current [6])	I_N	A	0.35 .... 0.46			
Medium air voltage	V	m³/h	1500			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.

Fig. 4-51: Data sheet MAD180C

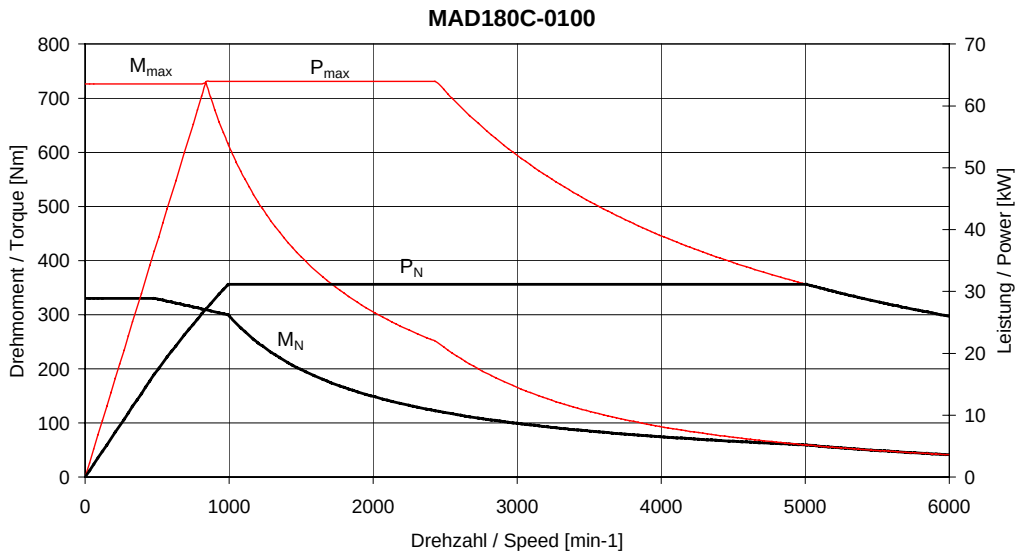
Characteristic Curves of MAD180C Motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180C-0050.WMF

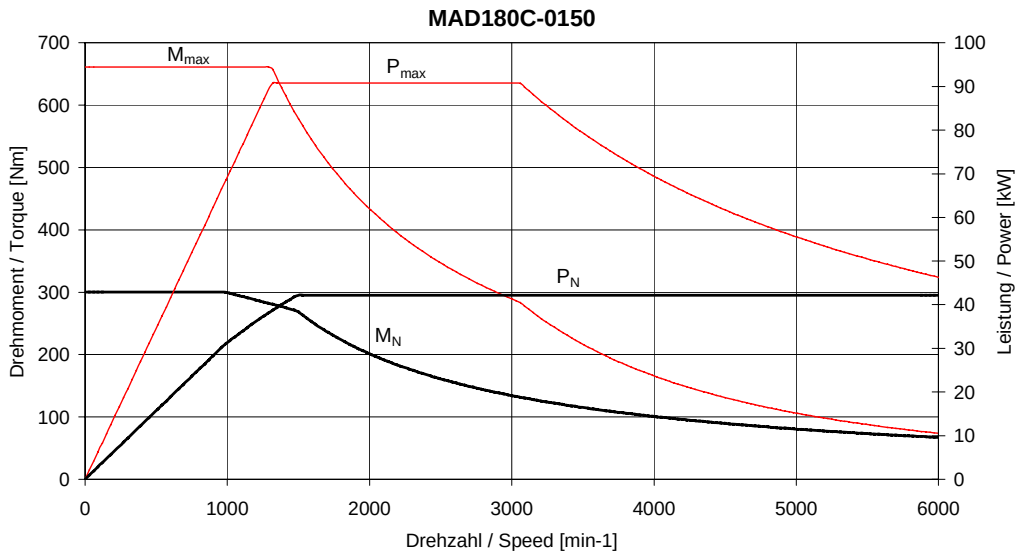
Fig. 4-52: Characteristic curve of MAD180C-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180C-0100.WMF

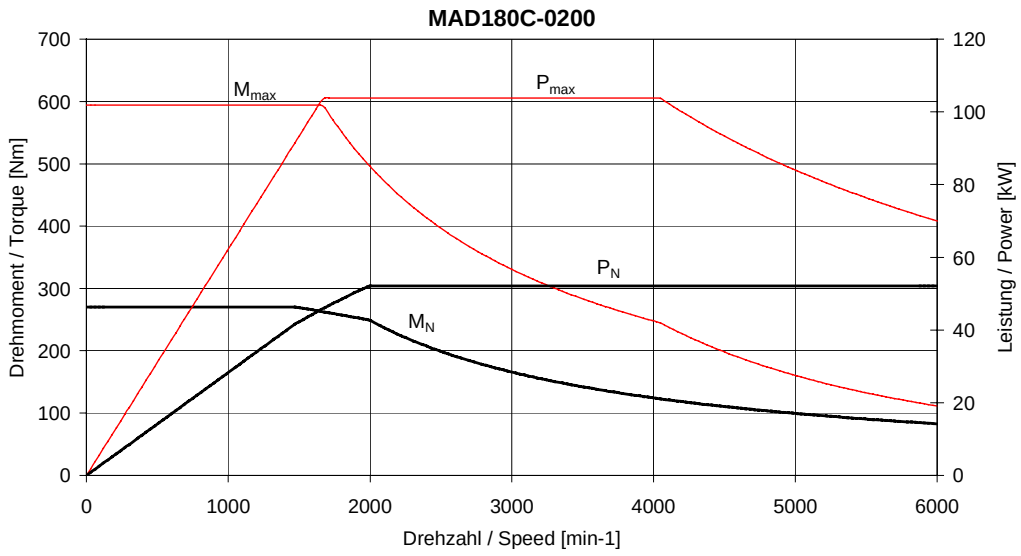
Fig. 4-53: Characteristic curve of MAD180C-0100 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180C-0150.WMF

Fig. 4-54: Characteristic curve of MAD180C-0150 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180C-0200.WMF

Fig. 4-55: Characteristic curve of MAD180C-0200 motors

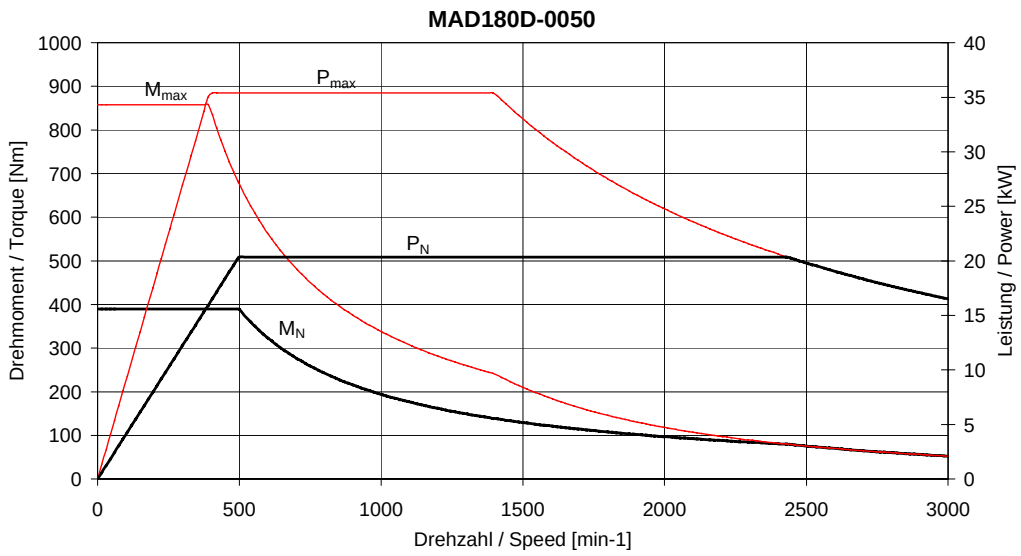
4.12 Data Sheet MAD180D

Description	Symbol	Unit	MAD180D			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_N	Nm	390	370	340	300
Rated power	P_N	kW	20.4	38.7	53.4	62.8
Rated current	I_N	A	39.7	82.4	107.8	117.4
Rated speed	n_N	rpm	500	1000	1500	2000
Key speed	n_1	rpm	500	500	1000	1500
Maximum torque	M_{max}	Nm	858	901	793	768
Maximum output	P_{max}	kW	41.8	79.3	109.5	128.7
Maximum current	I_{max}	A	78.4	188	218.1	269.7
Maximum speed with bearing… N	n_{max}	rpm	3000	6000		
Maximum speed with bearing… R	n_{max}	rpm	3000	4200		
Maximum speed with bearing… V	n_{max}	rpm	3000	6000		
Maximum speed with bearing… H	n_{max}	rpm	not available			
Continuous torque at standstill	M_{n1}	Nm	390	410	360	350
Continuous current at standstill	I_{n1}	A	39.7	90.0	112.3	132.6
Torque constant at 20° C	K_{M_N}	Nm/A	11.31	5.66	3.77	2.92
Thermal time constant	T_{th}	min	70			
Duty cycle time (S6-44%)	T_C	min	10			
Discharge capacity	C_{ab}	nF	38	38.4	38	38
Number of pole pairs	p		2			
Power wire cross-section [2])	A	mm²	10	25	35	35
Moment of inertia [3])	J_{rot}	kgm²	0.594			
Mass [4])	m	kg	403			
Sound pressure level [5])	L_P	dB(A)	78 (+3)			
Ambient temperature in operation	T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1			F			
Motor protection class			IP65			
Holding brake (optional)			**Electrically clamping**		**Electrically releasing**	
Transmittable torque	M_4	Nm	300		240	
Connection voltage	U_{Br}	V	DC 24 ± 10 %			
Rated current	I_{Br}	A	2		1.87	
Moment of inertia	J_{Br}	kgm²	0.0188			
Max. permissible braking energy	W_{max}	Ws	70000			
Disconnection time	t_2	ms	90		300	
Connection time	t_1	ms	150		30	
Mass	m	kg	25			
Fan			**Axial fan**			
Air current			B → A blowing			
Connection voltage	U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ±10 %, 50/60 Hz			
Power consumption	S_N	VA	242 382			
Fan current [6])	I_N	A	0.35 .... 0.46			
Medium air voltage	V	m³/h	1500			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.

Fig. 4-56: Data Sheet MAD180D

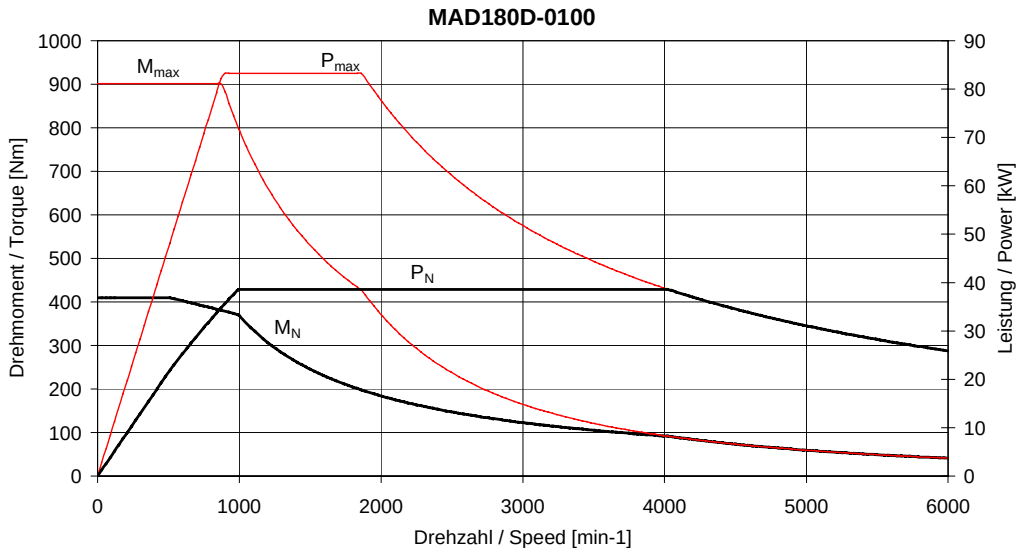
Characteristic Curves of MAD180D Motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180D-0050.WMF

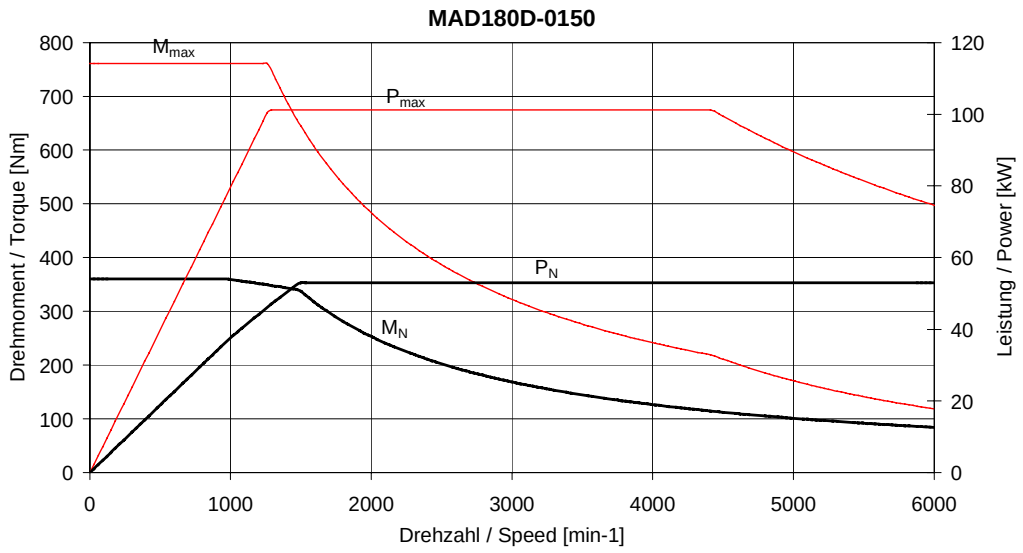
Fig. 4-57: Characteristic curve of MAD180D-0050 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180D-0100.WMF

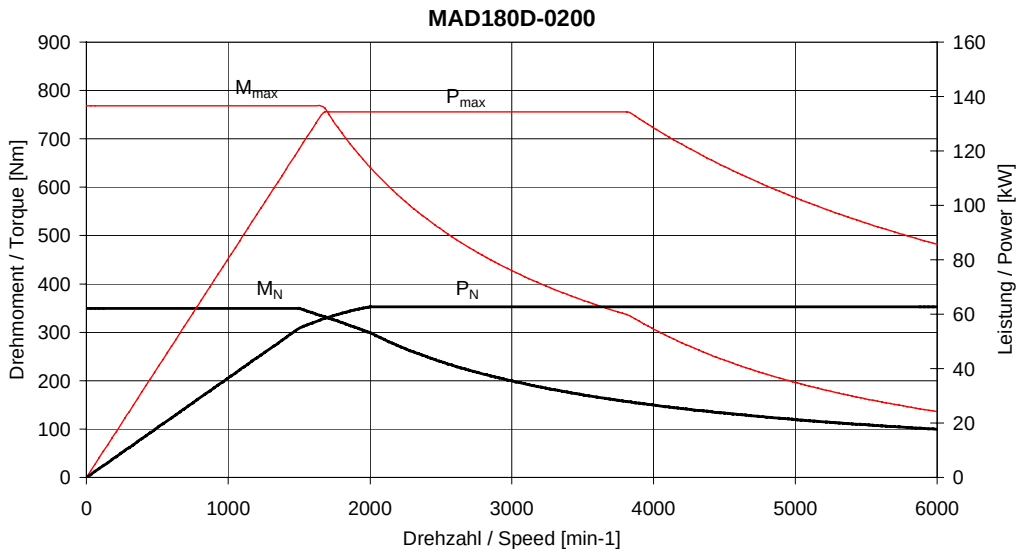
Fig. 4-58: Characteristic curve of MAD180D-0100 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HNV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HNV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAD180D-0150.WMF

Fig. 4-59: Characteristic curve of MAD180D-0150 motors



Mit Regelgerät DKR04.1-W400 an 3x AC400...480V (-5%)
With Drive Controller DKR04.1-W400 and main connection 3x AC400...480V (-5%)

Kennl_MAD180D-0200.WMF

Fig. 4-60: Characteristic curve of MAD180D-0200 motors

4.13 Data Sheet MAD225C

Description		Symbol	Unit	MAD225C		
Motor data [1])						
Winding				0050*	0100*	0150
Rated torque		M_N	Nm	640	620	593
Rated power		P_N	kW	33.5	64.9	93
Rated current		I_N	A	72	129	174
Rated speed		n_N	rpm	500	1000	1500
Key speed		n_1	rpm	500	500	1000
Maximum torque		M_{max}	Nm	1450	1450	1450
Maximum output		P_{max}	kW	70	135	190
Maximum current		I_{max}	A	160	280	376
Maximum speed with bearing…	N	n_{max}	rpm	3000	3750	3750
	R	n_{max}	rpm	not available		
	V	n_{max}	rpm	3000	3750	3750
	H	n_{max}	rpm	not available		
Continuous torque at standstill		M_{n1}	Nm	640	640	660
Continuous current at standstill		I_{n1}	A	72	135	187
Torque constant at 20° C		K_{M_N}	Nm/A	10.2	5.5	3.9
Thermal time constant		T_{th}	min	45	45	45
Duty cycle time (S6-44%)		T_C	min	5	5	5
Discharge capacity		C_{ab}	nF	126	126	126
Number of pole pairs		p		2		
Power wire cross-section [2])		A	mm²	25	2 x 16	2 x 35
Moment of inertia [3])		J_{rot}	kgm²	1.55		
Mass [4])		m	kg	610		
Sound pressure level [5])		L_P	dB(A)	78 (+3)		
Ambient temperature in operation		T_{um}	°C	0....+40		
Insulation class according to DIN EN 60034-1				F		
Motor protection class				IP65		
Fan				**Axial fan**		
Air current				B → A blowing		
Connection voltage		U_N	V	3 x 400V ±15 %, 50/60Hz ..... 3 x 480V ± 10 %, 50/60 Hz		
Power consumption		S_N	VA	i.p.		
Fan current [6])		I_N	A	i.p.		
Medium air voltage		V	m³/h	i.p.		

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value = 540 V_{DC} intermediate circuit.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) Value without holding brake, with fan.
[5]) At 1m distance, with PWM = 4 kHz
[6]) With I_N + 20% and higher, fans should be monitored.
*) Preliminary data
i. p.) in preparation

Fig. 4-61: Data sheet MAD225C

Characteristic Curve MAD225C Motor

in preparation

Fig. 4-62: Characteristic curves of MAD225C motors

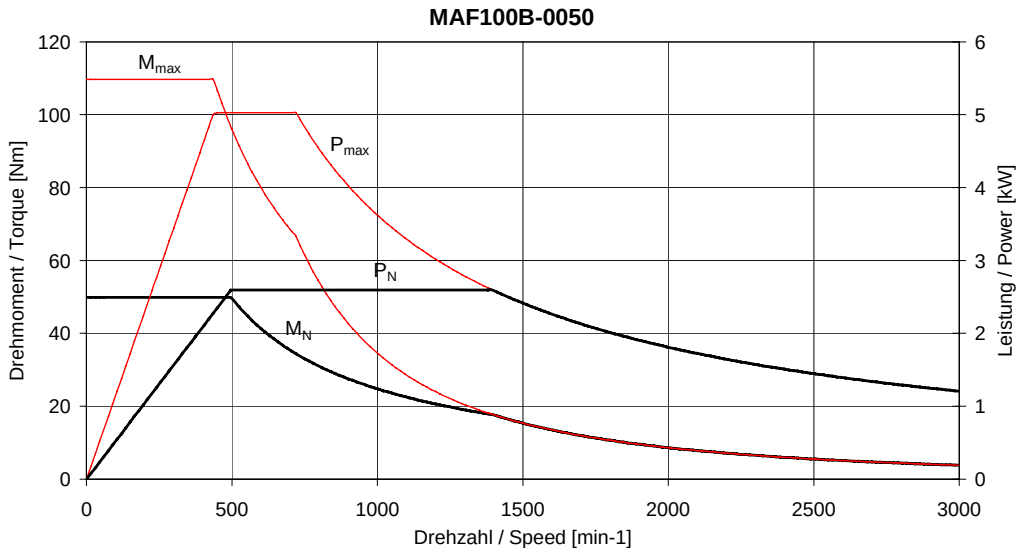
4.14 Data Sheet MAF100B

Description		Symbol	Unit	MAF100B				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	50	46	42	38	33
Rated power		P_N	kW	2.6	4.8	6.6	8	8.6
Rated current		I_N	A	8.5	14.3	18.1	23.9	26
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	110	110	101	92	84
Maximum output		P_{max}	kW	5.3	9.8	13.5	16.4	17.7
Maximum current		I_{max}	A	20.3	36.7	46.2	51.7	50.7
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	9000		
	R	n_{max}	rpm	3000	6000	6300		
	V	n_{max}	rpm	not available				
	H	n_{max}	rpm	3000	6000	9000	11000 [6])	
Continuous torque at standstill		M_{n1}	Nm	50	50	46	42	38
Continuous current at standstill		I_{n1}	A	8.5	17.9	22.7	25.8	26
Torque constant at 20° C		K_{M_N}	Nm/A	6.68	3.73	2.76	1.84	1.49
Thermal time constant		T_{th}	min	10				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	6				
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	1	1.5	2.5	4	4
Moment of inertia [3])		J_{rot}	kgm²	0.019				
Mass [3])		m	kg	38				
Sound pressure level [4])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	1.0				
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.4				
	with snap-on coupling	Δp_{diff}	bar	0.8				
Required coolant flow at P_V		Q_{min}	l/min	1.45				
Permissible inlet pressure		p_{max}	bar	3				
Volume of coolant duct		V_{cool}	l	0.06				
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**		
Transmittable torque		M_4	Nm	30		24		
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	0.9		1.1		
Moment of inertia		J_{Br}	kgm²	0.00056				
Maximum permissible braking energy		W_{max}	Ws	20000				
Disconnection time		t_2	ms	50		90		
Connection time		t_1	ms	42		30		
Maximum speed brake		n_{Br_max}	rpm	10000		10000		
Mass		m	kg	2		1.6		

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
[6]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-63: Data sheet MAF100B

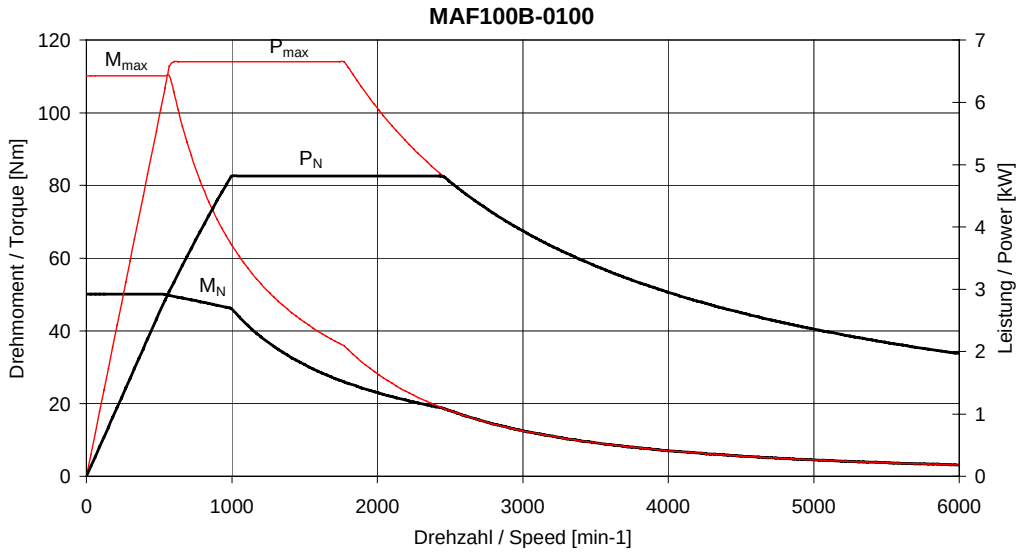
Characteristic Curves of MAD100B Motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100B-0050.WMF

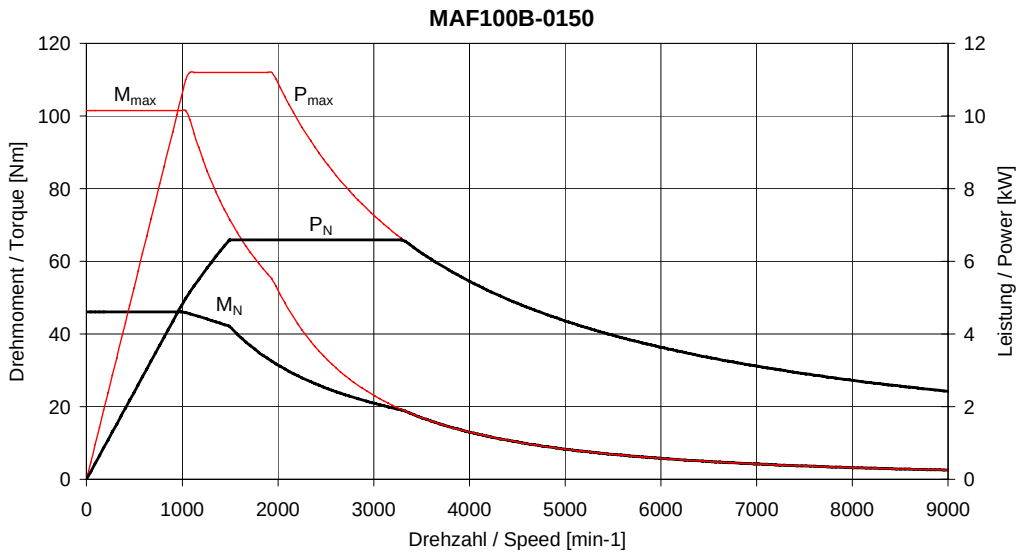
Fig. 4-64: Characteristic curves of MAF100B-0050 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100B-0100.WMF

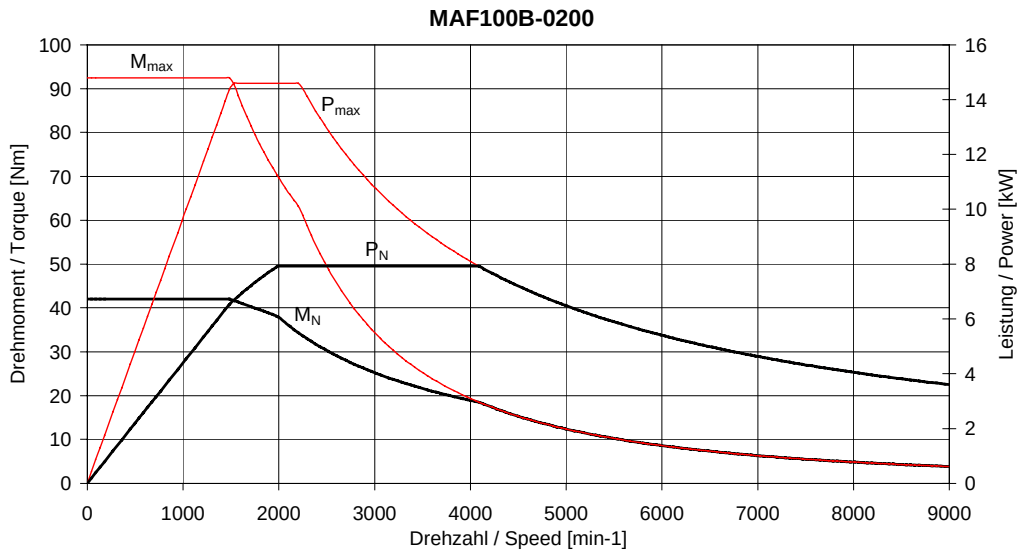
Fig. 4-65: Characteristic curves of MAF100B-0100 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100B-0150.WMF

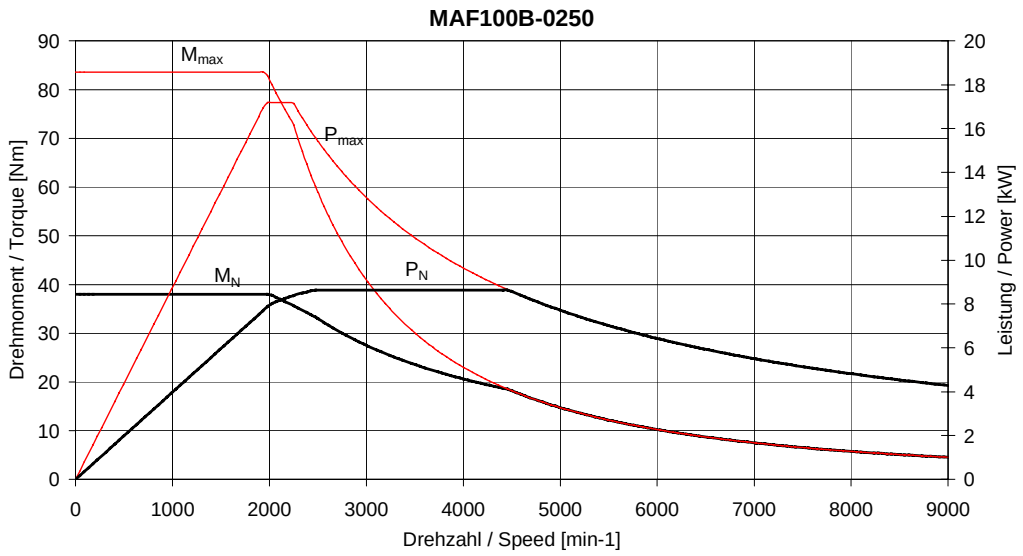
Fig. 4-66: Characteristic curves of MAF100B-0150 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100B-0200.WMF

Fig. 4-67: Characteristic curves of MAF100B-0200 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100B-0250.WMF

Fig. 4-68: Characteristic curves of MAF100B-0250 motors

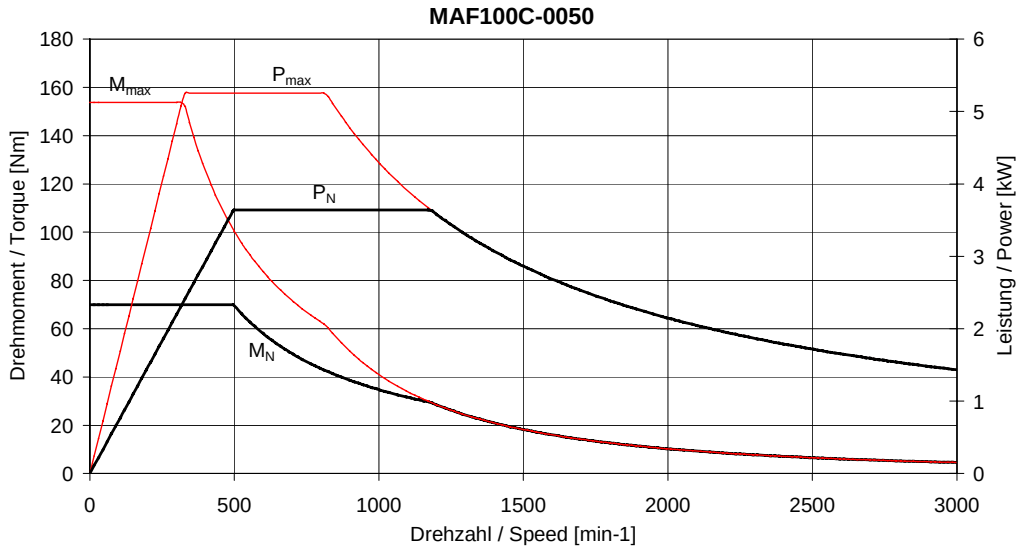
4.15 Data Sheet MAF100C

Description		Symbol	Unit	MAF100C				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	70	68	66	64	62
Rated power		P_N	kW	3.9	7.5	10.4	13.4	16.2
Rated current		I_N	A	12.1	19	27.9	36.7	40.2
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	154	154	149	145	138
Maximum output		P_{max}	kW	8	15.4	21.3	27.5	33.3
Maximum current		I_{max}	A	25.6	41.4	60.4	77.5	85.9
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	9000		
	R	n_{max}	rpm	3000	6000	6300		
	V	n_{max}	rpm	not available				
	H	n_{max}	rpm	3000	6000	9000	11000 [6])	
Continuous torque at standstill		M_{n1}	Nm	70	70	68	66	64
Continuous current at standstill		I_{n1}	A	12.1	19.5	28.6	37.6	38.5
Torque constant at 20° C		K_{M_N}	Nm/A	6.06	3.77	2.5	1.91	1.55
Thermal time constant		T_{th}	min	10				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	8.5	8.5	8.6	8.5	9.4
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	1	2.5	4	6	10
Moment of inertia [3])		J_{rot}	kgm²	0.0284				
Mass [3])		m	kg	52				
Sound pressure level [4])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	1.1		1.2	1.3	2
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.6				
	with snap-on coupling	Δp_{diff}	bar	1.2				
Required coolant flow at P_V		Q_{min}	l/min	1.6		1.75	1.9	2.8
Permissible inlet pressure		p_{max}	bar	3				
Volume of coolant duct		V_{cool}	l	0.08				
Holding brake (optional)				**Electrically clamping**			**Electrically releasing**	
Transmittable torque		M_4	Nm	30			24	
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	0.9			1.1	
Moment of inertia		J_{Br}	kgm²	0.00056				
Max. permissible braking energy		W_{max}	Ws	20000				
Disconnection time		t_2	ms	50			90	
Connection time		t_1	ms	42			30	
Maximum speed brake		n_{Br_max}	rpm	10000			10000	
Mass		m	kg	2			1.6	

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
[6]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-69: Data Sheet MAF100C

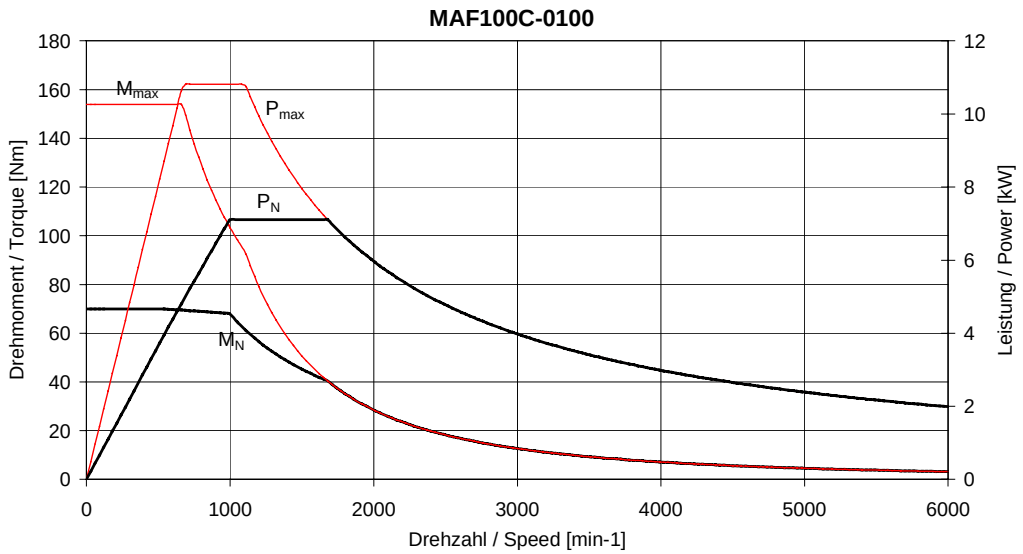
Characteristic Curves of MAF100C Motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100C-0050.WMF

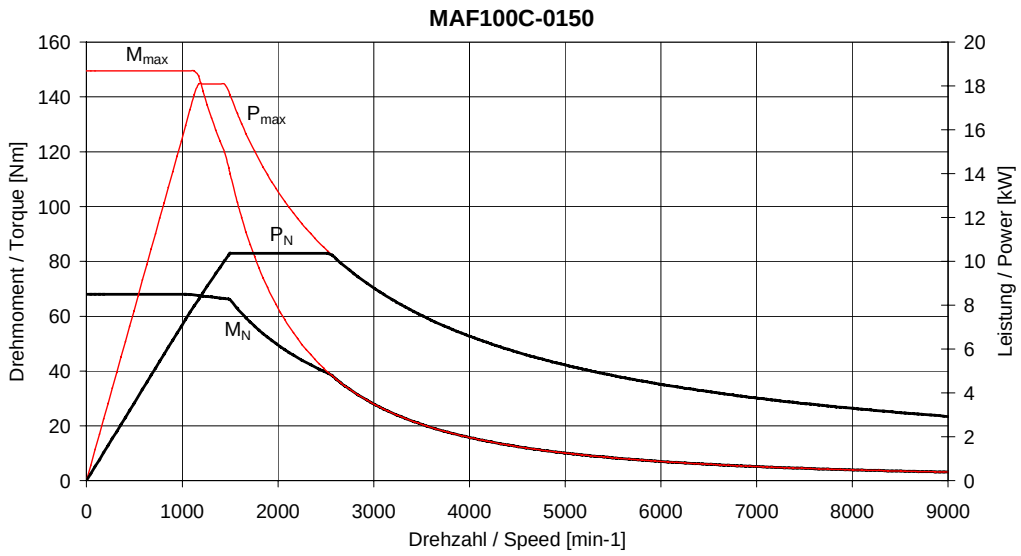
Fig. 4-70: Characteristic curves of MAF100C-0050 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100C-0100.WMF

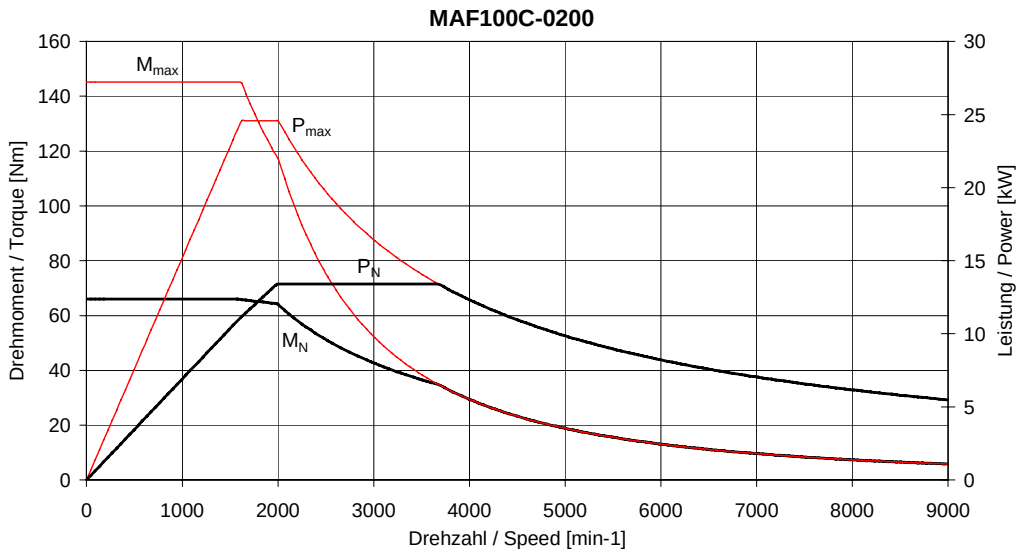
Fig. 4-71: Characteristic curves of MAF100C-0100 motor



Mit Regelgerät HMS01.1N-W0070 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100C-0150.WMF

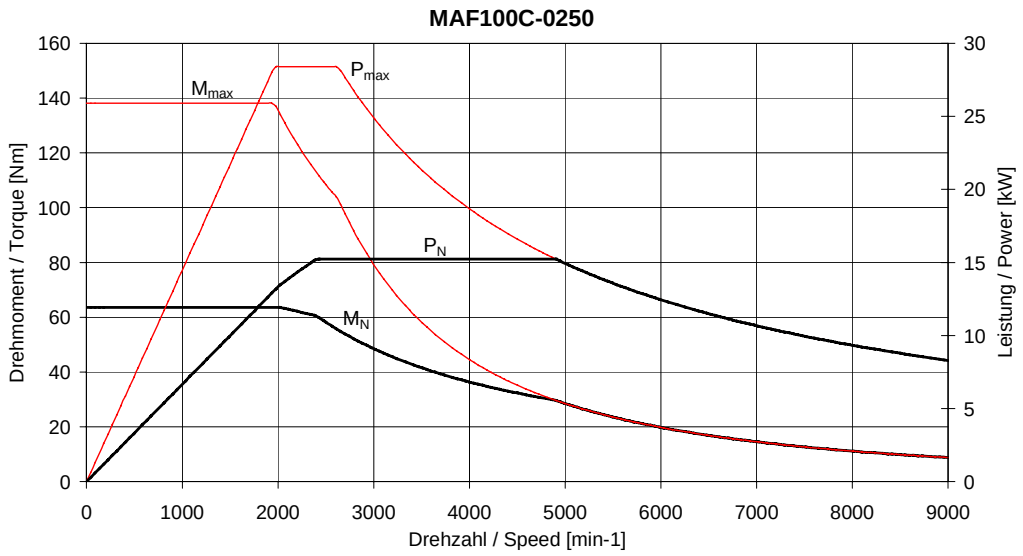
Fig. 4-72: Characteristic curves of MAF100C-0150 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100C-0200.WMF

Fig. 4-73: Characteristic curves of MAF100C-0200 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100C-0250.WMF

Fig. 4-74: Characteristic curves of MAF100C-0250 motors

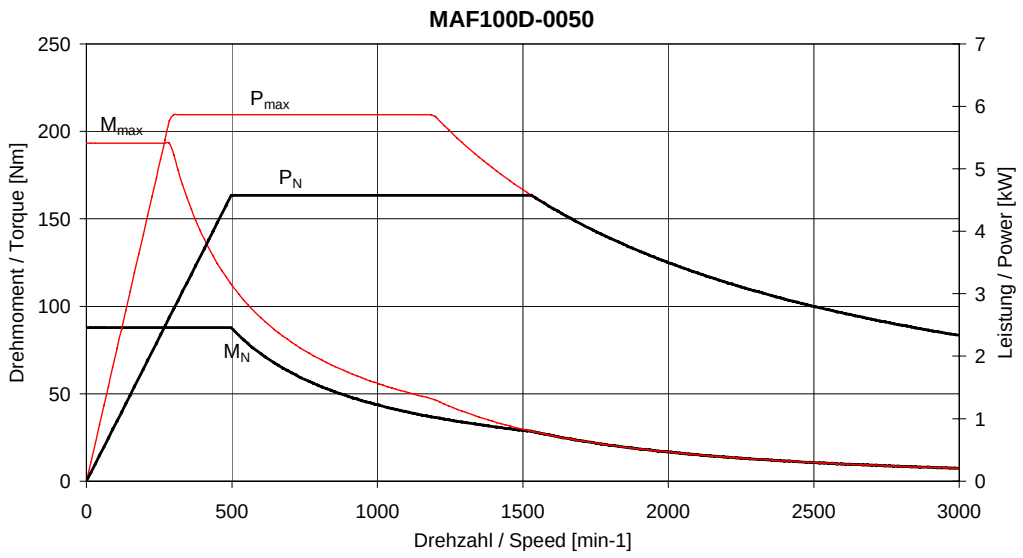
4.16 Data Sheet MAF100D

Description		Symbol	Unit	MAF100D				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	88	84	79	80	75
Rated power		P_N	kW	4.6	8.8	12.4	16.8	19.6
Rated current		I_N	A	14.5	25.1	32.7	43.1	45.8
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	193	194	185	182	177
Maximum output		P_{max}	kW	9.4	18	25.4	34.4	40.2
Maximum current		I_{max}	A	29.2	52.7	68.7	89.8	100.4
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	9000		
	R	n_{max}	rpm	3000	6000	6300		
	V	n_{max}	rpm	not available				
	H	n_{max}	rpm	3000	6000	9000	11000 [6])	
Continuous torque at standstill		M_{n1}	Nm	88	88	84	83	80
Continuous current at standstill		I_{n1}	A	14.5	26.1	34.3	44.4	56.1
Torque constant at 20° C		K_{M_N}	Nm/A	6.79	3.78	2.77	2.08	1.55
Thermal time constant		T_{th}	min	10				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	11	11	11	11	9.2
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	1.5	4	6	10	10
Moment of inertia [3])		J_{rot}	kgm²	0.032				
Mass [3])		m	kg	64				
Sound pressure level [4])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	1.4	1.45	1.5	1.55	1.9
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	1.0				
	with snap-on coupling	Δp_{diff}	bar	1.9				
Required coolant flow at P_V		Q_{min}	l/min	2	2.1	2.2	2.3	2.8
Permissible inlet pressure		p_{max}	bar	3				
Volume of coolant duct		V_{cool}	l	0.11				
Holding brake (optional)				**Electrically clamping**			**Electrically releasing**	
Transmittable torque		M_4	Nm	30			24	
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	0.9			1.1	
Moment of inertia		J_{Br}	kgm²	0.00056				
Max. permissible braking energy		W_{max}	Ws	20000				
Disconnection time		t_2	ms	50			90	
Connection time		t_1	ms	42			30	
Maximum speed brake		n_{Br_max}	rpm	10000			10000	
Mass		m	kg	2			1.6	

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
[6]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-75: Data Sheet MAF100D

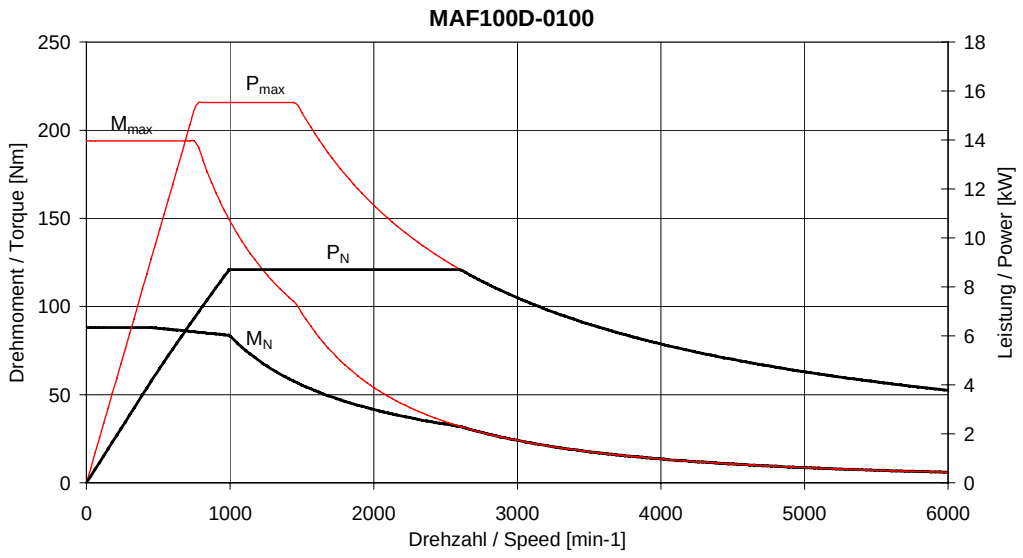
Characteristic Curves of MAF100D Motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100D-0050.WMF

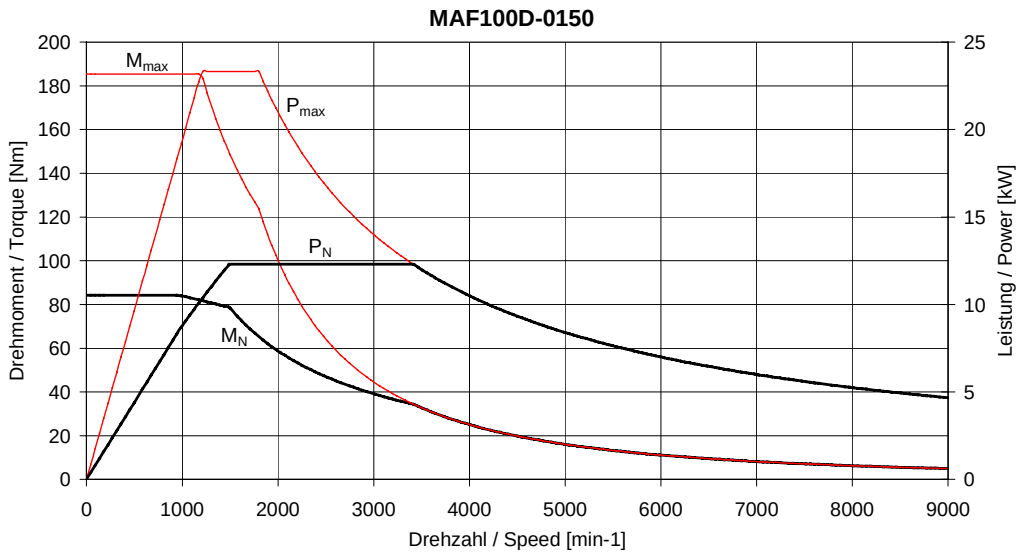
Fig. 4-76: Characteristic curves of MAF100D-0050 motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100D-0100.WMF

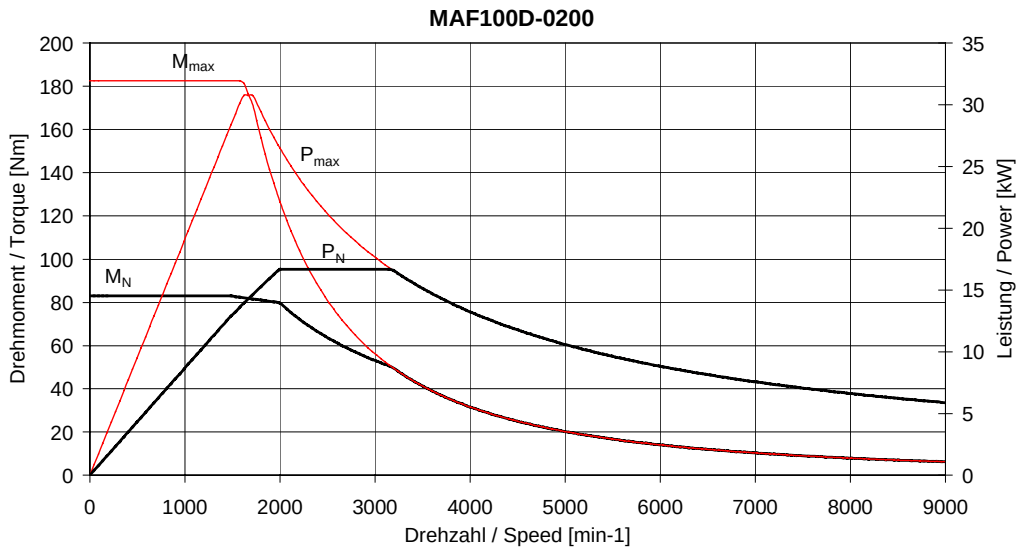
Fig. 4-77: Characteristic curves of MAF100D-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100D-0150.WMF

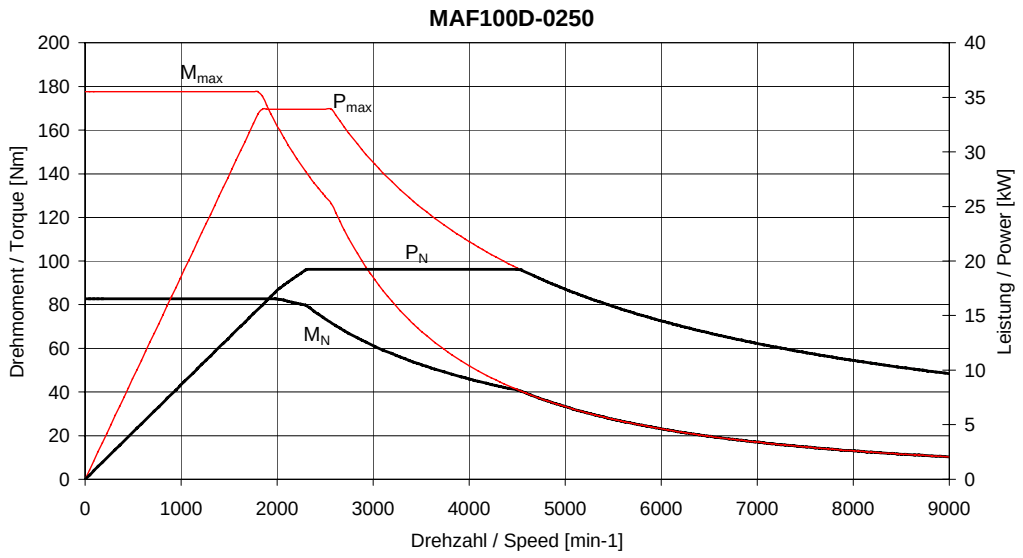
Fig. 4-78: Characteristic curves of MAF100D-0150 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100D-0200.WMF

Fig. 4-79: Characteristic curves of MAF100D-0200 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF100D-0250.WMF

Fig. 4-80: Characteristic curves of MAF100D-0250 motors

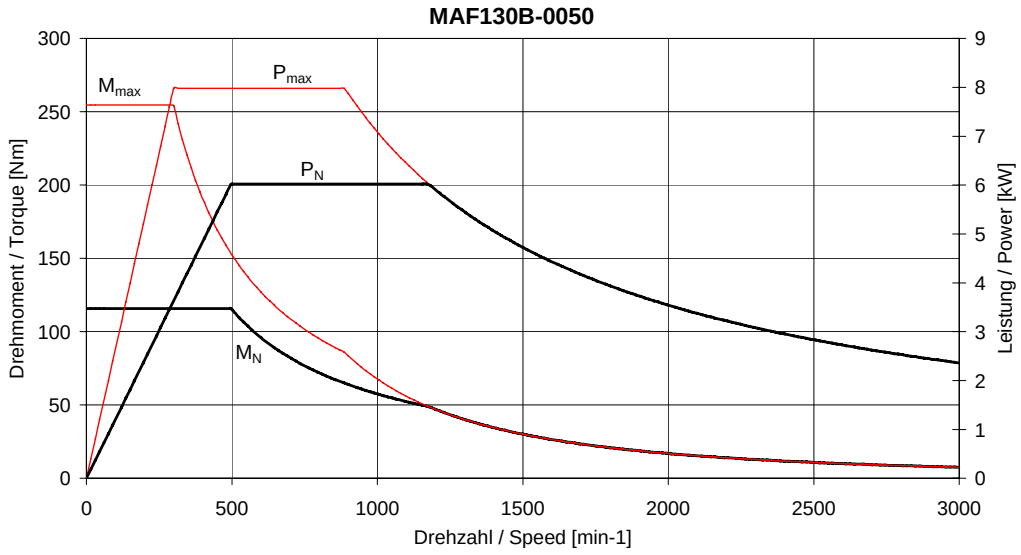
4.17 Data Sheet MAF130B

Description		Symbol	Unit	MAF130B				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	116	112	115	100	90
Rated power		P_N	kW	6.1	11.7	18.1	20.9	23.6
Rated current		I_N	A	14.7	28.4	43.7	52.7	55.5
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	255	255	264	220	221
Maximum output		P_{max}	kW	12.5	24	37.1	42.9	48.3
Maximum current		I_{max}	A	30.5	60.9	94.7	114.1	111.4
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	7500		
	R	n_{max}	rpm	3000	5250			
	V	n_{max}	rpm	3000	6000	7500		
	H	n_{max}	rpm	3000	6000	9000 [6])	10000 [6])	
Continuous torque at standstill		M_{n1}	Nm	116	116	120	108	100
Continuous current at standstill		I_{n1}	A	14.7	29.3	45.3	55.2	55.5
Torque constant at 20° C		K_{M_N}	Nm/A	8.46	4.25	2.83	2.12	1.83
Thermal time constant		T_{th}	min	15				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	16				
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	1.5	4	10	10	16
Moment of inertia [3])		J_{rot}	kgm²	0.079				
Mass [3])		m	kg	81				
Sound pressure level [4])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	1.8	1.9	2	2.1	2.2
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.22				
	with snap-on coupling	Δp_{diff}	bar	0.45				
Required coolant flow at P_V		Q_{min}	l/min	2.7	2.8	2.9	3.1	3.2
max. system pressure		p_{max}	bar	3				
Holding brake (optional)				**Electrically clamping**			**Electrically releasing**	
Transmittable torque		M_4	Nm	100			80	
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	1.5			1.6	
Moment of inertia		J_{Br}	kgm²	0.002				
Max. permissible braking energy		W_{max}	Ws	30000				
Disconnection time		t_2	ms	65			140	
Connection time		t_1	ms	110			50	
Maximum speed brake		n_{Br_max}	rpm	8000			8000	
Mass		m	kg	8				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
[6]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-81: Data sheet MAF130B

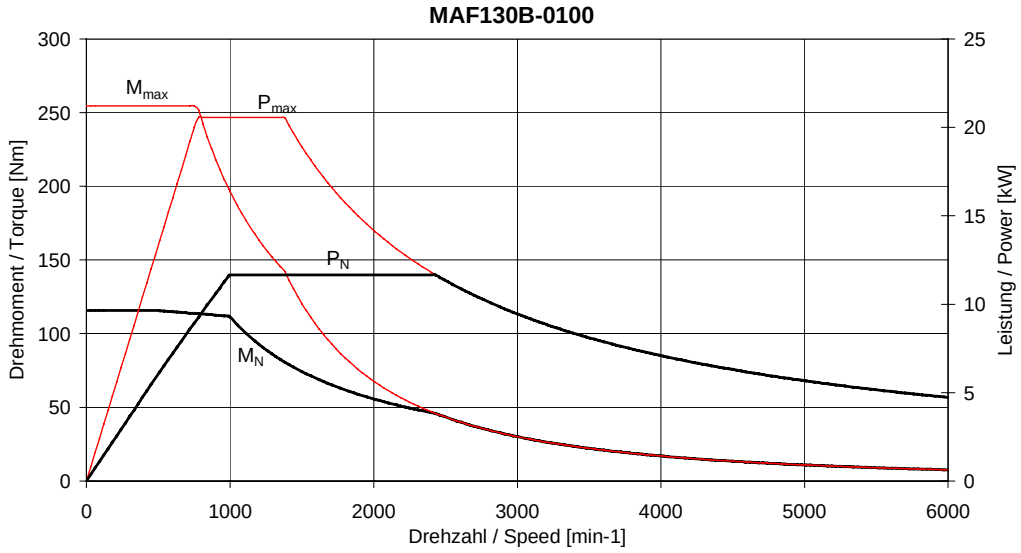
Characteristic Curves of MAF130B Motors



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130B-0050.WMF

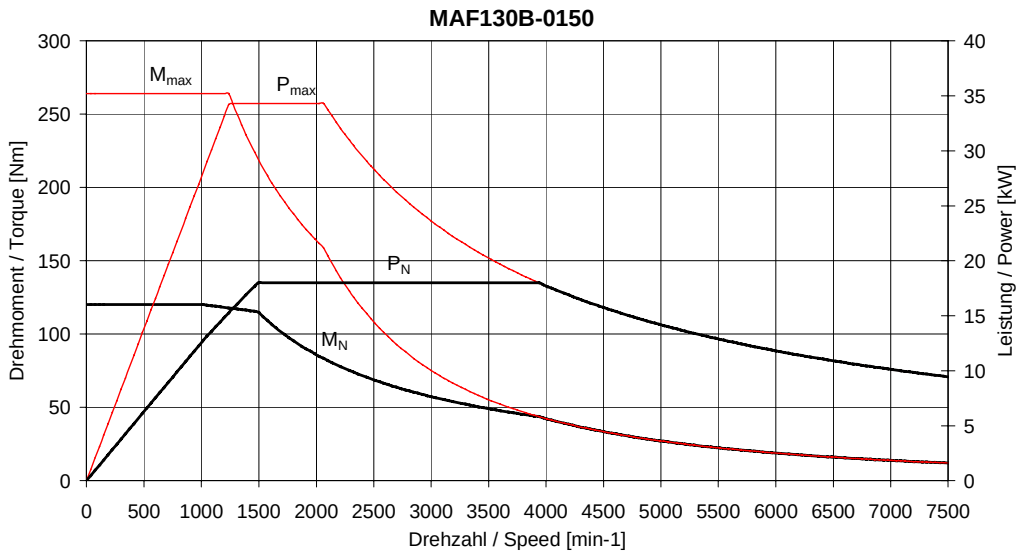
Fig. 4-82: Characteristic curve of MAF130B-0050 motors



Mit Regelgerät HMS01.1N-W0070 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130B-0100.WMF

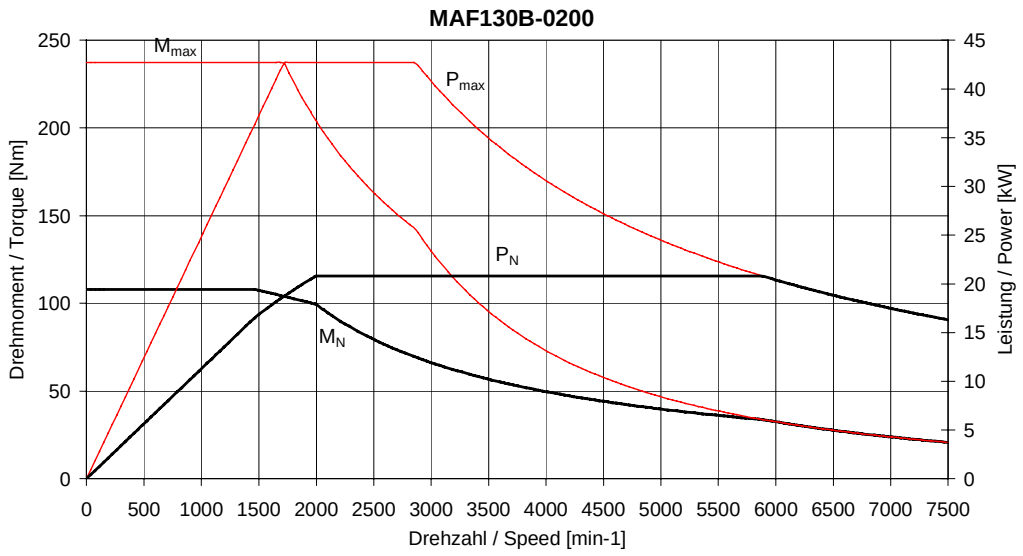
Fig. 4-83: Characteristic curve of MAF130B-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130B-0150.WMF

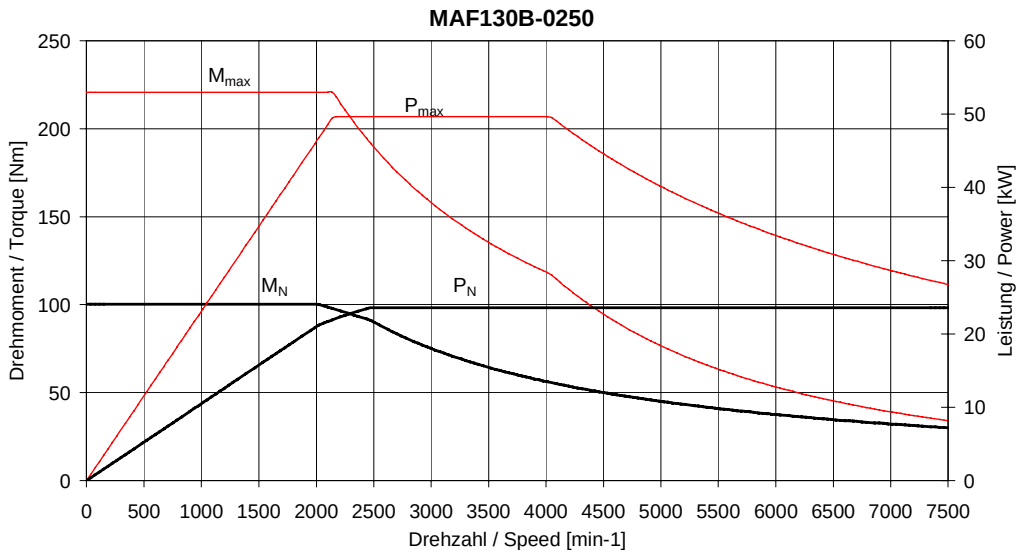
Fig. 4-84: Characteristic curve of MAF130B-0150 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130B-0200.WMF

Fig. 4-85: Characteristic curve of MAF130B-0200 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130B-0250.WMF

Fig. 4-86: Characteristic curve of MAF130B-0250 motors

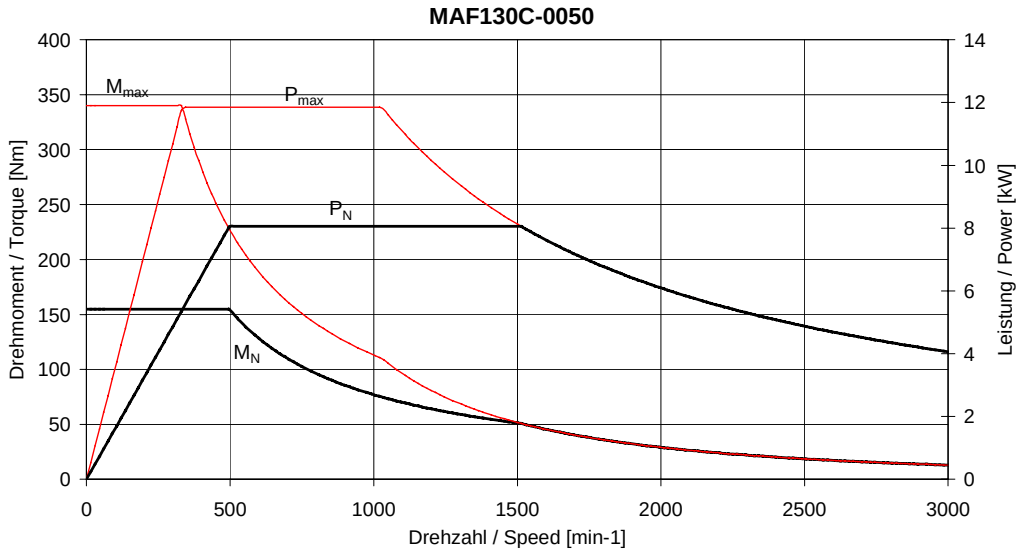
4.18 Data Sheet MAF130C

Description		Symbol	Unit	MAF130C				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	155	150	145	135	125
Rated power		P_N	kW	8.1	15.7	22.8	28.3	32.7
Rated current		I_N	A	21	38	53.2	69.8	75.5
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	340	330	330	315	298
Maximum output		P_{max}	kW	16.6	32.2	46.7	58	67.1
Maximum current		I_{max}	A	42.6	71.8	111	142.9	150.8
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	7500		
	R	n_{max}	rpm	3000	5250			
	V	n_{max}	rpm	3000	6000	7500		
	H	n_{max}	rpm	3000	6000	9000 [6])	10000 [6])	
Continuous torque at standstill		M_{n1}	Nm	155	155	150	143	135
Continuous current at standstill		I_{n1}	A	21	39	54.7	71.2	75.5
Torque constant at 20° C		K_{M_N}	Nm/A	8.04	5.09	3.04	2.19	1.88
Thermal time constant		T_{th}	min	15				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	20	15.4	20	16.8	20
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	2.5	6	16	16	25
Moment of inertia [3])		J_{rot}	kgm²	0.101				
Mass [3])		m	kg	106				
Sound pressure level [4])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	2.3				
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.35				
	with snap-on coupling	Δp_{diff}	bar	0.7				
Required coolant flow at P_V		Q_{min}	l/min	3.4				
max. system pressure		p_{max}	bar	3				
Holding brake (optional)				**Electrically clamping**			**Electrically releasing**	
Transmittable torque		M_4	Nm	100			80	
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	1.5			1.6	
Moment of inertia		J_{Br}	kgm²	0.002				
Max. permissible braking energy		W_{max}	Ws	30000				
Disconnection time		t_2	ms	65			140	
Connection time		t_1	ms	110			50	
Maximum speed brake		n_{Br_max}	rpm	8000			8000	
Mass		m	kg	8				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
[6]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-87: Data sheet MAF130C

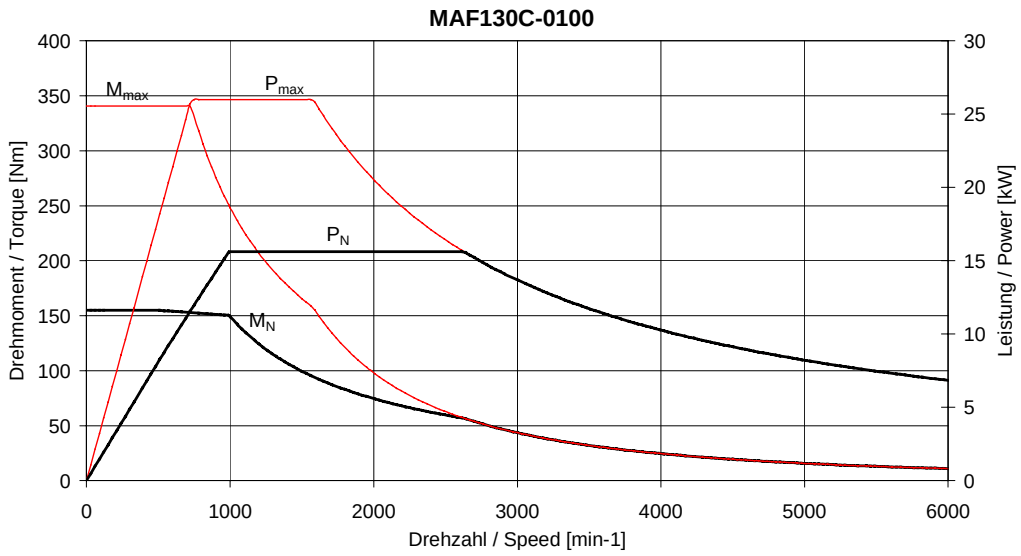
Characteristic Curves of MAF130C Motors



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130C-0050.WMF

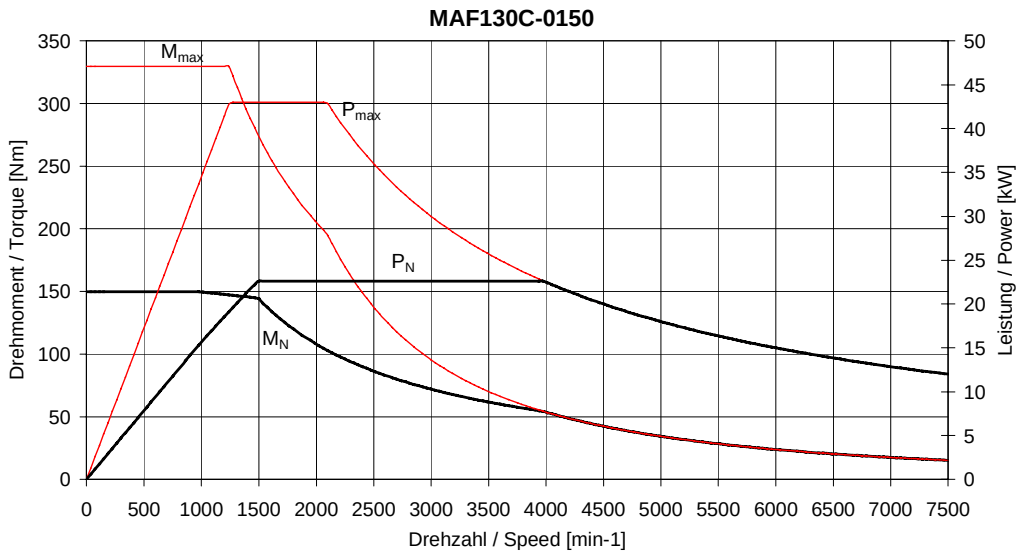
Fig. 4-88: Characteristic curve of MAF130C-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130C-0100.WMF

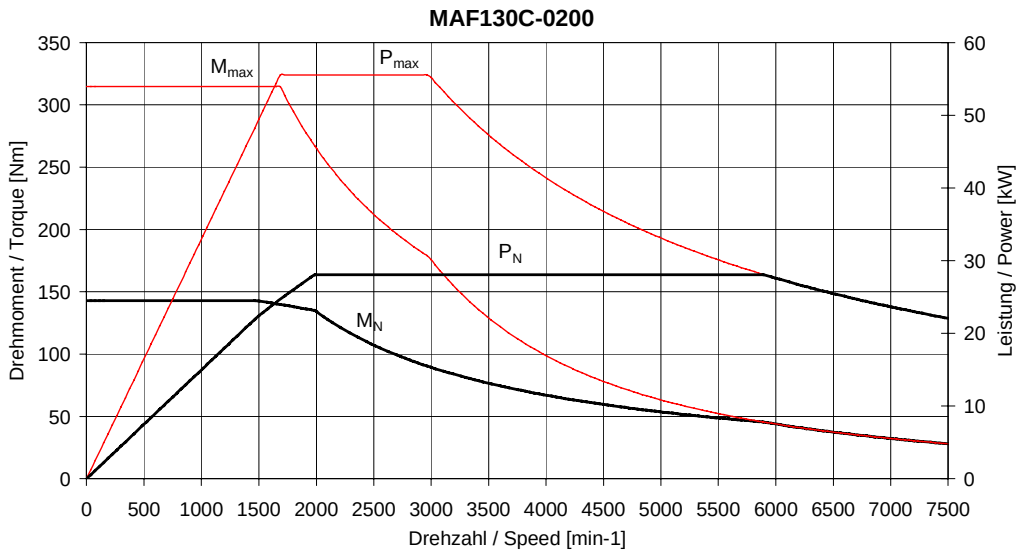
Fig. 4-89: Characteristic curve of MAF130C-0100 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130C-0150.WMF

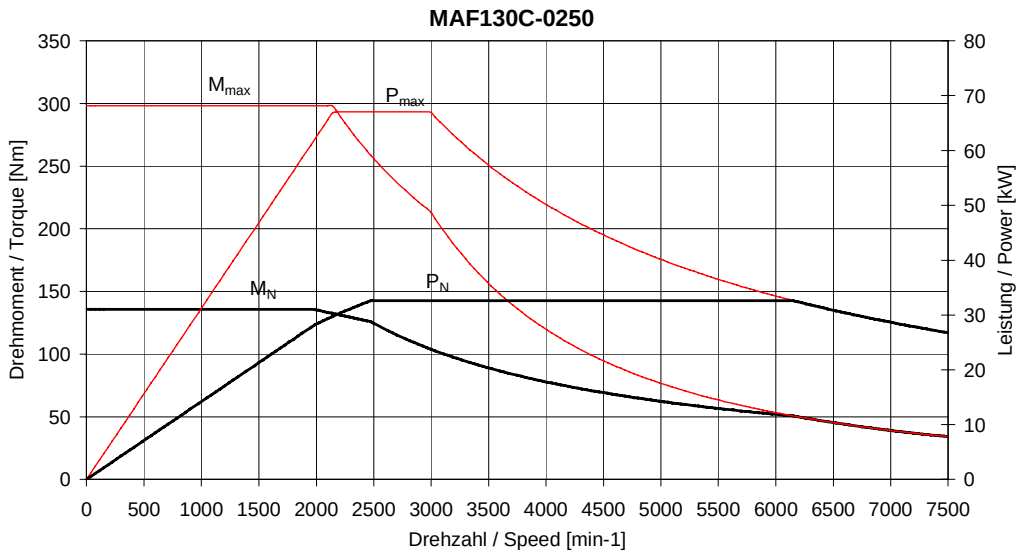
Fig. 4-90: Characteristic curve of MAF130C-0150 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130C-0200.WMF

Fig. 4-91: Characteristic curve of MAF130C-0200 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130C-0250.WMF

Fig. 4-92: Characteristic curve of MAF130C-0250 motors

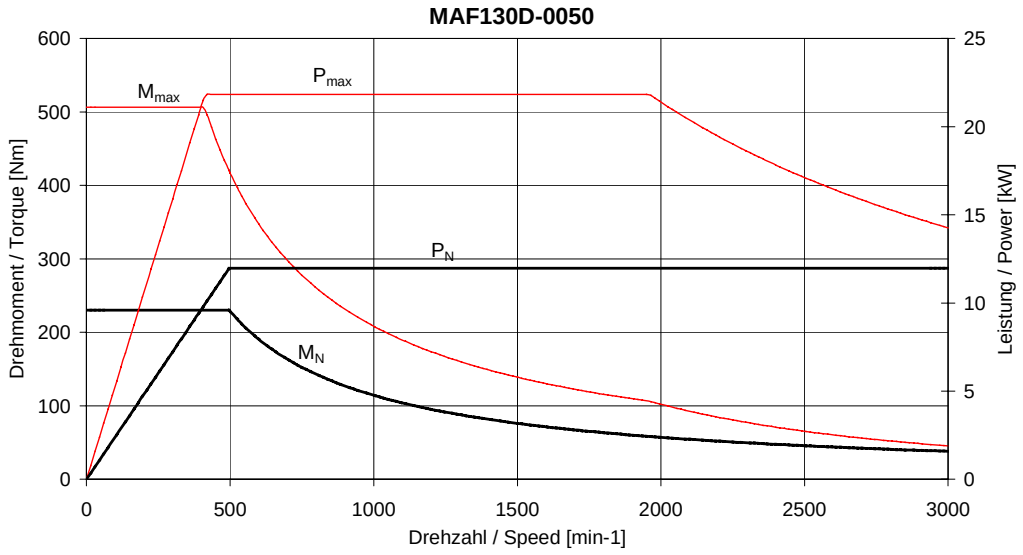
4.19 Data Sheet MAF130D

Description		Symbol	Unit	MAF130D				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_N	Nm	230	220	200	200	190
Rated power		P_N	kW	12	23	31.4	41.9	49.7
Rated current		I_N	A	32.3	52	72.6	93.9	113
Rated speed		n_N	rpm	500	1000	1500	2000	2500
Key speed		n_1	rpm	500	500	1000	1500	2000
Maximum torque		M_{max}	Nm	506	506	484	461	432
Maximum output		P_{max}	kW	24.6	47.2	64.4	85.9	102
Maximum current		I_{max}	A	64.3	108	155.4	190.9	214.9
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000	7500		
	R	n_{max}	rpm	3000	5250			
	V	n_{max}	rpm	3000	6000	7500		
	H	n_{max}	rpm	3000	6000	9000 [6])	10000 [6])	
Continuous torque at standstill		M_{n1}	Nm	230	230	220	210	200
Continuous current at standstill		I_{n1}	A	32.3	53.8	78	97.5	113
Torque constant at 20° C		K_{M_N}	Nm/A	7.71	4.81	3.21	2.51	2.04
Thermal time constant		T_{th}	min	15				
Duty cycle time (S6-44%)		T_C	min	10				
Discharge capacity		C_{ab}	nF	27.5	27.5	27.5	25.1	27.5
Number of pole pairs		p		3				
Power wire cross-section [2])		A	mm²	6	10	25	25	35
Moment of inertia [3])		J_{rot}	kgm²	0.151				
Mass [3])		m	kg	147				
Sound pressure level [4])		L_P	dB(A)	70 (+3)				
Ambient temperature in operation		T_{um}	°C	0....+40				
Insulation class according to DIN EN 60034-1				F				
Motor protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	3.3				
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.5				
	with snap-on coupling	Δp_{diff}	bar	1.0				
Required coolant flow at P_V		Q_{min}	l/min	4.8				
max. system pressure		p_{max}	bar	3				
Holding brake (optional)				**Electrically clamping**			**Electrically releasing**	
Transmittable torque		M_4	Nm	100			80	
Connection voltage		U_{Br}	V	DC 24 ± 10 %				
Rated current		I_{Br}	A	1.5			1.6	
Moment of inertia		J_{Br}	kgm²	0.002				
Max. permissible braking energy		W_{max}	Ws	30000				
Disconnection time		t_2	ms	140			110	
Connection time		t_1	ms	110			70	
Maximum speed brake		n_{Br_max}	rpm	8000			8000	
Mass		m	kg	8				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
[6]) Value without holding brake. Observe maximum speed of holding brake.

Fig. 4-93: Data sheet MAF130D

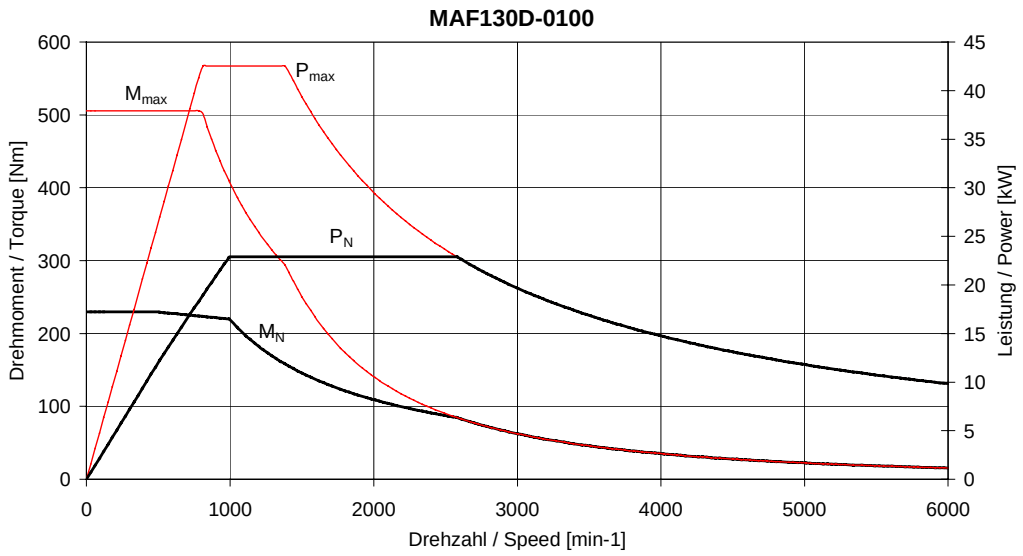
Characteristic Curves of MAF130D Motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130D-0050.WMF

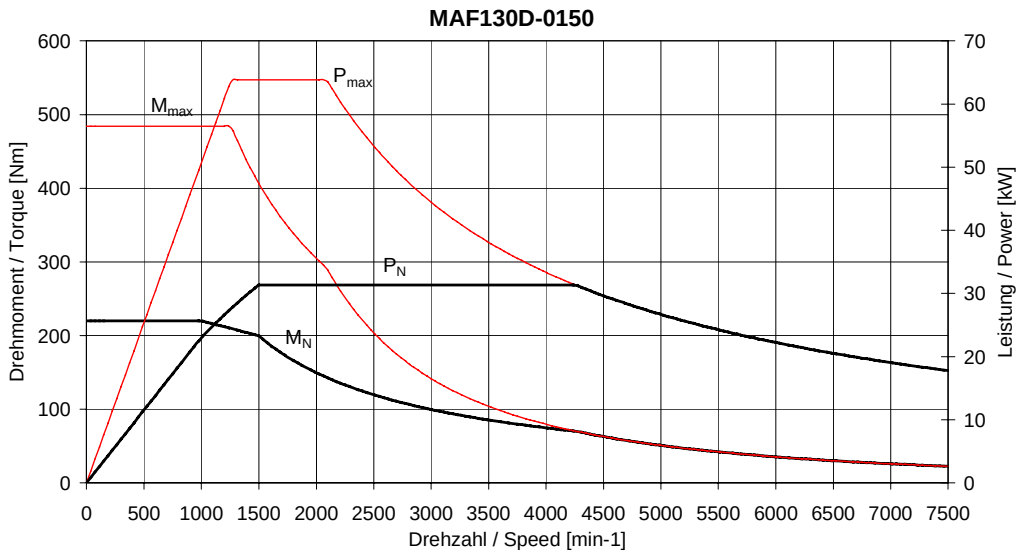
Fig. 4-94: Characteristic curve of MAF130D-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130D-0100.WMF

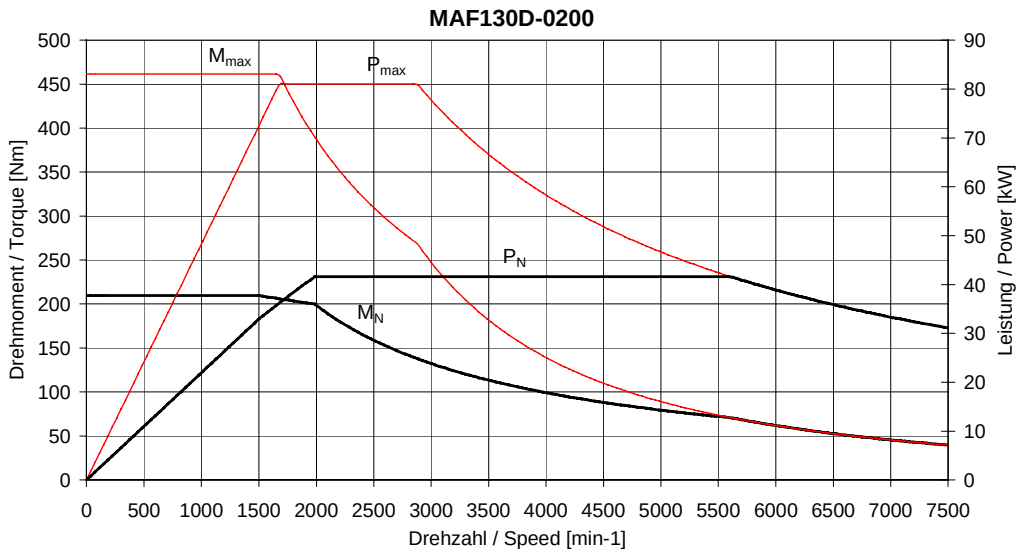
Fig. 4-95: Characteristic curve of MAF130D-0100 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130D-0150.WMF

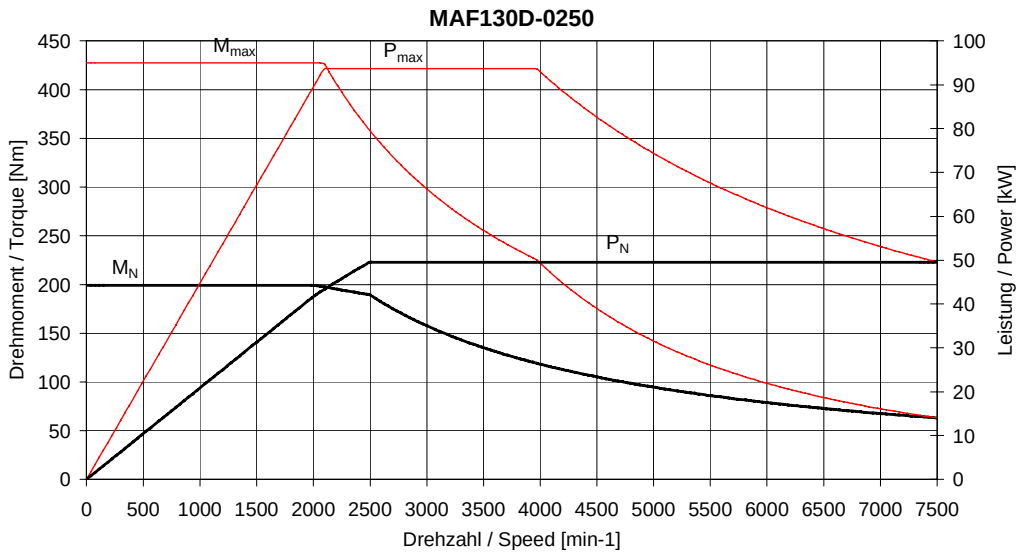
Fig. 4-96: Characteristic curve of MAF130D-0150 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130D-0200.WMF

Fig. 4-97: Characteristic curve of MAF130D-0200 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF130D-0250.WMF

Fig. 4-98: Characteristic curve of MAF130D-0250 motors

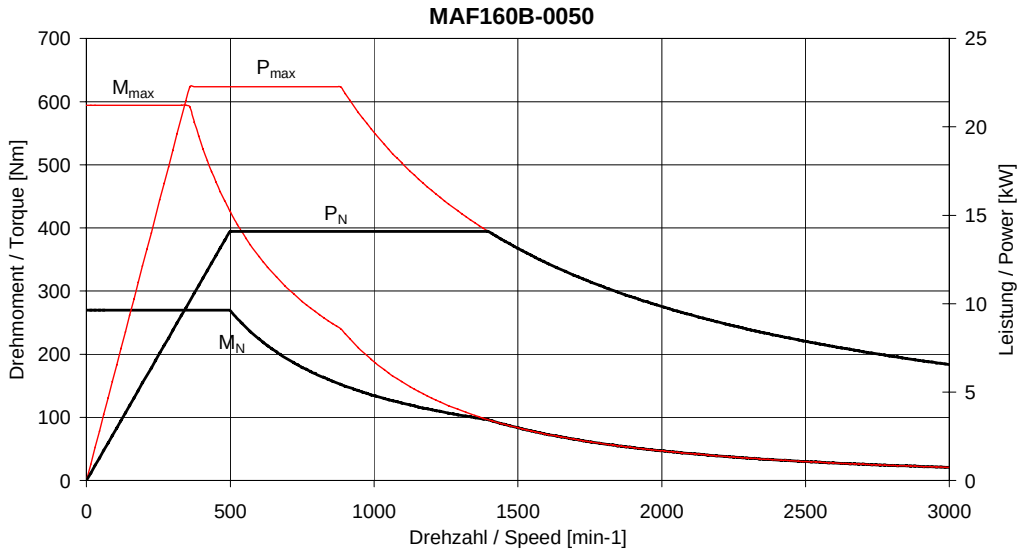
4.20 Data Sheet MAF160B

Description		Symbol	Unit	MAF160B			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_N	Nm	270	260	250	240
Rated power		P_N	kW	14.1	27.2	39.3	50.3
Rated current		I_N	A	34.2	73.7	89.5	108.5
Rated speed		n_N	rpm	500	1000	1500	2000
Key speed		n_1	rpm	500	500	1000	1500
Maximum torque		M_{max}	Nm	594	593	571	550
Maximum output		P_{max}	kW	28.9	55.8	80.6	103.1
Maximum current		I_{max}	A	65.4	149	179.7	232.7
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000		
	R	n_{max}	rpm	3000	4200		
	V	n_{max}	rpm	3000	6000		
	H	n_{max}	rpm	not available			
Continuous torque at standstill		M_{n1}	Nm	270	270	260	250
Continuous current at standstill		I_{n1}	A	34.2	75.8	92.1	112.3
Torque constant at 20° C		K_{M_N}	Nm/A	9.5	4.13	3.3	2.4
Thermal time constant		T_{th}	min	20			
Duty cycle time (S6-44%)		T_C	min	10			
Discharge capacity		C_{ab}	nF	26.9	35	35	21.7
Number of pole pairs		p		3			
Power wire connection [2])		A	mm²	6	25	25	35
Moment of inertia [3])		J_{rot}	kgm²	0.23			
Mass [3])		m	kg	197			
Sound pressure level [4])		L_P	dB(A)	72 (+3)			
Ambient temperature in operation		T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1				F			
Motor protection class				IP65			
Liquid cooling [5])							
Power loss to be dissipated		P_V	kW	2.7	4.0		4.5
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.25			
	with snap-on coupling	Δp_{diff}	bar	0.5			
Required coolant flow at P_V		Q_{min}	l/min	3.8	5.8		6.5
max. system pressure		p_{max}	bar	3			
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**	
Transmittable torque		M_4	Nm	100			
Connection voltage		U_{Br}	V	DC 24 ± 10 %			
Rated current		I_{Br}	A	1.8		2.0	
Moment of inertia		J_{Br}	kgm²	0.0065			
Max. permissible braking energy		W_{max}	Ws	40000			
Disconnection time		t_2	ms	100		190	
Connection time		t_1	ms	85		12	
Mass		m	kg	20			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.

Fig. 4-99: Data sheet MAF160B

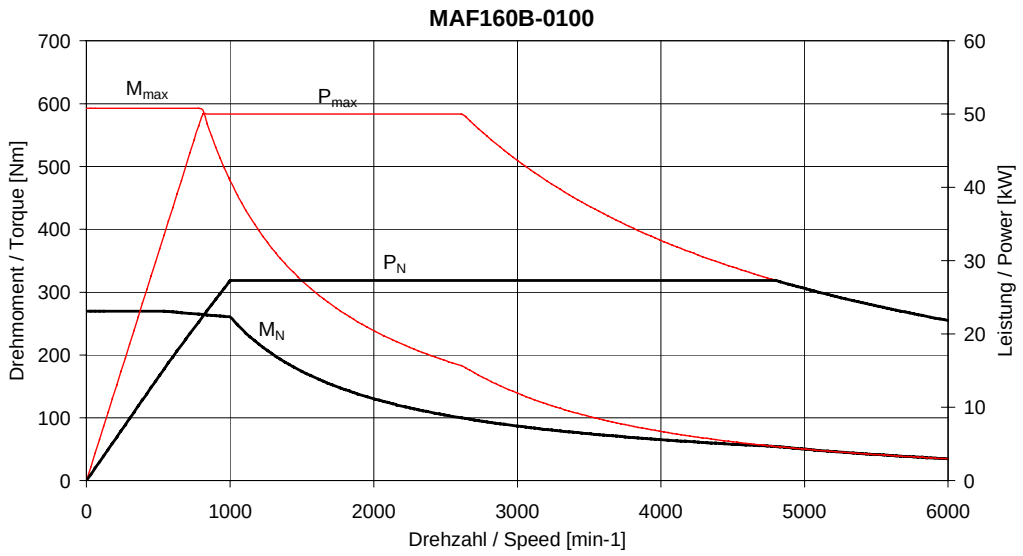
Characteristic Curves of MAF160B Motors



Mit Regelgerät HMS01.1N-W0070 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160B-0050.WMF

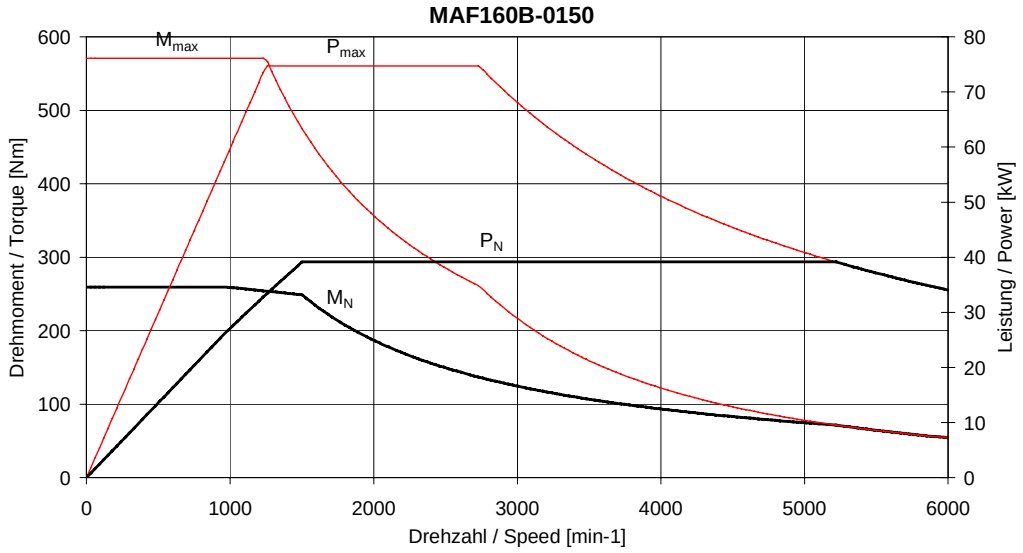
Fig. 4-100: Characteristic curve of MAF160B-0050 motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160B-0100.WMF

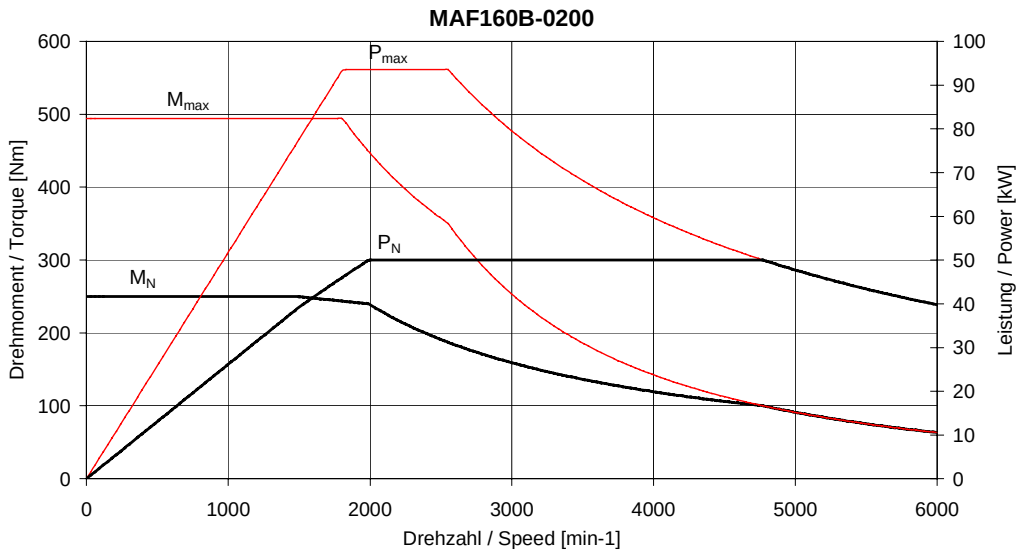
Fig. 4-101: Characteristic curve of MAF160B-0100 motor



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160B-0150.WMF

Fig. 4-102: Characteristic curve of MAF160B-0150 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160B-0200.WMF

Fig. 4-103: Characteristic curve of MAF160B-0200 motors

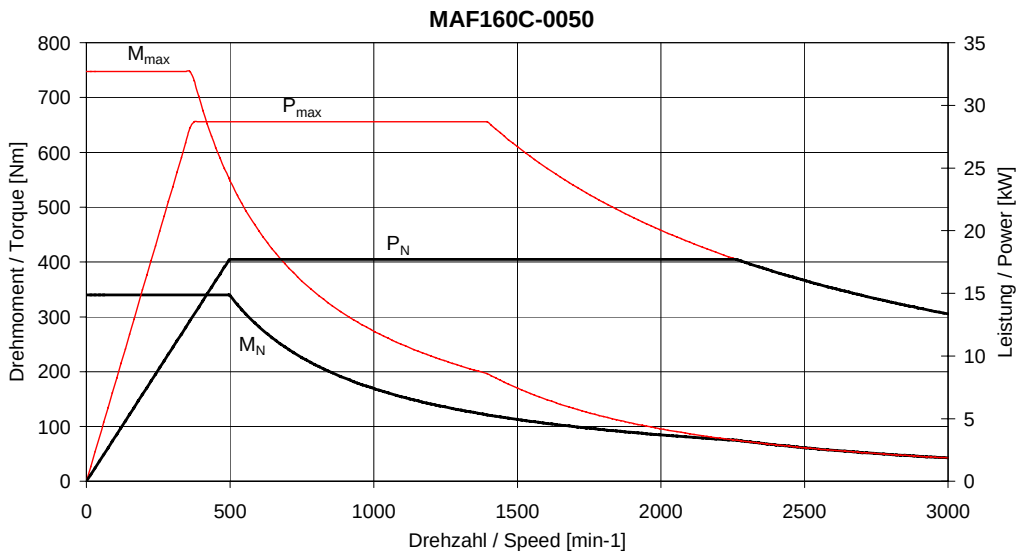
4.21 Data Sheet MAF160C

Description		Symbol	Unit	MAF160C			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_N	Nm	340	325	300	285
Rated power		P_N	kW	17.8	34	47.1	59.7
Rated current		I_N	A	47.4	91.2	109.5	136
Rated speed		n_N	rpm	500	1000	1500	2000
Key speed		n_1	rpm	500	500	1000	1500
Maximum torque		M_{max}	Nm	748	746	681	677
Maximum output		P_{max}	kW	36.5	69.7	96.6	122.4
Maximum current		I_{max}	A	98	196	212.2	290.7
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000		
	R	n_{max}	rpm	3000	4200		
	V	n_{max}	rpm	3000	6000		
	H	n_{max}	rpm	not available			
Continuous torque at standstill		M_{n1}	Nm	340	340	310	295
Continuous current at standstill		I_{n1}	A	47.4	94.8	111.9	141.4
Torque constant at 20° C		K_{M_N}	Nm/A	7.76	3.88	3.37	2.3
Thermal time constant		T_{th}	min	20			
Duty cycle time (S6-44%)		T_C	min	10			
Discharge capacity		C_{ab}	nF	28	28	28.8	25.3
Number of pole pairs		p		3			
Power wire cross-section [2])		A	mm²	10	25	35	2x16
Moment of inertia [3])		J_{rot}	kgm²	0.26			
Mass [3])		m	kg	227			
Sound pressure level [4])		L_P	dB(A)	72 (+3)			
Ambient temperature in operation		T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1				F			
Motor protection class				IP65			
Liquid cooling [5])							
Power loss to be dissipated		P_V	kW	4.5		3.8	4.2
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.5			
	with snap-on coupling	Δp_{diff}	bar	1.0			
Required coolant flow at P_V		Q_{min}	l/min	6.5		5.5	6
max. system pressure		p_{max}	bar	3			
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**	
Transmittable torque		M_4	Nm	100			
Connection voltage		U_{Br}	V	DC 24 ± 10 %			
Rated current		I_{Br}	A	1.8		2.0	
Moment of inertia		J_{Br}	kgm²	0.0065			
Max. permissible braking energy		W_{max}	Ws	40000			
Disconnection time		t_2	ms	100		190	
Connection time		t_1	ms	85		12	
Mass		m	kg	20			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Value without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.

Fig. 4-104: Data sheet MAF160C

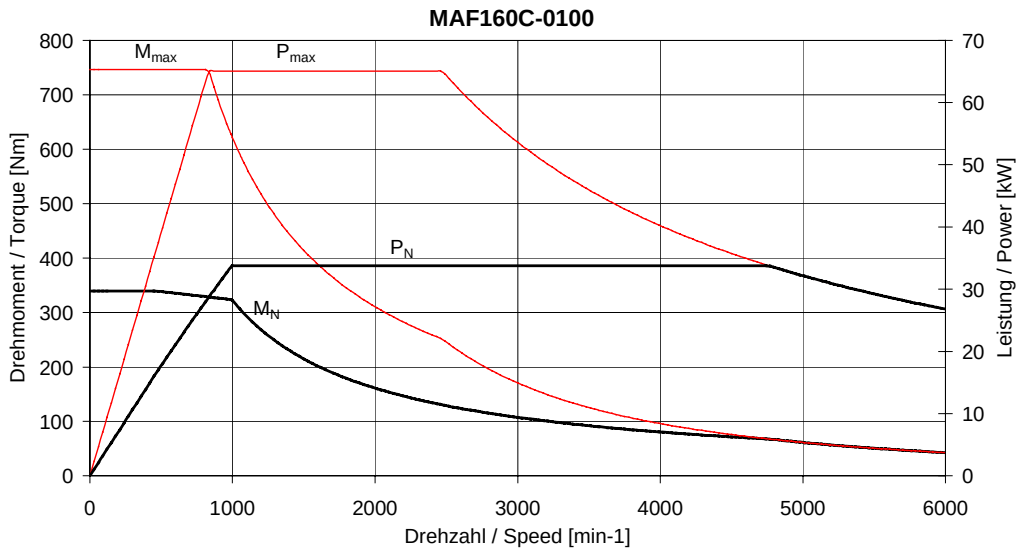
Characteristic Curves of MAF160C Motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160C-0050.WMF

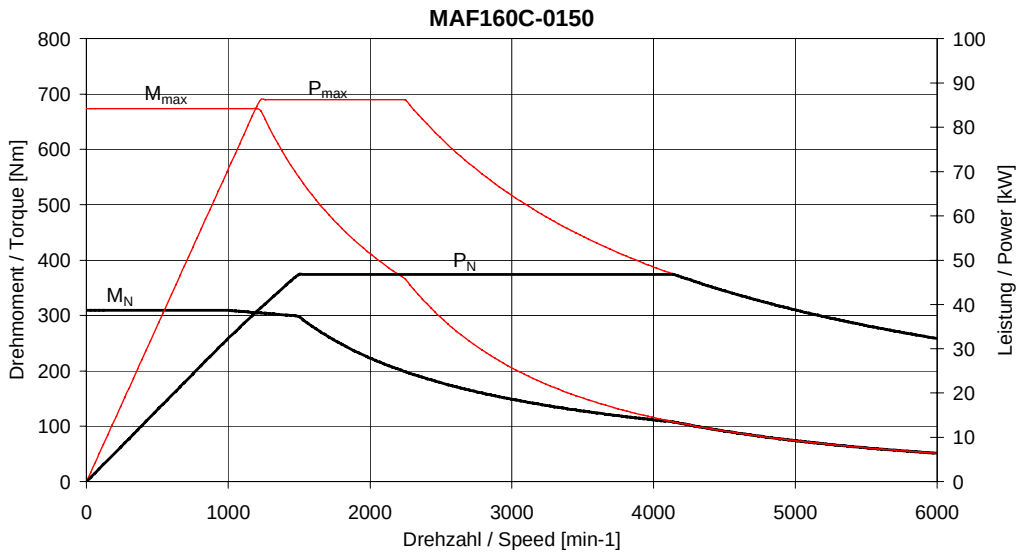
Fig. 4-105: Characteristic curve of MAF160C-0050 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160C-0100.WMF

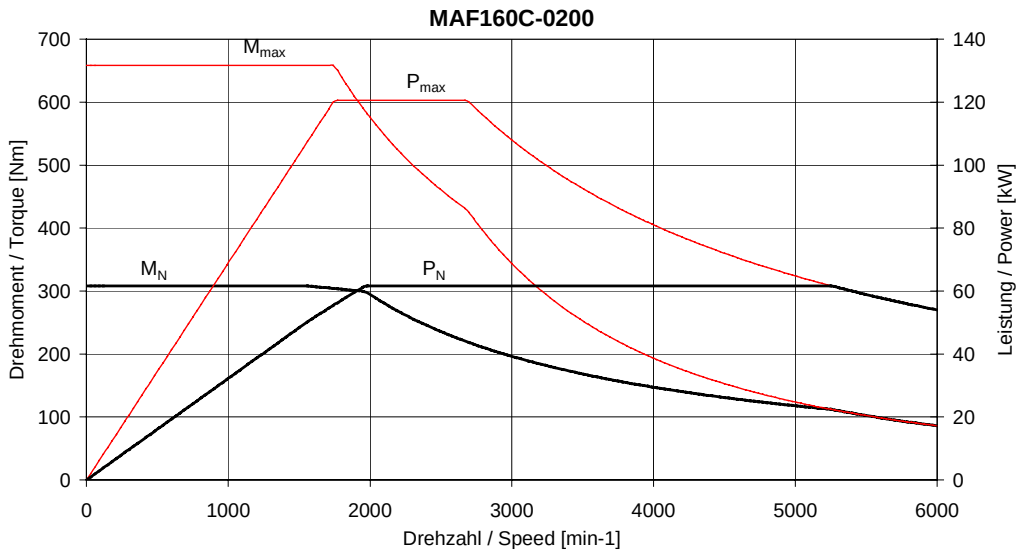
Fig. 4-106: Characteristic curve of MAF160C-0100 motor



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF160C-0150.WMF

Fig. 4-107: Characteristic curve of MAF160C-0150 motors



Mit Regelgerät DKR04.1-W400 an 3x AC400...480V (-5%)
With Drive Controller DKR04.1-W400 and main connection 3x AC400...480V (-5%)

Kennl_MAF160C-0200.WMF

Fig. 4-108: Characteristic curve of MAF160C-0200 motors

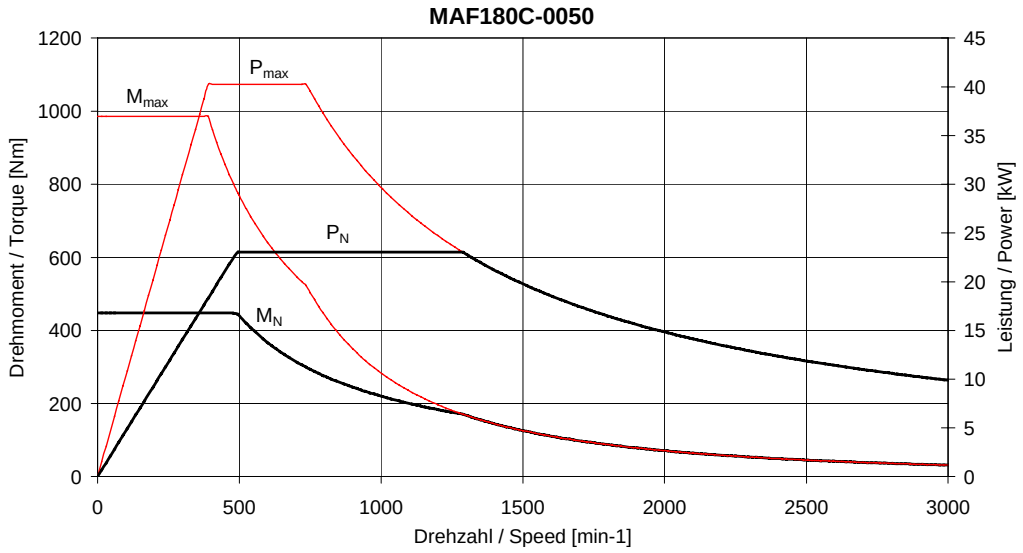
4.22 Data Sheet MAF180C

Description		Symbol	Unit	MAF180C			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_N	Nm	435	390	365	318
Rated power		P_N	kW	22.8	40.8	57.3	66.6
Rated current		I_N	A	50	90.7	128.8	154
Rated speed		n_N	rpm	500	1000	1500	2000
Key speed		n_1	rpm	500	500	1000	1500
Maximum torque		M_{max}	Nm	986	957	858	739
Maximum output		P_{max}	kW	46.7	83.7	117.5	136.5
Maximum current		I_{max}	A	104.7	208	280.9	318.9
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000		
	R	n_{max}	rpm	3000	4200		
	V	n_{max}	rpm	3000	6000		
	H	n_{max}	rpm	not available			
Continuous torque at standstill		M_{n1}	Nm	435	435	390	336
Continuous current at standstill		I_{n1}	A	50	99.7	136.1	160.5
Torque constant at 20° C		K_{M_N}	Nm/A	9.61	4.67	3.11	2.39
Thermal time constant		T_{th}	min	25			
Duty cycle time (S6-44%)		T_C	min	10			
Discharge capacity		C_{ab}	nF	32.5	30	30	38.9
Number of pole pairs		p		3			
Power wire cross-section [2])		A	mm²	10	25	2x16	2x25
Moment of inertia [3])		J_{rot}	kgm²	0.49			
Mass [3])		m	kg	322			
Sound pressure level [4])		L_P	dB(A)	75 (+3)			
Ambient temperature in operation		T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1				F			
Motor protection class				IP65			
Liquid cooling [5])							
Power loss to be dissipated		P_V	kW	4.5			
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.5			
	with snap-on coupling	Δp_{diff}	bar	1.0			
Required coolant flow at P_V		Q_{min}	l/min	6.6			
max. system pressure		p_{max}	bar	3			
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**	
Transmittable torque		M_4	Nm	300		240	
Connection voltage		U_{Br}	V	DC 24 ± 10 %			
Rated current		I_{Br}	A	2		1.87	
Moment of inertia		J_{Br}	kgm²	0.0188			
Max. permissible braking energy		W_{max}	Ws	70000			
Disconnection time		t_2	ms	90		300	
Connection time		t_1	ms	150		30	
Mass		m	kg	25			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Rated for cable assemblies with current carrying capacity according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at 40°C ambient temperature.
[3]) Values without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.

Fig. 4-109: Data sheet MAF180C

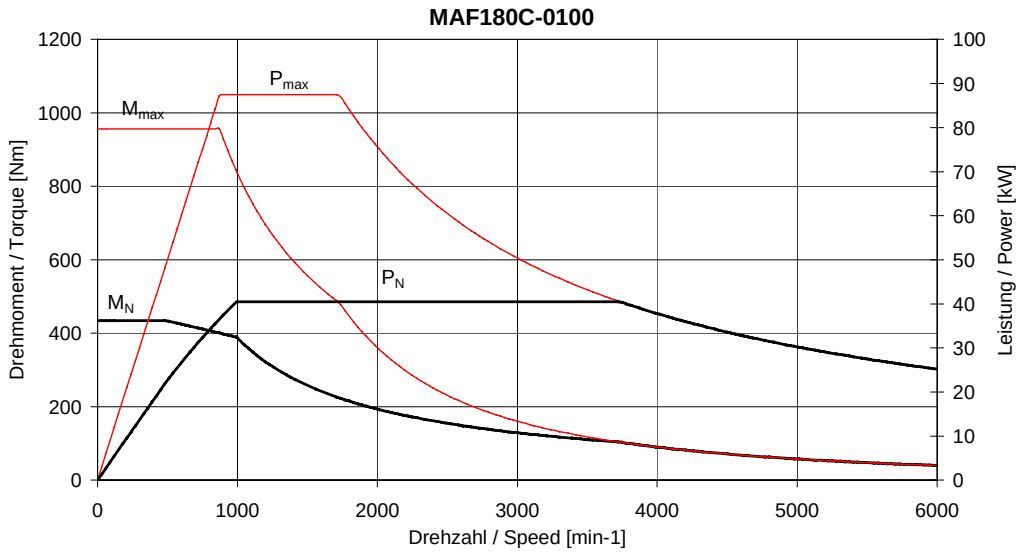
Characteristic Curves of MAF180C Motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF180C-0050.WMF

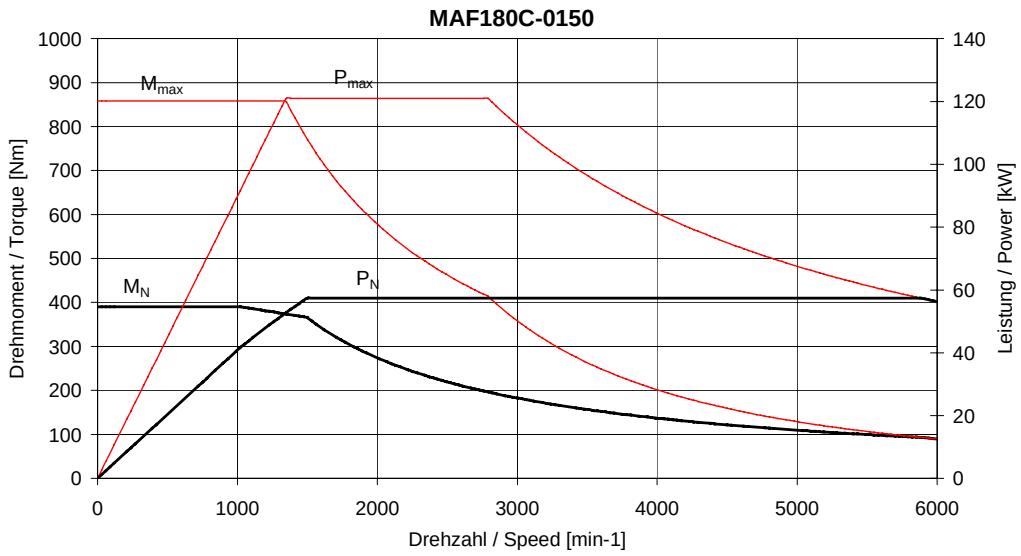
Fig. 4-110: Characteristic curve of MAF180C-0050 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF180C-0100.WMF

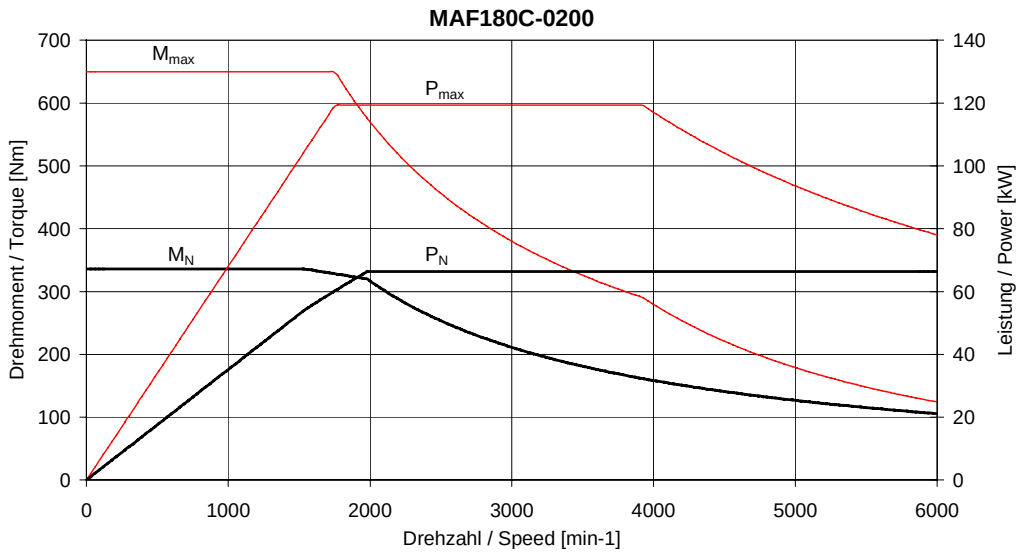
Fig. 4-111: Characteristic curve of MAF180C-0100 motors



Mit Regelgerät DKR04.1-W400 an 3x AC400...480V (-5%)
With Drive Controller DKR04.1-W400 and main connection 3x AC400...480V (-5%)

Kennl_MAF180C-0150.WMF

Fig. 4-112: Characteristic curve of MAF180C-0150 motors



Mit Regelgerät DKR04.1-W400 an 3x AC400...480V (-5%)
With Drive Controller DKR04.1-W400 and main connection 3x AC400...480V (-5%)

Kennl_MAF180C-0200.WMF

Fig. 4-113: Characteristic curve of MAF180C-0200 motors

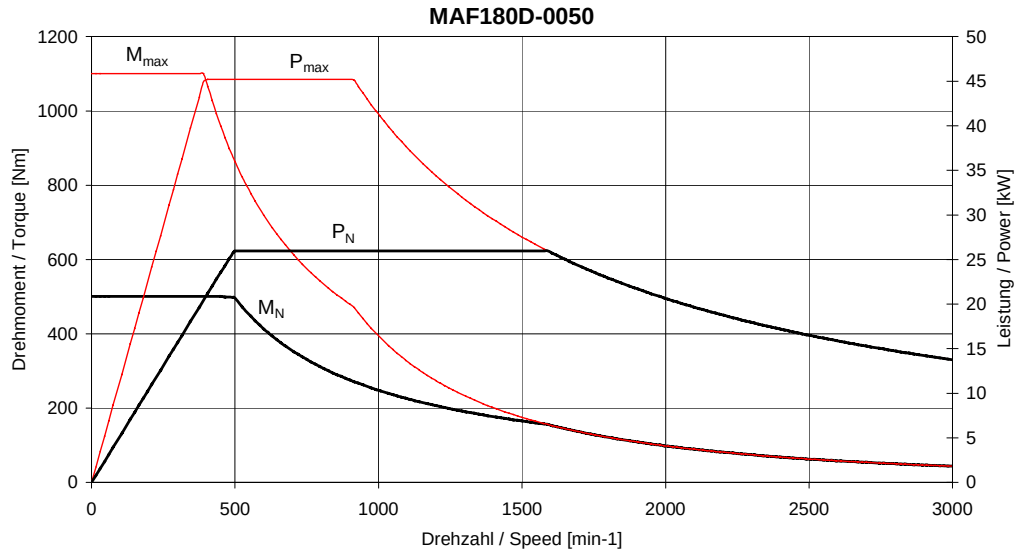
4.23 Data Sheet MAF180D

Description		Symbol	Unit	MAF180D			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_N	Nm	500	460	435	400
Rated power		P_N	kW	26.2	48.1	68.3	83.8
Rated current		I_N	A	60.4	94.8	146.1	168.5
Rated speed		n_N	rpm	500	1000	1500	2000
Key speed		n_1	rpm	500	500	1000	1500
Maximum torque		M_{max}	Nm	1100	1094	1013	1008
Maximum output		P_{max}	kW	53.7	98.8	140	171.8
Maximum current		I_{max}	A	117.3	213.1	294.9	377.1
Maximum speed with bearing…	N	n_{max}	rpm	3000	6000		
	R	n_{max}	rpm	3000	4200		
	V	n_{max}	rpm	3000	6000		
	H	n_{max}	rpm	not available			
Continuous torque at standstill		M_{n1}	Nm	500	500	460	460
Continuous current at standstill		I_{n1}	A	60.4	101.9	142.1	187.3
Torque constant at 20° C		K_{M_N}	Nm/A	10	5.23	3.49	2.75
Thermal time constant		T_{th}	min	25			
Duty cycle time (S6-44%)		T_C	min	10			
Discharge capacity		C_{ab}	nF	37.4	38	38	50
Number of pole pairs		p		3			
Power wire cross-section [2])		A	mm²	16	35	50	2x25
Moment of inertia [3])		J_{rot}	kgm²	0.61			
Mass [3])		m	kg	382			
Sound pressure level [4])		L_P	dB(A)	75 (+3)			
Ambient temperature in operation		T_{um}	°C	0....+40			
Insulation class according to DIN EN 60034-1				F			
Motor protection class				IP65			
Liquid cooling [5])							
Power loss to be dissipated		P_V	kW	3.5			5.4
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.4			
	with snap-on coupling	Δp_{diff}	bar	0.8			
Required coolant flow at P_V		Q_{min}	l/min	5.1			7.9
max. system pressure		p_{max}	bar	3			
Holding brake (optional)				**Electrically clamping**		**Electrically releasing**	
Transmittable torque		M_4	Nm	300		240	
Connection voltage		U_{Br}	V	DC 24 ± 10 %			
Rated current		I_{Br}	A	2		1.87	
Moment of inertia		J_{Br}	kgm²	0.0188			
Max. permissible braking energy		W_{max}	Ws	70000			
Disconnection time		t_2	ms	90		300	
Connection time		t_1	ms	150		30	
Mass		m	kg	25			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Values without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.

Fig. 4-114: Data sheet MAF180D

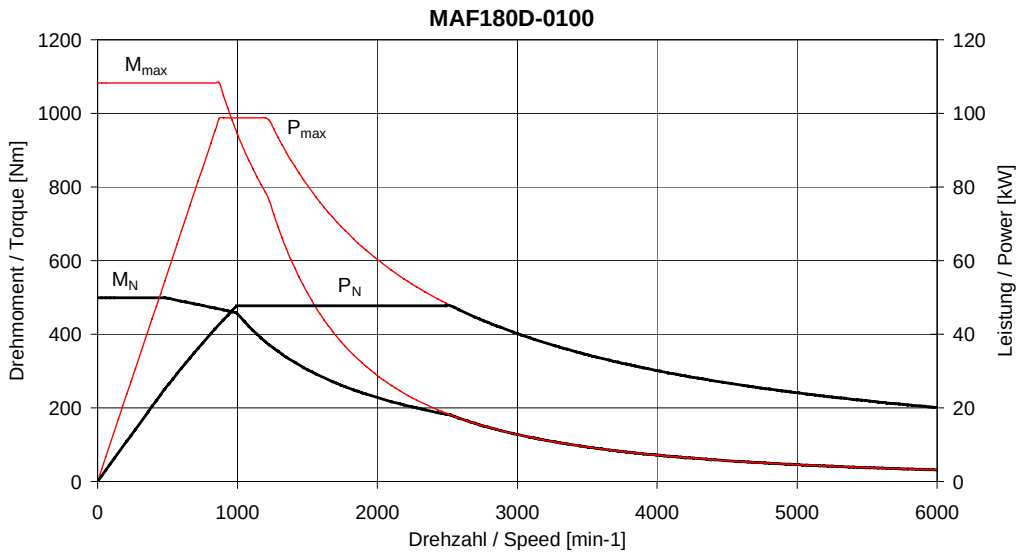
Characteristic Curves of MAF180D Motors



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF180D-0050.WMF

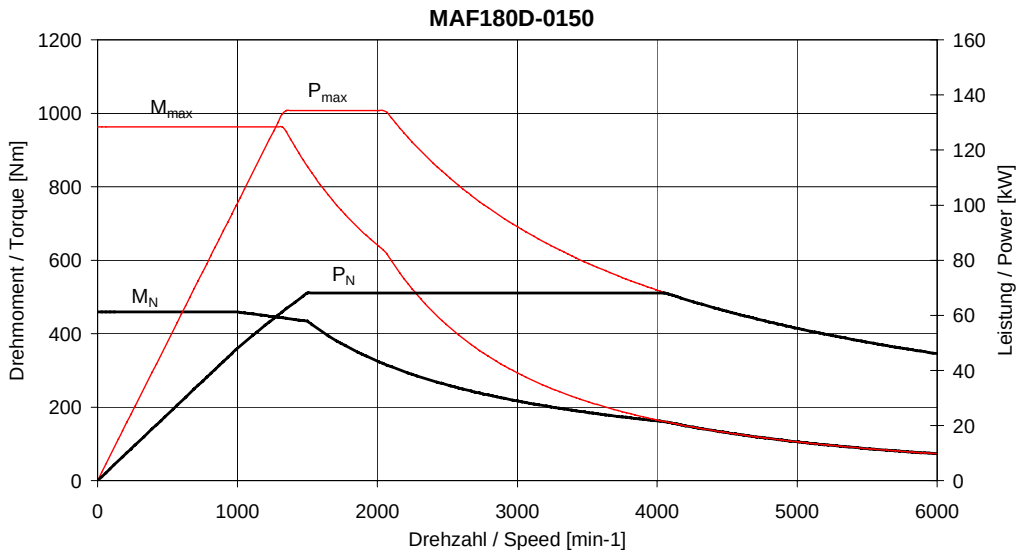
Fig. 4-115: Characteristic curve of MAF180D-0050 motors



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

Kennl_MAF180D-0100.WMF

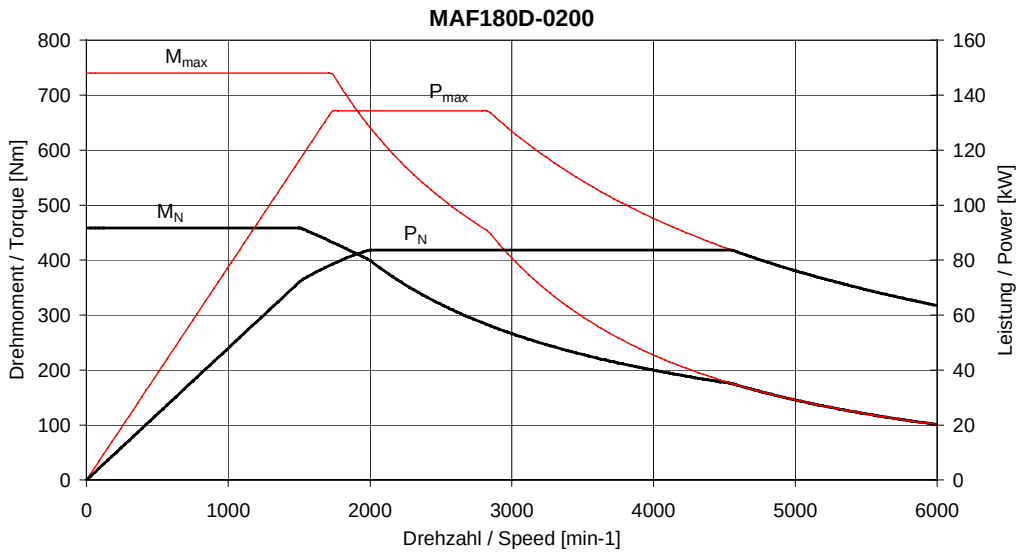
Fig. 4-116: Characteristic curve of MAF180D-0100 motors



Mit Regelgerät DKR04.1-W400 an 3x AC400...480V (-5%)
With Drive Controller DKR04.1-W400 and main connection 3x AC400...480V (-5%)

Kennl_MAF180D-0150.WMF

Fig. 4-117: Characteristic curve of MAF180D-0150 motors



Mit Regelgerät DKR04.1-W400 an 3x AC400...480V (-5%)
With Drive Controller DKR04.1-W400 and main connection 3x AC400...480V (-5%)

Kennl_MAF180D-0200.WMF

Fig. 4-118: Characteristic curve of MAF180D-0200 motors

4.24 Data Sheet MAF225C

Description		Symbol	Unit	MAF225C		
Motor data [1])						
Winding				0050*	0100*	0150
Rated torque		M_N	Nm	820	790	764
Rated power		P_N	kW	42.9	82.7	120
Rated current		I_N	A	98	170	215
Rated speed		n_N	rpm	500	1000	1500
Key speed		n_1	rpm	500	500	1000
Maximum torque		M_{max}	Nm	1750	1750	1750
Maximum output		P_{max}	kW	88	170	246
Maximum current		I_{max}	A	215	375	489
Maximum speed with bearing…	N	n_{max}	rpm	3000	3750	3750
	R	n_{max}	rpm	not available		
	V	n_{max}	rpm	3000	3750	3750
	H	n_{max}	rpm	not available		
Continuous torque at standstill		M_{n1}	Nm	820	820	825
Continuous current at standstill		I_{n1}	A	98	179	228
Torque constant at 20° C		K_{M_N}	Nm/A	9.7	5	3.68
Thermal time constant		T_{th}	min	35	35	35
Duty cycle time (S6-44%)		T_C	min	5	5	5
Discharge capacity		C_{ab}	nF	43.9	43.9	43.9
Number of pole pairs		p		3		
Power wire cross-section [2])		A	mm²	2 x 16	2 x 25	2x35
Moment of inertia [3])		J_{rot}	kgm²	1.65		
Mass [3])		m	kg	587		
Sound pressure level [4])		L_P	dB(A)	75 (+3)		
Ambient temperature in operation		T_{um}	°C	0....+40		
Insulation class according to DIN EN 60034-1				F		
Motor protection class				IP65		
Liquid cooling [5])						
Power loss to be dissipated		P_V	kW	8		
Cooling agent temperature	Cooling agent inlet	T_{in}	°C	+10....+40		
	Permissible increase at P_V	ΔT_{diff}	K	10		
Decompression at Q_N	without snap-on coupling	Δp_{diff}	bar	0.8		
	with snap-on coupling	Δp_{diff}	bar	1.6		
Required coolant flow at P_V		Q_{min}	l/min	11.5		
max. system pressure		p_{max}	bar	3		

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 V_{DC} DC bus voltage.
[2]) Please note the explanations on power wire cross section in Chapter 4.2, Operating Behavior.
[3]) Values without holding brake.
[4]) At 1m distance, with PWN = 4 kHz.
[5]) Data refer to water as a cooling agent. When other coolants are used, convert data. Observe the information on coolant entry temperature in Chapter 9.8.
*) Preliminary data

Fig. 4-121: Data sheet MAF225C

Characteristic Curves MAF225C Motors

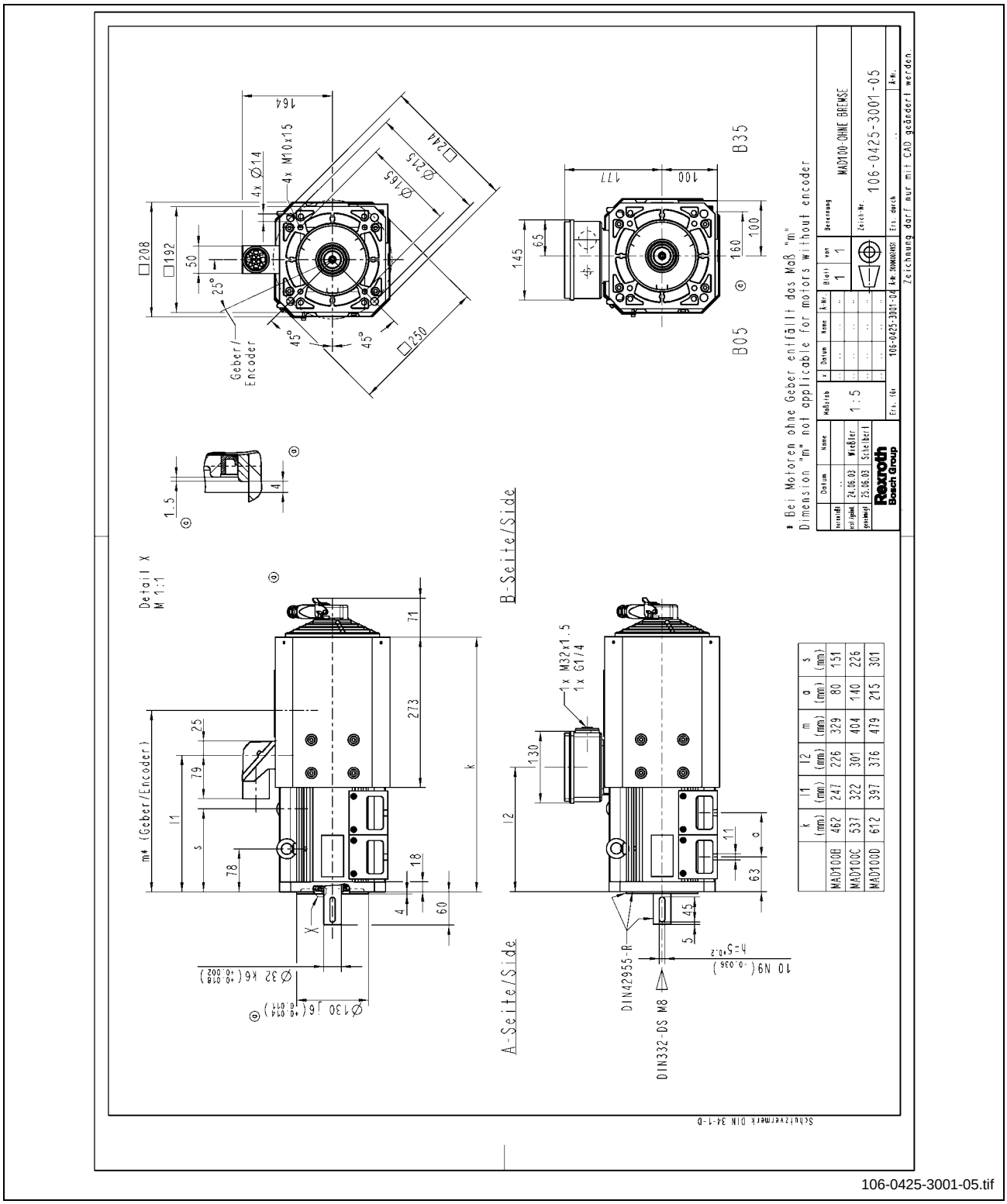
in preparation

Fig. 4-119: Characteristic curves MAF225C motors

5 Dimension Sheets IndraDyn A

5.1 Frame Size MAD100

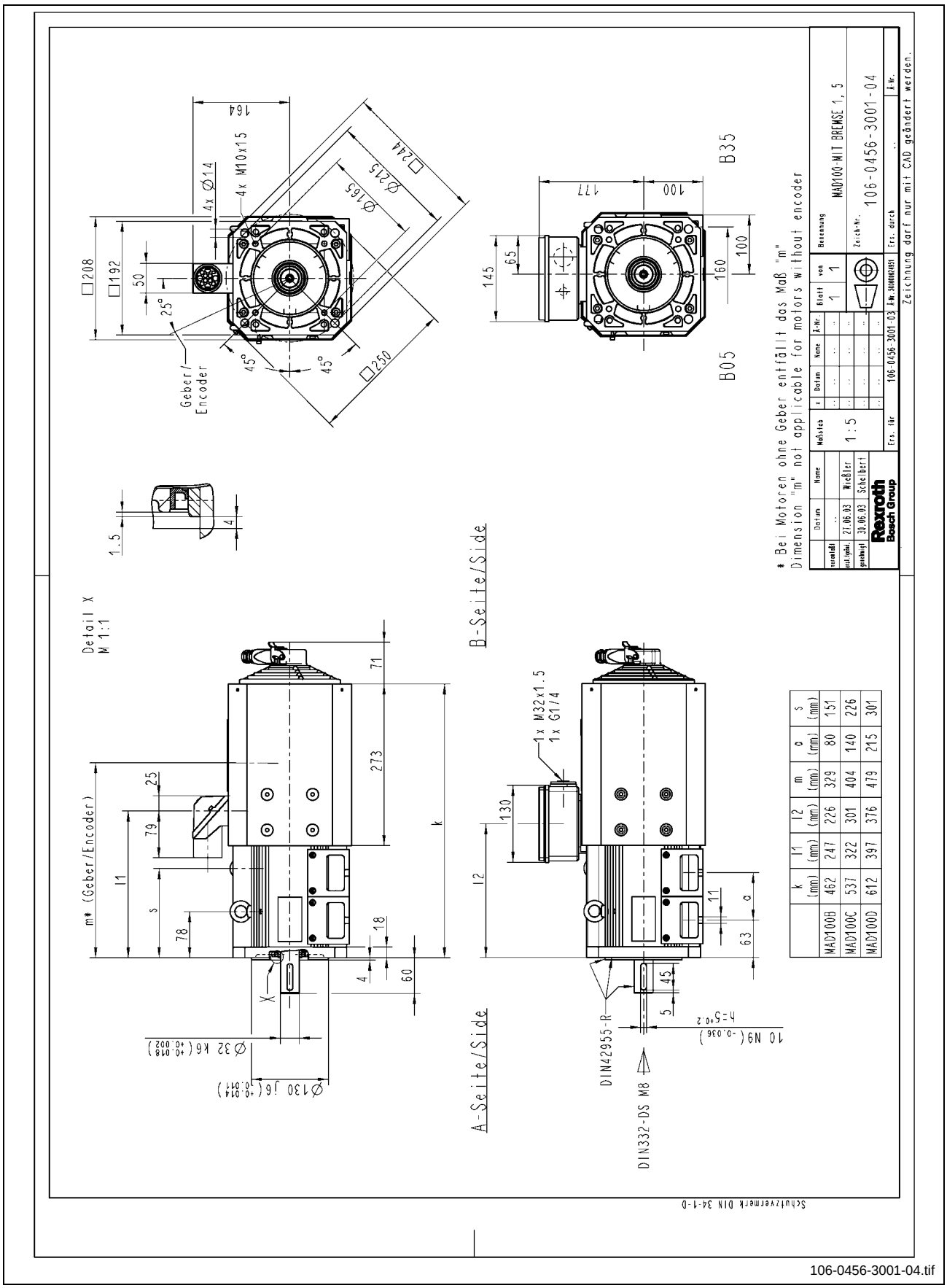
MAD100 without Holding Brake



106-0425-3001-05.tif

Fig. 5-1: Dimension sheet for MAD100 without holding brake

MAD100 with Brake 1 or 5

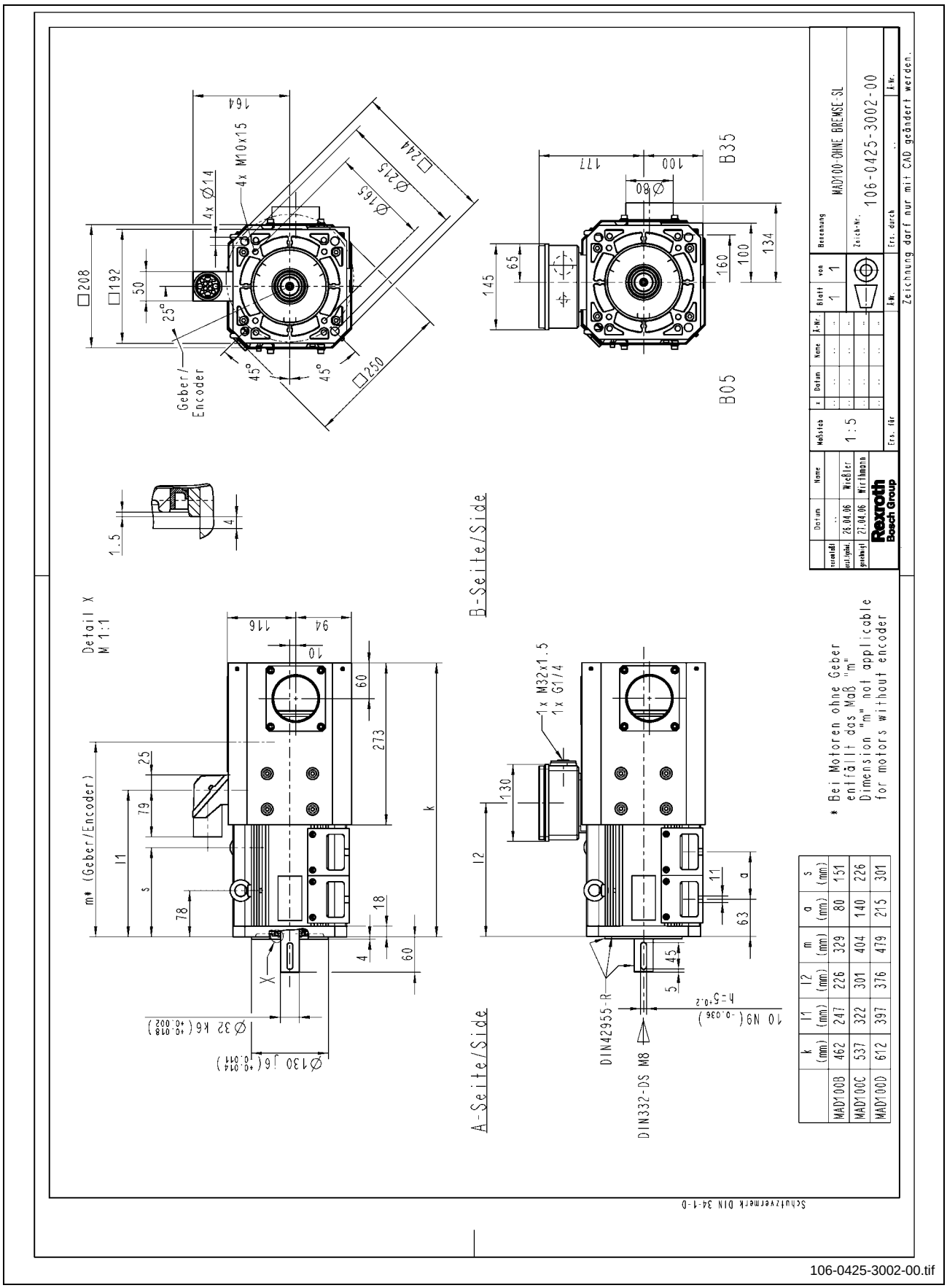


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	o (mm)	s (mm)
MAD100B	462	247	226	329	80	151
MAD100C	537	322	301	404	140	226
MAD100D	612	397	376	479	215	301

106-0456-3001-04.tif

Fig. 5-2: Dimension sheet MAD100 with brake 1 or 5

MAD100 with Fan Cowl, without Holding Brake

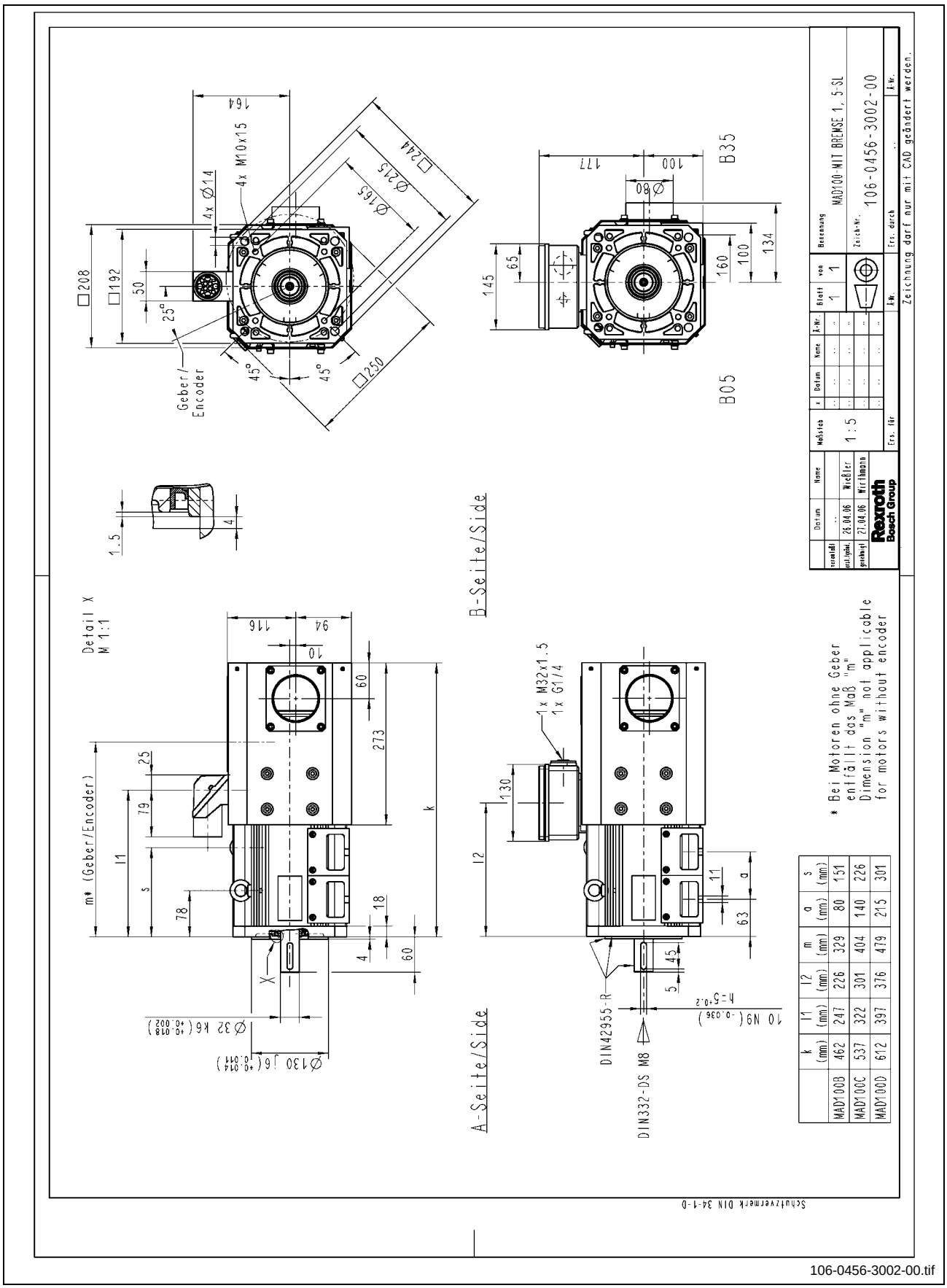


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAD100B	462	247	226	329	80	151
MAD100C	537	322	301	404	140	226
MAD100D	612	397	376	479	215	301

106-0425-3002-00.tif

Fig. 5-3: Dimension sheet MAD100 with SL cooling, without holding brake

MAD100 with Fan Cowl and Brake 1 or 5

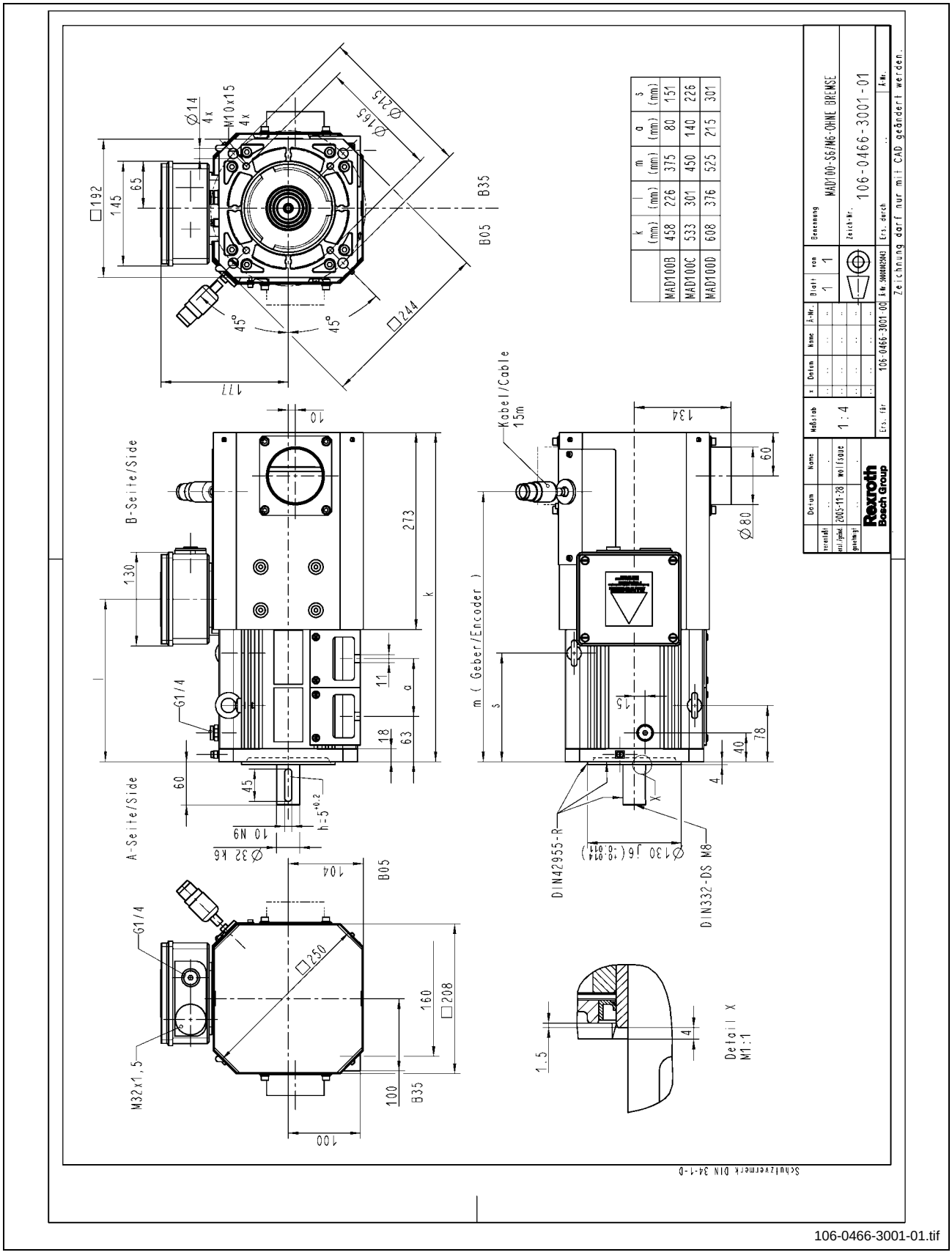


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAD100B	462	247	226	329	80	151
MAD100C	537	322	301	404	140	226
MAD100D	612	397	376	479	215	301

106-0456-3002-00.tif

Fig. 5-4: Dimension sheet MAD100 with SL cooling and brake 1 or 5

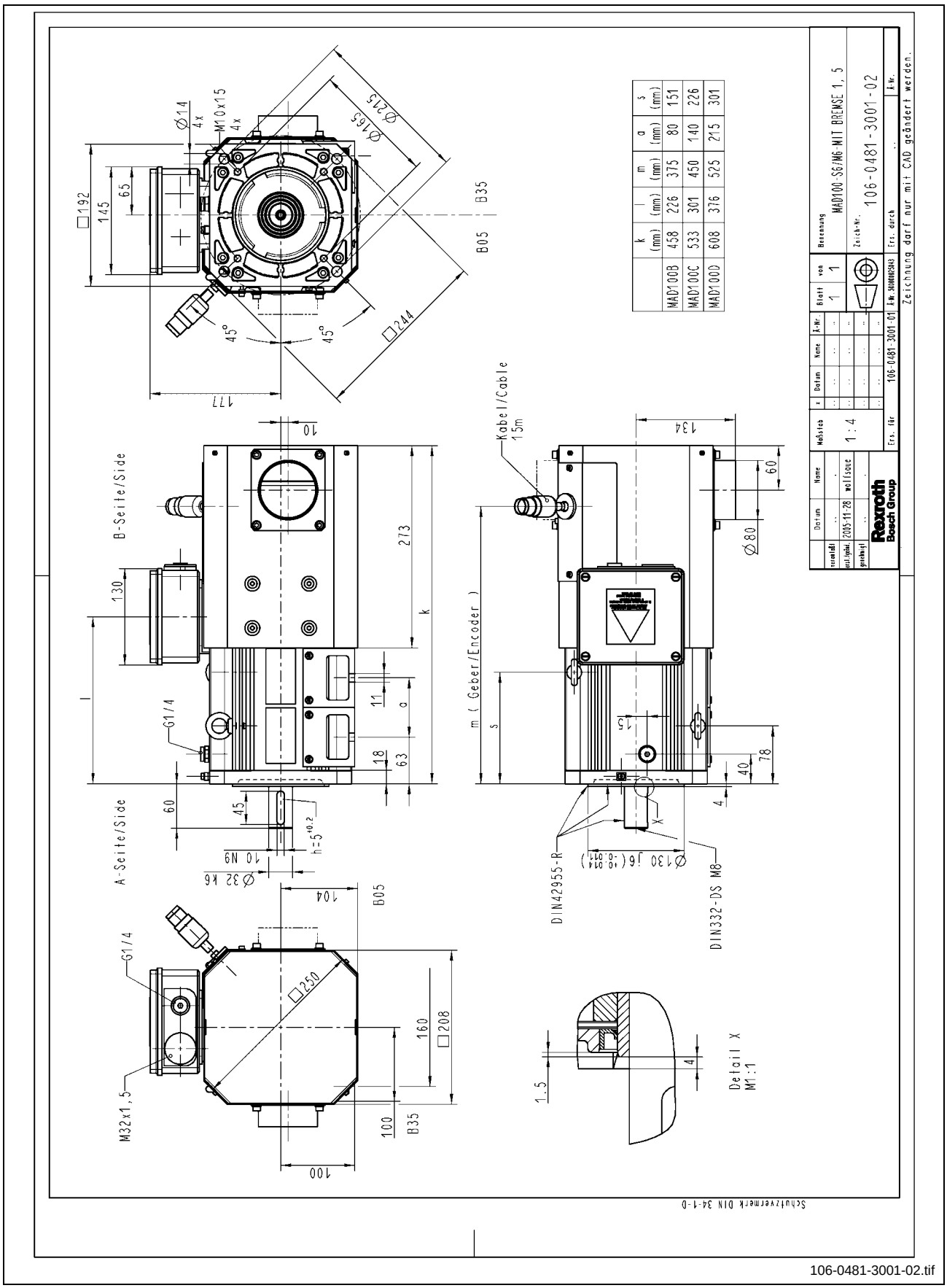
MAD100 in Explosion-Protected Design, without Holding Brake



	k (mm)	l (mm)	m (mm)	a (mm)	s (mm)
MAD100B	458	226	375	80	151
MAD100C	533	301	450	140	226
MAD100D	608	376	525	215	301

Fig. 5-5: Dimension sheet MAD100 with encoder M6 or S6, without holding brake

MAD100 in ATEX Design, with Brake 1 or 5

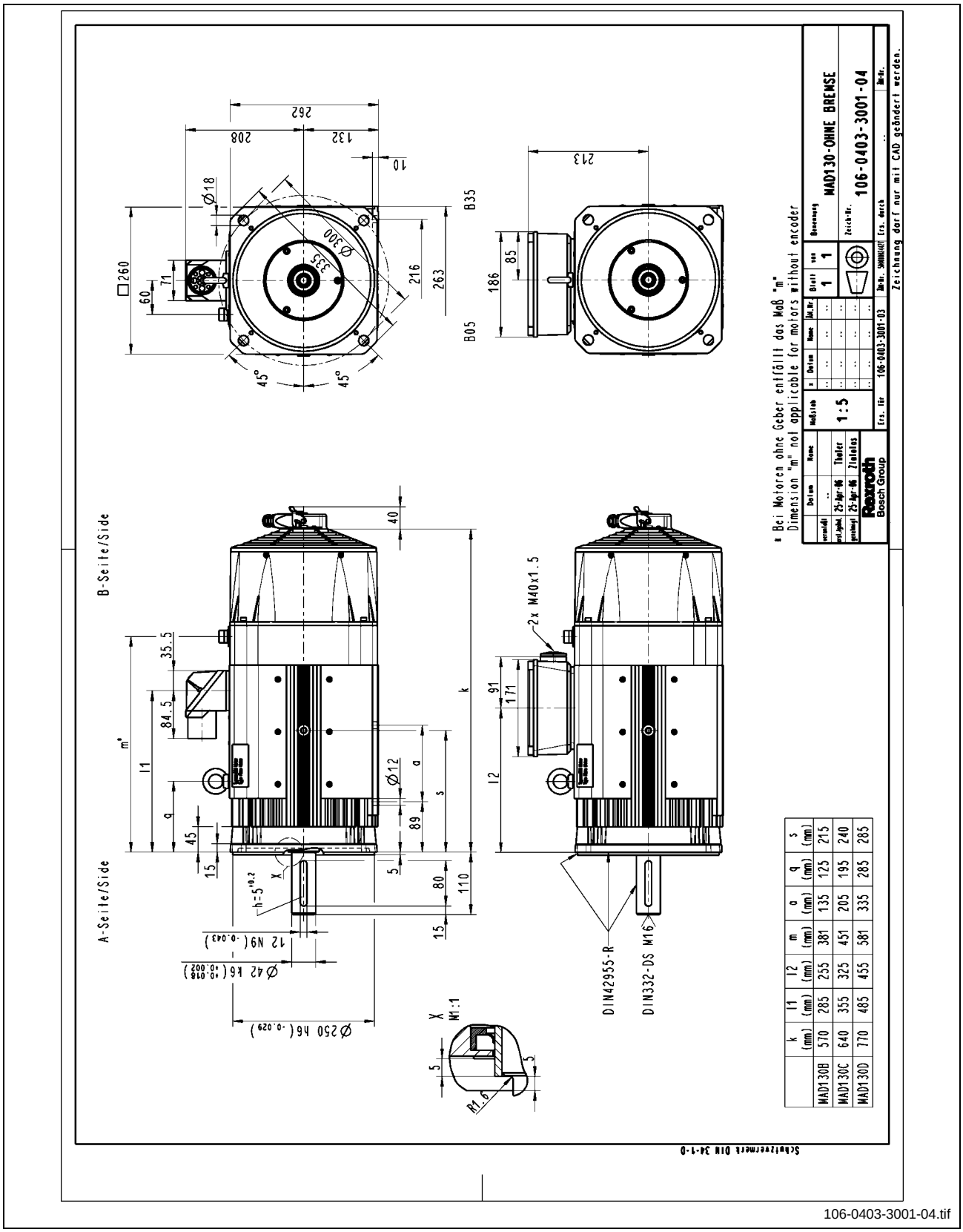


	k (mm)	l (mm)	m (mm)	a (mm)	s (mm)
MAD100B	458	226	375	80	151
MAD100C	533	301	450	140	226
MAD100D	608	376	525	215	301

Fig. 5-6: Dimension sheet MAD100 with encoder M6 or S6 and brake 1 or 5

5.2 Frame Size MAD130

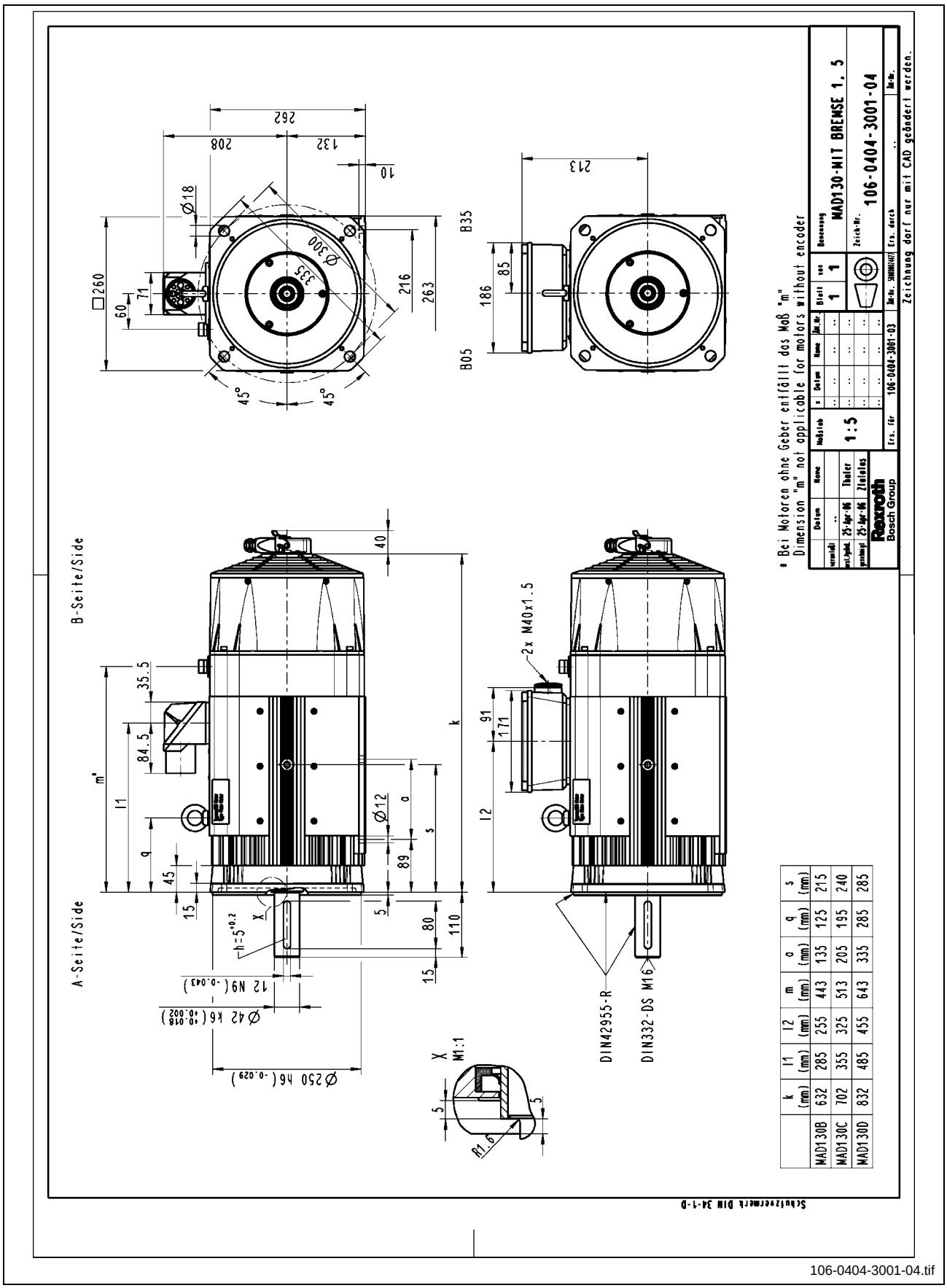
MAD130 without Holding Brake



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAD130B	570	285	255	381	135	125	215
MAD130C	640	355	325	451	205	195	240
MAD130D	770	485	455	581	335	285	285

Fig. 5-7: Dimension sheet for MAD130 without holding brake

MAD130 with Brake 1 or 5



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAD130B	632	285	255	443	135	125	215
MAD130C	702	355	325	513	205	195	240
MAD130D	832	485	455	643	335	285	285

106-0404-3001-04.tif

Fig. 5-8: Dimension sheet MAD130 with brake 1 or 5

MAD130 with Fan Cowl, without Holding Brake

in preparation

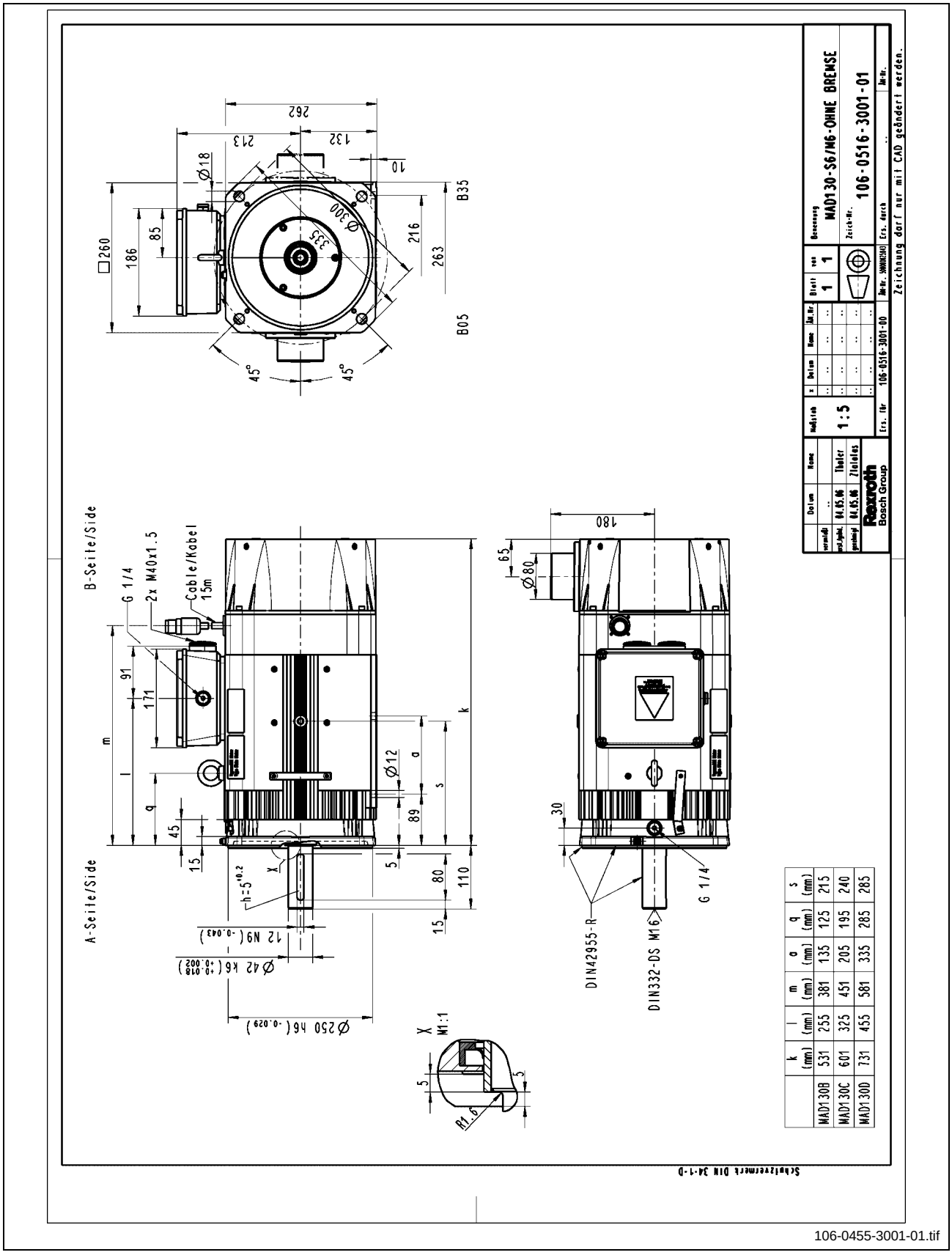
Fig. 5-9: Dimension sheet MAD130 with SL cooling, without holding brake

MAD130 with Fan Cowl and Brake 1 or 5

in preparation

Fig. 5-10: Dimension sheet MAD130 with SL cooling and brake 1 or 5

MAD130 in ATEX Design, without Holding Brake

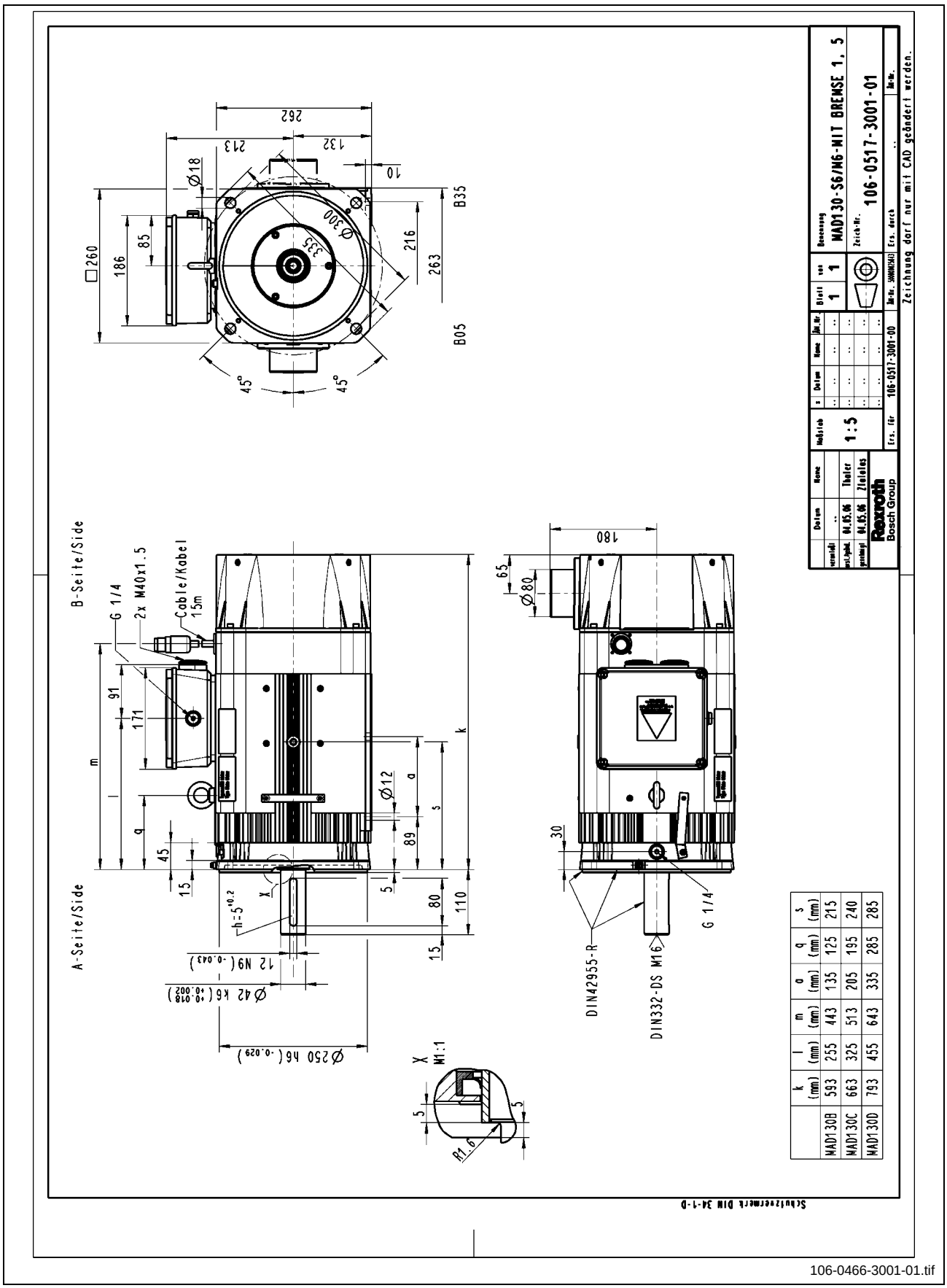


	k (mm)	l (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAD130B	531	255	381	135	125	215
MAD130C	601	325	451	205	195	240
MAD130D	731	455	581	335	285	285

106-0455-3001-01.tif

Abb. 5-1: Dimension sheet MAD130 with encoder M6 or S6, without holding brake

MAD130 in ATEX Design, with Brake 1 or 5

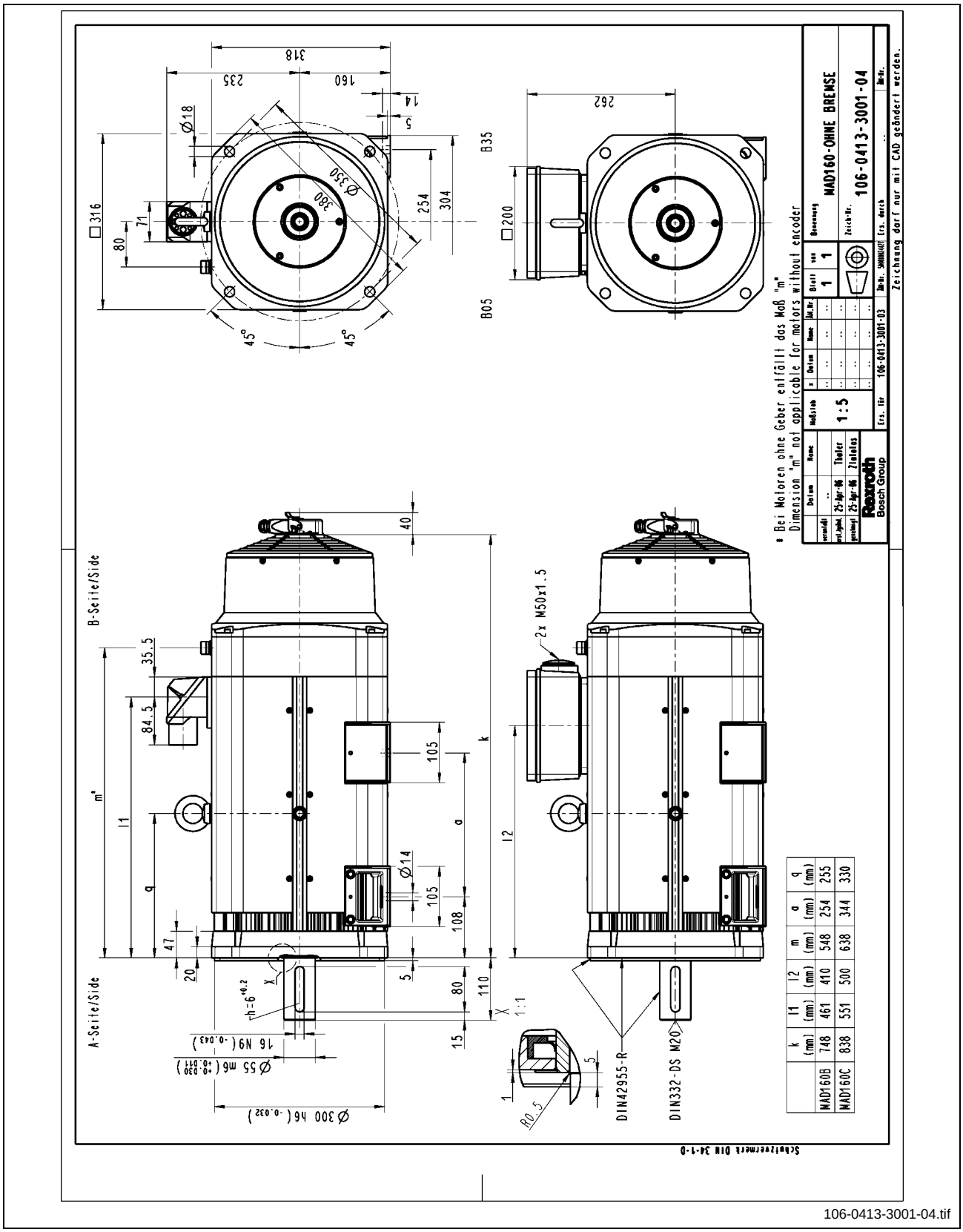


106-0466-3001-01.tif

Fig. 5-12: Dimension sheet MAD130 with encoder M6 or S6 and brake 1 or 5

5.3 Frame Size MAD160

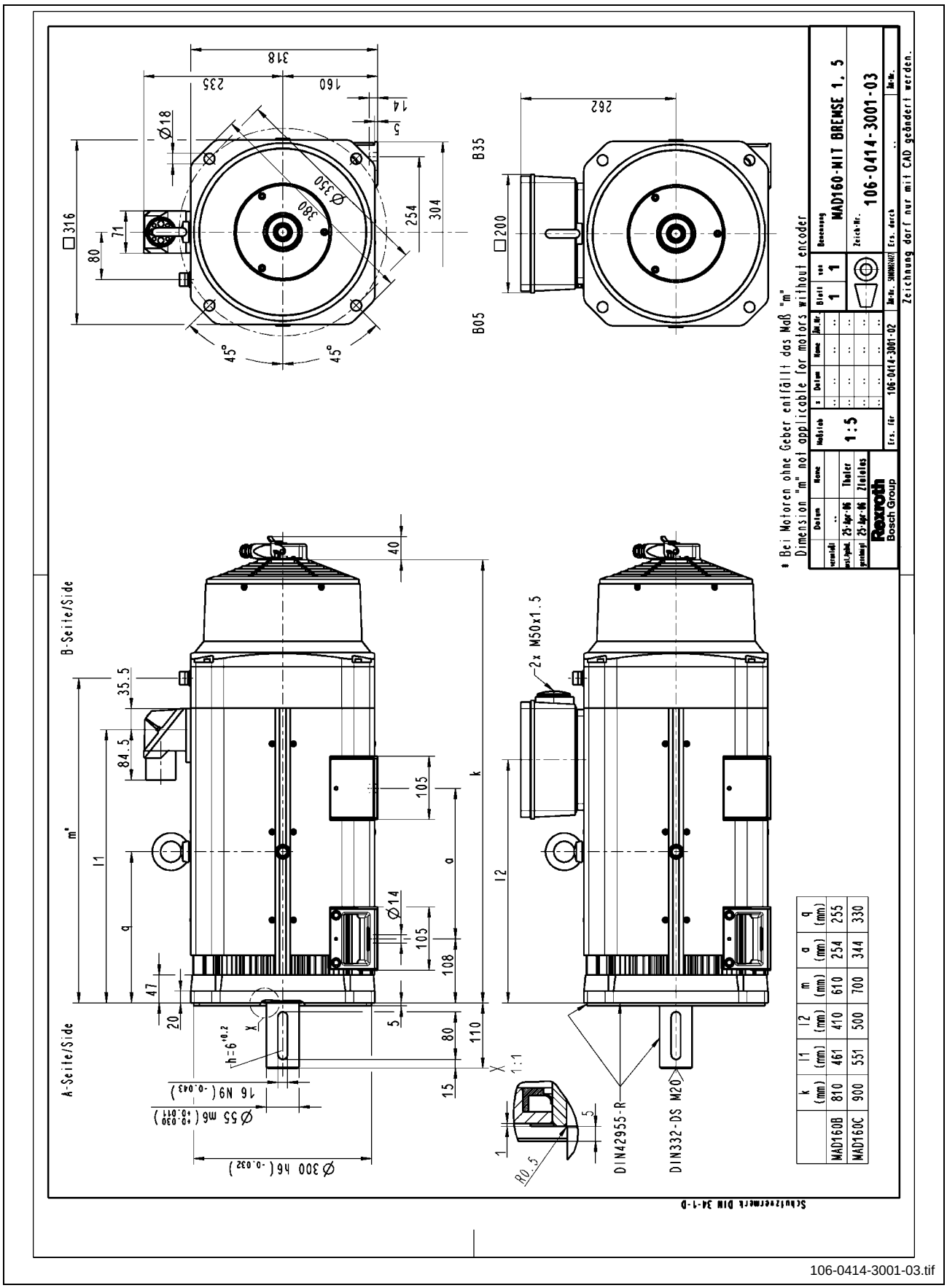
MAD160 without Holding Brake



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)
MAD160B	748	461	410	548	254	255
MAD160C	838	551	500	638	344	330

Fig. 5-13: Dimension sheet for MAD160 without holding brake

MAD160 with Brake 1 or 5

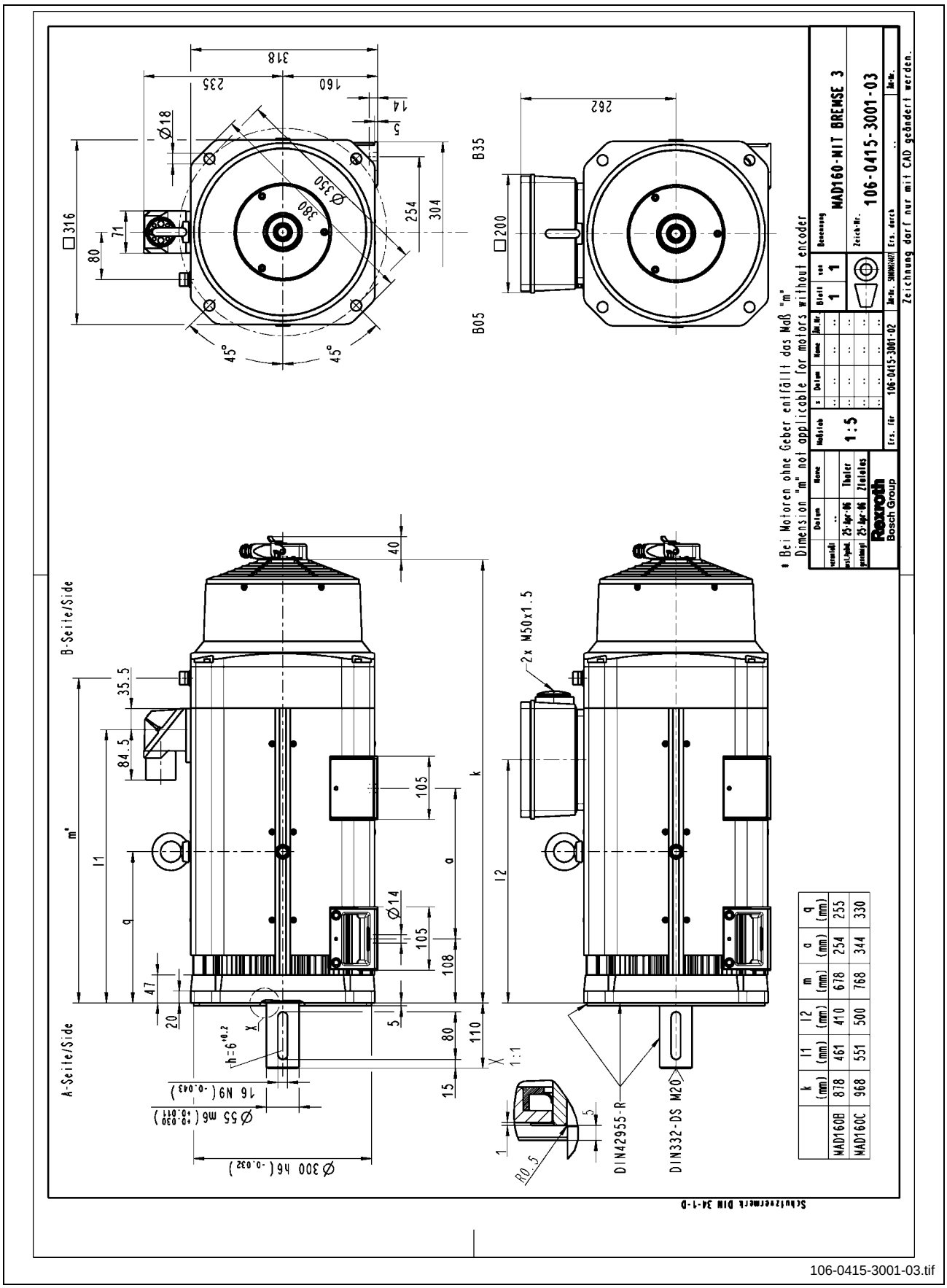


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)
MAD160B	810	461	410	610	254	255
MAD160C	900	551	500	700	344	330

106-0414-3001-03.tif

Fig. 5-14: Dimension sheet MAD160 with brake 1 or 5

MAD160 with Brake 3



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)
MAD160B	878	461	410	678	254	255
MAD160C	968	551	500	768	344	330

Fig. 5-15: Dimension sheet for MAD160 with brake 3

MAD160 with Fan Cowl, without Holding Brake

in preparation

Fig. 5-16: Dimension sheet MAD160 with SL cooling, without holding brake

MAD160 with Fan Cowl and Brake 1 or 5

in preparation

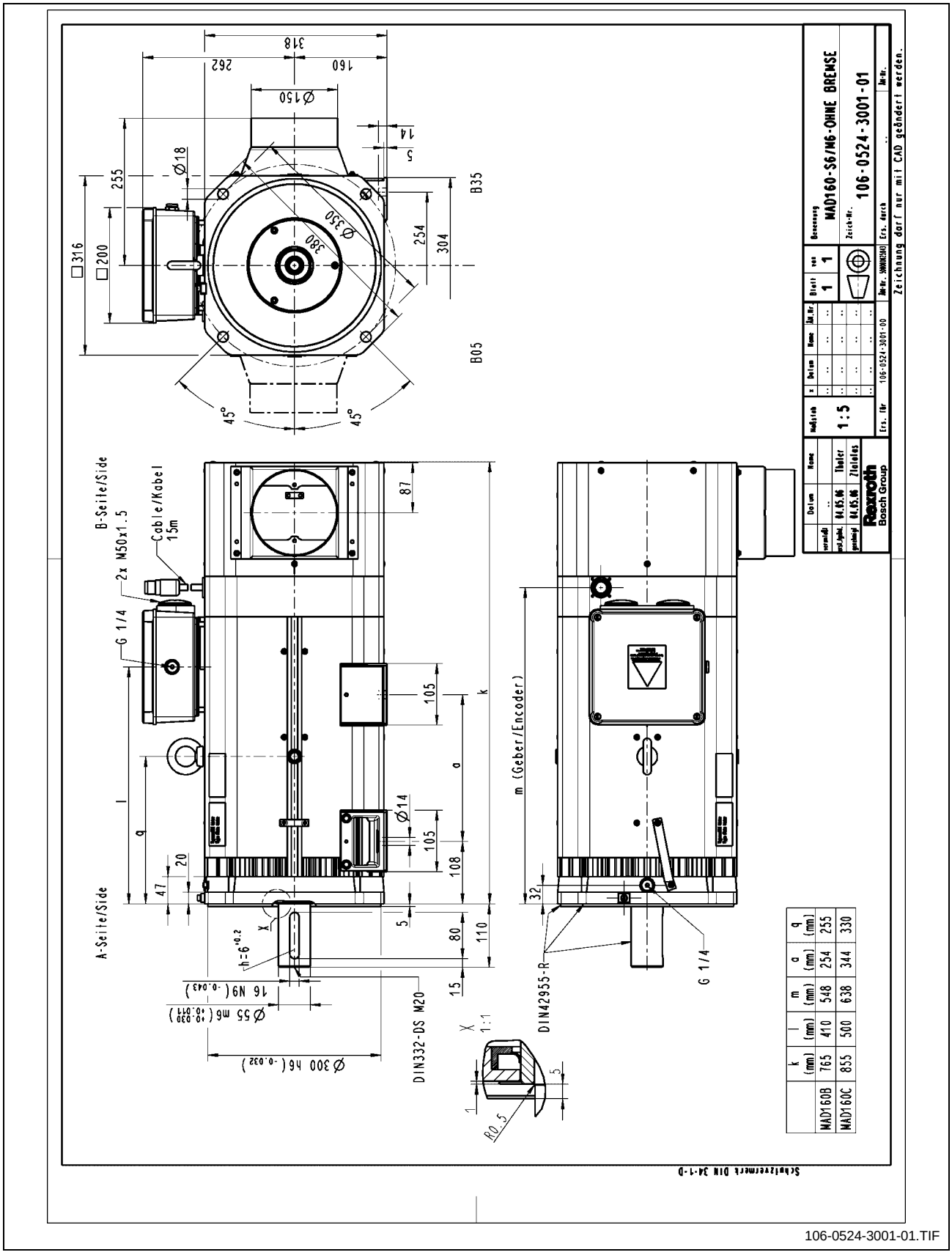
Fig. 5-17: Dimension sheet MAD160 with SL cooling and brake 1 or 5

MAD160 with Fan Cowl and Brake 3

in preparation

Fig. 5-18: Dimension sheet MAD160 with SL cooling and brake 3 or 5

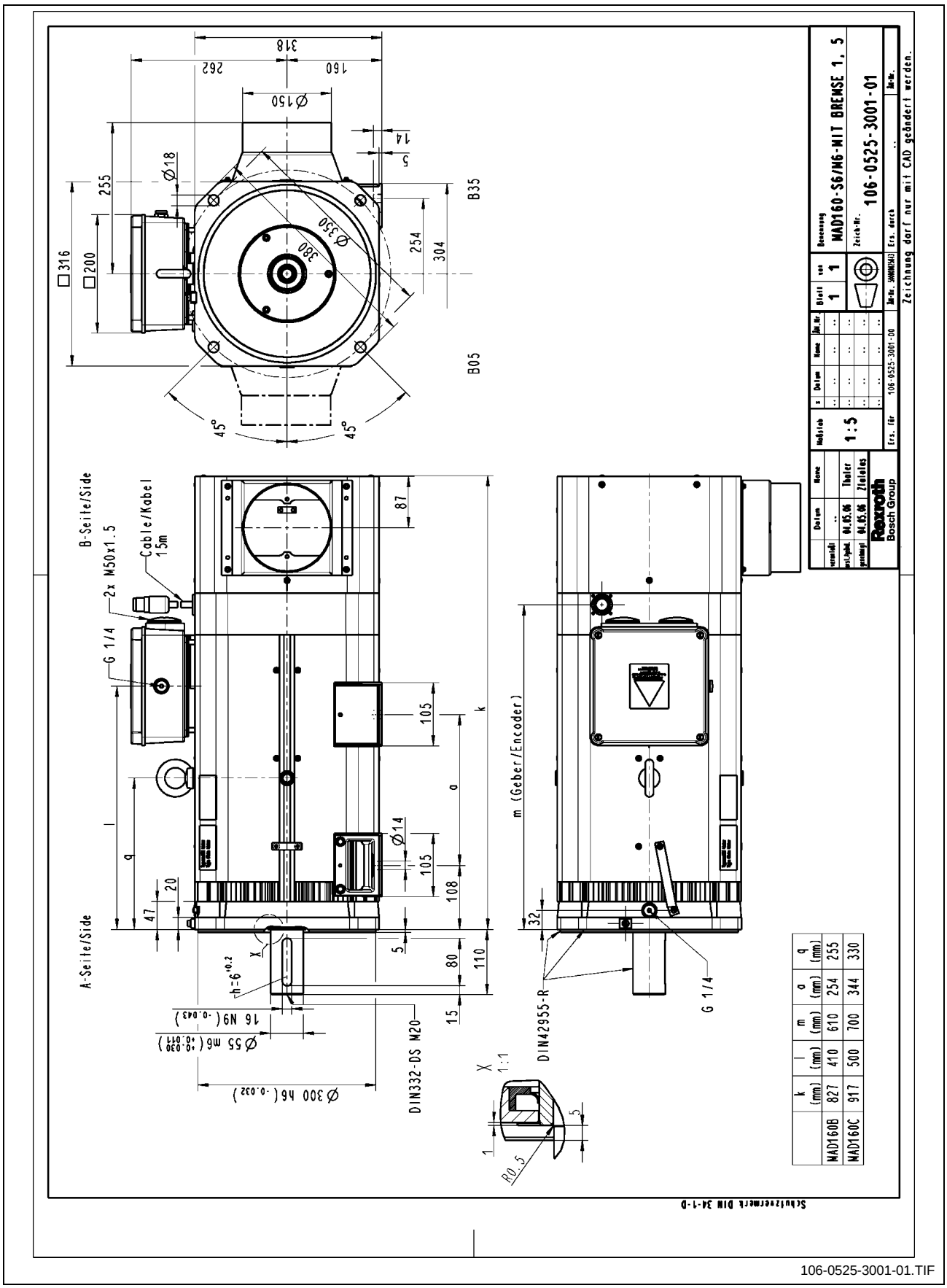
MAD160 in ATEX Design, without Holding Brake



106-0524-3001-01.TIF

Fig. 5-19: Dimension sheet MAD160 with encoder M6 or S6, without holding brake

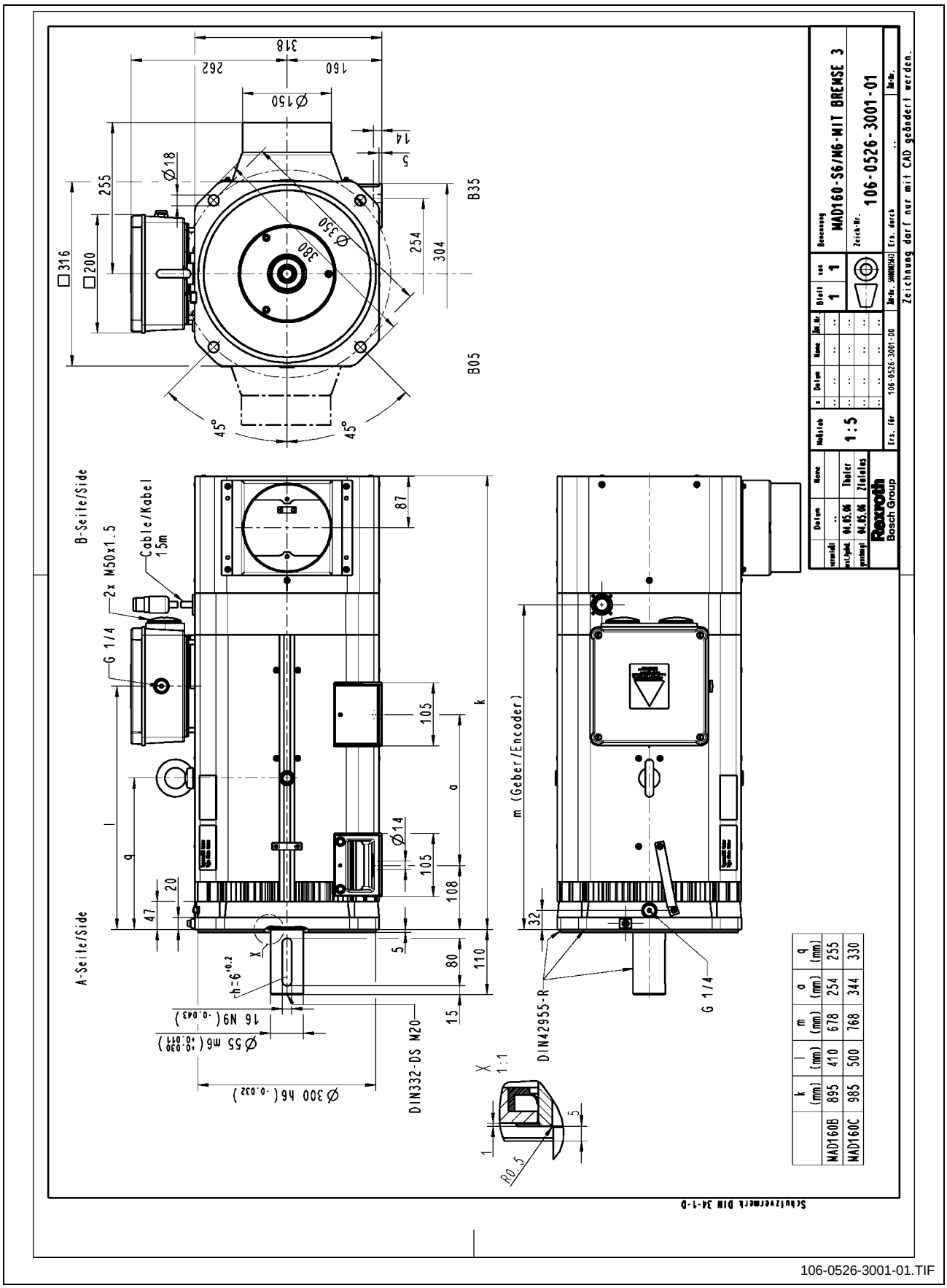
MAD160 in ATEX Design, with Brake 1 or 5



106-0525-3001-01.TIF

Fig. 5-20: Dimension sheet MAD160 with encoder M6 or S6 and brake 1 or 5

MAD160 in ATEX Design, with Brake 3



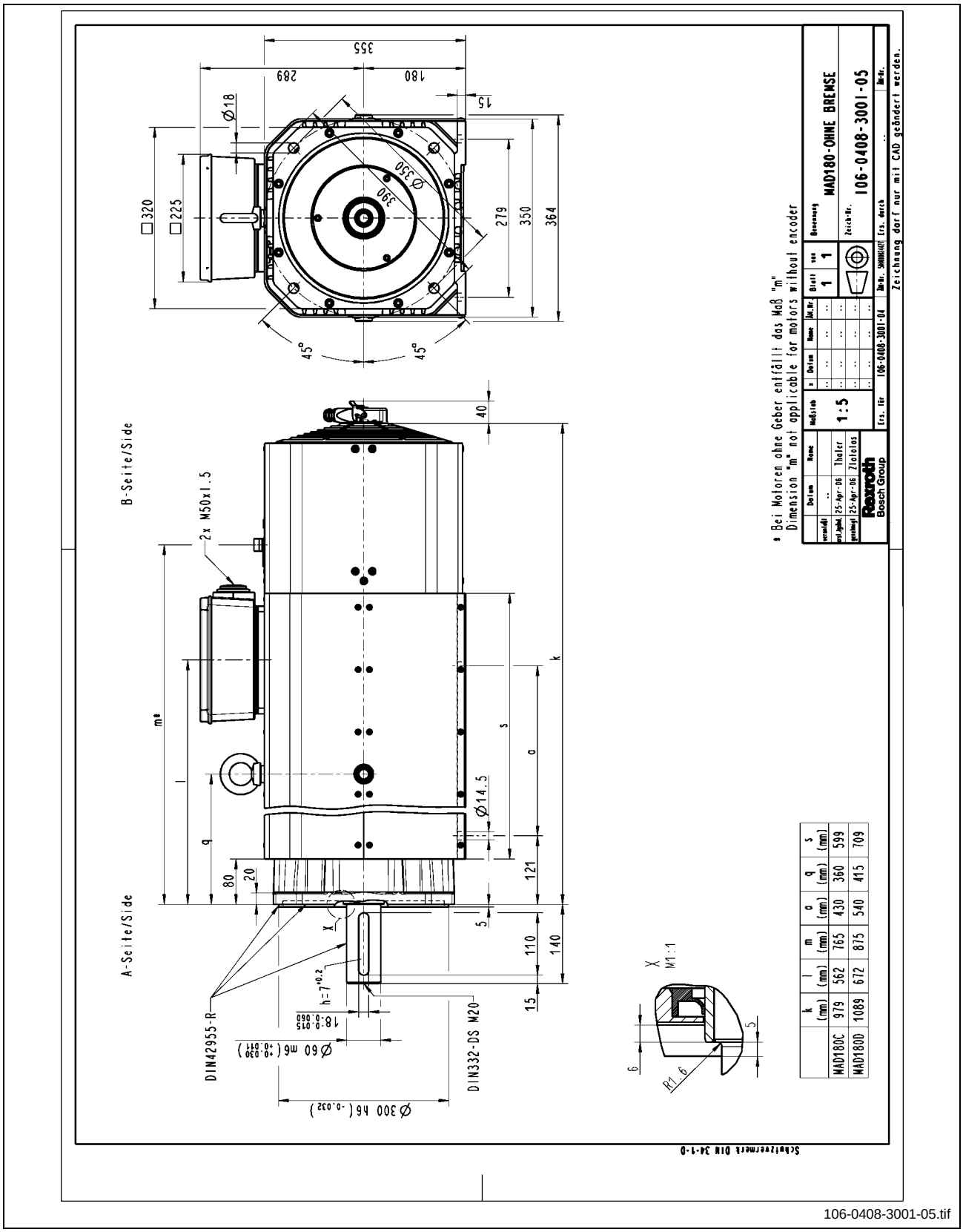
	k (mm)	l (mm)	m (mm)	a (mm)	q (mm)
MAD160B	895	410	678	254	255
MAD160C	985	500	768	344	330

106-0526-3001-01.TIF

Fig. 5-21: Dimension sheet MAD160 with encoder M6 or S6 and brake 3

5.4 Frame Size MAD180

MAD180 without Holding Brake

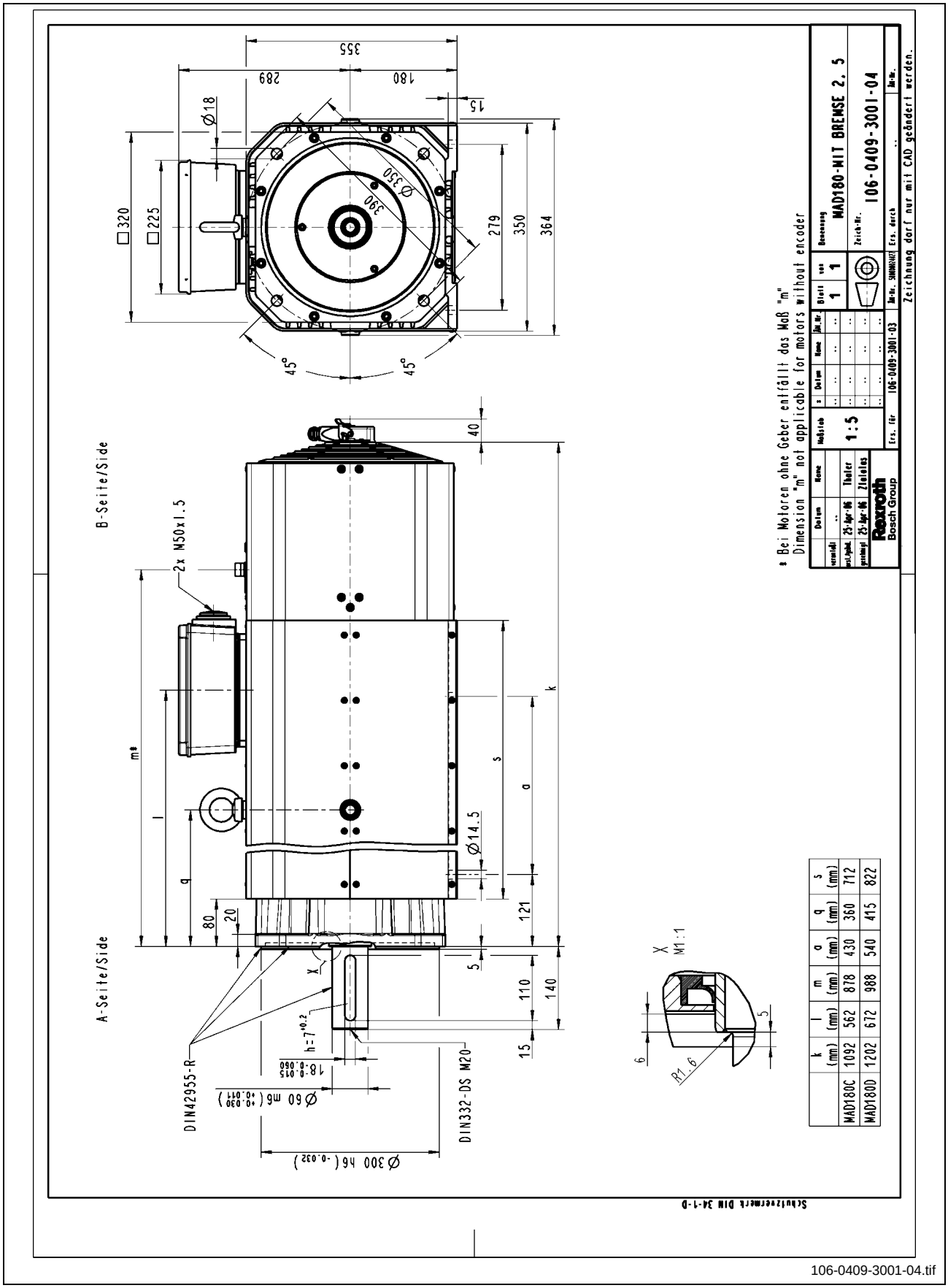


	k (mm)	l (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAD180C	979	562	765	430	360	599
MAD180D	1089	672	875	540	415	709

106-0408-3001-05.tif

Fig. 5-22: Dimension sheet for MAD180 without holding brake

MAD180 with Brake 2 or 5



	k (mm)	l (mm)	m (mm)	a (mm)	q (mm)	s (mm)
MAD180C	1092	562	878	430	360	712
MAD180D	1202	672	988	540	415	822

106-0409-3001-04.tif

Fig. 5-23: Dimension sheet MAD180 with brake 2 or 5

MAD180 with Fan Cowl, without Holding Brake

in preparation

Fig. 5-24: Dimension sheet MAD180 without holding brake, SL cooling

MAD180 with Fan Cowl and Brake 2 or 5

in preparation

Fig. 5-25: Dimension sheet MAD180 with SL cooling and brake 2 or 5

MAD180 in ATEX Design, without Holding Brake

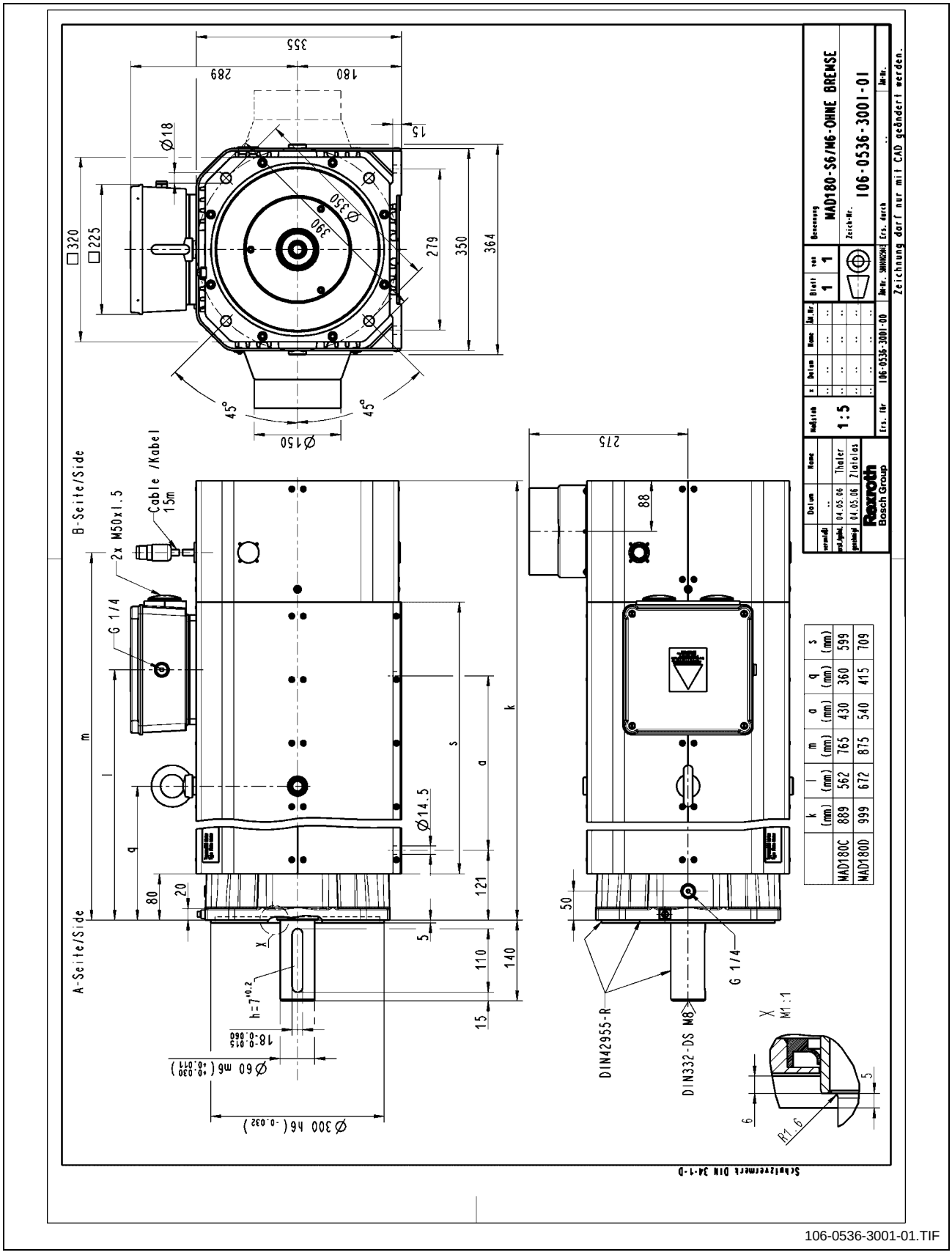


Fig. 5-26: Dimension sheet MAD180 with encoder M6 or S6, without holding brake

MAD180 in ATEX Design, with Brake 2 or 5

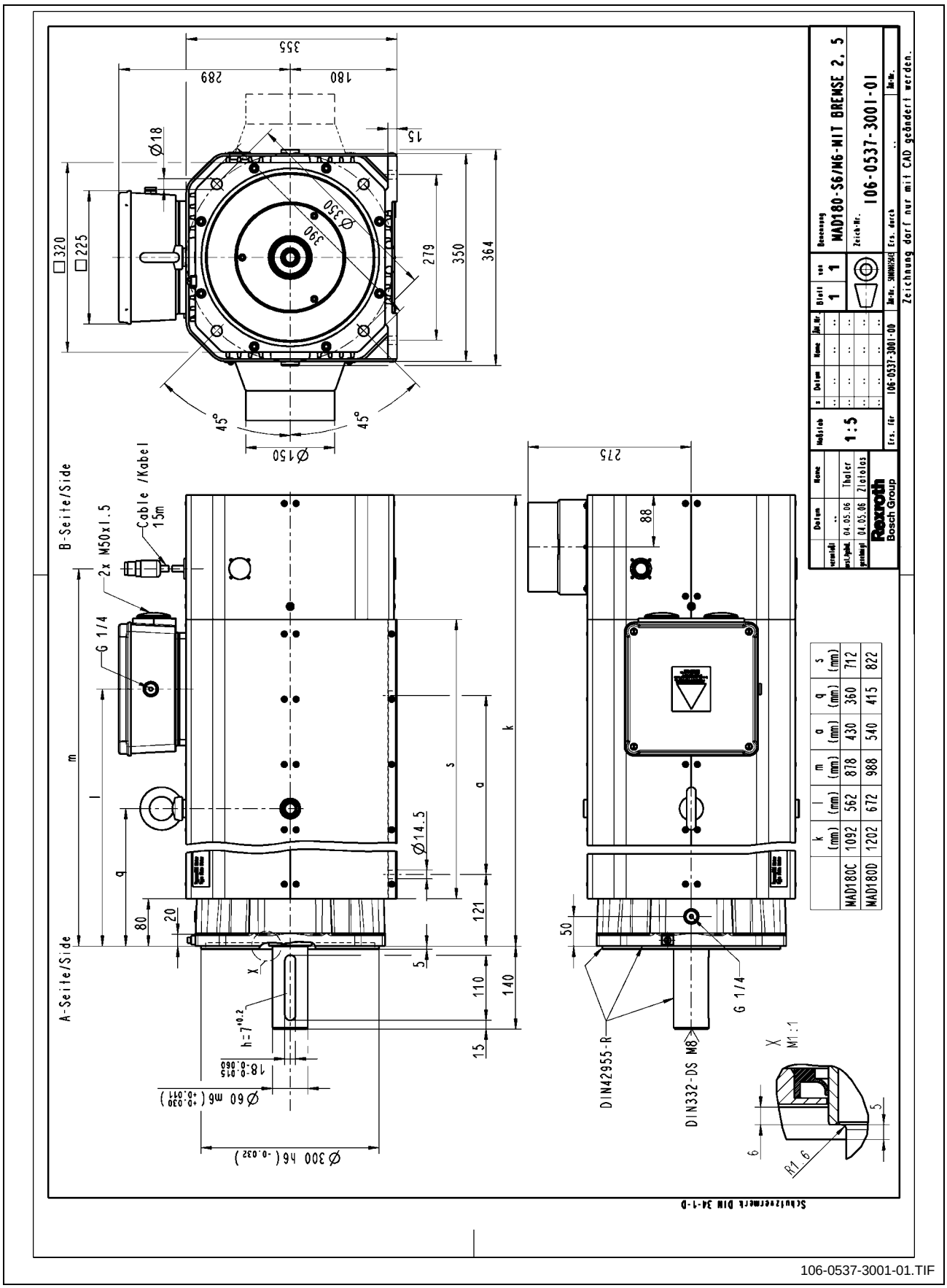


Fig. 5-27: Dimension sheet MAD180 with encoder M6 or S6 and brake 2 or 5

5.5 Frame Size MAD225

MAD225 (without Holding Brake)

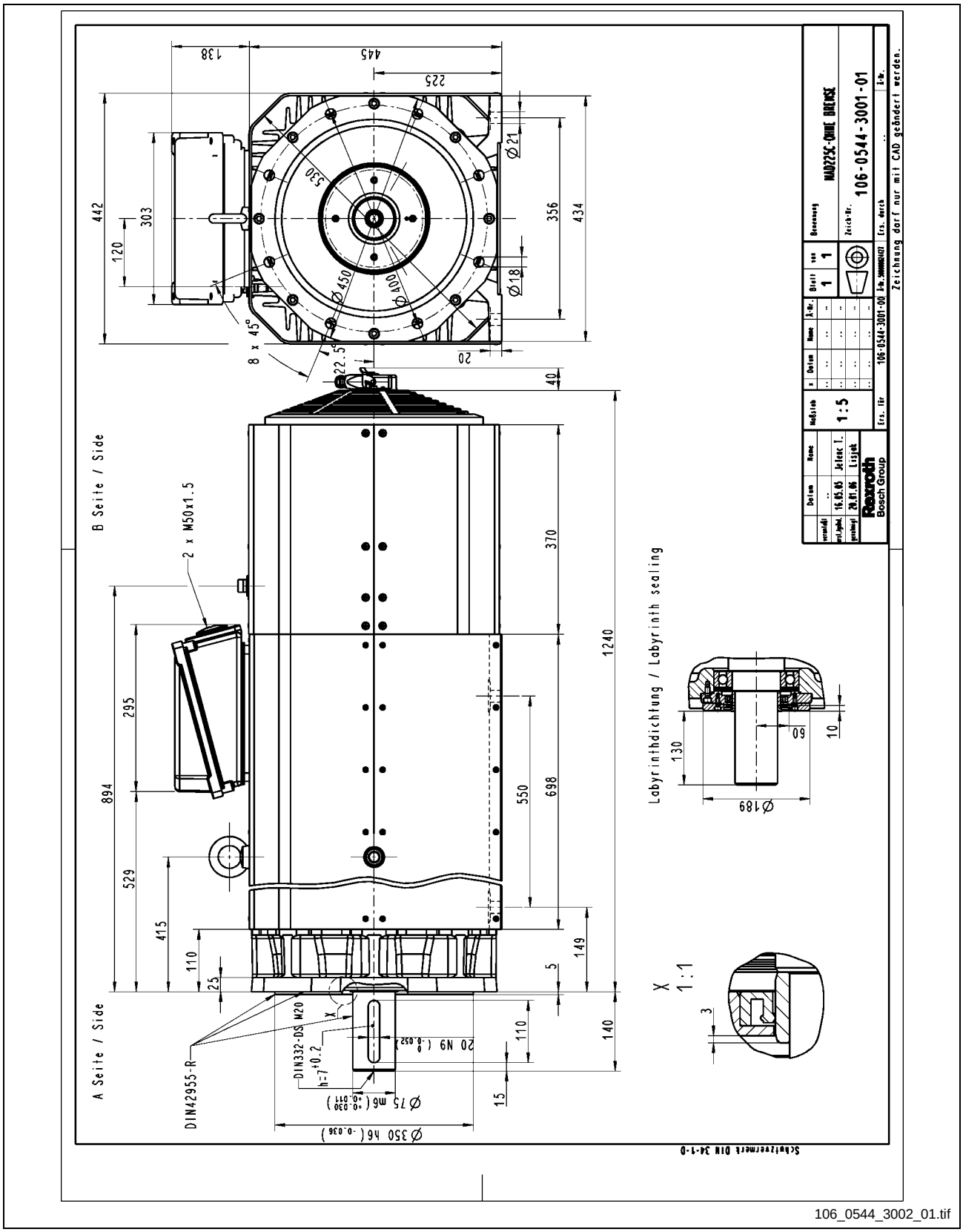
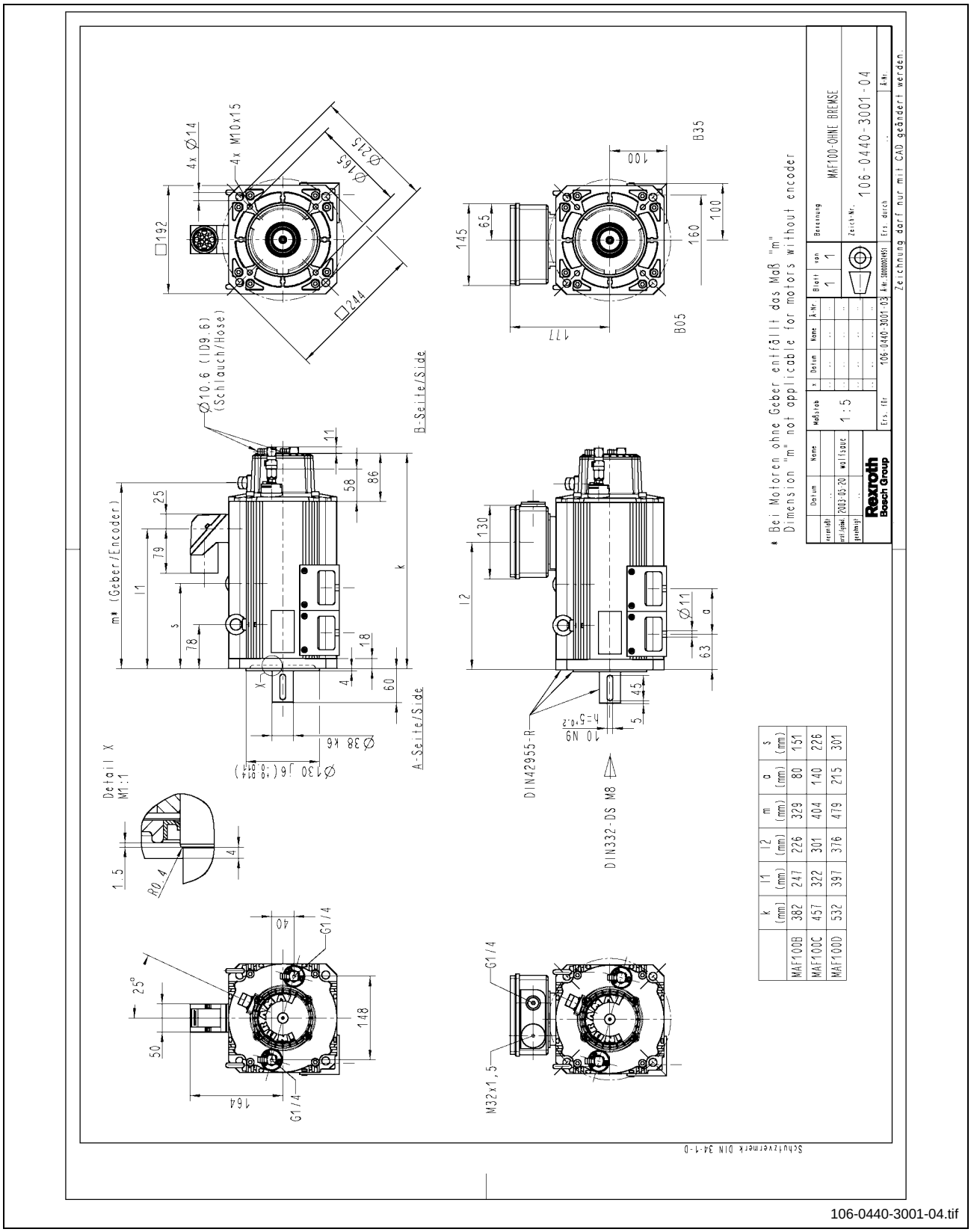


Fig. 5-28: Dimension sheet MAD225 (without Holding Brake)

5.6 Frame Size MAF100

MAF100 without Holding Brake

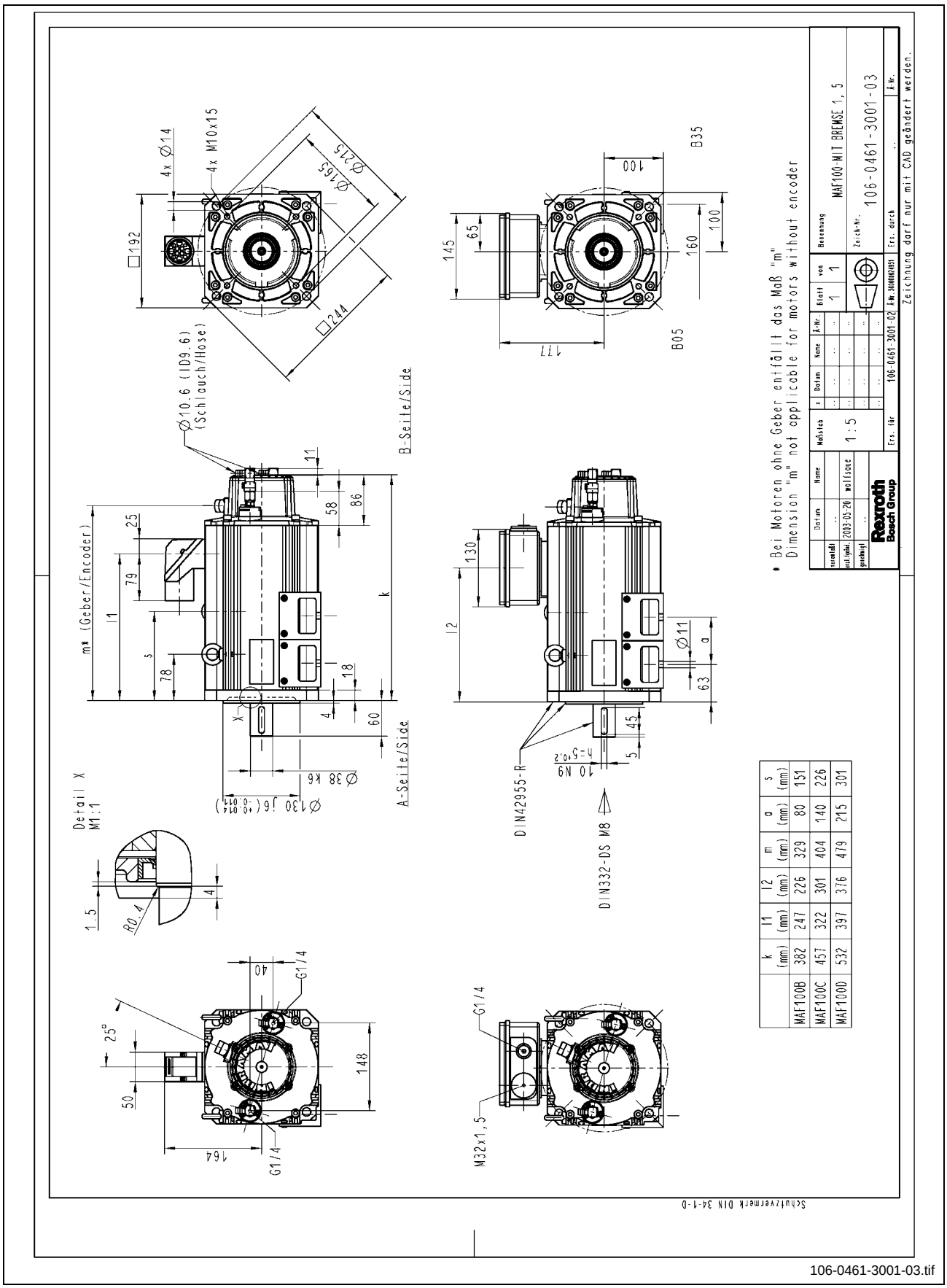


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAF100B	382	247	226	329	80	131
MAF100C	457	322	301	404	140	226
MAF100D	532	397	376	479	215	301

106-0440-3001-04.tif

Fig. 5-29: Dimension sheet for MAF100 without holding brake

MAF100 with Brake 1 or 5

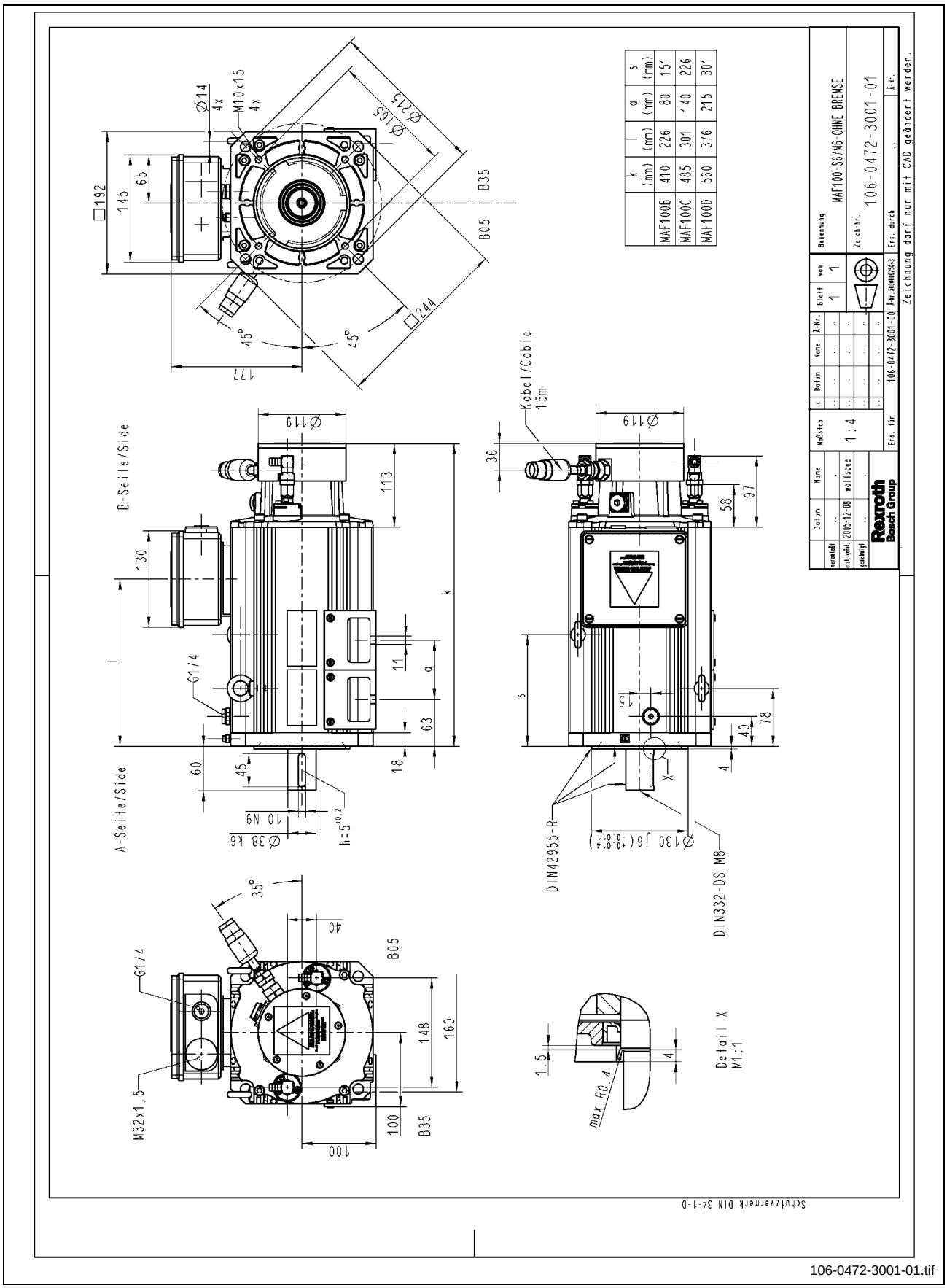


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAF100B	382	247	226	329	80	151
MAF100C	457	322	301	404	140	226
MAF100D	532	397	376	479	215	301

106-0461-3001-03.tif

Fig. 5-30: Dimension sheet MAF100 with brake 1 or 5

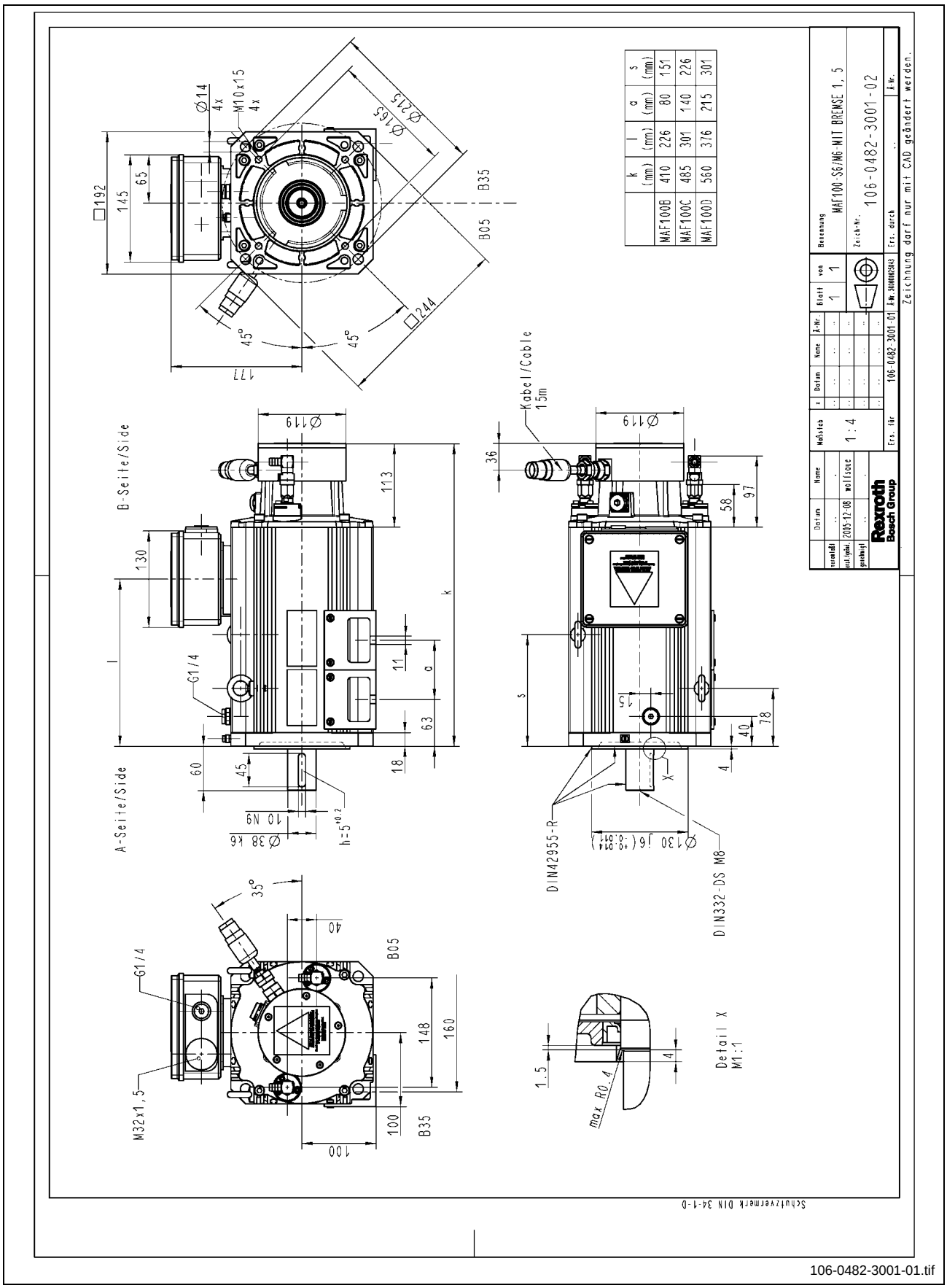
MAF100 in ATEX Design, without Holding Brake



	k (mm)	l (mm)	a (mm)	s (mm)
MAF100B	410	226	80	151
MAF100C	485	301	140	226
MAF100D	560	376	215	301

Fig. 5-31: Dimension sheet MAF100 with encoder M6 or S6, without holding brake

MAF100 in ATEX Design, with Brake 1 or 5



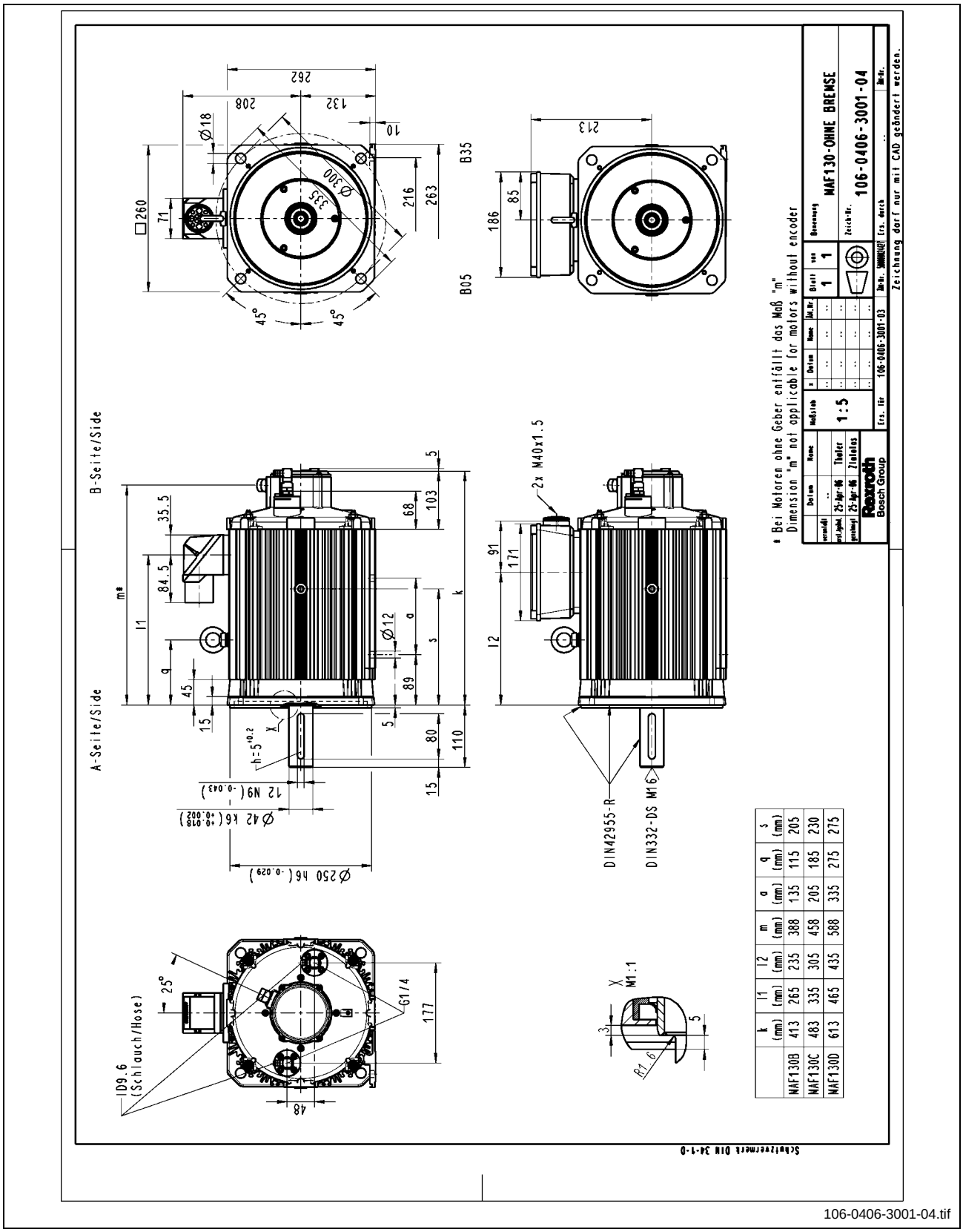
	k (mm)	l (mm)	a (mm)	s (mm)
MAF100B	410	226	80	151
MAF100C	485	301	140	226
MAF100D	560	376	215	301

106-0482-3001-01.tif

Fig. 5-32: Dimension sheet MAF100 with encoder M6 or S6 and brake 1 or 5

5.7 Frame Size MAF130

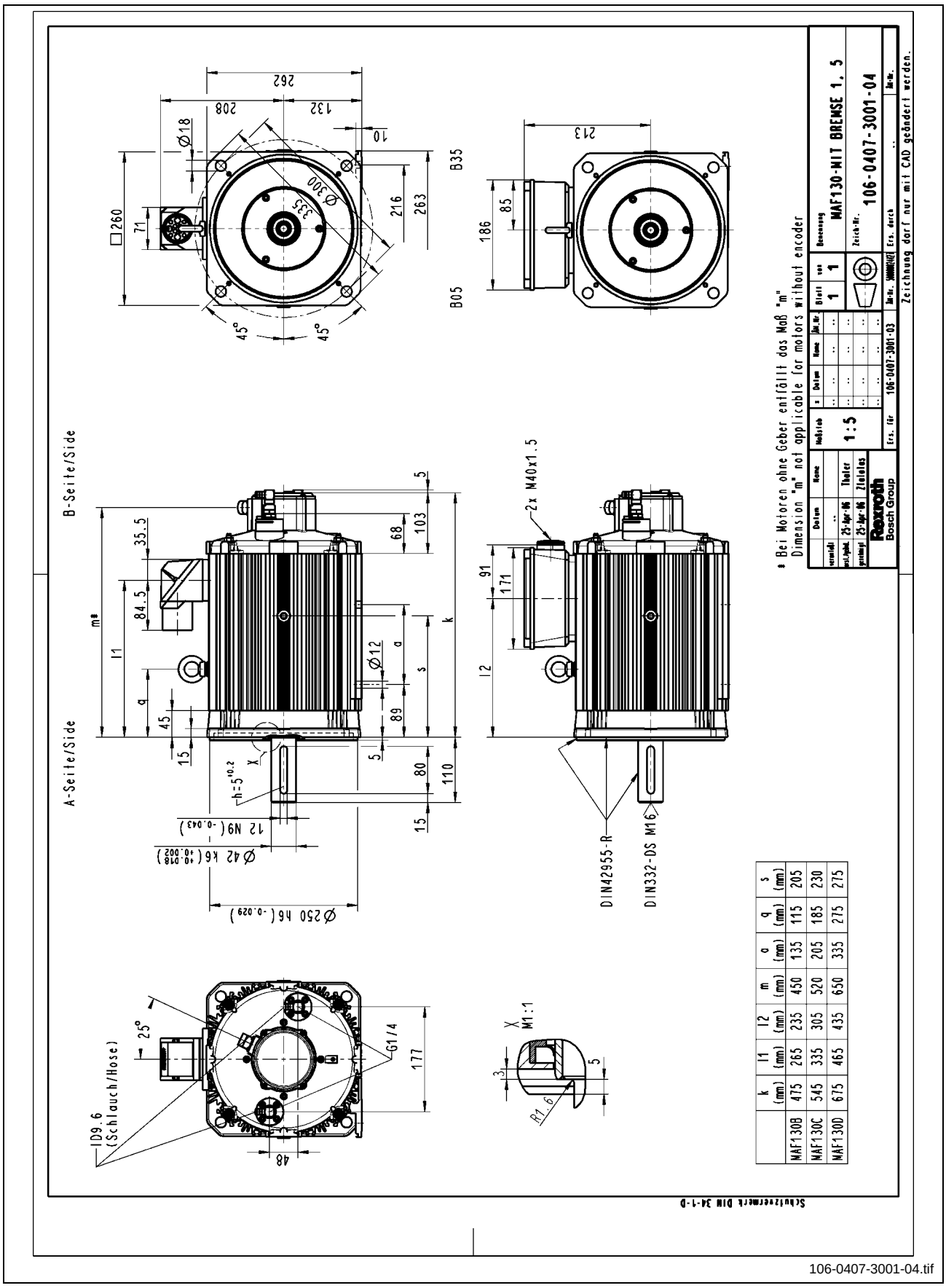
MAF130 without Holding Brake



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAF130B	413	265	235	388	135	115	205
MAF130C	483	335	305	458	205	185	230
MAF130D	613	465	435	588	335	275	275

Fig. 5-33: Dimension sheet for MAF130 without holding brake

MAF130 with Brake 1 or 5

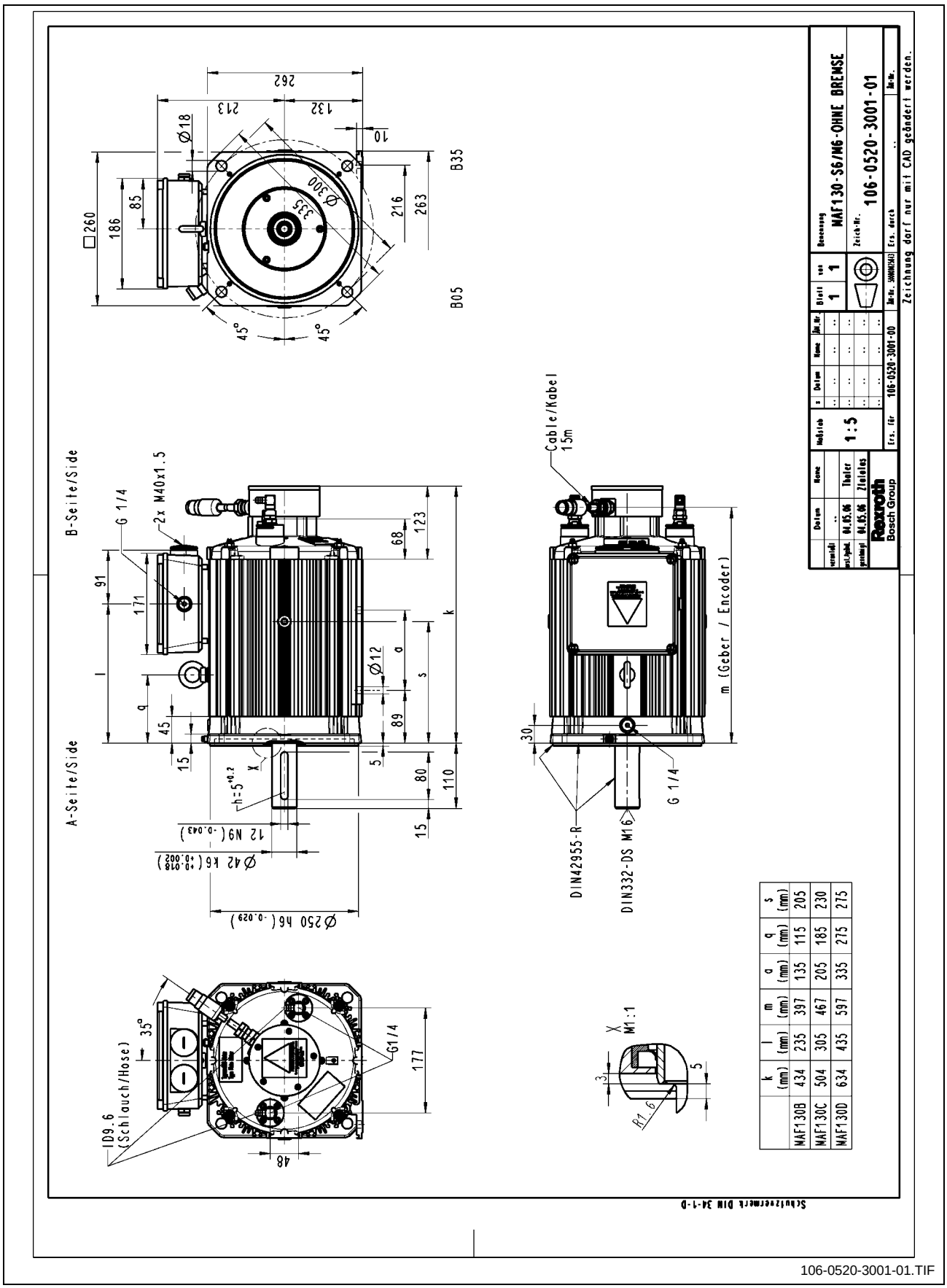


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)	s (mm)
MAF130B	475	265	235	450	135	115	205
MAF130C	545	335	305	520	205	185	230
MAF130D	675	465	435	650	335	275	275

106-0407-3001-04.tif

Fig. 5-34: Dimension sheet MAF130 with brake 1 or 5

MAF130 in ATEX Design, without Holding Brake



	k (mm)	l (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAF130B	434	235	397	135	115	205
MAF130C	504	305	467	205	185	230
MAF130D	634	435	597	335	275	275

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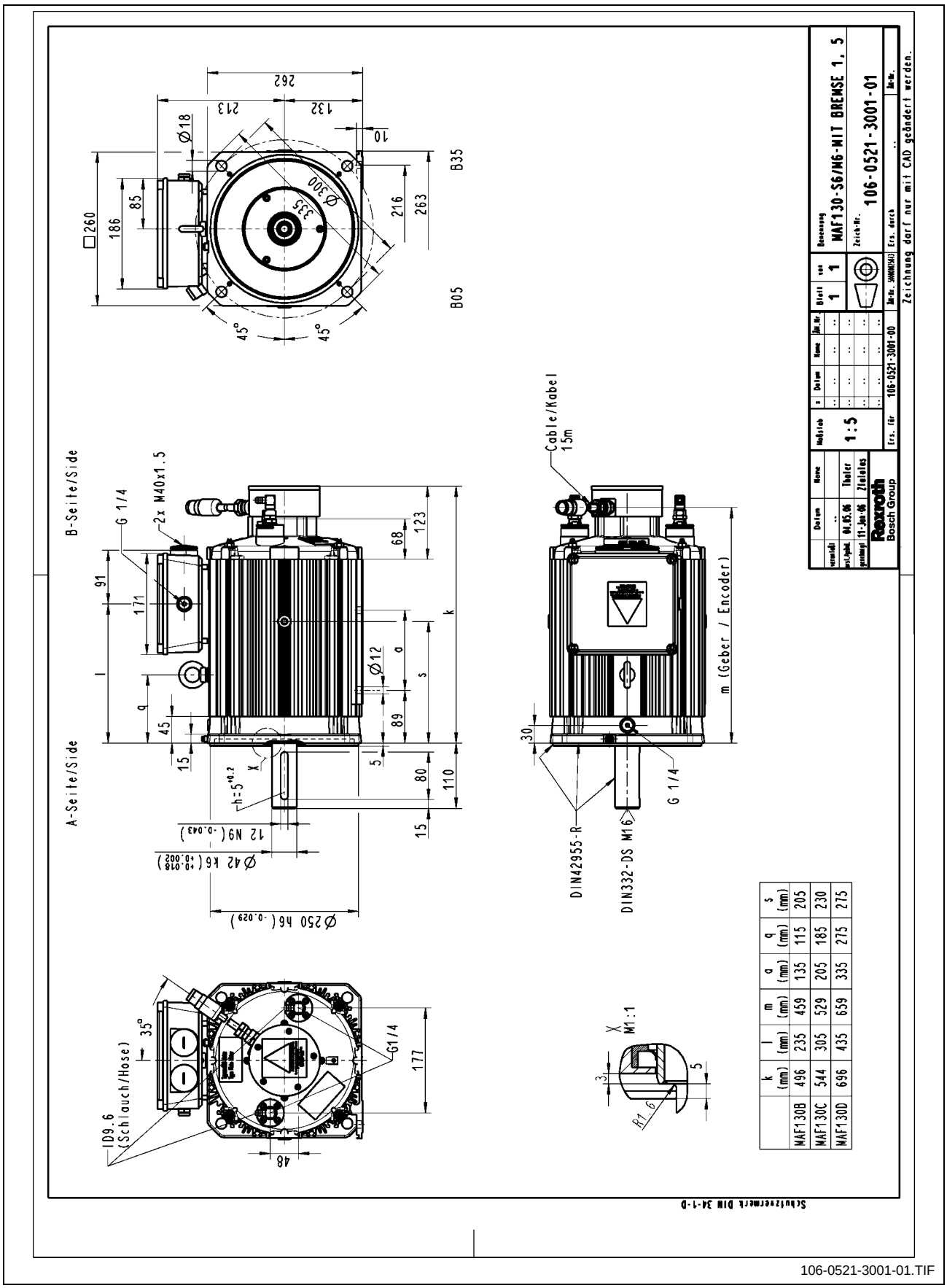
Fig. 5-35: Dimension sheet MAF130 with encoder M6 or S6, without holding brake

MAF130 in ATEX Design, with Brake 1 or 5

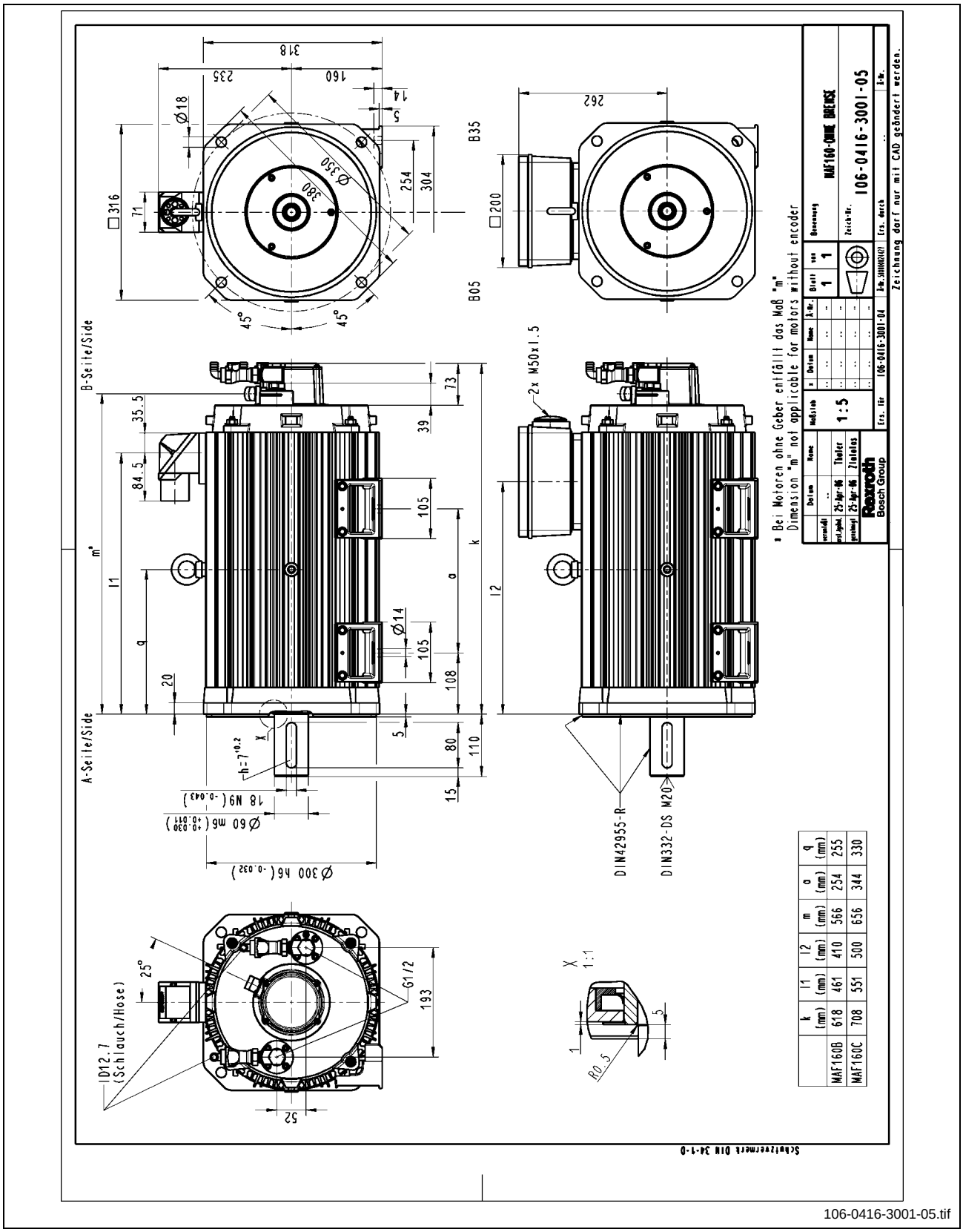


106-0521-3001-01.TIF

Fig. 5-36: Dimension sheet MAF130 with encoder M6 or S6 and brake 1 or 5

5.8 Frame Size MAF160

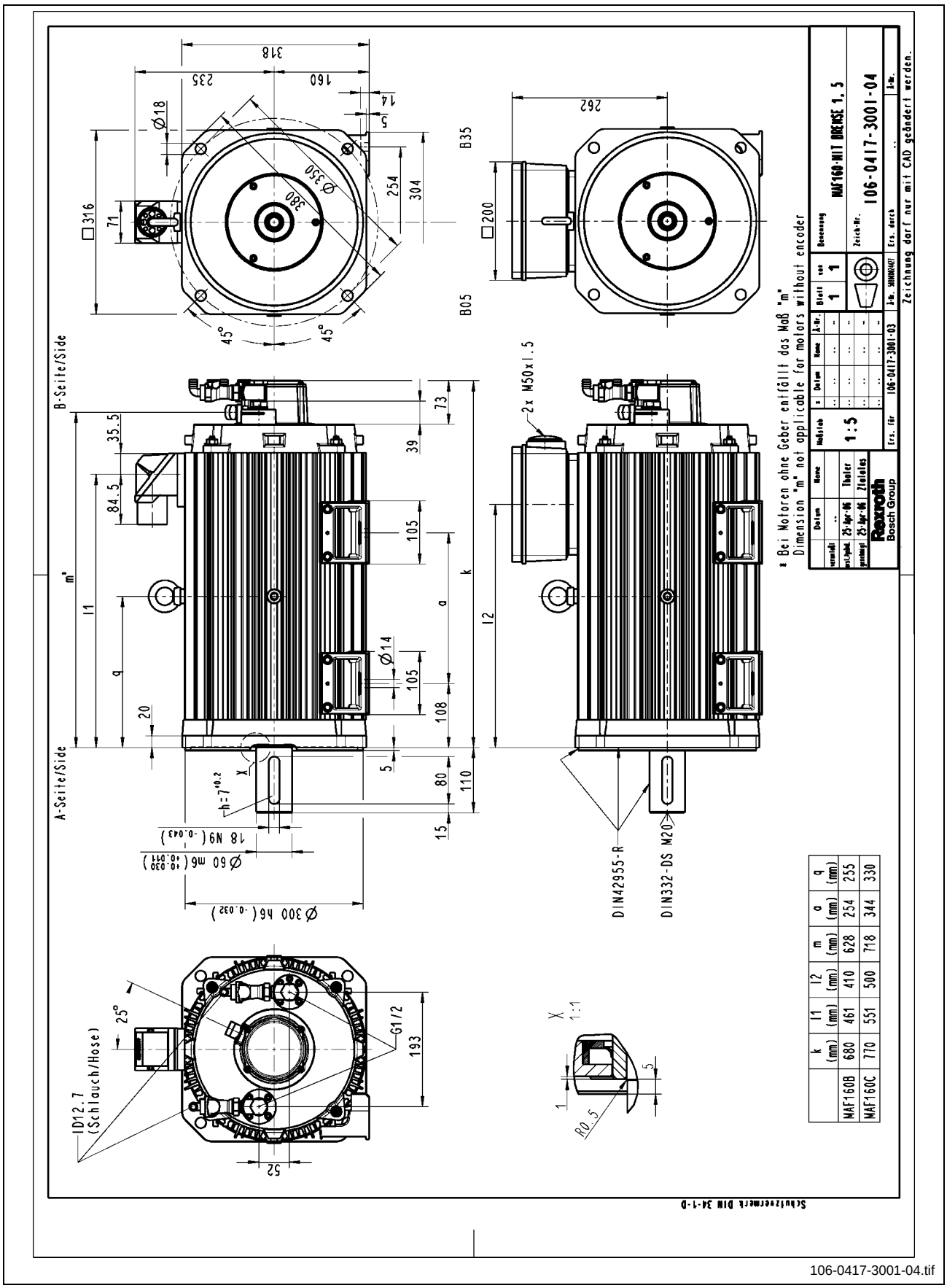
MAF160 without Holding Brake



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)
MAF160B	618	461	410	566	254	255
MAF160C	708	551	500	656	344	330

Fig. 5-37: Dimension sheet for MAF160 without holding brake

MAF160 with Brake 1 or 5

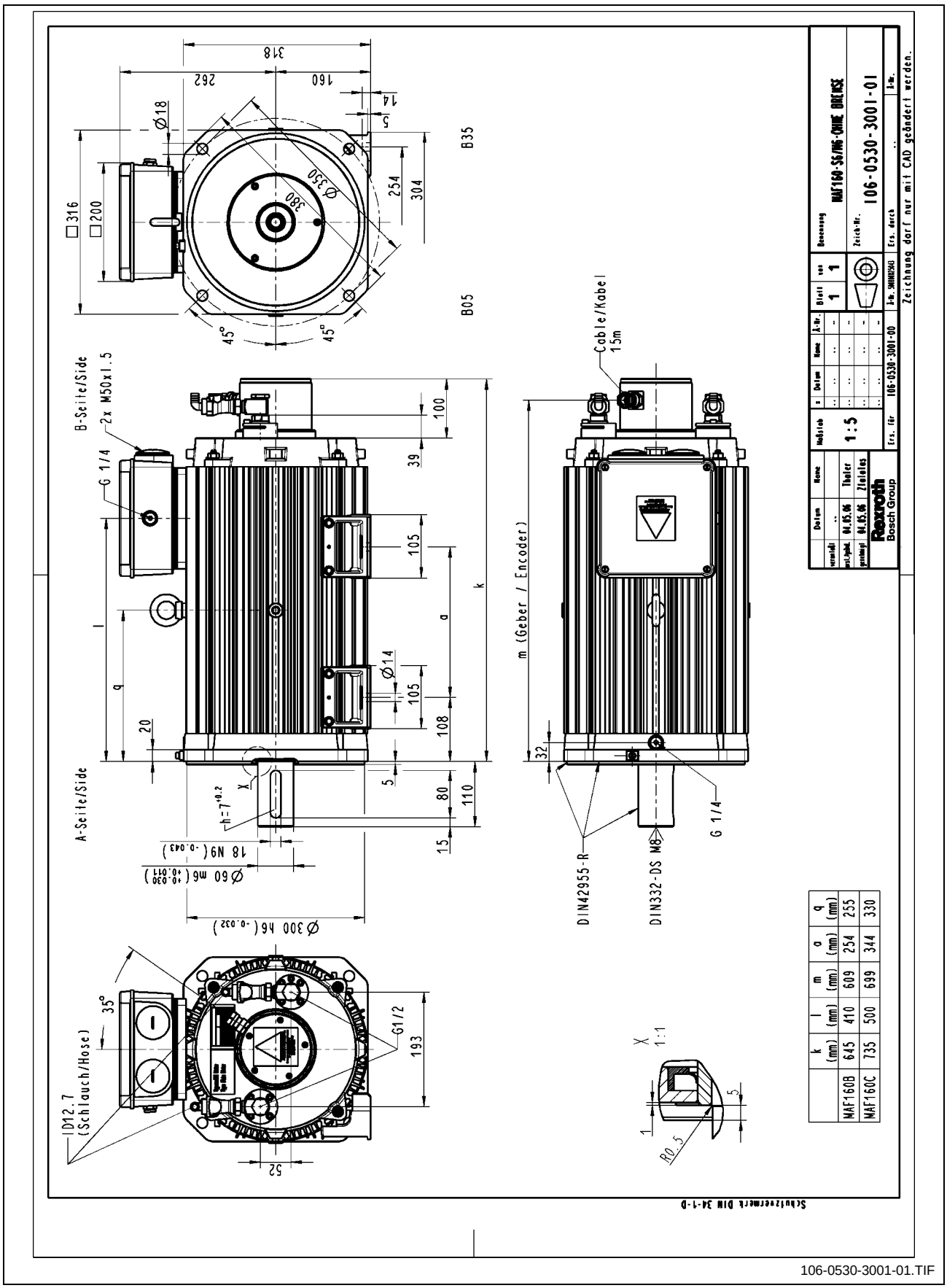


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)
MAF160B	680	461	410	628	254	255
MAF160C	770	551	500	718	344	330

106-0417-3001-04.tif

Fig. 5-38: Dimension sheet MAF160 with brake 1 or 5

MAF160 in ATEX Design, without Holding Brake



	k (mm)	l (mm)	m (mm)	o (mm)	q (mm)
MAF160B	645	410	609	254	255
MAF160C	735	500	699	344	330

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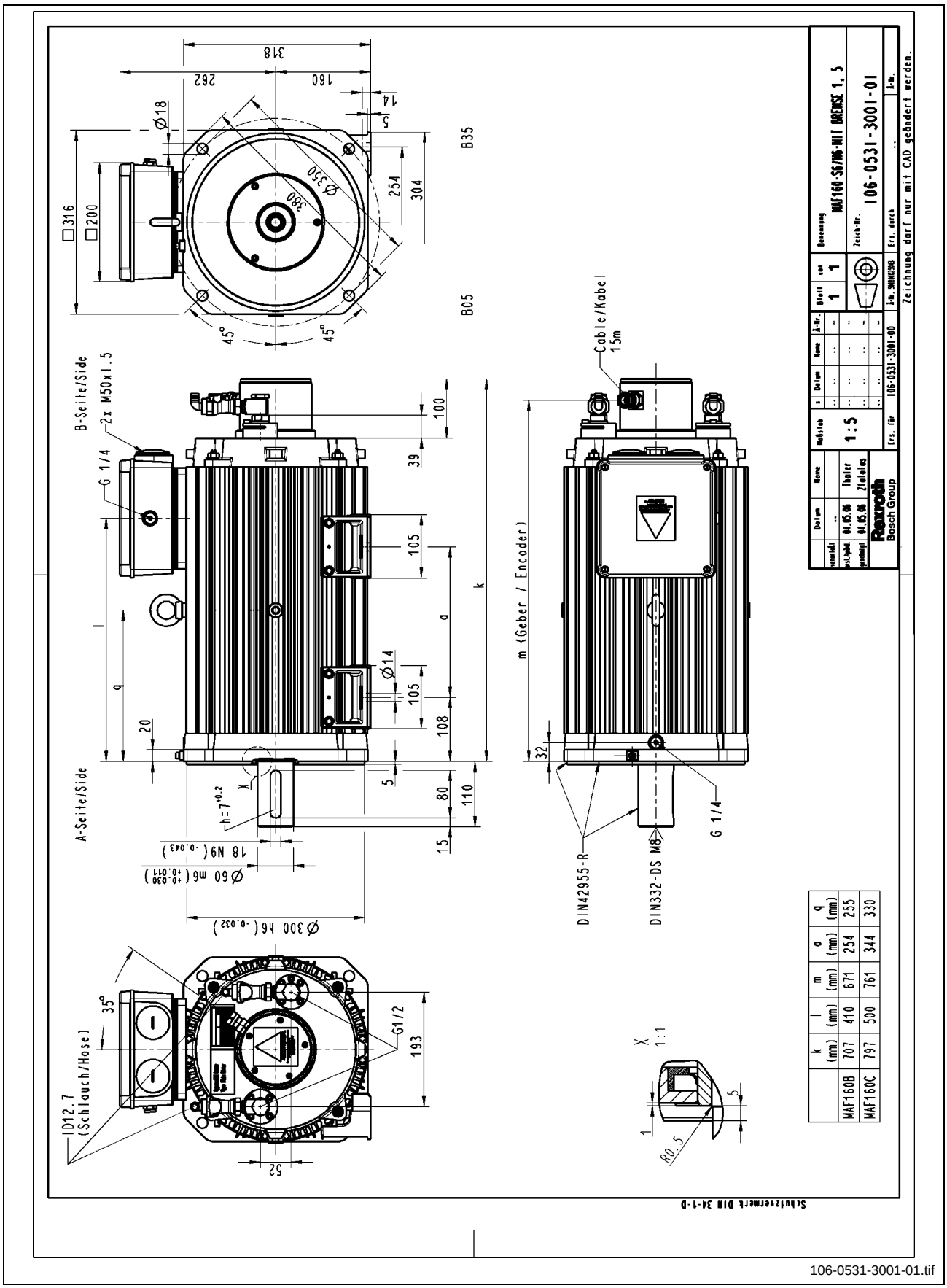
Fig. 5-39: Dimension sheet MAF160 with encoder M6 or S6, without holding brake

MAF160 in ATEX Design, with Brake 1 or 5



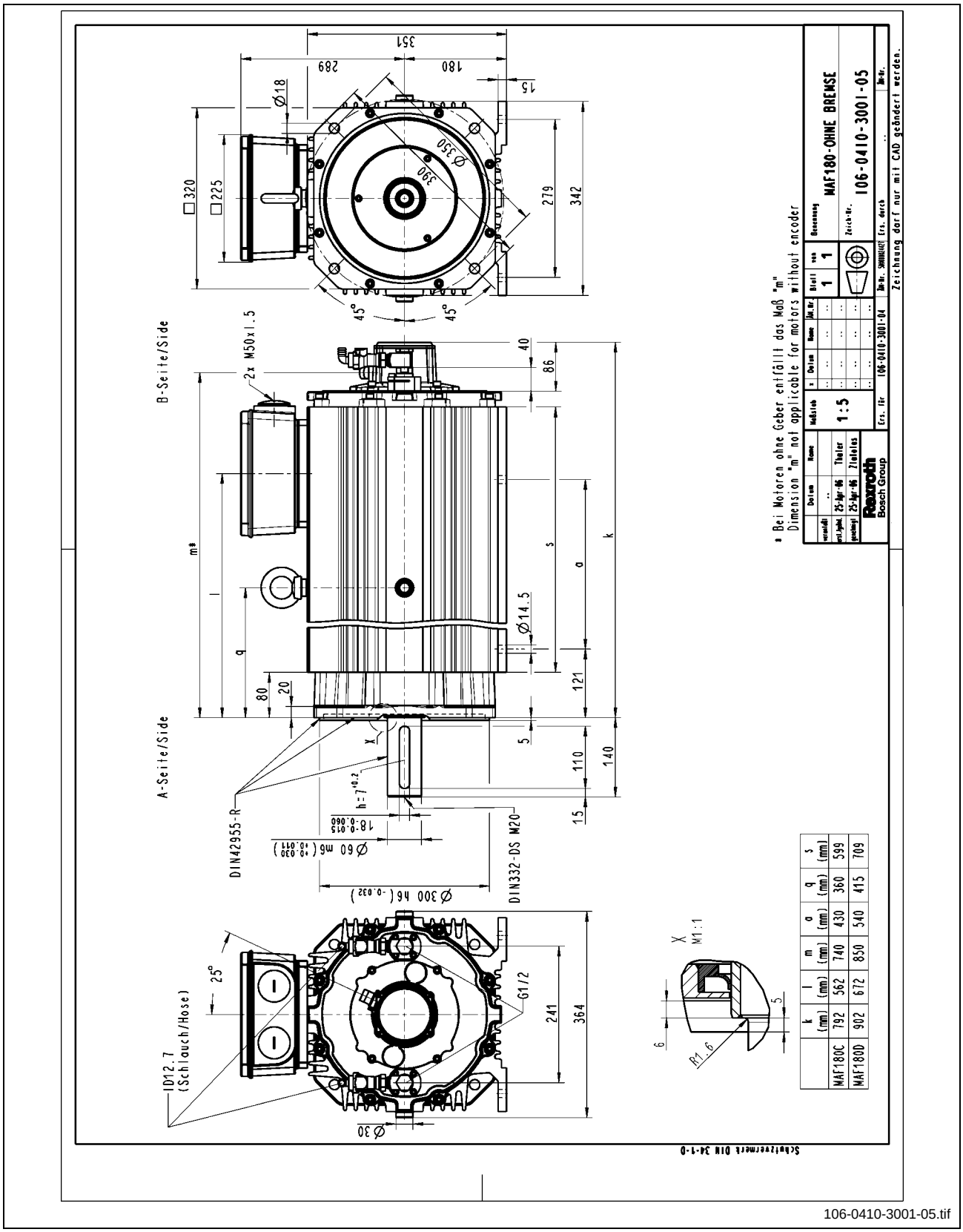
	k (mm)	l (mm)	m (mm)	a (mm)	q (mm)
MAF160B	707	410	671	254	255
MAF160C	797	500	761	344	330

106-0531-3001-01.tif

Fig. 5-40: Dimension sheet MAF160 with encoder M6 or S6 and brake 1 or 5

5.9 Frame Size MAF180

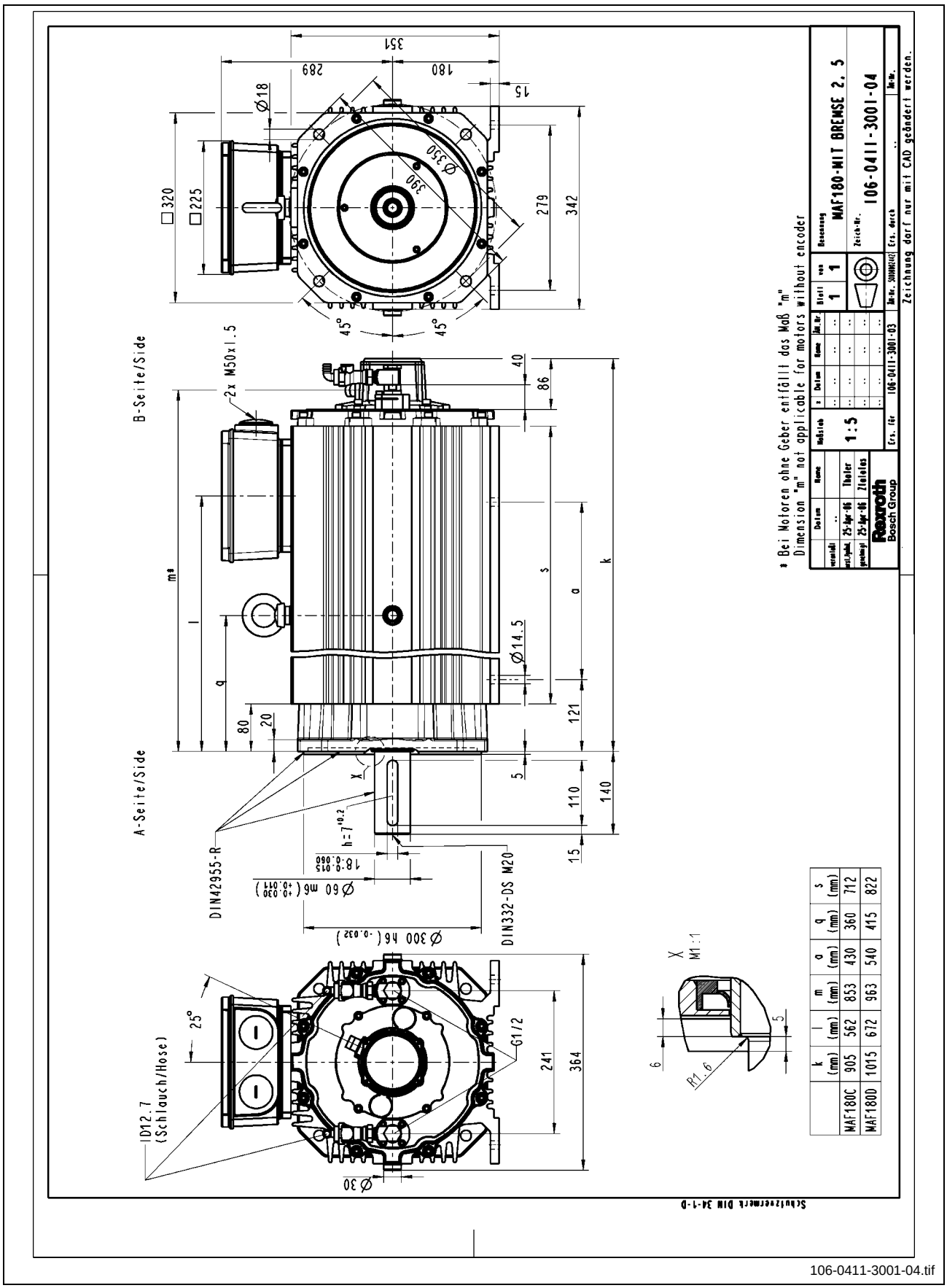
MAF180 without Holding Brake



	k (mm)	l (mm)	m (mm)	o (mm)	q (mm)	s (mm)
MAF180C	792	562	740	430	360	599
MAF180D	902	672	850	540	415	709

Fig. 5-41: Dimension sheet for MAF180 without holding brake

MAF180 with Brake 2 or 5

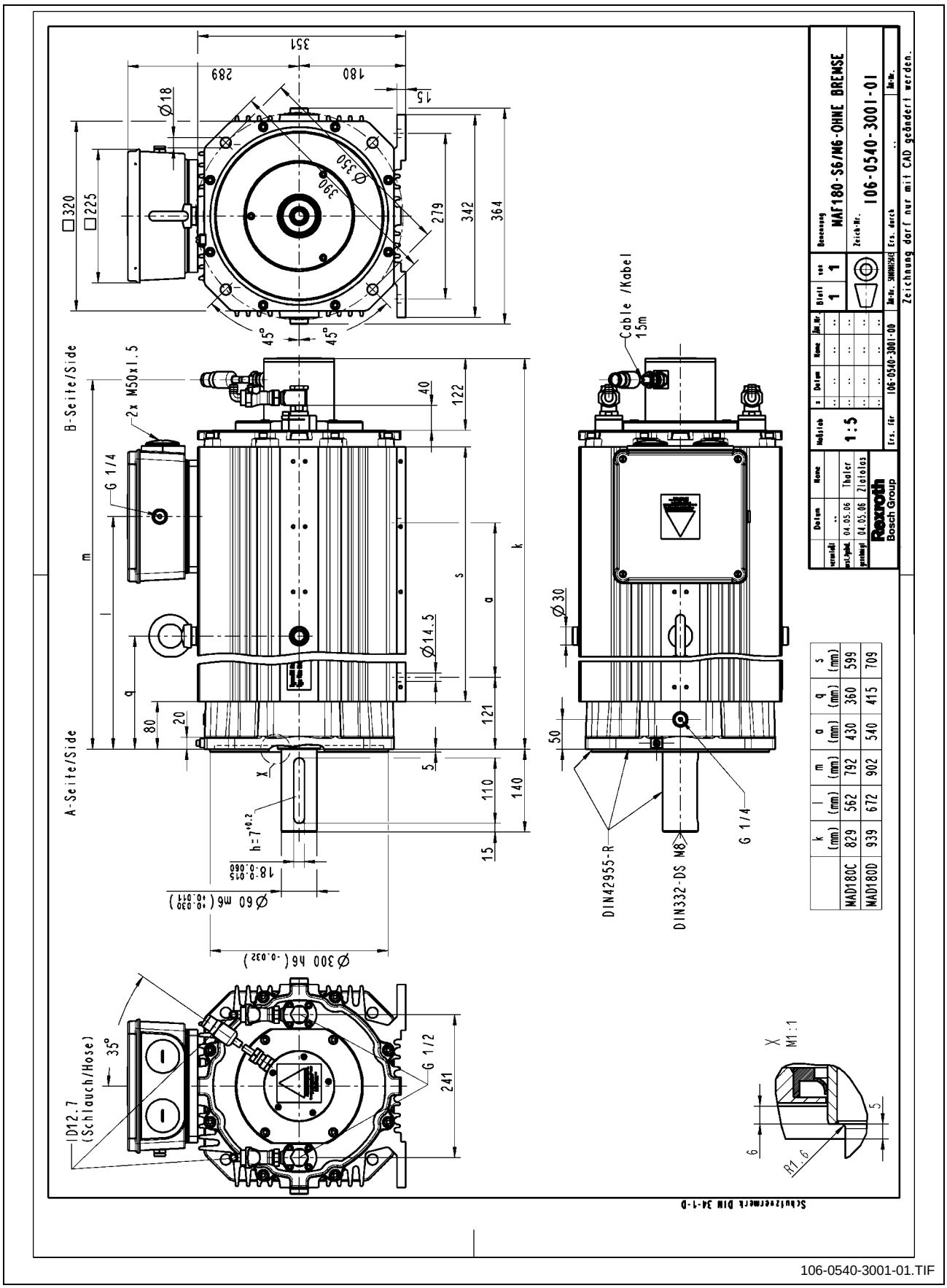


	k (mm)	l (mm)	m (mm)	a (mm)	q (mm)	s (mm)
MAF180C	905	562	853	430	360	712
MAF180D	1015	672	963	540	415	822

106-0411-3001-04.tif

Fig. 5-42: Dimension sheet MAF180 with brake 2 or 5

MAF180 in ATEX Design, without Holding Brake



	k (mm)	l (mm)	m (mm)	q (mm)	s (mm)
MAD180C	829	562	792	360	599
MAD180D	939	672	902	415	709

Fig. 5-43: Dimension sheet MAF180 with encoder M6 or S6, without holding brake

MAF180 in ATEX Design, with Brake 2 or 5

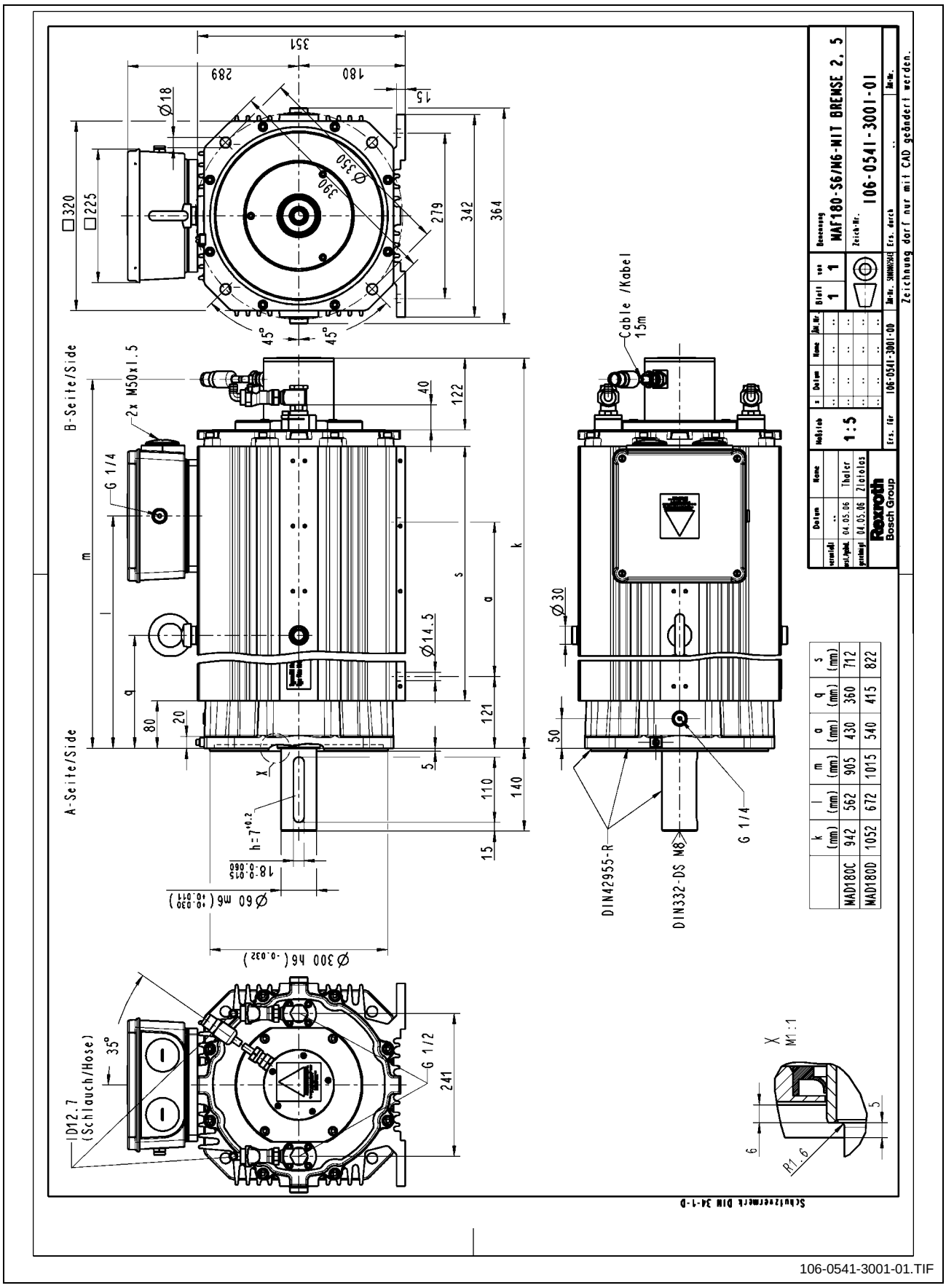


Fig. 5-44: Dimension sheet MAF180 with encoder M6 or S6 and brake 2 or 5

5.10 Frame Size MAF225

MAF225 (without Holding Brake)

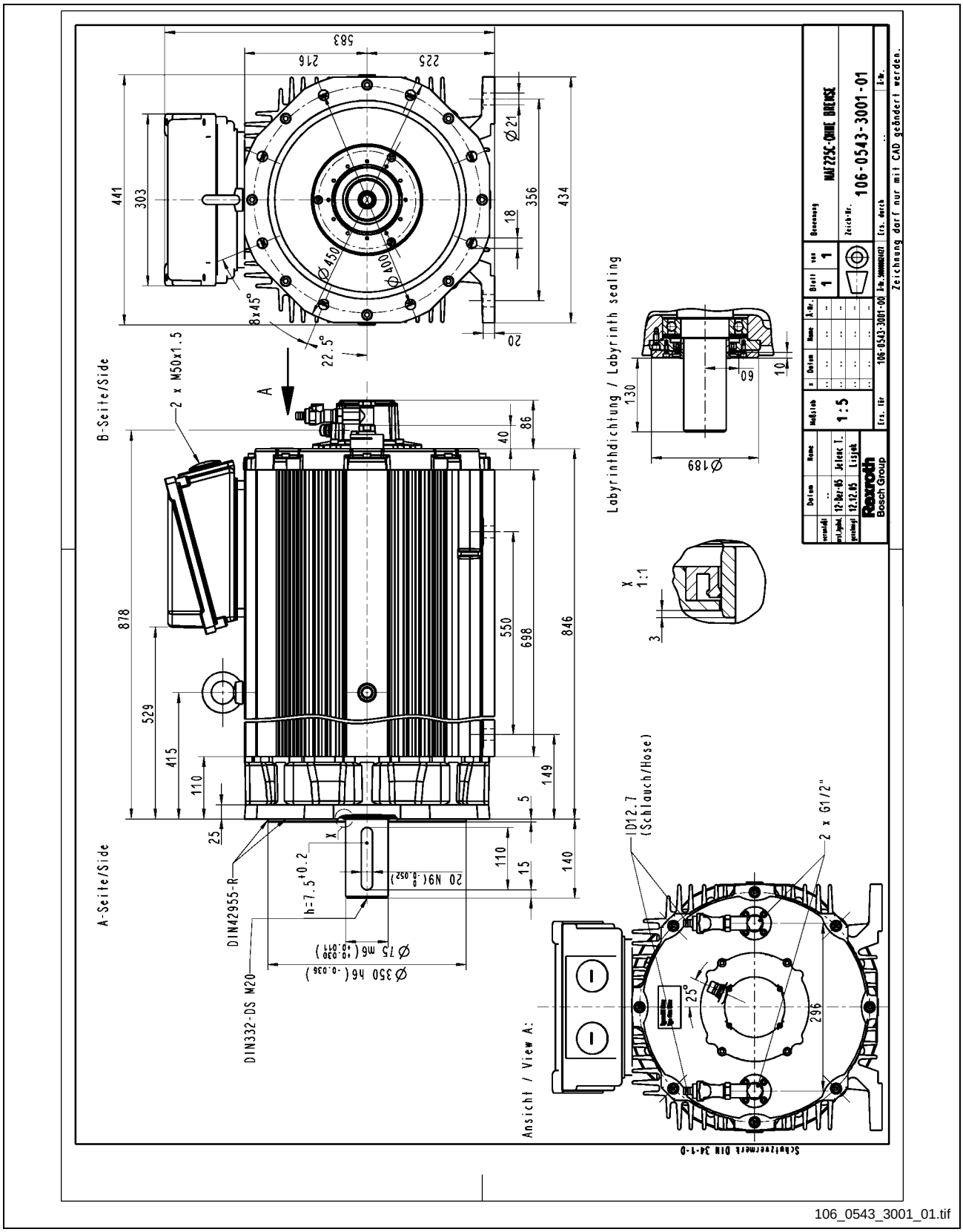


Fig. 5-45: Dimension sheet MAF225 (without Holding Brake)

6 Type Codes IndraDyn A

6.1 Introduction

IndraDyn A is the general product name for all new asynchronous housing motors by REXROTH.

The type code describes the available motor variants; it is the basis for selecting and ordering products from BOSCH REXROTH. This applies to both new products as well as spare parts and repairs.

The following descriptions provide an overview of the separate columns of the type code (”abbrev. column”) and their meaning.

Note: When selecting a product, always consider the detailed specifications in the chapter 4 ”Technical Data”, chapter 9 ”Notes regarding Application”, and chapter 13 "Motors for Hazardous Areas".

Definition

1. Product

Abbrev. column 1 2 3

MAD is the description of the new type series of air-cooled asynchronous housing motors.

MAF is the description of the new type series of liquid-cooled asynchronous housing motors.

2. Motor Frame Size

Abbrev. Column 4 5 6

The motor frame size is derived from the dimensions of the flange at the output end and represents different power ranges.

3. Motor Frame Length

Abbrev. column 7

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

Frame lengths are, for example, **B**, **C** and **E**.

4. Winding Code

Abbrev. column 9 10 11 12

The four-digit sequence of figures identifies the rated speed applicable for the respective type of winding. The last figure is omitted. Example: The winding code 0200 means a rated speed of 2000 min^{-1}.

5. Type of Cooling

Abbrev. column 14 15

MAD motors must always be operated with a fan whose air currents are guided from the fan shroud over the surface of the motor ("surface ventilation"). The air current of the axial fan (Option "**SA**") is defined as "blowing" according to the following figure.

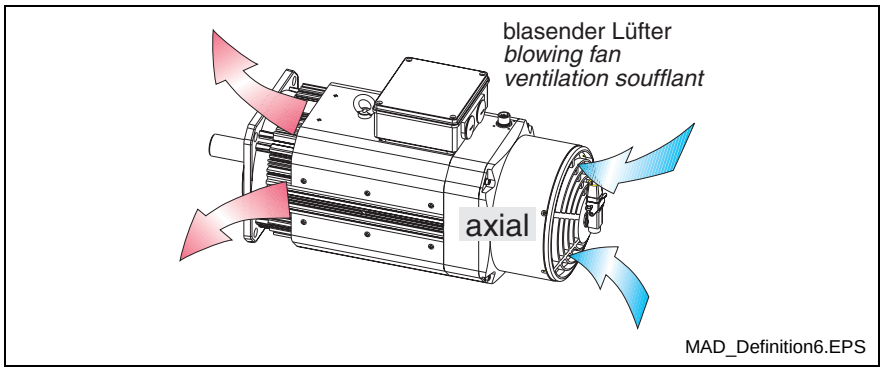


Fig. 6-1: MAD, blowing fan

The fan unit can be removed for maintenance. Operation without ventilation is not permissible.

For certain applications, MAD motors can also be operated with an external fan. To this effect, the motors are equipped with a fan cover and a fan cowl (option "**SL**") to connect the air hose.

MAF motors must always be operated with an external cooling system (not included in the delivery).

6. Motor Encoder

Abbrev. column 17 18

IndraDyn A motors are supplied with integrated encoders.

Option	Type	Periods	Signal [1])	Interface	Supply voltage
C0	Incremental encoder	2048	1 V_{ss}	-	5 V
M0	Multiturn absolute encoder	512	1 V_{ss}	I²C	8 V
M2	Multiturn absolute encoder	2048	1 V_{ss}	EnDat2.1	11 V
M6	Multiturn absolute encoder for ATEX motors (length of cable set: 15 m)	2048	1 V_{ss}	EnDat2.1	5 V
N0	The motor is supplied without a factory-attached encoder unit. The rear of the motor is blocked by a cover.				
S0	Singleturn absolute encoder	512	1 V_{ss}	I²C	8 V
S2	Singleturn absolute encoder	2048	1 V_{ss}	EnDat2.1	11 V
S6	Singleturn absolute encoder for ATEX motors (length of cable set: 15 m)	2048	1 V_{ss}	EnDat2.1	5 V
[1]) All encoder signals are sinusoidal.					

Fig. 6-2: IndraDyn A motor encoder

7. Electrical Connection

Abbrev. column 20

The motors of frame size 100..160 can be electrically connected optionally via flange socket or via terminal box. Motors of frame size 180…225 and ATEX version motors can only be connected by means of terminal box.

For more information, see the type code of the motor and chapter 8, "Connection Techniques".

8. Output Shaft

Abbrev. column 21

In order to connect the machine elements to be driven to the motor shafts, the following options are available for all IndraDyn A motors:

Output Shaft			
	Plain shaft	with keyway	
		Balanced with complete key	Balanced with half key
Without shaft sealing ring	H	Q	L
With shaft sealing ring	G	P	K
with labyrinth seal (only for frame size 225)	F	R	---

Fig. 6-3: Output shaft options

Motors with a keyway are always supplied with a key.

The motor drive shafts of frame sizes 130…225 have threaded centering holes on the end face in "DS" version in accordance with DIN 332, sheet 2. For details, see the respective motor dimension sheet.

Please observe the supplementary notes on shaft sealing ring, drive shaft, and labyrinth seal in chapter 9.12, "Drive Shaft".

9. Holding Brake

Abbrev. column 22

Up to frame size 180, IndraDyn A motors are optionally available with integrated holding brake and different holding torques. Depending on the application, an "**electrically-clamped**" or "**electrically-released**" holding brake can be selected.

Note: The motor holding brake is not suitable for the protection of personnel or as a service brake! Heed the notes regarding holding brakes in chapter 9 "Application Notes" and chapter 12 "Startup".

10. Design

Abbrev. column 24 25

IndraDyn A motors are available in the design **05** (flange mounting) or design **35** (flange and foot installation). The permitted conditions of installation are explained in chapter 9 "Notes Regarding Application".

11. Bearing

Abbrev. column 27

The standard bearing (option "**N**") consists of deep-groove ball bearings in all IndraDyn A motors.

Reinforced bearings (option "**V**") can be used to taking up high radial forces. With reinforced bearing, there is an additional cylindrical-roller bearing at the drive side next to the deep-groove ball bearing.

The high-speed suspension (option "**H**") consists of a deep-groove ball bearing; it permits higher speeds at a reduced axial and radial load-bearing capacity.

The bearing for the coupling connection (option "**R**") consists of a deep-groove ball bearing. This bearing variant has a special bearing seat for taking up rotating radial forces which may occur during motor operation with coupling.

Heed the notes regarding bearings in chapter 4 "Technical Data …." and chapter 9.17 "Bearing Variants".

12. Vibration Severity Level

Abbrev. column 28

IndraDyn A motors are dynamically balanced according to the requirements of DIN ISO 2373; the standard is step "**R**". With frame size MAD/MAF100-180, options **"S"** and **"S1"** can be selected.

6.2 Type Code MAD100

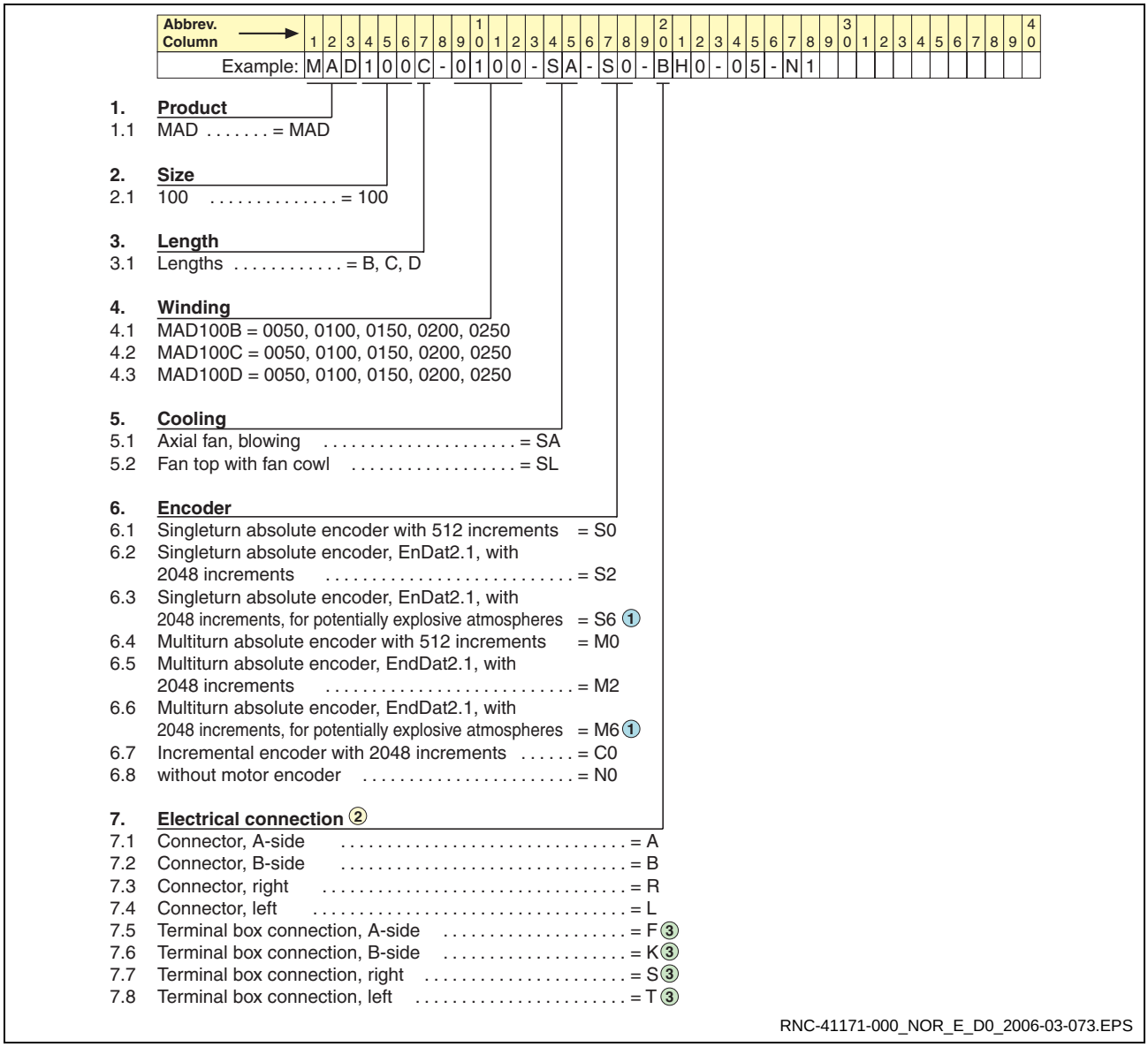


Fig. 6-4: Type code MAD100 (1/2)

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

8. Shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 24 Nm ..... = 1
9.3 electrically-clamped, 30 Nm ..... = 5

10. Mounting style

10.1 Flange mounting ..... = 05
10.2 Flange and foot mounting ..... = 35

11. Bearings

11.1 Standard ..... = N
11.2 High Speed ..... = H ④
11.3 for coupling mounting ..... = R

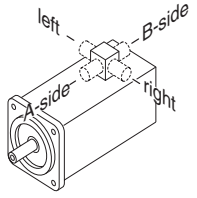
12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ⑤

Note:

① Encoder "S6" and "M6" are only available with cooling "SL", electrical connection "F", "K", "S" and "T", shaft "G", "P" and "K" and bearings "N" and "H"
② Looking from front onto driven shaft (see picture 1)
③ Electrical connections "F", "K", "S" and "T" at mounting style "35" are only available on top
④ Bearing "H" is only available with shaft "H" and holding brake "0"
⑤ Vibration severity grade "3" is not available with bearing "R"

Position of power connection = top



Picture 1

RNC-41171-000_NOR_E_D0_2006-03-074.EPS

Fig. 6-5: Type code MAD100 (2/2)

6.3 Type Code MAD130

Abbrev. Column →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	A	D	1	3	0	B	-	0	1	5	0	-	S	A	-	S	0	-	A	G	0	-	0	5	-	N	1												

1. Product
1.1 MAD . . . . . = MAD

2. Size
2.1 130 . . . . . = 130

3. Length
3.1 Lengths . . . . . = B, C, D

4. Winding
4.1 MAD130B = 0050, 0100, 0150, 0200, 0250
4.2 MAD130C = 0050, 0100, 0150, 0200, 0250
4.3 MAD130D = 0050, 0100, 0150, 0200, 0250

5. Cooling
5.1 Axial fan, blowing . . . . . = SA
5.2 Fan top with fan cowl . . . . . = SL

6. Encoder
6.1 Singleturn absolute encoder with 512 increments = S0
6.2 Singleturn absolute encoder, EnDat2.1, with 2048 increments . . . . . = S2
6.3 Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 ①
6.4 Multiturn absolute encoder with 512 increments = M0
6.5 Multiturn absolute encoder, EndDat2.1, with 2048 increments . . . . . = M2
6.6 Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 ①
6.7 Incremental encoder with 2048 increments . . . . . = C0
6.8 without motor encoder . . . . . = N0

7. Electrical connection ②
7.1 Connector, A-side . . . . . = A
7.2 Connector, B-side . . . . . = B
7.3 Connector, right . . . . . = R
7.4 Connector, left . . . . . = L
7.5 Terminal box connection, A-side . . . . . = F ③
7.6 Terminal box connection, B-side . . . . . = K ③
7.7 Terminal box connection, right . . . . . = S ③
7.8 Terminal box connection, left . . . . . = T ③

RNC-41171-300_NOR_E_D0_2006-03-073.EPS

Fig. 6-6: Type code MAD130 (1/2)

Abbrev. Column →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	A	D	1	3	0	B	-	0	1	5	0	-	S	A	-	S	0	-	A	G	0	-	0	5	-	N	1													

8. Shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 80 Nm ..... = 1
9.3 electrically-clamped, 100 Nm ..... = 5

10. Mounting style

10.1 Flange mounting ..... = 05
10.2 Flange and foot mounting ..... = 35

11. Bearings

11.1 Standard ..... = N
11.2 High Speed ..... = H ④
11.3 for coupling mounting ..... = R
11.4 reinforced bearings ..... = V

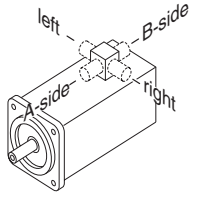
12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ⑤

Note:

① Encoder "S6" and "M6" are only available with cooling "SL", electrical connection "F", "K", "S" and "T", shaft "G", "P" and "K" and bearings "N", "H" and "V"
② Looking from front onto driven shaft (see picture 1)
③ Electrical connections "F", "K", "S" and "T" at mounting style "35" are only available on top
④ Bearing "H" is only avalable with shaft "H" and holding brake "0"
⑤ Vibration severity grade "3" is only available with length "B" and "C" and bearings "N" and "H"

Position of power connection = top



Picture 1

RNC-41171-300_NOR_E_D0_2006-03-074.EPS

Fig. 6-7: Type code MAD130 (2/2)

6.4 Type Code MAD160

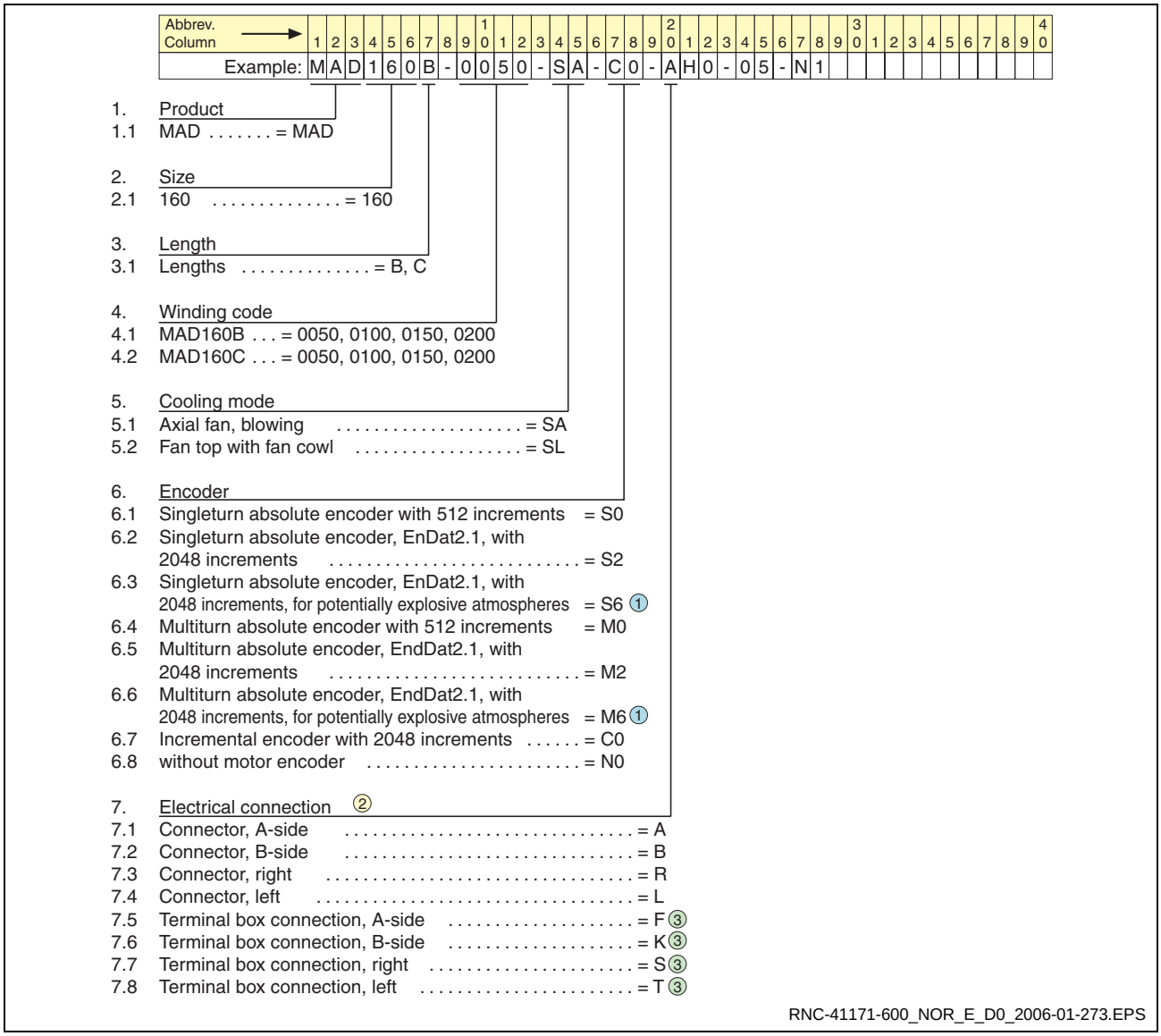


Fig. 6-8: Type code MAD160 (1/2)

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

8. Shaft

	plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1 without shaft sealing ring	H	Q	L
8.2 with shaft sealing ring	G	P	K

9. Holding brake
- 9.1 Without holding brake ..... = 0
- 9.2 Electrically-released, 100 Nm ..... = 1
- 9.3 Electrically-released, 240 Nm ..... = 3
- 9.4 Electrically-clamped, 100 Nm ..... = 5

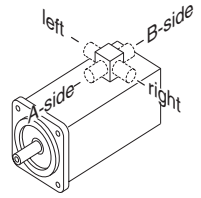
10. Mounting style
- 10.1 Flange mounting ..... = 05
- 10.2 Flange and foot mounting ..... = 35

11. Bearings
- 11.1 Standard ..... = N
- 11.2 High Speed ..... = H ④
- 11.3 for coupling mounting ..... = R
- 11.4 reinforced bearings ..... = V

12. Vibration severity grade
- 12.1 R ..... = 1
- 12.2 S ..... = 2
- 12.3 S1 ..... = 3 ⑤

Note:
① Encoder "S6" and "M6" are only available with cooling "SL", electrical connection "F" and "K", shaft "G", "P" and "K" and bearings "N", "H" and "V"
② Looking from front onto output shaft (see picture 1)
③ Electrical connections "F", "K", "S" and "T" at mounting style "35" are only available on top
④ Bearing "H" ist only available with shaft "H" and holding brake "0"
⑤ Vibration severity grade "3" is only available with bearing "N"

Position of power connection = top



Picture 1

RNC-41171-600_NOR_E_D0_2006-01-274.EPS

Fig. 6-9: Type code MAD160 (2/2)

6.5 Type Code MAD180

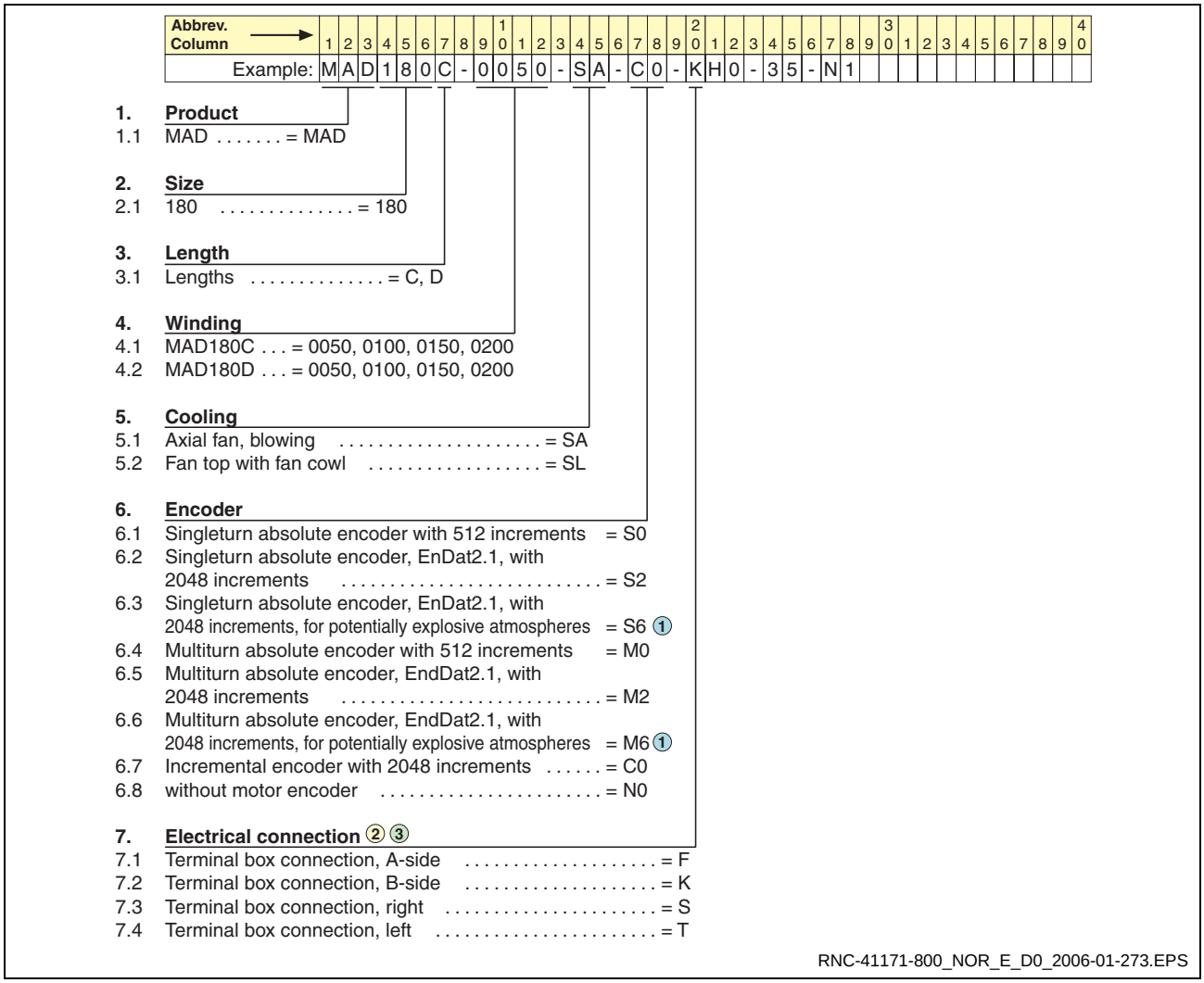


Fig. 6-10: Type code MAD180 (1/2)

Abbrev. Column →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	A	D	1	8	0	C	-	0	0	5	0	-	S	A	-	C	0	-	K	H	0	-	3	5	-	N	1														

8. Shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 240 Nm ..... = 2
9.3 electrically-clamped, 300 Nm ..... = 5

10. Mounting style

10.1 Flange and foot mounting ..... = 35

11. Bearings

11.1 Standard ..... = N
11.2 reinforced bearings ..... = V
11.3 for coupling mounting ..... = R

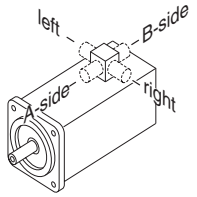
12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ④

Note:

① Encoder "S6" and "M6" are only available with cooling "SL", electrical connection "F" and "K", shaft "G", "P" and "K" and bearings "N" and "V"
② Looking from front onto driven shaft (see picture 1)
③ Electrical connections "F", "K", "S" and "T" are only available on top
④ Vibration severity grade "S1" is not available with bearing "V"

Position of power connection = top



Picture 1

RNC-41171-800_NOR_E_D0_2006-01-274.EPS

Fig. 6-11: Type code MAD180 (2/2)

6.6 Type Code MAD225

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

1. Product
1.1 MAD . . . . . = MAD

2. Size
2.1 225 . . . . . = 225

3. Length
3.1 Lengths . . . . . = C

4. Winding
4.1 MAD225C . . . . . = 0150

5. Cooling
5.1 Axial fan, blowing . . . . . = SA

6. Encoder
6.1 Singleturn absolute encoder with 512 increments. . = S0
6.2 Singleturn absolute encoder, EnDat2.1, with 2048 increments . . . . . = S2
6.3 Multiturn absolute encoder with 512 increments . . = M0
6.4 Multiturn absolute encoder, EnDat2.1, with 2048 increments . . . . . = M2

7. Electrical connection ①②
7.1 Terminal box connection, A-side . . . . . = F
7.2 Terminal box connection, B-side . . . . . = K
7.3 Terminal box connection, right . . . . . = S
7.4 Terminal box connection, left . . . . . = T

8. Shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K
8.3	with labyrinth sealing	F	R	-

9. Holding brake
9.1 without holding brake . . . . . = 0

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Fig. 6-12: Type code MAD225 (1/2)

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

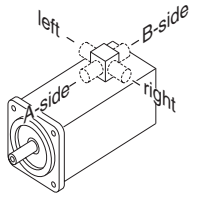
10. Mounting style
10.1 Flange and foot mounting . . . . . = 35

11. Bearings
11.1 Standard . . . . . = N
11.2 Reinforced bearings . . . . . = V

12. Vibration severity grade
12.1 R . . . . . = 1

Note:
① Looking from front onto driven shaft (see picture 1)
② Electrical connections "F", "K", "S" and "T" are only available on top

Position of power connection = top



Picture 1

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Fig. 6-13: Type code MAD225 (2/2)

6.7 Type Code MAF100

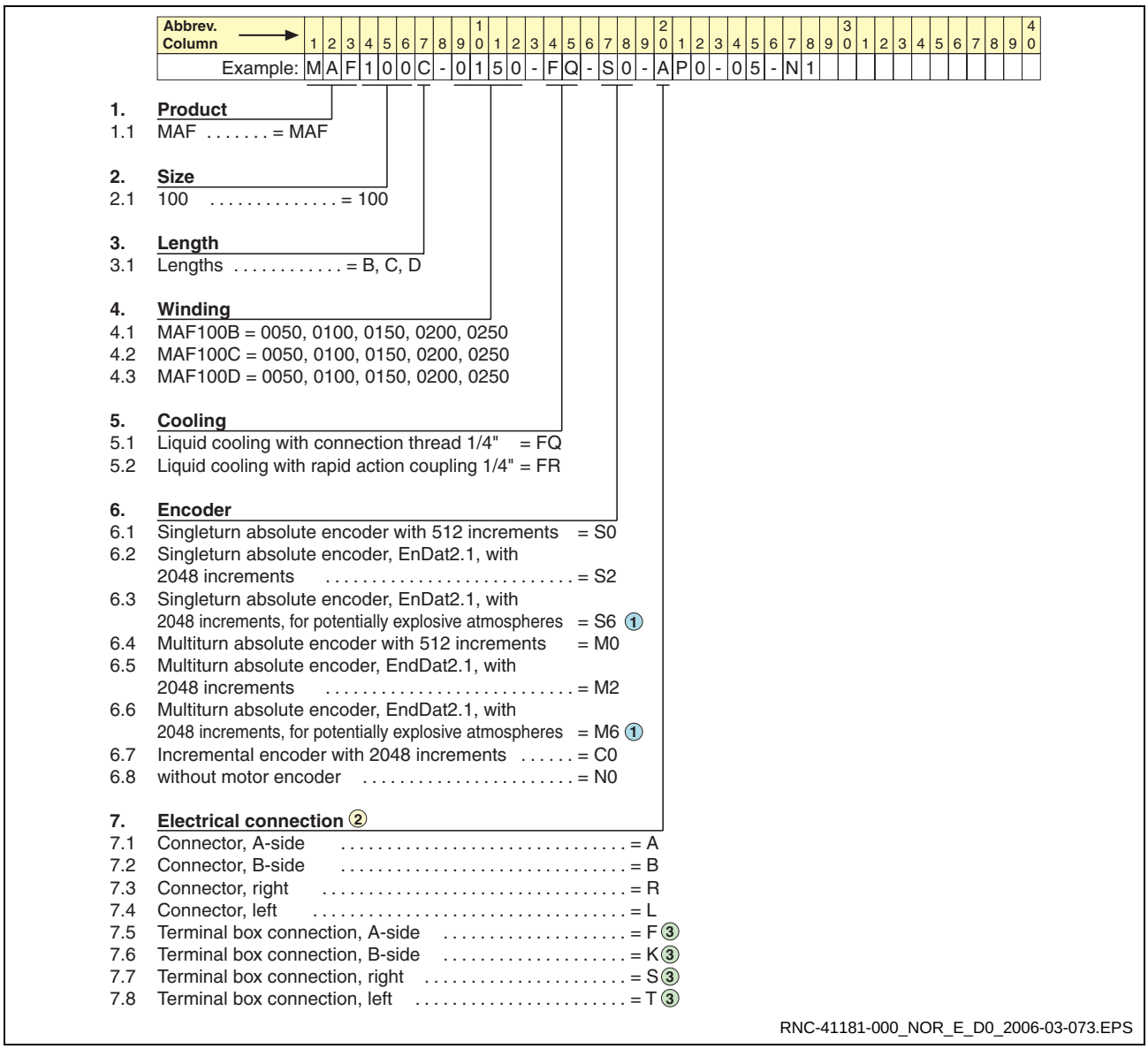


Fig. 6-14: Type code MAF100 (1/2)

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

8. Shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 24 Nm ..... = 1
9.3 electrically-clamped, 30 Nm ..... = 5

10. Mounting style

10.1 Flange mounting ..... = 05
10.2 Flange and foot mounting ..... = 35

11. Bearings

11.1 Standard ..... = N
11.2 High Speed ..... = H ④
11.3 for clutch mounting ..... = R

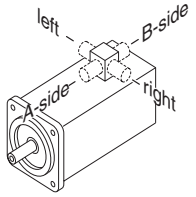
12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ⑤

Note:

① Encoder "S6" and "M6" are only available with electrical connection "F", "K", "S" and "T", shaft "G", "P" and "K" and bearings "N" and "H"
② Looking from front onto driven shaft (see picture 1)
③ Electrical connections "F", "K", "S" and "T" at mounting style "35" are only available on top
④ Bearings "H" only available with shaft "H" and holding brake "0"
⑤ Vibration severity grade "3" is not available with bearing "R"

Position of power connection = top



Picture 1

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Fig. 6-15: Type code MAF100 (2/2)

6.8 Type Code MAF130

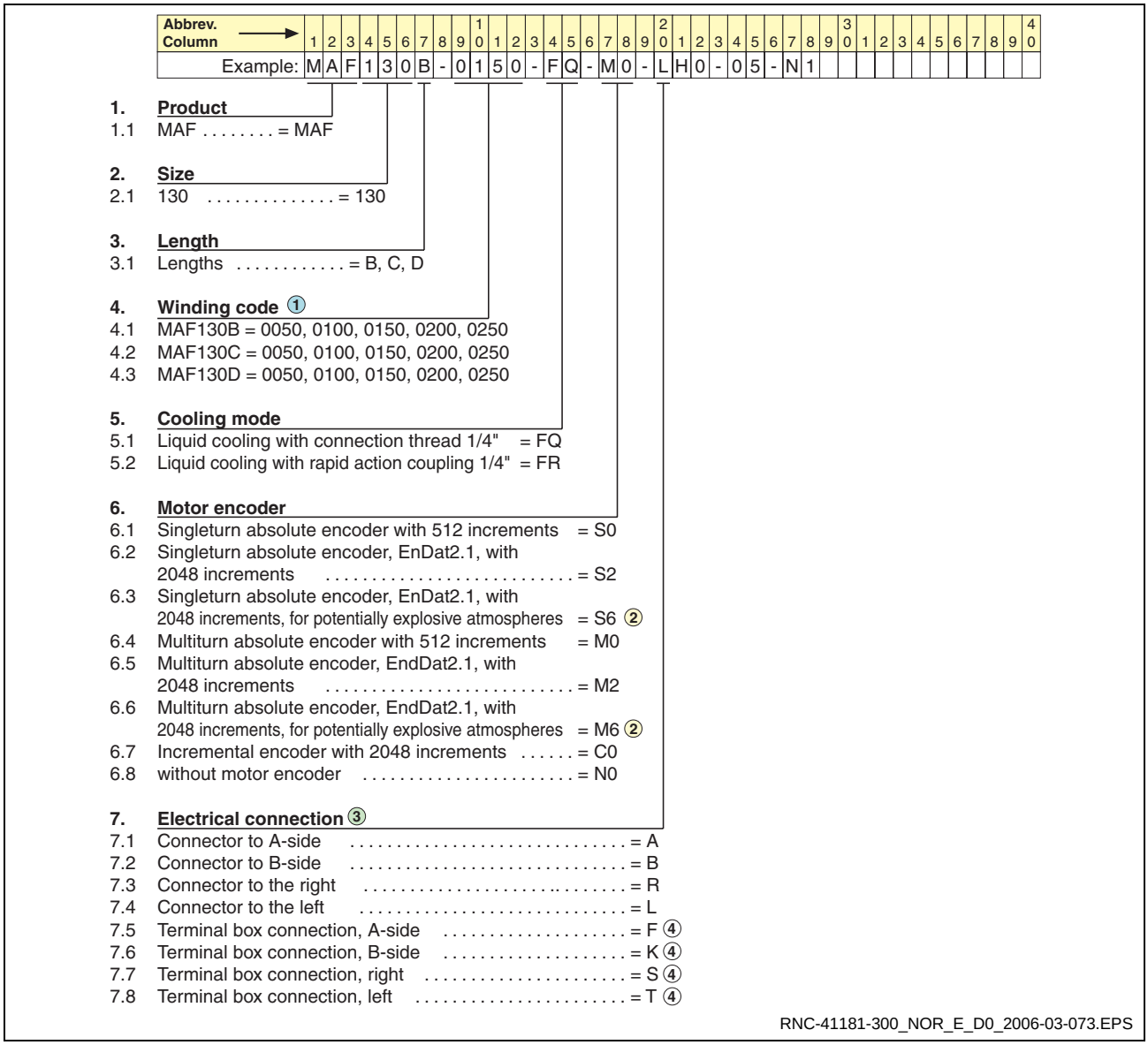


Fig. 6-16: Type code MAF130 (1/2)

Abbrev. Column →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	A	F	1	3	0	B	-	0	1	5	0	-	F	Q	-	M	0	-	L	H	0	-	0	5	-	N	1													

8. Driven shaft

		plain shaft	with key: balanced with ent. key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 80 Nm ..... = 1
9.3 electrically-clamped, 100 Nm ..... = 5

10. Mounting style

10.1 Flange mounting ..... = 05
10.2 Flange and foot mounting ..... = 35

11. Bearings

11.1 Standard ..... = N
11.2 High Speed ..... = H ⑤
11.3 for clutch mounting ..... = R
11.4 reinforced bearings ..... = V

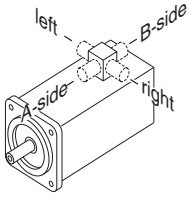
12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ⑥

Note:

① Winding code "0250" with length "D" is only available with electrical connection "F", "K", "S" and "T"
② Encoder "S6" and "M6" are only available with electrical connection "F", "K", "S" and "T", shaft "G", "P" and "K" and bearings "N", "H" and "V"
③ Looking from front onto driven shaft (see picture 1)
④ Electrical connection "F", "K", "S" and "T" at mounting style "35" is only available at the top
⑤ Bearings "H" is only available with shaft "H" and holding brake "0"
⑥ Vibration severity grade "3" is only available with length "B" and "C" and bearings "N" and "H"

Position of power connection = top



Picture 1

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Fig. 6-17: Type code MAF130 (2/2)

6.9 Type Code MAF160

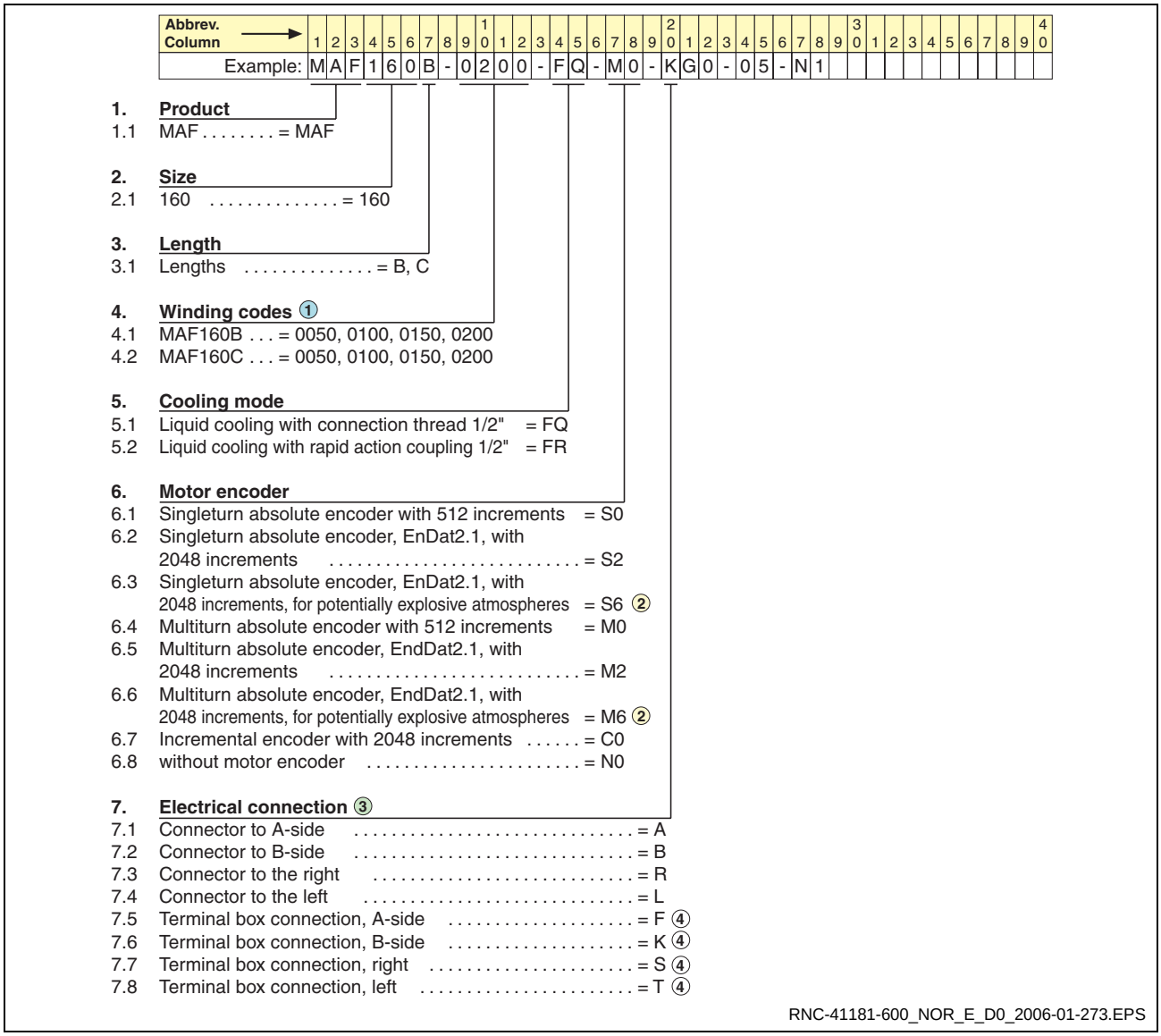


Fig. 6-18: Type code MAF160 (1/2)

Abbrev. Column →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	A	F	1	6	0	B	-	0	2	0	0	-	F	Q	-	M	0	-	K	G	0	-	0	5	-	N	1													

8. Output shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 100 Nm ..... = 1
9.3 electrically-clamped, 100 Nm ..... = 5

10. Mounting style

10.1 Flange mounting ..... = 05
10.2 Flange and foot mounting ..... = 35

11. Bearings

11.1 Standard ..... = N
11.2 for clutch mounting ..... = R
11.3 reinforced bearings ..... = V

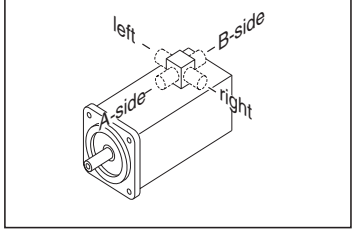
12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ⑤

Note:

① Winding codes "MAF160B-0200", "MAF160C-0150" and "MAF160C-0200" are only available with electrical connection "F" and "K"
② Encoder "S6" and "M6" are only available with electrical connection "F" and "K", shaft "G", "P" and "K" and bearings "N" and "V"
③ Looking from front onto driven shaft (see picture 1)
④ Electrical connections "F", "K", "S" and "T" at mounting style "35" are only available on top
⑤ Vibration severity grade "3" is only available with bearings "N"

Position of power connection = top



Picture 1

RNC-41181-600_NOR_E_D0_2006-01-274.EPS

Fig. 6-19: Type code MAF160 (2/2)

6.10 Type Code MAF180

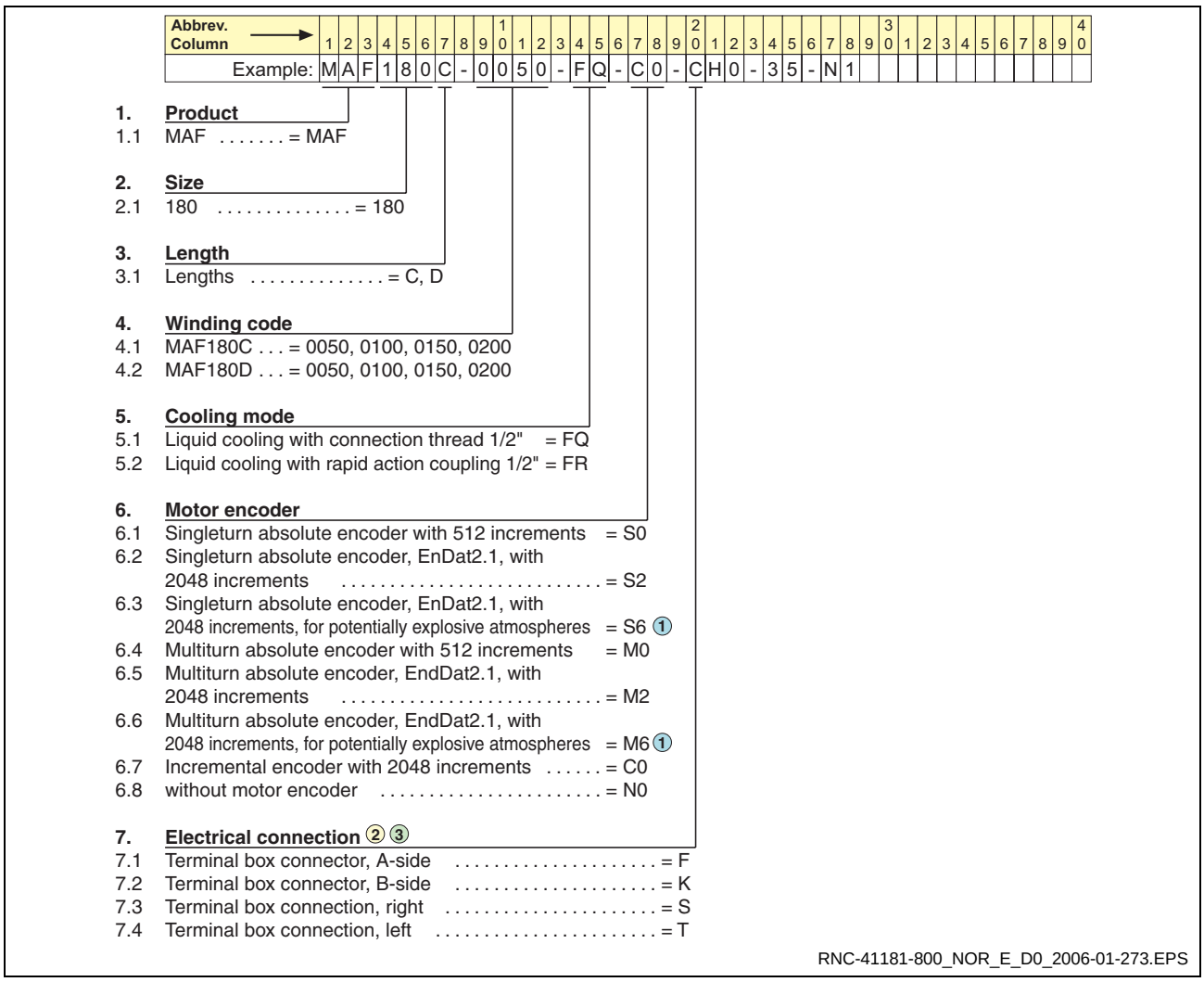


Fig. 6-20: Type code MAF180 (1/2)

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

8. Output shaft

		plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1	without shaft sealing ring	H	Q	L
8.2	with shaft sealing ring	G	P	K

9. Holding brake

9.1 without holding brake ..... = 0
9.2 electrically-released, 240 Nm ..... = 2
9.3 electrically-clamped, 300 Nm ..... = 5

10. Mounting style

10.1 Flange and foot mounting ..... = 35

11. Bearings

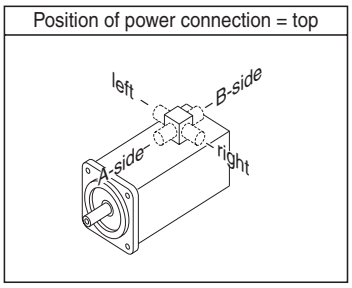
11.1 Standard ..... = N
11.2 for clutch mounting ..... = R
11.3 reinforced bearing ..... = V

12. Vibration severity grade

12.1 R ..... = 1
12.2 S ..... = 2
12.3 S1 ..... = 3 ④

Note:

① Encoder "S6" and "M6" are only available with electrical connection "F" and "K", shaft "G", "P" and "K" and bearings "N" and "V"
② Looking from front onto driven shaft (see picture 1)
③ Electrical connection "F", "K", "S" and "T" only available on top
④ Vibration severity grade "3" is not available with reinforced bearing "V"



Picture 1

RNC-41181-800_NOR_E_D0_2006-01-274.EPS

Fig. 6-21: Type code MAF180 (2/2)

6.11 Type Code MAF225

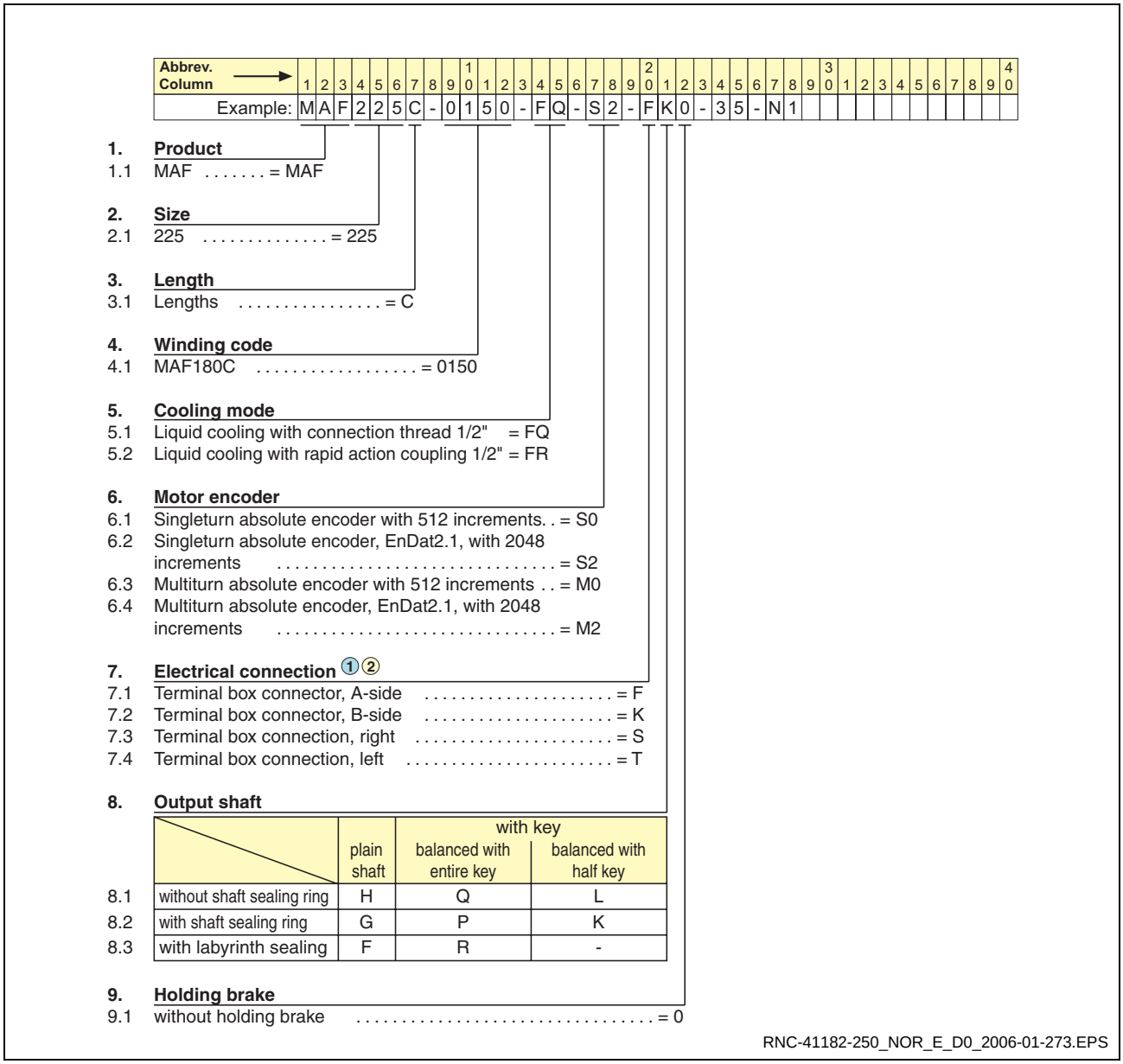


Fig. 6-22: Type code MAF225 (1/2)

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

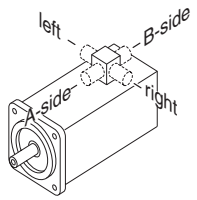
10. Mounting style
10.1 Flange and foot mounting . . . . . = 35

11. Bearings
11.1 Standard . . . . . = N
11.2 Reinforced bearings . . . . . = V

12. Vibration severity grade
12.1 R . . . . . = 1

Note:
① Looking from front onto driven shaft (see picture 1)
② Electrical connection "F", "K", "S" and "T" only available on top

Position of power connection = top



Picture 1

RNC-41182-250_NOR_E_D0_2006-01-274.EPS

Fig. 6-23: Type code MAF225 (2/2)

7 Accessories

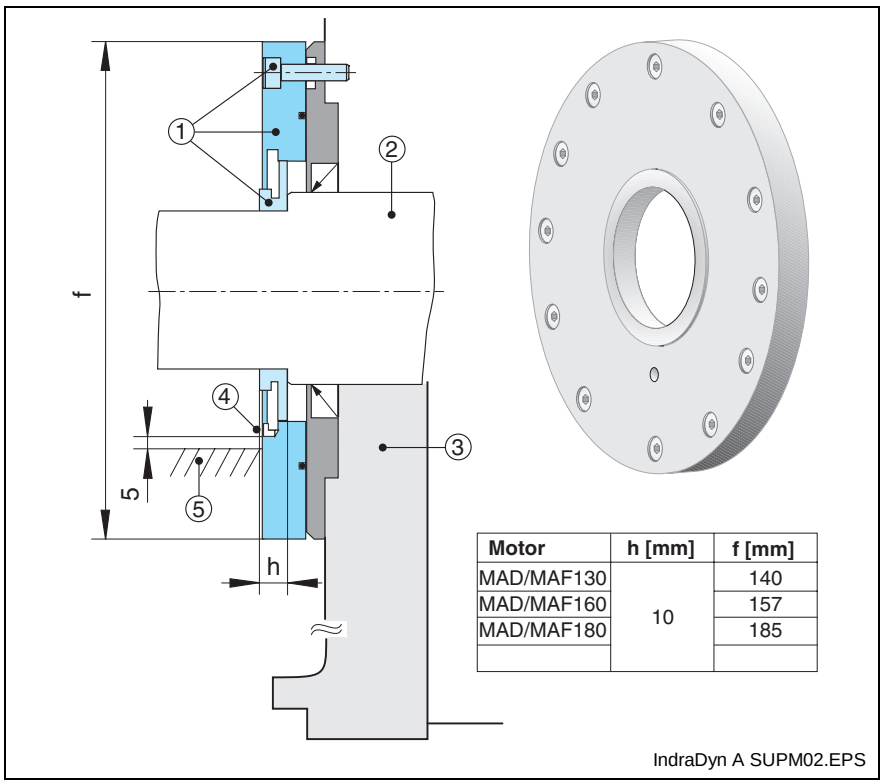
7.1 Labyrinth Seal

To protect the motor output shaft against spraying fluids, IndraDyn A motors of frame sizes 130…180 that are already equipped with the "shaft sealing ring" option can be retrofitted with labyrinth seals (accessory SUP-M02-2AD...).

Labyrinth seal for	Type	Material number
MAD/MAF130	SUP-M02-2AD132	R911273268
MAD160	SUP-M02-2AD160	R911272843
MAF160	SUP-M02-ADF164	R911299702
MAD/MAF180	SUP-M02-2AD180	R911273209
MAD/MAF225	see "Labyrinth Seal" in chapter 9.12	

Fig. 7-1: Labyrinth seal

Accessory SUP-M02-xxx... is supplied complete with fastening screws and assembly instructions.



Motor	h [mm]	f [mm]
MAD/MAF130	10	140
MAD/MAF160		157
MAD/MAF180		185

(1): Labyrinth seal with fastening screws (within the scope of delivery)
(2): Motor shaft A-side
(3): Motor flange A-side
(4): Drain hole
(5): Max. permitted level of a fluid
(h): Height of labyrinth seal

Fig. 7-2: Labyrinth seal mounted

Note:

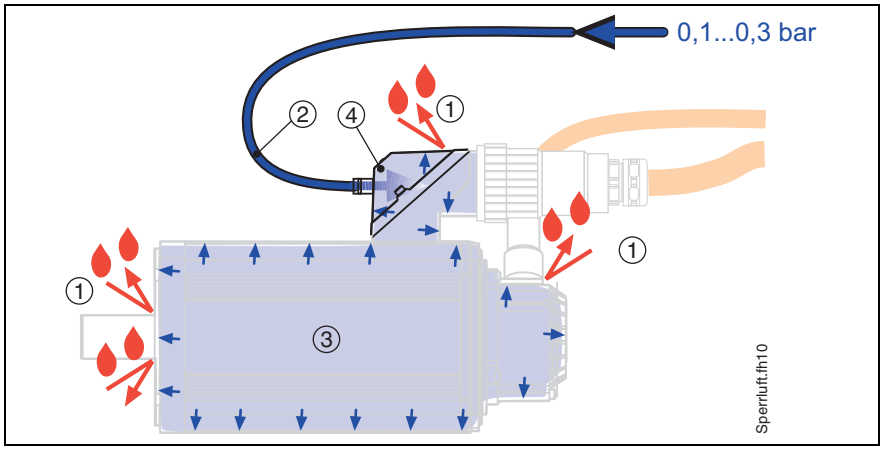
- Pay attention to the assembly instructions for accessory SUP-M02-xxx... (in the scope of delivery).
- The labyrinth seal is effective only in horizontal installation position and from approx. 200 rpm. It may only be attached to motors with a factory-mounted shaft sealing ring.

- Seeping fluids can lead to damage to the motor. The tightness of the motor seal is ensured only according to the guidelines of the corresponding motor protection class.

7.2 Sealing Air Connection

When the motor is to be operated under adverse conditions, a higher protection class than the standard protection class with radial shaft sealing ring (IP65) may be required. High demands may be made on the tightness of motor seals when the motors are used in areas where oily coolants are used. We recommend to use sealing air in addition to the radial shaft sealing ring for these areas of application.

A defined excess pressure in the motor interior induced by the sealing air connection reliably prevents the penetration of, for example, creep oils and coolants.



(1): Splashing water, lubricant
(2): Compressed air line
(3): Excess pressure inside the motor
(4): Lid for sealing air (with connector for compressed air line)

Fig. 7-3: Motor with sealing air connection

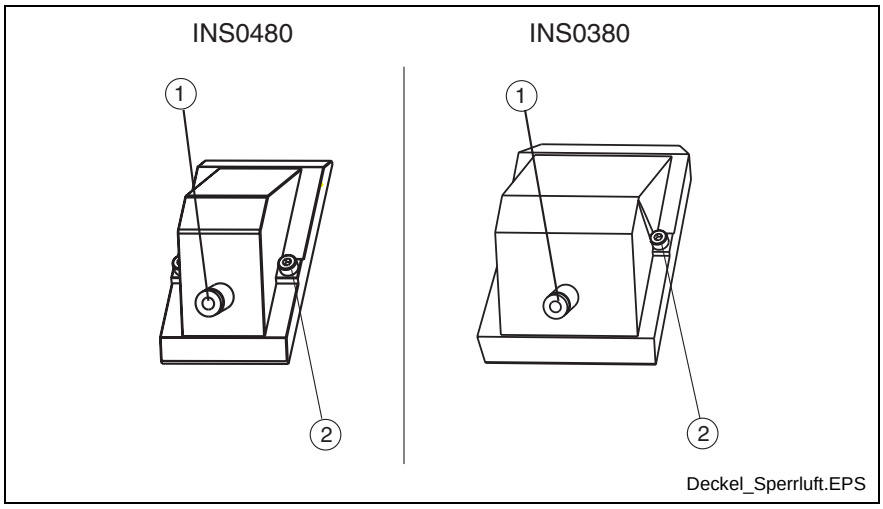
For IndraDyn A motors of frame sizes 100 to 160 with connector sockets for power connection, air pressure connector kits are available as accessory.

Ordering name of accessory sets

Motor size MAD/MAF...	Motor flange socket (type)	Description
100	INS0480	SUP-M01-MHD (MNR R911283006)
130...160	INS0380	SUP-M02-MHD (MNR R911283007)

Fig. 7-4: Sealing air connection accessory

The air-pressure connector can be retrofitted by simply replacing the existing lid with the lid in the accessory kit. This lid comprises the connector for the compressed air line.



(1): Connector for compressed air line
(2): Fixing screws (2x)

Fig. 7-5: Lid for the air-pressure connector kit

Note: When mounting the lid, make sure the O-ring is correctly positioned in the lid. The required motor protection class is only ensured when the O-ring is fitted correctly.

- Tightening torque of the two fixing screws: 3 Nm.
- An installation manual is included with the selected accessory kit.

Technical data

Motor operation with sealing is permitted only under the following conditions:

- system pressure at the motor
  ⇒ 0.1...0.2 bar
- properties of the compressed air
  ⇒ as far as possible free of dust and oil (select corresponding filter)
  ⇒ rel. air humidity 20…30%

Additional components

To operate the motor with sealing air under the above-named conditions, other devices or components as e.g.

- compressor
- pressure regulator valve
- compressed air filter plus compressed air dryer, if applicable
- compressed air line (e.g. plastic tube PA 4 x 0.75)

are required. The user will have to procure and install these components as required.

For information on selection or dimensioning of suitable Rexroth accessories, please contact your sales partner, or directly

Supplier of accessory components

Bosch Rexroth AG
Pneumatics
Ulmer Str. 4
30880 Laatzen, Germany
Phone: +49 (511) 21 36-0 / Fax: +49 (511) 2 13 62-69

7.3 Gearboxes

In certain conditions, switched and planetary gearboxes can be attached to IndraDyn A motors.

Type	Gearbox type	Motor requirements	Supplier
GTM	Planetary gearbox [1)]	Plain motor drive shaft	**ZF** Maschinenbetriebe GmbH P.O. bpx 2549 88015 Friedrichshafen, Germany Tel. +49-(0)7541-77-0
58...	Worm gear [1)]	Plain motor drive shaft	**ATLANTA** Zahnrad- und Werkzeugfabrik Seidenspinner GmbH & Co. Karl-Benz-Str. 16 74321 Bietigheim-Bissingen, Germany Tel. +49-(0)7142-7001-0
1) Bosch Rexroth is not the manufacturer of these gearboxes. Clarify compatibility and technical details with the manufacturer.			

Fig. 7-6: Gearboxes for IndraDyn A motors

Note: Only low axial shaft loads are permitted for IndraDyn A motors (also see chapter 9.13 "Bearing and Shaft Loads"). Therefore, the motors are not or not fully suitable for machine elements that generate axial loading of the motor (e.g. helical driving pinions).

7.4 Thread Reducers

For all IndraDyn A motors with power connection via terminal box, reducers for the connecting threads of the terminal box are comprised in the scope of delivery.

Note: The reducers are located in the terminal box and are comprised in the motor delivery. You do not need to order them separately.

To order additional reducers, please use the following order numbers:

Motor Frame Size	Winding	Reducer 1	Reducer 2	Order number
MAD/MAF100	all	from M32x1.5 to M25x1.5	---	R911311878
MAD/MAF130	all	from M40x1.5 to M32x1.5	from M40x1.5 auf M25x1.5	(Reducer 1) R911310197 (Reducer 2) R911310332
MAD/MAF160	all*	from M50x1.5 to M40x1.5	from M50x1.5 to M32x1.5	(Reducer 1) R91131880 (Reducer 2) R911311876
MAD/MAF180	all*			
MAF160C	0200	from M50x1.5 to M40x1.5	from M50x1.5 to M40x1.5	R911311880
MAF180C	0200			
MAF180D	0200			
MAD/MAF225	all	from M50x1.5 to M40x1.5	from M50x1.5 to M40x1.5	R911311880
*) Exceptions: MAF160C, MAF180C, MAF180D				

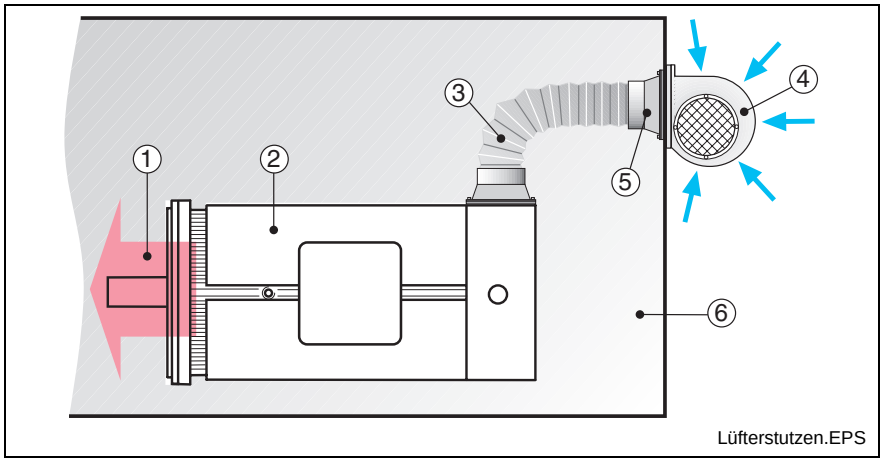
Fig. 7-7: Thread reducers for terminal box

7.5 Fan Cowl

When motors are used in a strongly polluted environment (e.g. dusts, oils, cutting materials and lubricants), clean air for motor cooling should by supplied from outside via a hose or an air duct.

For this application, Bosch Rexroth provides motors with a fan cover and fan cowl.

Sample application



(1): Air exit
(2): Motor
(3): Air duct (not included in scope of delivery)
(4): air intake (radial fan not included in scope of delivery)
(5): Fan cowl (accessory)
(6): Working area

Fig. 7-8: Fan cowl (example)

Note:

- For the installation shown above, another fan cowl is required in addition to the fan cowl at the motor; this can be ordered as an accessory.
- Radial fan, air duct or hose and the respective mounting material do not belong to the scope of delivery of Rexroth.

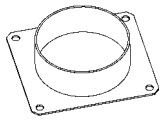
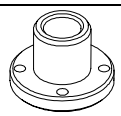
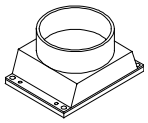
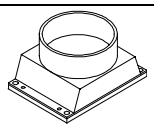
Fan cowl for	Type	Material number	
MAD100	SUP-M01-2AD100	R911249918	
MAD130	SUP-M01-2AD132	R911268753	
MAD160	SUP-M01-2AD160	R911275660	
MAD180	SUP-M01-2AD180	R911268606	

Fig. 7-9: Fan cowl (accessory)

Radial fans

For selection of suitable radial fans, please observe the notes on dimensioning, as well as the potential suppliers for radial fans in chapter 9.8 "Radial Ventilation in Hazardous Areas",

8 Connection Techniques

8.1 Notes

CAUTION

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

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

Power cables and power plugs are not in the scope of delivery of the linear motor. They must be ordered as a separate position.

Rexroth offers a wide range of ready-made cables and plug-in connectors that are optimally adapted to the products and different demands.

Decisive advantages of Rexroth ready-made cables are:

- Pre-wired without additional finishing
- Laid out for continuous alternate bending use
- Resistant against mineral oils, grease and biologic oils, silicon- and halogen-free, low adhesion
- Use of licensed cables acc. to UL and CSA
- Burning characteristics fulfill VDE0472-804 requirements
- Maintain EMC guidelines

Protection class up to IP67

Note: **Note that self-assembled cables or cable systems of other manufacturers may not fulfill these criteria.**

Bosch Rexroth shall not be held responsible for resulting malfunction states or damages.

You can find additional information….

- to connect IndraDyn A motors in **ATEX design** in Chaptr 13.8;
- to select power and encoder cables for IndraDyn A motors from the following descriptions in this chapter;
- to select **power and encoder cables** for the IndraDyn A motors, refer to the documentation "Rexroth Connection Cables", MNR. R911282688;
- for assembling **cables and plugs**, as well as technical data, in the documentation "Rexroth Connection Techniques, Assembling and Tools...", MNR R911286117.

8.2 Power Connection

The power connection of the IndraDyn A motors is situated on the top of the motors. Depending on the motor type, it can be in the form of a **connector socket or a terminal box**. Please also refer to the data in the type code of the respective motor.

Note: For the connection option ”connector socket”, please note:

- The power cable must be equipped on the motor side with a coupling with a bayonet connection**.**

For the connection option ”terminal box”, please note:

- Depending on the motor, the power cable must have wire end ferrules or ring cable lugs at U, V, W, and the PE must be equipped with a ring cable lug.

The design of the power cable also depends on the drive device used. Please observe the documentation of the drive device.

Overview

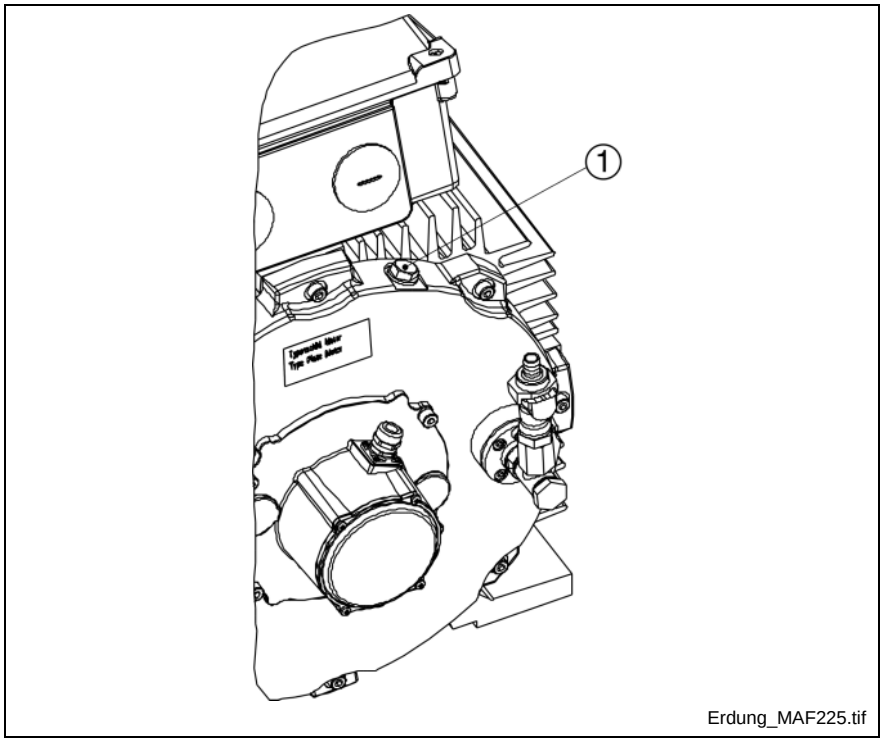
Motor size MAD/MAF...	Connector socket	Terminal box			
		U-V-W	Max. cross-section of connection	∅PE	Connecting thread
100	INS480	WEF*	10mm²	Ring cable lug for M6 thread	see motor dimension sheet and the information in Chapter 7, "Accessories"
130	INS380	WEF*	25mm²	Ring cable lug for M8 thread	
160	INS380	WEF*	35mm²	Ring cable lug for M8 thread	
180	not available	Ring cable lug for M6 thread	50mm²	Ring cable lug for M10 thread	
225	not available	Ring cable lug for M6 thread	2x 35mm²	Ring cable lug for M12 thread	
*) WES = wire end sleeve					

Fig. 8-1: Power connections - overview

Additional Grounding Wire at MAF225C

In accordance with EN 60034--1:2004 (11.1 Grounding of Machines), motors of frame size MAF225C must additionally be grounded with a separate grounding wire with a minimum core cross-section of 16 mm^2.

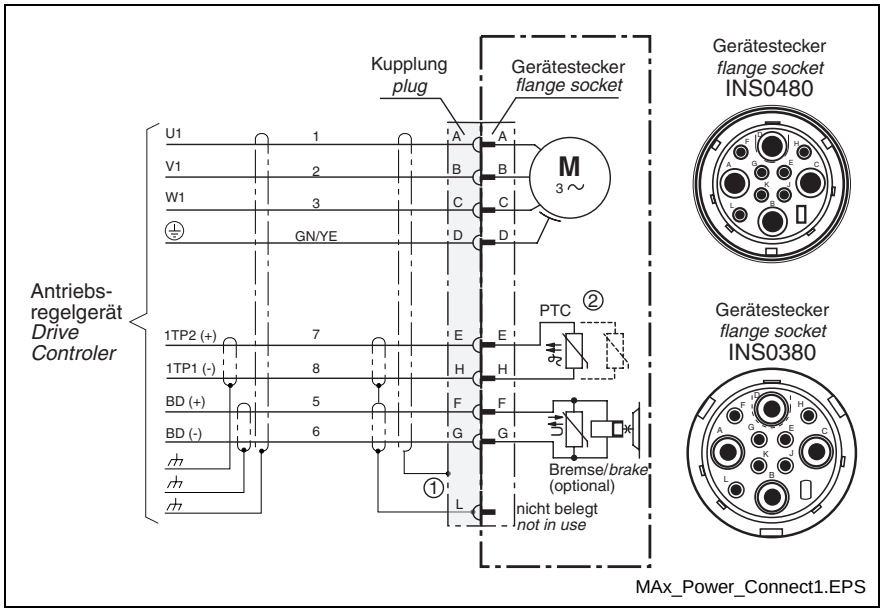
To this end, a connecting screw (Fig. 8-2) with thread M12 has been provided at the end shield of the MAF225C. By means of this connection screw, fasten the additional grounding wire with a ring cable lug for thread M12.



(1): Connecting screw for the additional grounding wire

Fig. 8-2: Additional grounding wire at MAF225C

8.3 Power Connection with Connector Socket



(1): Shield connection via cable clamp of strain relief in the plug
(2): Only one PTC sensor is applied. The cables for the spare sensor are in the connector housing

Fig. 8-3: Connector socket for power connection, diagram

Connector Socket

Ready-made Rexroth power cables with coupling for connecting IndraDyn A motors are provided with a bayonet connection .

Connector socket	Coupling	Terminal area	Current rating
INS0480	INS048x	1.5 mm² - 10 mm²	max. 41 A
INS0380	INS038x	6.0 mm - 35.0 mm²	max. 100 A

Fig. 8-4: Couplings for connector sockets

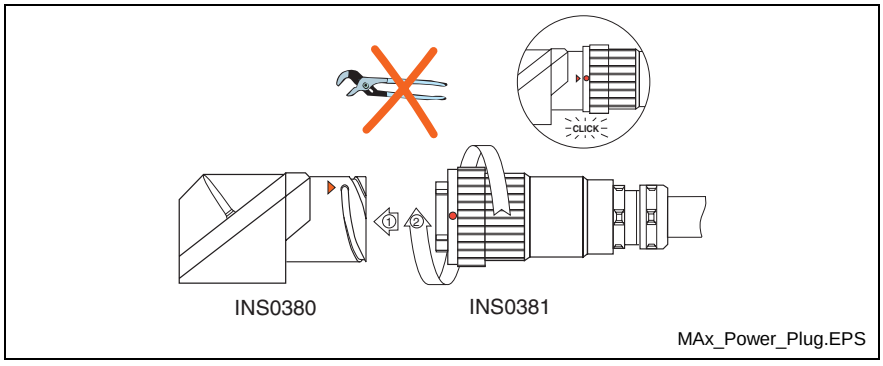
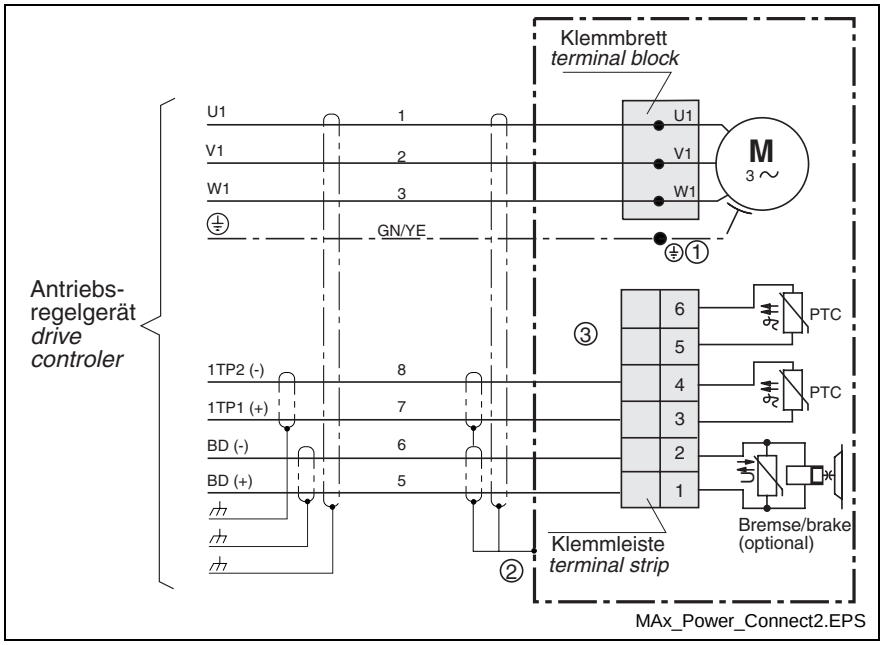


Fig. 8-5: Example, Plugged power connection

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

8.4 Power Connection with Terminal Box

IndraDyn A motors for drive combinations with high DC bus voltage are equipped in the terminal box with **a terminal strip or terminal blocks** for cables with wire end ferrules



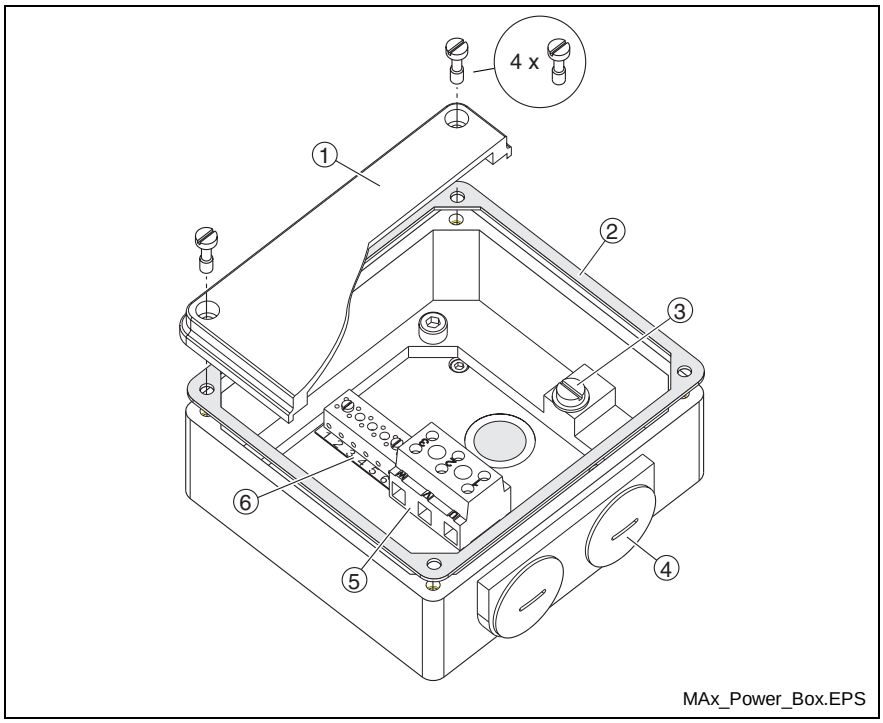
(1): Electrically conducting connection to motor housing
(2): Shield connection via cable clamp of strain relief in the screwed connection
(3): Only one PTC sensor is evaluated. Connect the spare sensor only if necessary

Fig. 8-6: Terminal box, diagram

Note:

- The brake connections are assigned only if the motor was manufactured with the "brake" option.
- Only one of the PTC thermistor connector pairs (3-4 or 5-6) in the motor cable should be connected to the motor; the other one pairs serves a spare.
- Do not remove or damage the seal glued into the cover.
- Observe the size of the screwed cable connection and connection thread for the cable inlet into the terminal box.
- In particular, heed a sorted and de-energized laying of the connection cables within the terminal box to avoid abrasion or pressure marks on the cables.
- The connections of the motor-windings in the terminal box must not be removed.

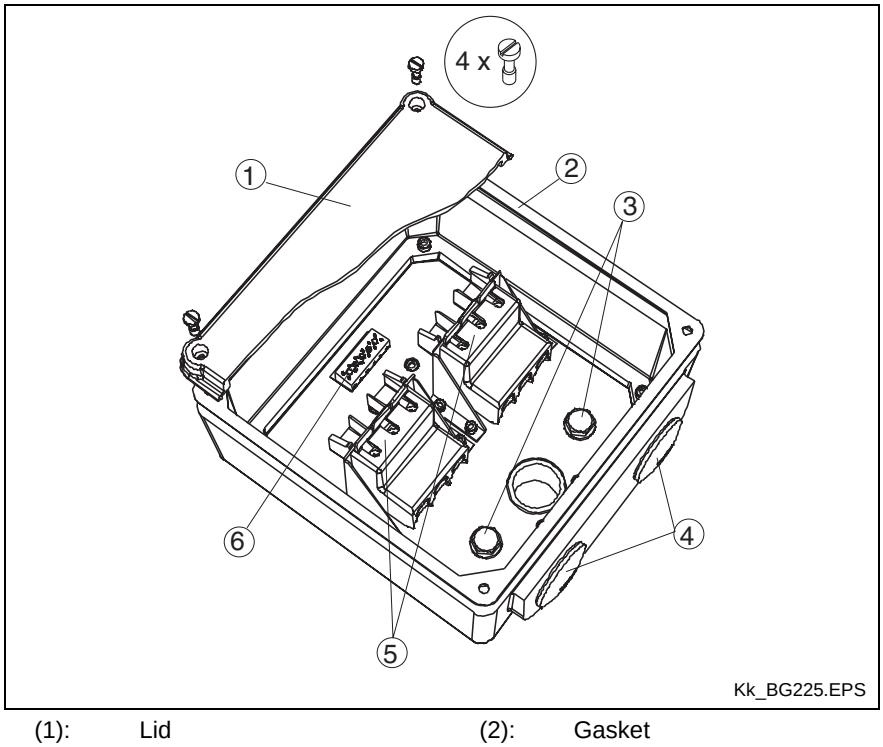
Terminal box, frame size 100..180



(1):	Lid	(2):	Gasket
(3):	PE connection	(4):	Cable entry
(5):	U-V-W power connection	(6):	Terminal strip

Fig. 8-7: Terminal box

Terminal box, frame size 225



(1):	Lid	(2):	Gasket
(3):	PE connection	(4):	Cable entry
(5):	U-V-W power connection	(6):	Terminal strip

Fig. 8-8: Terminal box, frame size 225

A schematic diagram of the respective connection is located in the lid of the terminal box.

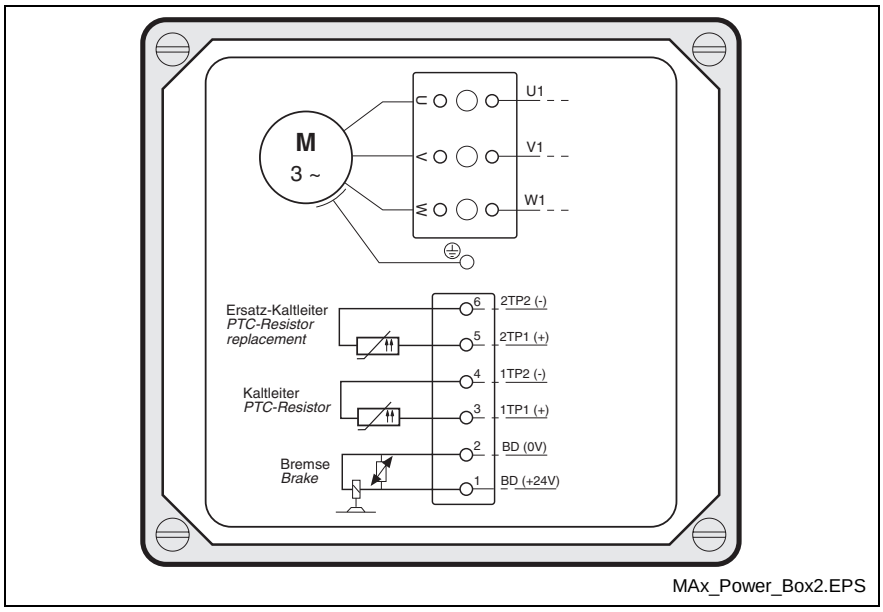


Fig. 8-9: Example of a terminal box lid

8.5 Connection Designations at the Drive Control Device

The following overview shows the connection and clamp designations for power connection, brake connection and the motor temperature monitoring at the respective Rexroth drive controller.

REXROTH drive control device	Clamp designation		
	Power	Temperature sensor	Holding brake
	(terminal box X5)	(terminal box X6)	
IndraDrive	A1, A2, A3	MotTemp+ MotTemp-	+24VBr 0VBr
DIAX04	A1, A2, A3	TM+ TM-	Br+ Br-
ECODRIVE	A1, A2, A3	TM+ TM-	Br+ Br-

Fig. 8-10: Clamp designations on drive control device

8.6 Double Cabling

A motor connection with two power cables is required if a corresponding single cable cannot be used due to the large bending radius or due to its dimensions.

Note: Double cabling can only be effected with power connection by means of terminal box.

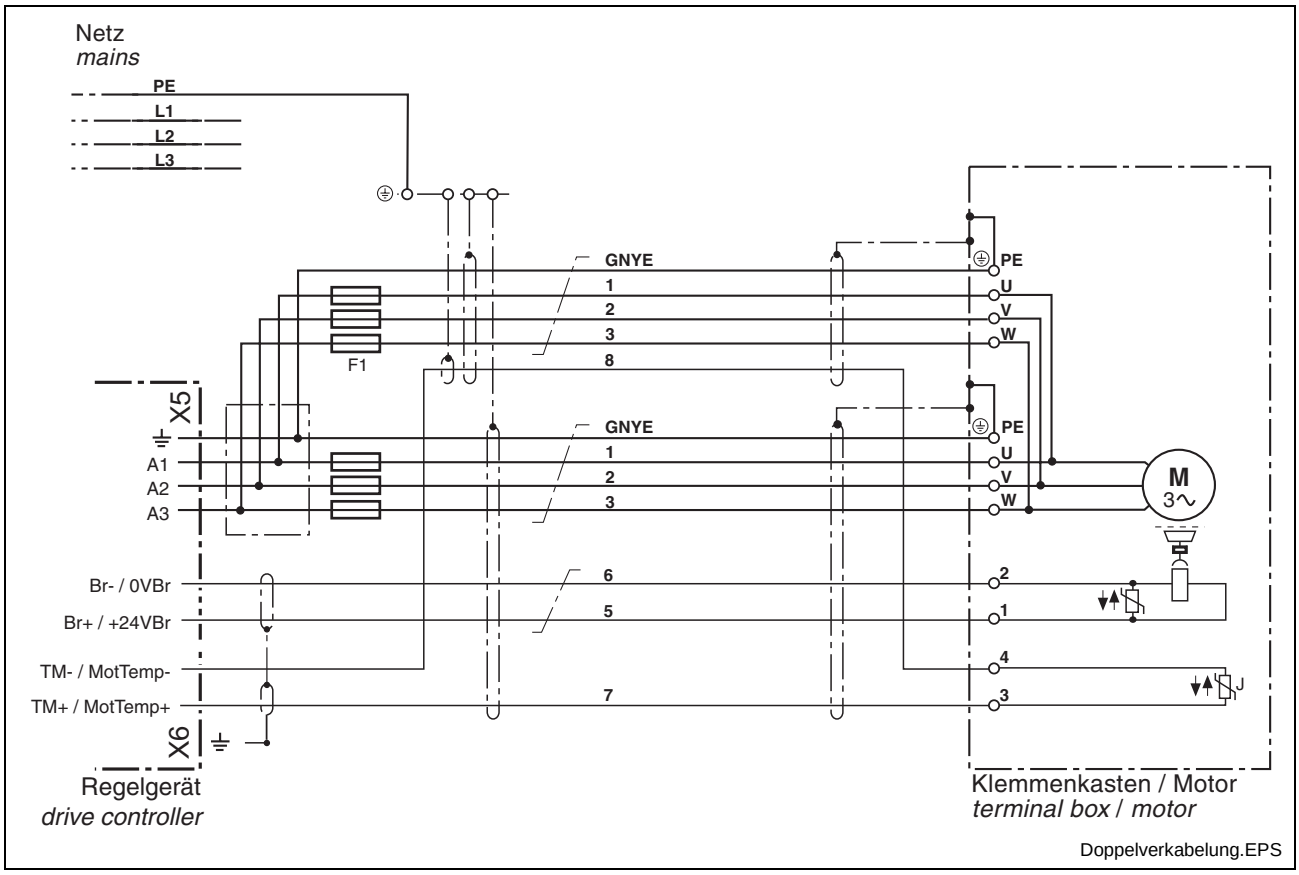


Fig. 8-11: Connection diagram double cabling

Notes:

- When connecting motors in frame size 225, wires 5 and 6 are not required as these motors are only available without brake.
- Wires not shown in the switching diagram are not required and must not be connected.
- The fuses F1 (NH…) which protect the wires from overload in case of cable break are dimensioned in accordance with the current carrying capacity of the respective line cross-section.
- The fuses should be installed in the switch cabinet so that they are as close as possible to the power output of the drive device.
- The shields of the power cables should be connected to the switch cabinet with the largest possible surface area.
- Cable pairs must be properly connected to series terminal strips or to the terminal studs of the drive controllers; they must also fulfill safety requirements.

Furthermore, observe the following documentation:

- "Electromagnetic Compatibility (EMC) …" MNR R911259740
- documentation of the motor used
- documentation of the drive device used
- “Rexroth Connection Cable“, MNR R911282688

8.7 Encoder Connection

Depending on the encoder type, the connection of the encoder to IndraDyn A motors has a 10-pole, 12-pole or 17-pole connector socket at the motor housing.

Motor Frame Size		Connector socket (X3) for encoder connection		
		C0	M0 / S0	M2 / S2
MAD	100	INS0629	INS0524	RGS1003
	130	INS0719	INS0638	RGS1004 *)
	160			
	180			
	225	not available		
MAF	100	INS0629	INS0524	RGS1003
	130			
	160			
	180			
	225	not available		
*) Connector socket RGS1004 cannot be ordered as an individual component. It is a an inseparable part of the encoder connection cable to connect encoder option M2/S2.				

Fig. 8-12: Designations of encoder connector sockets

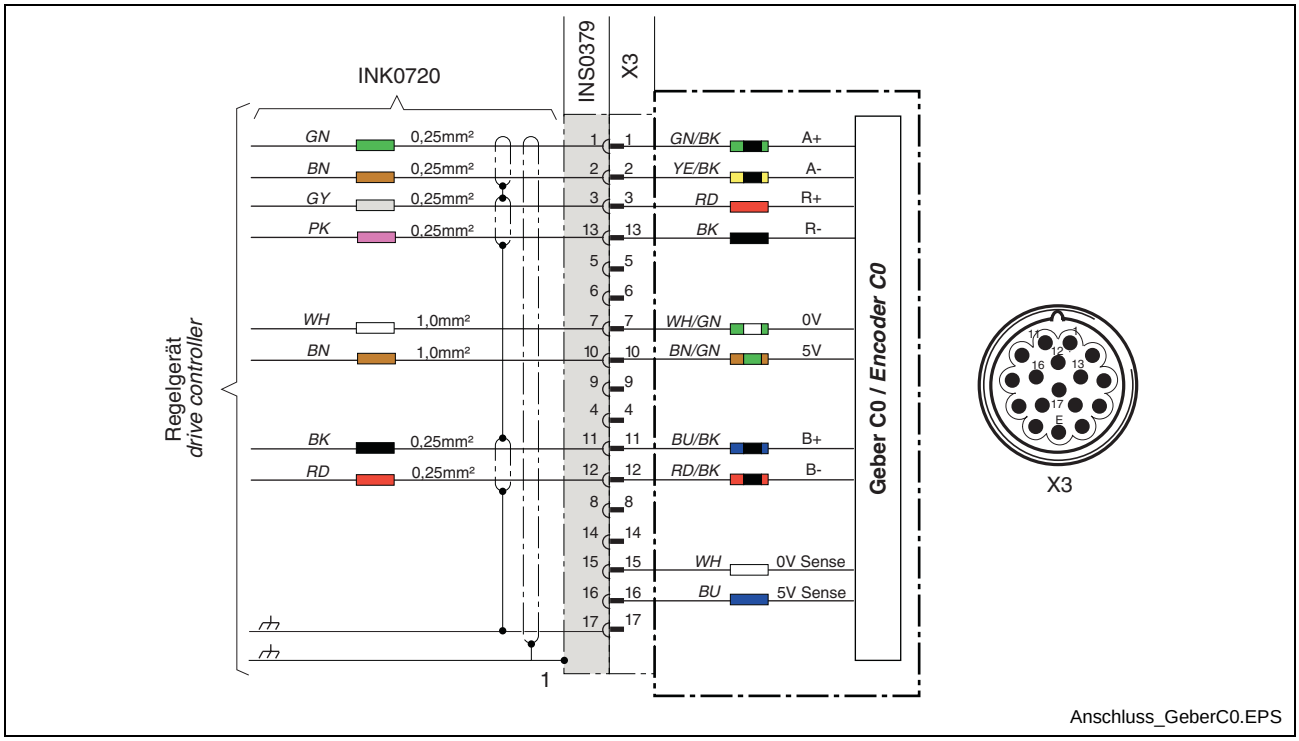
In connection with the specified connector sockets, the following couplings can be used at the connection cable:

Connector socket (X3)	Coupling
INS0524	INS0510, INS0511, INS0713
INS0629	INS0379
INS0638	INS0510, INS0511, INS0713
INS0719	INS0379
RGS1003	RGS1001
RGS1004 *)	RGS1001
*) Connector socket RGS1004 cannot be ordered as an individual component. It is a an inseparable part of the encoder connection cable to connect encoder option M2/S2.	

Fig. 8-13: Couplings for encoder connector sockets

See the following chart for the connector assignment:

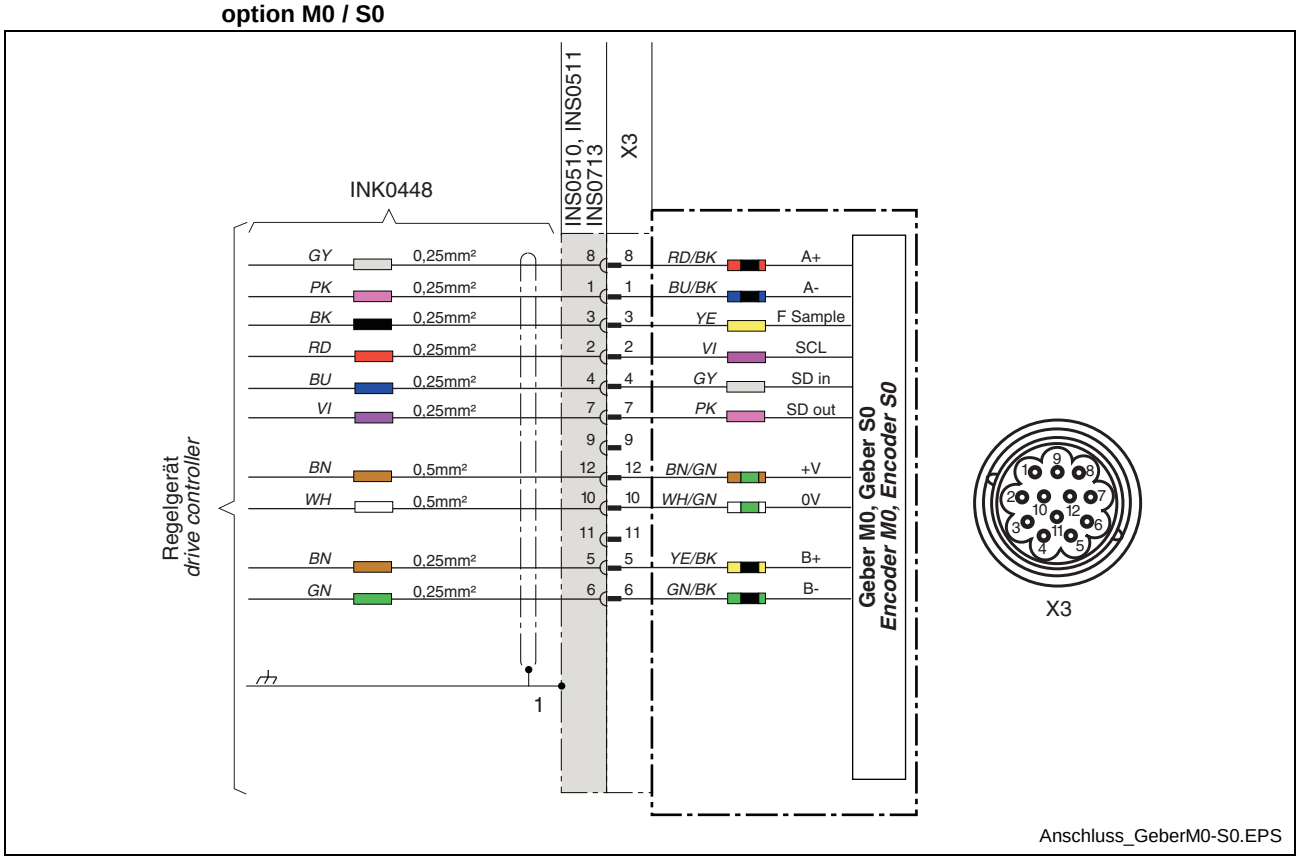
Pin assignment of encoder option C0



(1): Shield connection via cable clamp of strain relief

Fig. 8-14: Connection encoder type C0

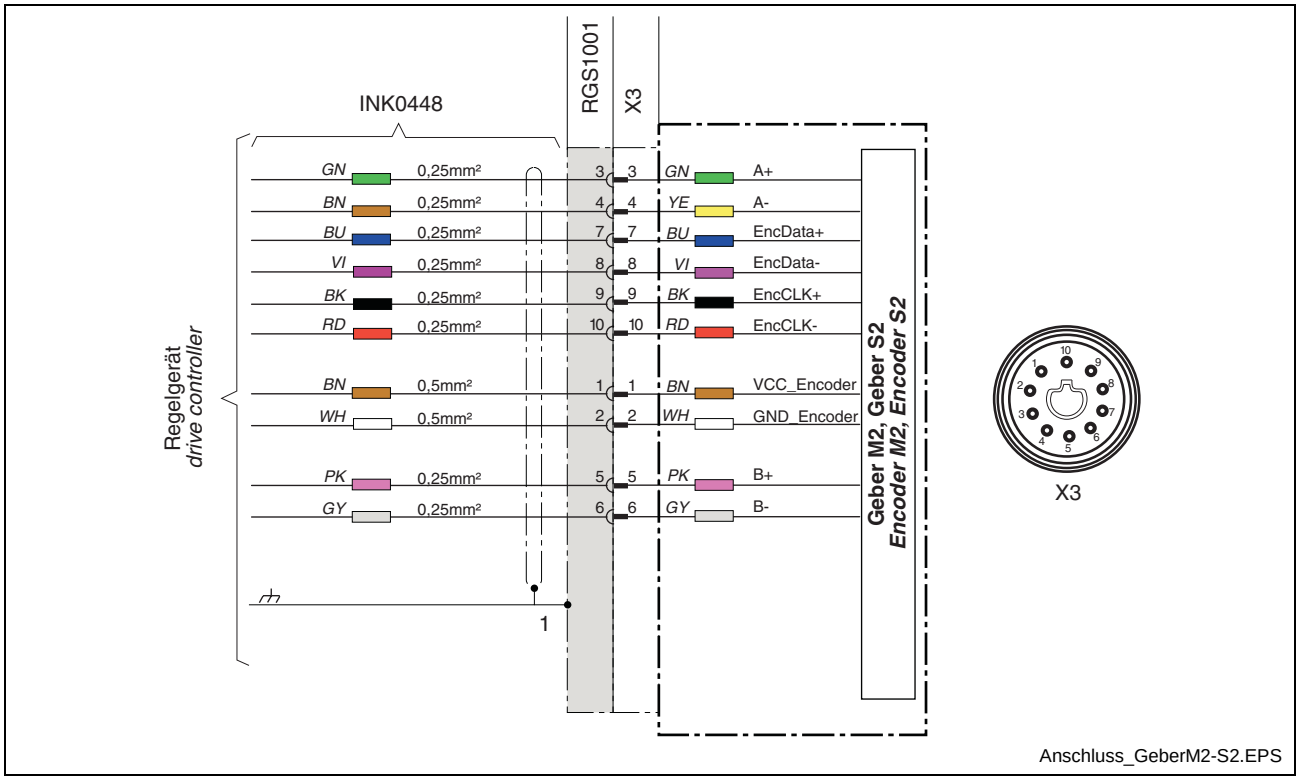
Connection assignment encoder option M0 / S0



(1): Shield connection via cable clamp of strain relief

Fig. 8-15: Connection assignment encoder type M0 / S0

Connection assignment encoder option M2 / S2



(1): Shield connection via cable clamp of strain relief

Fig. 8-16: Connection encoder type M2 / S2

The cable for connecting the motor encoder and the drive device must have a compatible coupling on the motor side.

The flange socket on the motor side and the coupling on the cable side are connected to each other and screwed on by hand. They are therefore structured as a mirror image, i.e. with different poles.

Please take note of the mechanical coding.

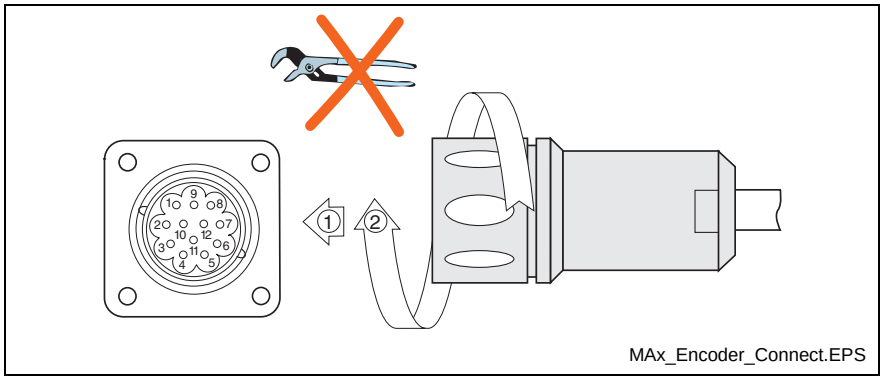


Fig. 8-17: Sample encoder plugged connection

1. Insert the coupling into the connector socket; pay attention to the coding.
2. Manually tighten the union nut.

8.8 Temperature sensor

IndraDyn A motors are equipped with two PTC temperature sensors KTY84-130 which are mounted stationary into the motor winding. For additional information on temperature sensors refer to Chapter 9.9 ”Motor Temperature Overview”.

Note:

- For the connection diagram, see Fig. 8-3 and Fig. 8-6 at the beginning of this chapter.
- Notice the correct polarity when using the sensor for temperature measurement external (see Fig. 9-18).
- The signal lines to the PTC sensors are routed to the controller via the motor power cable.
- Only one sensor is connected and evaluated. The function of the spare sensor cannot be guaranteed.

8.9 Holding Brake

The motor holding brake is triggered either directly through the drive device, or externally.

Note:

- For the connection diagram, see Fig. 8-3 and Fig. 8-6 at the beginning of this chapter.
- Control voltage is +24 V_{DC} (+/-10%)
- Take note of the different functions of an electrically clamping and an electrically releasing brake (see chapter 9.10, ”Motor Holding Brake”).

8.10 Motor Cooling System

Fan Connection

The motor fan is connected to the supply system via a cable and motor protecting switch and functions independent of the drive device.

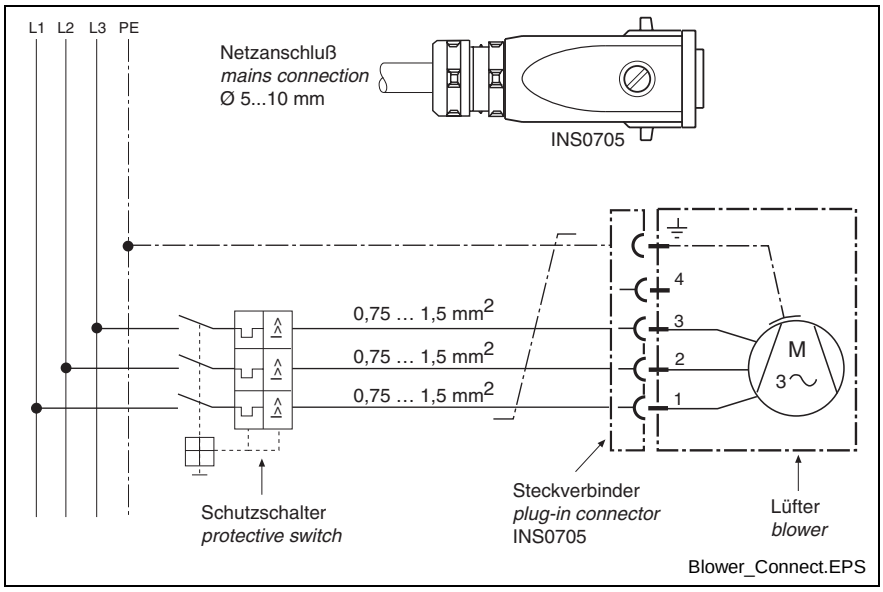


Fig. 8-18: Fan Connection

Note:

- To establish the connection, the fan plug must be opened and closed.
- The electric connection may be established by skilled personnel only. Please observe the safety notes.
- The tightness of the plug housing must not be reduced.
- The machine manufacturer selects the motor protecting switch and the electrical protection. Please observe the regulations in the country of installation.
- The plug for connecting the motor fan is included in the scope of delivery and is located on the fan.

Coolant Connection

For liquid-cooled motors, two different coolant connections are possible.

	Connection via ...		
Motor MAF ...	Thread	snap-on coupling [Ø d_i hose]	Note
100...130	G1/4"	9.6 mm	Selection of connection type by type code
160...225	G1/2"	12.7 mm	

Fig. 8-19: Overview coolant connections

Note: The assignment of inflow (IN) and outflow (OUT) can be made as desired; it has no influence on the performance data of the motor.

Thread The connecting threads at the motor have been covered with protective caps at the factory. When the coolant is connected via the connecting threads at the motor side, please make sure that the value of the

tightening torque for the screwed connection specified in Fig. 8-20 is not exceeded.

Please note that depending on the type of fittings and pipes you have selected, it may not be possible to make full use of the maximum permissible tightening torque of the screwed connection at the motor side but that it may be necessary to reduce the value of the screwed connection at the customer side.

The data below have to be observed. Exceeding the tightening torque or depth of engagement can lead to irreversible motor damage.

Notes:

- Please take note of the manufacturer's information, particularly the values for the permissible tightening torque of the screwed connection of your choice.
- To avoid overloading of the insertion or seat of the screwed connection at the motor side, steady and counter it with a suitable spanner when tightening.

Frame size MAF…	Thread	maximum permissible tightening torque
100...130	G1/4"	Values in preparation
160....225	G1/2"	

Fig. 8-20: Tightening torques for the connection thread at the motor

Snap-on Coupling

Another option for the coolant connection is a snap-on coupling which can also be released at full pressure. It has an integrated leak protection.

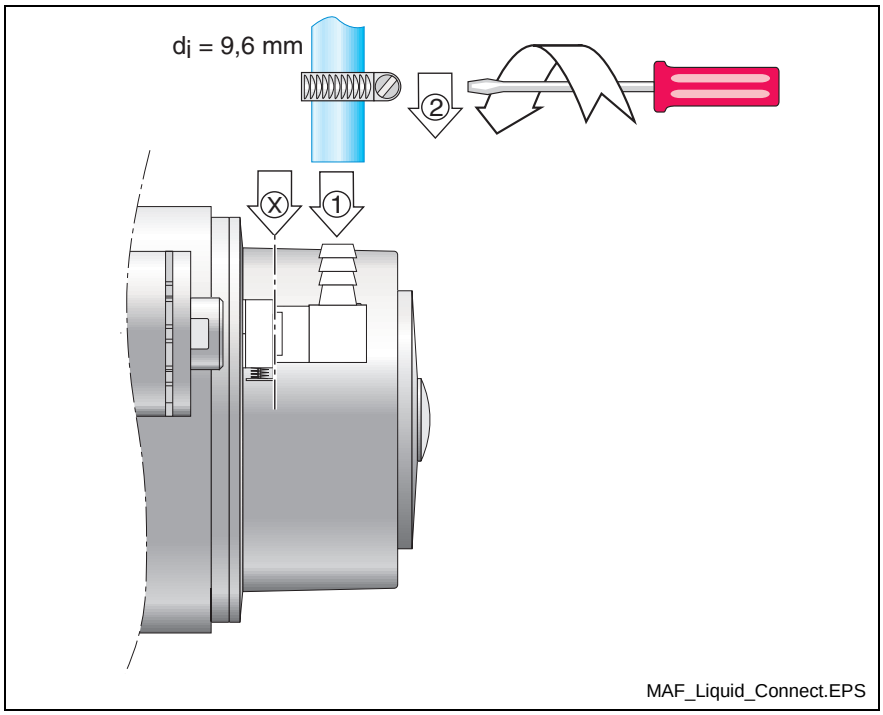


Fig. 8-21: Example for an MAF coolant connection

Proceed as follows:

1. Slip the hose on the motor connection (1). Avoid any bending or damaging of the screwed connection at the motor side.

2. With the fixing clamp (2), screw down the end of the hose over the connection.

⇒ For service purposes, the factory-attached screwed connection can be released at the point (X) (press bolt and withdraw the elbow in axial direction). It is not necessary to open the hose connection.

If you use another connection technology at the hose side, other assembly steps may be required. Refer to the manufacture for information on assembly.

To supply the MAF motors with cooling liquid, you will need additional installation material as e.g. hoses and fixing clamps (not included in the delivery). Select the supply hose with the correct inner diameter d_i.

Operating Pressure

A maximum coolant supply pressure of **3 bar** applies to all MAF motors, regarding the pressure effectively existing directly at the coolant connection of the motor.

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

9 Application Notes

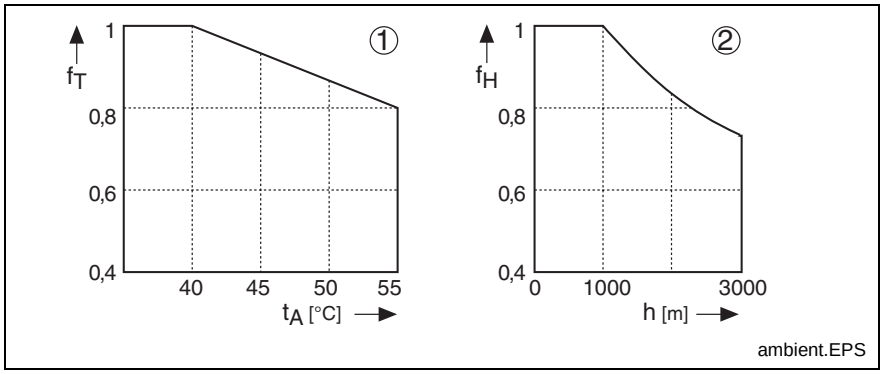
9.1 Operating Conditions

Setup Elevation and Ambient Temperature

The performance data specified for the motors apply in the following conditions:

- Ambient temperatures ranging from 0 ºC to +40 ºC
- Setup elevation of 0 m to 1,000 m above sea level.

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



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

Fig. 9-1: Utilization factors

If **either** the ambient temperature **or** the setup height exceeds the nominal data:

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

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

1. Multiply the determined utilization factors f_T and f_H by each other.
2. Multiply the value obtained by the motor data specified in the selection data.
3. Ensure that the reduced motor data are not exceeded by your application.

9.2 Air Humidity

Ambient climatic conditions are defined into different classes according to DIN EN 60721-3-3 (1995), Table 1. They are based on observations made over long periods of time throughout the world and take into account all influencing quantities that could have an effect, such as the air temperature and humidity.

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

This class is excerpted in the following table.

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

Fig. 9-2: Classification of climatic environmental conditions according to DIN EN 60721-3-3, Table 1

9.3 Vibration and Shock

Vibration

Sine-shaped vibrations occur in stationary use; depending on their intensity, they have different effects on the robustness of the motors.

The robustness of the overall system is determined by the weakest component.

According to DIN EN 60721-3-3 and DIN EN 60068-2-6, the following values are approved for Rexroth IndraDyn A motors:

Direction	Amplitude 0 – 55 Hz	Acceleration 55 – 2000Hz
axial	0.3 mm	1 m/s²
radial	0.75 mm	30 m/s² (10 m/s² in connection with M2/S2 encoders)

Fig. 9-3: Maximum values for sine-shaped vibrations

Shock

The shock load of the motors is indicated by specifying the maximum permitted acceleration in non-stationary use, such as during transport.

Damage to functions is prevented by maintaining the limit values specified.

According to DIN EN 60721-3-3 (1995), the values for IndraDyn A motors are as follows:

	Maximum permissible shock stress (duration 11 msec)	
Motor Frame Size	**axial**	**radial**
100 225	10 m/s²	150 m/s²

Fig. 9-4: Shock stress

Note: Please also observe the specifications in chapter 13.8 regarding transport and storage.

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

9.4 Compatibility with Foreign Material

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

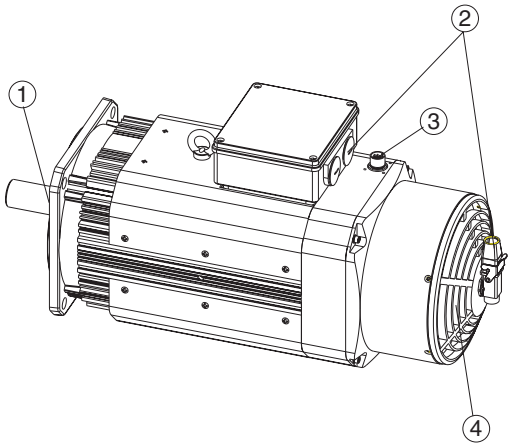
However, since it is impossible to follow the continuing further development of every material with which our controls and drives could come into contact (e.g. lubricants on tool machines), reactions with the materials that we use cannot be ruled out in every case.

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

9.5 Protection Class

The protection classes according to IEC 60529 apply for IndraDyn A motors. It must be ensured that, in each and every installation position of the motor, the motors are not subjected to ambient conditions outside of the applicable degree of protection.

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



Protection class range		Protection class	Note
1	Output shaft without shaft sealing ring	IP 54	IP40 with vertical installation position (see Fig. 9-9)
	Output shaft with shaft sealing ring	IP 65	Option
	Output shaft with labyrinth seal	IP 65	Accessory; seal effective starting at 200 rpm.
2	Power connection fan connection	IP 65	Terminal box or plug
3	Connection of motor encoder	IP 65	
4	Motor Fan	IP 65	Fan motor IP 65 Fan cowl IP 24

Fig. 9-5: Definition of the protection class ranges at the motor

It must be ensured that, in each and every installation position, the motors are not subjected to ambient conditions outside of the particularly applicable degree of protection according to IEC 60529.

Products and ranges with a low degree of protection are not suited for cleaning procedures with high pressures, vapors or water jets.

9.6 Frame Shape and Installation Position

IndraDyn A motors are available in frame shapes B05 and B35. Please refer to the table below for the conditions of installation permissible according to EN 60034-7.

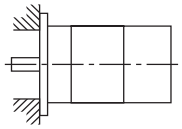
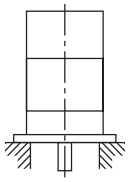
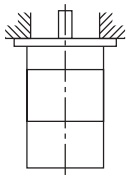
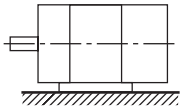
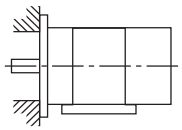
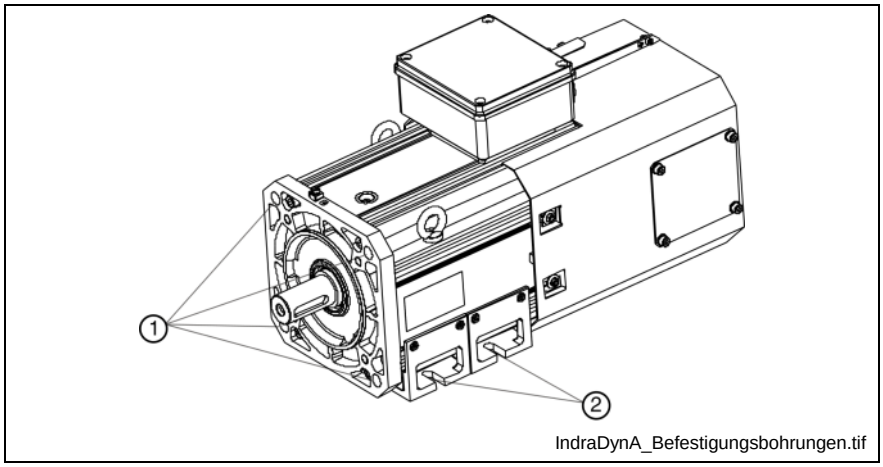
Motor frame shape	Permissible conditions of installation		
	Description	Sketch	Setup
B05	IM B5		Flange mounting on the drive end of the flange
	IM V1		Flange attached on the drive side of the flange; drive side pointing down
	IM V3		Flange attached on the drive side of the flange; drive side pointing up
B35	IM B3		Foot installation feet pointing down
	IM B5		Flange mounting on the drive end of the flange

Fig. 9-6: Installation positions

IndraDyn A motors in motor frame shape B35 can either be fixed by means of foot assembly or flange assembly.

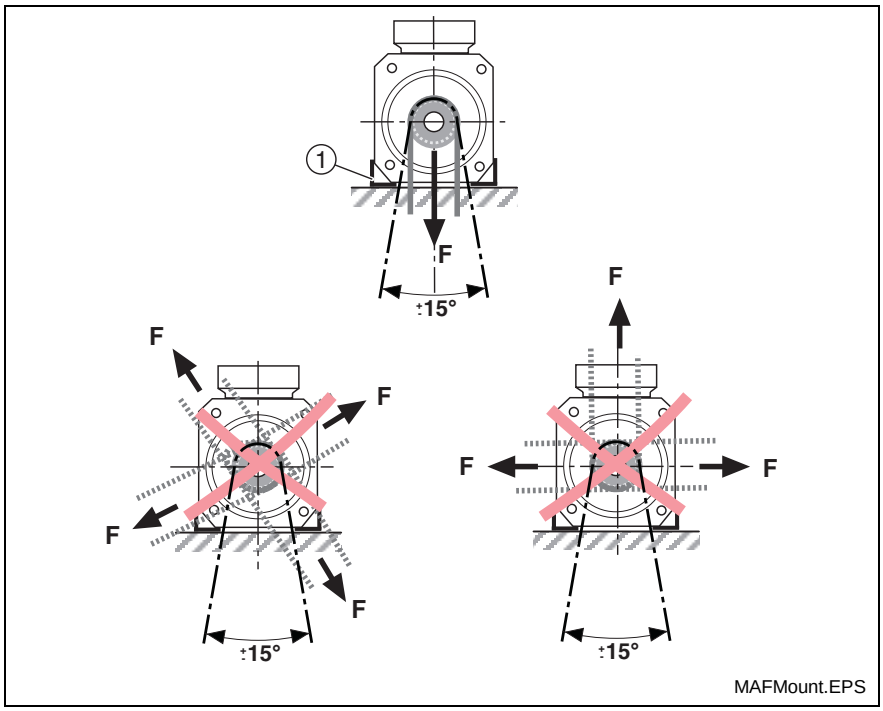


(1): Flange for flange assembly
(2): Assembly feet (both sides)

Fig. 9-7: Mounting types of the IndraDyn A motors

Foot Assembly

As opposed to flange assembly, the radial forces in the case of foot assembly may act on the assembly surface (± 15°) only in the vertical direction. The transfer of forces with other effective force directions is not permitted.



(1): Assembly feet

Fig. 9-8: Sample, MAF foot assembly

Notes: **When using foot assembly, please pay attention to the following:**

- Forces affecting the motor feet that are transferred from a gearbox are not permitted. Forces that are effective via a gearbox shaft must be supported on the gearbox.
- An improper installation situation results in forces that can quickly lead to motor damage.
- Note the information in chapter 11.2 on foot assembly. Check the alternative "flange assembly".

Vertical Installation Position

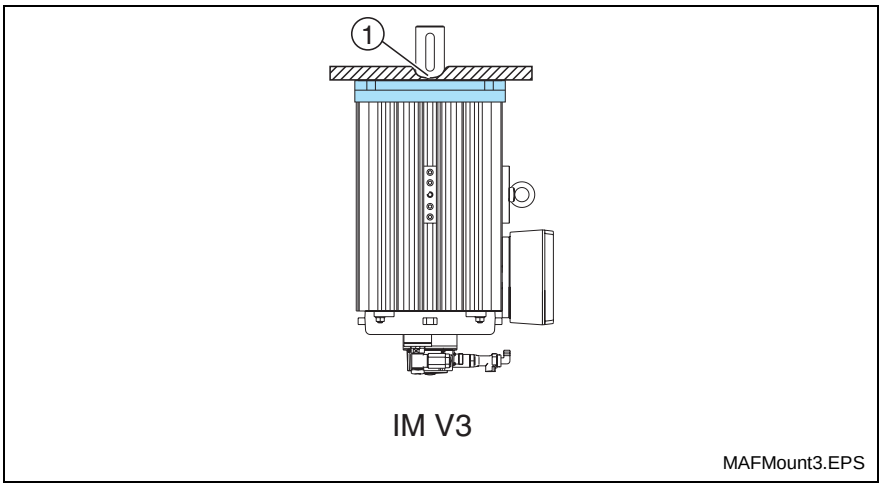
Output shaft pointing up

In the case of vertical installation positions of motors with output shafts pointing up (Fig. 9-9), dirt and fluids can enter the motor interior more easily, causing malfunctions or failure.

The degree of protection on the flange side of motors with a shaft sealing ring is IP 65. Hence, tightness is ensured only in case of splashing fluids. Fluid levels present on A-side require a higher degree of protection.

For motors of frame size 225, note as well that by reason of the high rotor weight and the bearing pre-tension, the axial bearing load (on the B-side) occurring with this installation position is so high that the useful life of the bearing must be expected to be significantly reduced to approx. 30% of the originally calculated bearing life.

Note: With vertical installation position in case of output shaft pointing up (Fig. 9-9), **the useful life of the bearing will be reduced to approx. 30%** in case of motors of frame size 225.



(1): Shaft duct IP 40 (standard)
Shaft duct with radial shaft sealing ring IP 65 (option)

Fig. 9-9: Example for MAF in vertical installation position, output shaft pointing up

Notes:

- **Shaft end:** The degree of protection on the flange side of motors with a shaft sealing ring is IP 65. However, sealing is ensured only in case of splashing fluids. Liquid levels present on the shaft end require a higher degree of protection.
- **B side:** The degree of protection for the fan screens in axial fans is IP 24. Chips or larger dirt particles can penetrate the fan screen as well.
- **Protection class:** The factory-attached protection class of IndraDyn A motors must not be reduced by modifications or by retrofitting accessories.

Output shaft pointing down

When motors of frame size 225 are operated in vertical installation position with output shaft pointing down and in connection with a coupling, pay attention to the following facts when selecting a suitable coupling:

The axial pre-tensioning force of the coupling in pre-tensioned state must not exceed **400 Nm**.

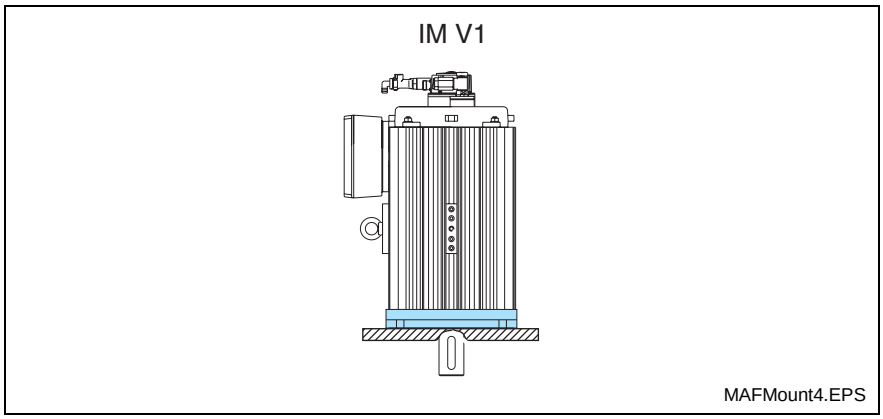


Fig. 9-10: Example for MAF in vertical installation position, output shaft pointing down

9.7 Housing Painting

The housing painting of the motors consists of a black (RAL9005) 2K epoxy resin coating based on epoxy polyamide resin in water.

Chemical resistance against	Limited resistance against	No resistance against
diluted acids and alkaline solutions	organic solvents	concentrated acids and alkaline solutions
water, sea-water, sewage	hydraulic oil	
commercial machine oils		

Fig. 9-11: Painting resistance

It is permitted to provide the housing with additional painting (coat thickness no more than 40 µm).
Check the adhesion and resistance of the new paint coat before applying it.

9.8 Motor Cooling System

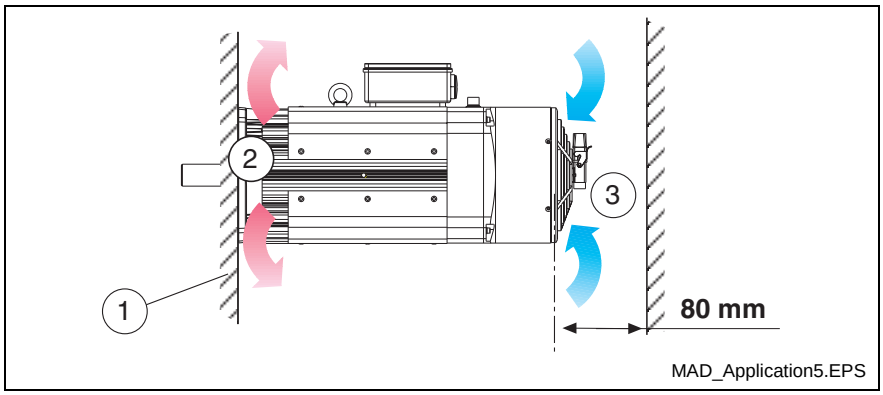
Fan

MAD motors may be operated only with fans. Cooling occurs using air currents that are guided through air plates over the surface of the motor.

Axial fan An axial fan is used for cooling purposes. The fan is only available with the ”blowing” option. Please note the information included in the type code.

Fan Cowl For applications where an external fan needs to be attached to the motor, e.g. in heavily soiled or hazardous areas, the motors are equipped with a fan cowl for connecting the air hose. Please note the respective information in the type code and in chapter 7, "Accessories".

In order to ensure that the required air amount (see Chapter 4, “Technical Data”) can be routed by the axial fan, a minimum distance between the fan screen and the machine must be kept so that the air can be sucked in and flow off. The distance (2) is determined by the motor construction.



(1): Machine
(2): Air flow-off space
(3): Air suck-in space

Fig. 9-12: MAD ventilation

⇒ Observe the air flow in the machine construction. The minimum distance is 80 mm for all MAD motors.

⇒ The design for all fan variants is "blowing".

Pollution can reduce the performance of the fans and lead to thermal overload of the motors.

When the machine is operated in a polluted environment, increase the system availability by regularly cleaning the fan and motor radiator fins.

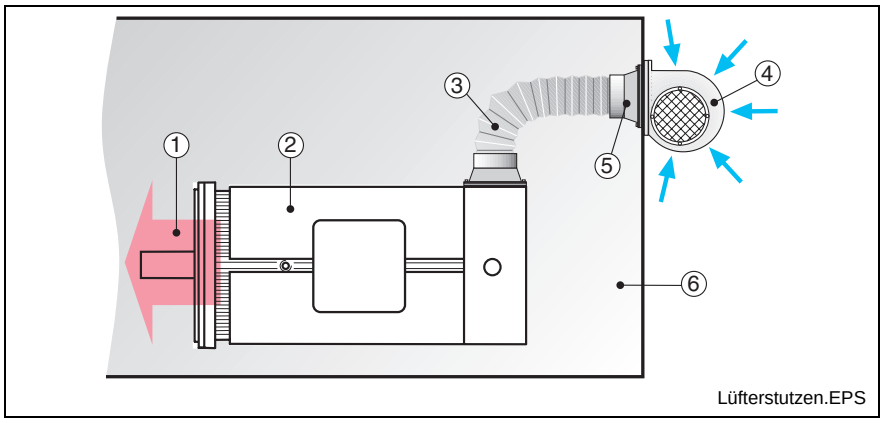
The machine construction must allow easy access to the motor and the fans for maintenance work purposes.

Radial Ventilation in Hazardous Areas

When IndraDyn A motors in ATEX version are operated in a potentially explosive atmosphere, clean air for the motor cooling must be supplied from the outside via a hose or an air channel.

⇒ For this application, select motors with fan cover and fan cowl to connect an air hose.

Sample application



(1): Air exit
(2): Motor
(3): Air duct (not included in scope of delivery)
(4): Air entry (not included in scope of delivery)
(5): Working area

Fig. 9-13: Example for radial ventilation via fan cowl

The machine manufacturer must select a suitable radial fan for potentially explosive areas under consideration of the machine specification. Radial fans for IndraDyn A motors are generally not comprised in the Rexroth scope of delivery. Please heed the additional information on the ATEX motors in chapter 13, “Motors for Hazardous Areas”.

Notes: After installation of the ventilation system, a specified air volume flow must be available at the motor (see the information on average air volume in the motor data sheet in chapter 4, "Technical Data"). Accordingly, when selecting radial fans, or in case of central ventilation, the installed length of hose or of air channel and the type of air supply (straight or angled) must be taken into consideration.

- The machine manufacturer carries out the calculation of the required air supply capacity using the system specifications.
- Air channel and fan hoses do not belong to the Rexroth scope of delivery.

The following manufacturers can supply powerful radial fans (list with no claim for completeness):

Suppliers of radial fans (excerpt)	
EBM	EBM Werke GmbH & Co. Bachmühle 2 74673 Mulfingen, Germany Tel. +49-(0)7938 / 81-0 Fax +49-(0)7938 / 81-110 http://www.ebm-werke.de/
ZIEHL-ABEGG	Ziehl-Abegg GmbH & Co. KG Zeppelinstraße 28 74653 Künzelsau, Germany Tel. +49-(0)7940 / 16-0 Fax +49-(0)7940 / 16-300 http://www.ziehl-abegg.de/

Fig. 9-14: Manufacturers of radial fans

Coolants

MAF motors must only be operated via an external cooling system.

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

CAUTION

Impairment or loss of motor, machine or cooling system!

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

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

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

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

A cooling with floating water from the supply network is not recommended. Calcareous water can cause deposits or corrosion and damage the motor and the cooling system.

For corrosion protection and for chemical stabilization, the cooling water must have an additional additive which is suitable for mixed-installations with the materials acc. to Fig. 9-16.

The utilization of aggressive coolants, additives, or cooling lubricants can cause irreparable motor damages.

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

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

Aqueous Solution

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

Emulsion with Corrosion Protection

Corrosion protection oils for coolant systems contain emulsifiers which ensure a fine distribution of the oil in the water. The oily components of the emulsion protect the metal surfaces of the coolant duct against corrosion and cavitation. Herewith, an oil content of 0.5 – 2 volume percent has proved itself.

Does the corrosion protection oil compared with the corrosion protection has also the coolant pumping lubricant, then the oil content of 5 volume percent is necessary.

⇒ Heed the instructions of the pumping manufacturer!

Coolant additives

Example for coolant additives:

Description	Manufacturer
1%...3%-Solutions	
Aquaplus 22	Petrofer, Hildesheim
Varidos 1+1	Schilling Chemie, Freiburg
33%-Solutions	
Glycoshell	Deutsche Shell Chemie GmbH, Eschborn
Tyfocor L	Tyforop Chemie GmbH, Hamburg
OZO antifreeze	Deutsche Total GmbH, Düsseldorf
Aral cooler antifreeze A	ARAL AG, Bochum
BP antifrost X 2270 A	Deutsche BP AG, Hamburg
Mineral grease concentrate – emulsive	
Shell Donax CC (WGK: 3)	Shell, Hamburg

Fig. 9-15: Coolant additives

Note: Bosch Rexroth can give no general statements or investigations regarding applicability of process-related coolants, additives, or operating conditions.

The performance test for the used coolants and the design of the liquid coolant system are generally the responsibility of the machine manufacturer. See also Chapter 9.4 ”Compatibility”.

Used Materials

When used with MAF motors, the coolant comes into contact with the following materials:

Motor, housing	Screwed connections	Snap-on coupling
CU, CuZn39Pb2	Brass chromium-plated	Brass chromium-plated

Fig. 9-16: MAF material

In dimensioning and operating the cooling system, the machine manufacturer has to exclude all chemical or electro-chemical interactions with subsequent corrosion or decomposition of motor parts.

Coolant Inlet Temperature

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

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

Setting of the inlet temperature

Observe the temperature range permitted and consider the existing ambient temperature when setting the coolant inlet temperature.

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

Example 1:

Permitted coolant inlet temperature range +10... +40°C

Ambient temperature: +20°C

Set coolant inlet temperature: +15... +40°C

Example 2:

Permitted coolant inlet temperature range +10... +40°C

Ambient temperature: +30°C

Set coolant inlet temperature: +25... +40°C

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

9.9 Motor Temperature Overview

In their standard configuration, stators of IndraDyn A motors are equipped with built-in motor protection temperature sensors.

This sensor has a nearly linear characteristic curve (see Fig. 9-18).

Temperature measurement sensor

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

Fig. 9-17: Temperature measurement sensor

The activation temperatures set on the controller side for protection of the motor are specified at:

⇒ **110°C** pre-warning temperature

⇒ **120°C** switch-off temperature

Exception:

- frame size MAD225 ⇒ **120°C** pre-warning temperature
- frame size MAD225 ⇒ **130°C** switch-off temperature

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

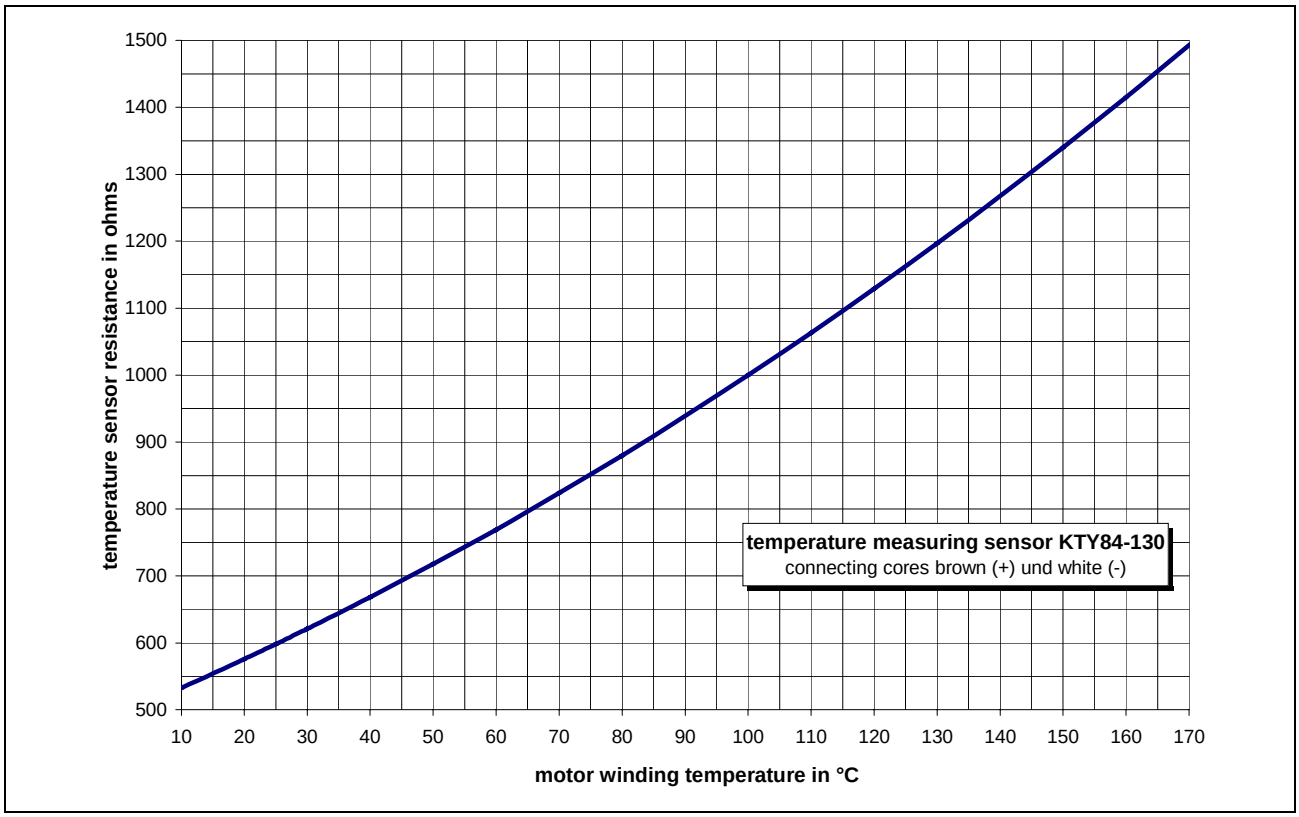


Fig. 9-18: Characteristic of temperature measurement sensor KTY84-130 (PTC)

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

Temperature depending on resistance

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

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

Fig. 9-19: Polynomial used for determining the temperature with a known sensor resistance (KTY84)

Resistance depending on temperature

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

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

Fig. 9-20: Polynomial used for determining the sensor resistance (KTY84) with a known temperature

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

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

9.10 Holding Brake (Option)

In **normal operation**, use the brake only when at a standstill and when performing the drive-internal brake check. The motor holding brake is required for holding the axle when the machine is in a de-energized state.

DANGER

Dangerous movements! Persons endangered by falling or descending axles!

⇒ Observe supplementary DIN and recommendations. For European countries:

- DIN EN 954 / 03.97 on security-related parts of controllers.
- Instruction sheet for vertical axes

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  55130 Mainz, Germany

USA: See National Electric Code (NEC), National Electrical Manufacturers Association (NEMA) as well as local building regulations.

The following is generally valid: the national terms must be observed!

⇒ The serially delivered motor holding brake does not suffice to ensure protection of persons!

⇒ Ensure protection of persons by superordinate fail-safe measures.

⇒ Cordon off the hazardous area by means of a safety fence or a safety screen.

⇒ Additionally secure vertical axes to prevent them from sinking or descending after having shutdown the motor, for instance as follows:

– lock the vertical axes mechanically,

– provide an external braking / collecting / clamping device, or

– ensure sufficient weight compensation of the axes.

- Miscellaneous suitable measures.

Brake control

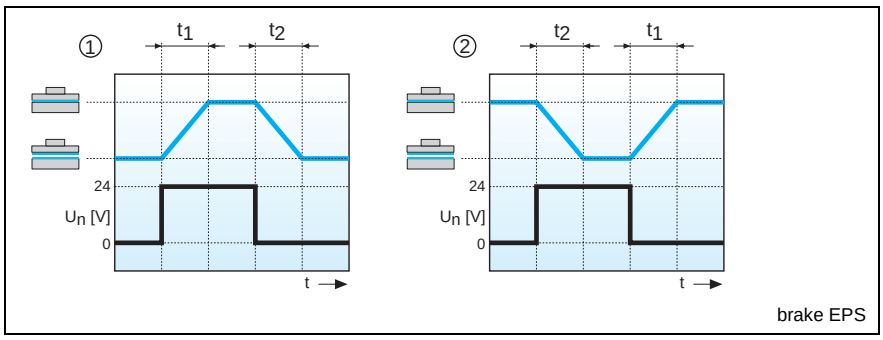
The brake's control mechanism must ensure this function in normal operation. Under the worst load condition of the power supply with a voltage of 24 V_{DC} +/- 10% must provided the motor. To identify a failure on time during operation, the power supply for the brakes must be monitored by an undervoltage detection system.

Functional test

Before startup and during operation specifications the brake function must be tested with the "brake command" function. By applying a small amount of motor torque, the brake is checked for slippage. Additional information and specifications of this function may be found in the ECODRIVE firmware functional descriptions.

Selecting Holding Brakes

Brakes are either electrically clamping or electrically releasing.. Due to functional differences, different brakes should be used for main spindle and servo-axles. Observe the safety requirements during the system design.



(1): Electrically clamping brake (2): Electrically releasing brake
t_1: Combination delay
t_2: Release delay

Fig. 9-21: Holding brake diagram

Main Spindle Applications

Electrically clamping holding brake

An **electrically clamping** holding brake can be used to lock a main spindle during standstill and when the control ”controller enable” signal is off, e.g. when a tool change is performed without a closed position loop.

⇒ Clamp the motor only at standstill, after the controller has signaled the motor is at standstill.

The **electrically releasing** holding brake should not be used for main spindles. Unintentional clamping of the holding brake at a high engine speed can lead to extreme deterioration or even demolition of the brake (e.g. in the case of power loss or wire breakage).

Servo Applications

Electrically releasing holding brake

The **electrically releasing** holding brake is used to hold the axes at a standstill and when the “controller enable” signal is off. When the supply voltage fails and the controller is enabled, the **electrically releasing** brake will automatically close.

⇒ Do not use the holding brake as an operational brake for moving axles.

If the brake is engaged repeatedly on a drive in motion or the rated brake torque is exceeded, premature brake wear can occur.

The **electrically clamping** holding brake is inappropriate for servo applications because clamping in a de-energized clamping state is not possible.

Sizing of Holding Brakes (Application)

The physical conditions of holding brakes require consideration of two states. In addition to normal operation, failures must also be considered. The effective braking torques are physically different.

Normal Operation

In **normal operation**, using the holding brake for clamping of an axis standstill, the brake`s static torque (M4) rating in the data sheets applies directly as static friction (M4) – stiction (friction coefficient μ_H).

Fault Condition (EMERGENCY STOP)

In **fault conditions (i.e., EMERGENCY STOP)**, where the holding brake is used to stop a moving axis, the ”dynamic braking torque”, or sliding friction (friction factor μ_G) applies.

The dynamic braking torque is reduced in comparison to the indicated static holding torque M4. Therefore, note the following description of dynamic sizing.

Dynamic sizing

The load torque must be lower than the minimum dynamic torque which the brake can provide. Otherwise the dynamic brake torque is not sufficient to stop the axis.

If a mass is to be decelerated in a defined time or in a defined way, the additional moment of inertia of the whole system must be taken into account.

Further important aspects for sizing:

The holding brake is not a safety brake (see DIN EN 954 / 03.97 and vertical axis data sheet SMBG). Due to uncontrollable influencing factors such as a rust film on the brake surface, the brake holding torque can be reduced. Additionally, excessive voltages and temperatures can weaken the permanent magnets and the brake.

Sizing recommendation

Bringing these factors together, the following recommendations can be given for sizing the holding brakes to the axles.

The necessary holding torque required for the application must not exceed a maximum of 60% of the static holding torque (M4) of the used holding brake.

Note: **Holding torque reduction and premature wear occur when braking moving axles!**

Do not use the holding brake to stop a moving axle! This is permitted for EMERGENCY STOP situations only. In this situation, the specified rated torque of the holding brake (M4) is reduced to the value of the available dynamic braking torque. Complete deterioration of brake holding capability can be expected after approximately 20,000 revolutions of the brake when clamped.

Observe the instructions on commissioning holding brakes as described in chapter 12 ”Startup, Operation, and Maintenance”.

9.11 Motor Encoder

Options

"**S0**": Singleturn absolute encoder with I²C interface. $1V_{ss}$ sine/cosine signals with 512 lines per rotation and absolute period assignment within one shaft rotation.

"**S2**": Singleturn absolute encoder with EnDat2.1 interface. $1V_{ss}$ sine/cosine signals with 2048 lines per rotation and absolute period assignment within one shaft rotation. The encoder has a data memory which comprises all relevant motor parameters required for commissioning the motor.

"**S6**": Encoder option for hazardous areas in pressure-resistant encapsulation with connection cable length 15 m. Technical characteristics same as option "**S2**".

"**M0**": Multiturn absolute encoder with I²C interface. $1V_{ss}$ sine/cosine signals with 512 lines per rotation and absolute period assignment within 4096 shaft rotations. The axle position is recorded if the power fails.

"**M2**": Multiturn absolute encoder with EnDat2.1 interface. $1V_{ss}$ sine/cosine signals with 2048 lines per rotation and absolute period assignment within 4096 shaft rotations. The axle position is recorded if the power fails. The encoder has a data memory which already contains all relevant motor parameters required for commissioning the motor.

"**M6**": Encoder option for hazardous areas in pressure-resistant casing with connection cable length 15 m Technical characteristics same as option "M**2**".

"**C0**": Incremental encoder sine-/cosine signals 1Vss with 2048 lines per revolution.

"**N0**": The motor is supplied without a factory-attached encoder unit. The rear of the motor is blocked by a cover.

Compatibility

Due to different encoder technologies, the motor encoders can be connected to only certain drive controllers and interfaces. The encoder data must be parameterized in the controller. The compatibility can be seen in the following table:

Encoder option	ECO03	DIAX04	IndraDrive					
	DKC 40...200	HDD, HDS	ADVANCED	BASIC OPENLOOP	BASIC SERCOS	BASIC PROFIBUS	BASIC ANALOG	BASIC UNIVERSAL
C0, M0, S0	+	+	+	-	-	-	-	+
M2, S2 M6, S6	-	-	+	+	+	+	+	+
+ compatible - incompatible								

Fig. 9-22: Encoder compatibility

Accuracy

There are two types of accuracy for rotary encoders: "absolute accuracy" and "relative accuracy".

Absolute

The absolute accuracy of rotary encoders is determined primarily by the quality and precision of the encoder construction as well as by the mechanical attachment to the motor.

The following values apply to IndraDyn A motors:

Encoder option acc. to type code	Technical Data	Absolute accuracy
C0	Incremental encoder sinus/cosine signal 1Vss with 2048 lines	± 0,0056° (± 20")
M0	Multiturn absolute encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines	± 0,0167° (± 60")
M2, M6	Multiturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2048 lines	± 0,0056° (± 20")
S0	Singleturn absolutel encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines	± 0,0167° (± 60")
S2, S6	Singleturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2048 lines	± 0,0056° (± 20")

Fig. 9-23: Absolute encoder precision

Relative

The relative accuracy of encoder systems is also referred to as "repeatability". It is determined primarily by the interpolation variances during further processing of the measured signals in the installed and in the external interpolation and digitization electronics.

For 2AD motors, the following guidelines apply for operation with Rexroth drive controllers (as of the publishing date of this documentation):

Encoder option acc. to type code	Technical Data	Relative accuracy
C0	Incremental encoder sinus/cosine signal 1Vss with 2048 lines	± 0,01'
M0	Multiturn absolute encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines	± 0,005'
M2, M6	Multiturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2048 lines	± 0,005'
S0	Singleturn absolute encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines	± 0,001'
S2, S6	Singleturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2048 lines	± 0,001'

Fig. 9-24: Relative encoder precision

Continuous further development of the hardware and firmware for drive controllers may result in variances from the above values. Therefore, always observe the information in the current drive controller documentation.

The accuracy of encoder systems is only a secondary factor for the precision of processing and positioning processes in a system.
Determining factors for the precision that can be attained include the functions of the system and the quality of the mechanical construction, among other things.

Connection

The encoder connection is always on the same side of the motor as the power connection. The position of the encoder connection can not be changed after the motor has been delivered. For more details, refer to the motor dimension sheet and to chapter 8, “Connection Techniques”.

Detailed information on the encoder connection on the controller side and on setting its parameters can be found in the documentation of the drive controllers.

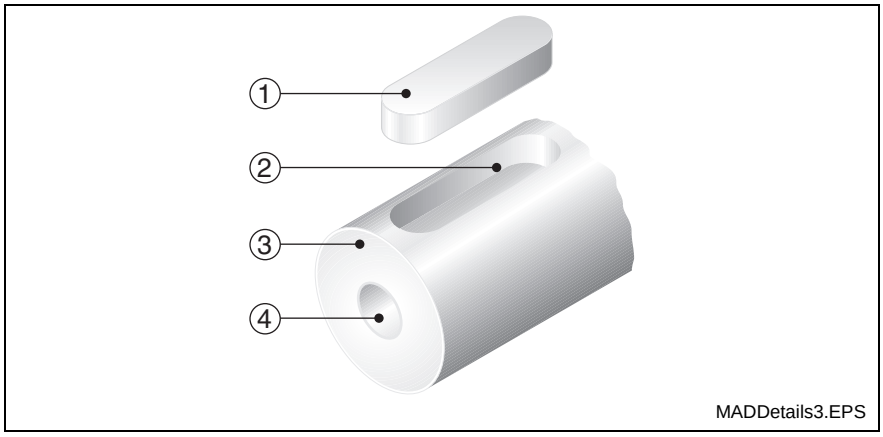
9.12 Output Shaft

Plain Shaft

The recommended standard model for all IndraDyn A motors provides a non-positive, zero backlash shaft-hub connection with a high degree of quiet running. Use clamping sets, clamping sleeves or clamping elements to couple the machine elements to be driven.

Output Shaft With Key

The optional key according to DIN 6885, Sheet 1, version 08-1968, permits keyed transmission of torques with constant direction, with low requirements for the shaft-hub connection.



(1): Key (2): Keyway
(3): Motor shaft (4): Center hole

Fig. 9-25: IndraDyn A output shaft with key

The machine elements to be driven must additionally be secured in the axial direction via the centering hole on the end face.

Note: Avoid strong reversing operation. Deformations in the area of the keyway can lead to breakage of the shaft.

Balancing with a half key

The motor is balanced by a half key. The mass relationships are similar to those for a plain shaft. Inserting a complete key results in an imbalance that must be compensated on the machine element that is to be driven.

The hub of a machine element that is to be driven (pinion, pulley, etc.) should correspond to the key length.

Note: If the hub is shorter, use a graduated key.

Balancing with a complete key

The motor is balanced using the included key. Hence, the machine element to be driven must be balanced without a key. The groove length in the hub is independent of the length of the key.

Modifications to the key may be made only by the user himself and on his own responsibility.
Bosch Rexroth does not provide any warranty for modified keys or motor drive shafts.

Output Shaft with Shaft Sealing Ring

With the optional radial shaft sealing ring according to DIN 3760 – Design A, gearboxes with oil bath or circulating oil lubrication can be attached to IndraDyn A motors. IndraDyn A motors can also be operated in a dusty or humid environment.

Note: With open oil-lubricated gearboxes, heavy sprays or speeds exceeding 4,000 rpm, we recommend to use an additional labyrinth seal which can be ordered or refitted as an accessory (see chapter 7).

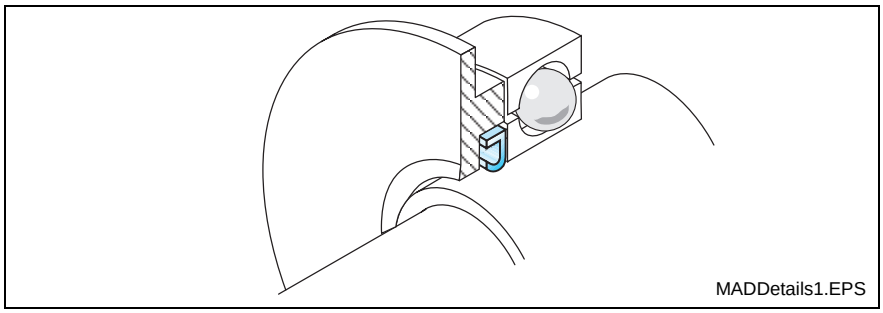


Fig. 9-26: Shaft sealing ring

Wear

Radial shaft sealing rings are rubbing seals. Hence, they are subject to wear and generate frictional heat.

Wear of the rubbing seal can be reduced only if lubrication is adequate and the sealing point is clean. Here, the lubricant also acts as a coolant, supporting the discharge of frictional heat from the sealing point. The

useful life of the sealing lip at the radial shaft sealing ring depends in cleanliness, lubrication and motor speed.

Note: Prevent the sealing point from becoming dry and dirty. Always ensure sufficient cleanliness and lubrication.

Resistance

The materials used for the radial shaft sealing rings are highly resistant to oils and chemicals. The performance test for the particular operating conditions lies, however, within the machine manufacturer's responsibility.

As of the publication date of this document, the following material assignment is applicable:

MAD/MAF motor ...	Sealing material	Abbreviation
100...160	Polytetrafluorethylene	PTFE
180	Viton	FKM
225	Polytetrafluorethylene	PTFE

Fig. 9-27: IndraDyn A shaft sealing ring

The complex interactions between the sealing ring, the shaft and the fluid to be sealed, as well as the particular operating conditions (frictional heat, soiling, etc.), do not allow accurate calculation of the lifetime of the shaft sealing ring.

However, with a circumferential speed of 5 m/s and under favorable conditions (e.g. sufficient cleanliness and lubrication), a useful life of 5,000…10,000 h can be realized.

Vertical mounting positions IM V3/IM V6

The degree of protection on the flange side of motors with a shaft sealing ring is IP 65. Hence, tightness is ensured only in case of splashing fluids. Fluid levels present on the A-side require a higher degree of protection. In the case of the vertical installation position of the motor, also heed the notes in the "9.6" section of this chapter ("Vertical Installation").

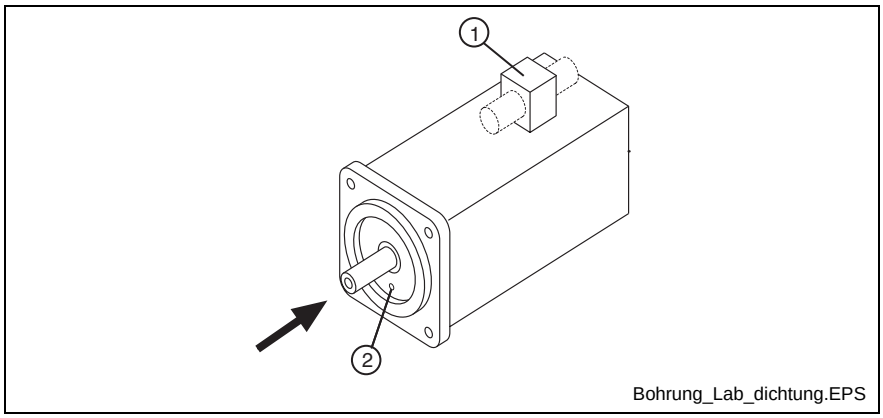
Labyrinth Seal

To protect the motor output shaft against spraying fluids, IndraDyn A motors of frame size 225 can be directly ordered with labyrinth seal Please heed the correct order designation of the motors according to chapter 6, "Type Codes".

The labyrinth seal is provided to prevent the penetration of oil and splashing water (lubricating coolants etc). into the motor.

However, correct functioning of the labyrinth seal is only ensured when the motor installation position is horizontal, the position of the drain hole is always below the output shaft, the fluid level present at the motor is at least 5 mm below the drain hole (Fig. 7-2), the motor speed is at least 200 rpm.

On delivery, the labyrinth seal at the motor is installed in such a way that when looking at the A-side of the motors, the terminal box points up and the drain hole points down (below the output shaft).

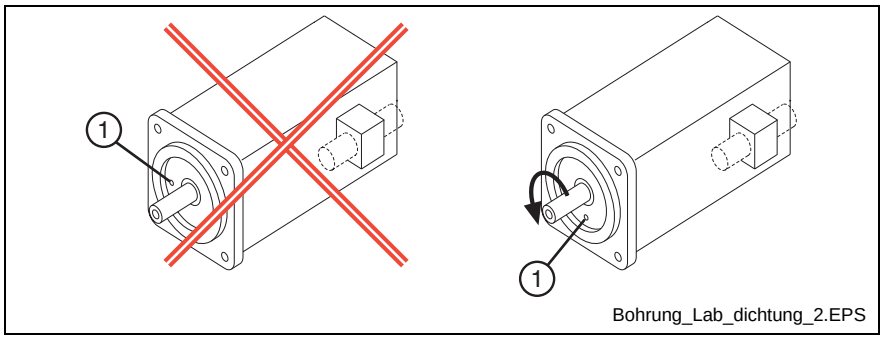


1: Terminal box = pointing up
2: Drain hole = pointing down

Fig. 9-28: Position of the drain hole in the motor as delivered

In certain installation situations, it may be necessary to install the motor with the terminal box positioned at the side or pointing down.

In these cases, turn the flange of the labyrinth seal before installing the motor until the drain hole is once more below the output shaft. In this way, correct functioning of the labyrinth seal is ensured.



(1): Drain hole

Fig. 9-29: Example for a permissible position of the drain hole of the labyrinth seal

For this purpose, the flange has a hole circle with additional mounting holes in a 30° grid. To bring the drain hole of the labyrinth seal into the required position, perform the following assembly steps:

1. Unscrew the mounting screws (4x M6 DIN912).
   - If necessary, heat the screws to approx. 70°C to loosen them as they are glued in with Loctite 243.
2. Turn the flange on its center so that the drain hole points down once more.
3. Moisten the mounting screws (4x M6 DIN912) with Loctite 243 and screw them into the aligned threaded holes through the holes in the flange.
   - Tightening torque 9 Nm.
4. Attach the motor.

Note: For motors of frame sizes 130 to 180, Rexroth offers suitable accessories for retrofitting the motors. For more information, please refer to chapter 7.1 “Labyrinth Seal”.

9.13 Bearing and Shaft Loads

During operation, both radial and axial forces act upon the motor drive shaft and thus upon the bearings. Machine design and motor type must be carefully adapted to make sure that the specified load limits are not exceeded.

Radial Load, Axial Load

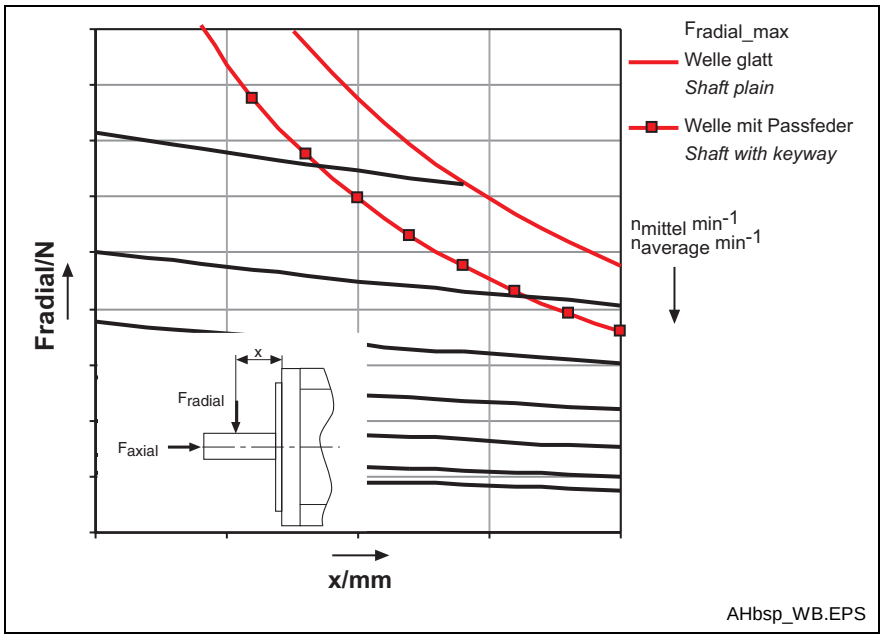


Fig. 9-30: Example of a shaft load diagram

Maximum permissible radial force F_{radial_max}

The maximum permissible radial force F_{radial_max} depends on the following factors:

- Shaft break load
- Point of force application (see Fig. 9-30)
- Shaft design (plain; with key)

Permitted radial force F_{radial}

The permitted radial force F_{radial} depends on the following factors:

- Arithmetic mean speed (n_{mean})
- Point of force application (see Fig. 9-30)
- Bearing Lifetime

Permitted axial force F_{axial}

For IndraDyn A motors, only low axial shaft loads are permitted.

MAD/MAF	100	130 ...180	225
perm. axial load [N]	30	50	100

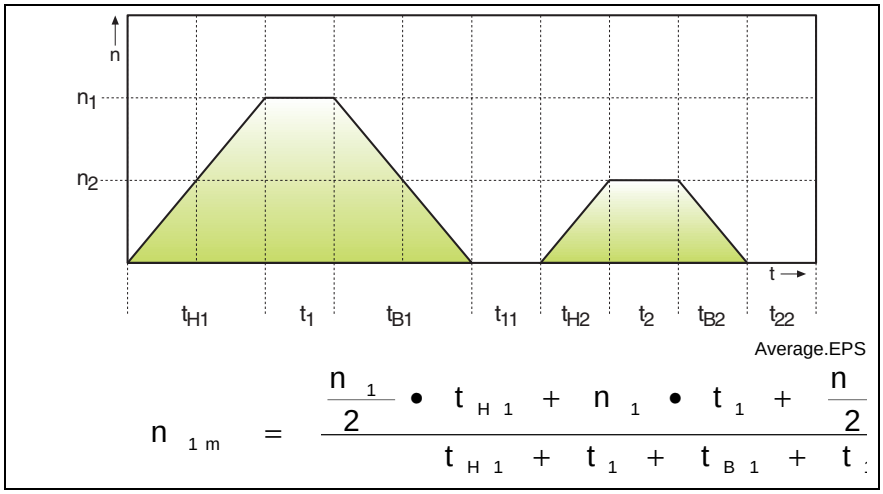
Fig. 9-31: Axial load

The permitted axial load applies for all installation positions. Therefore, the motors are **not** suitable for machine elements that generate axial loading of the motors (e.g. helical driving pinions).

Note: Avoid impermissible axial loads or jolting of the motor drive shaft.

Mean speed

The initialization and deceleration times can be ignored in the calculation if the time in which the drive is operated at a constant speed is significantly higher than the acceleration and deceleration time. In the exact calculation of the mean speed according to the following example, the run-up and braking times are taken into account.



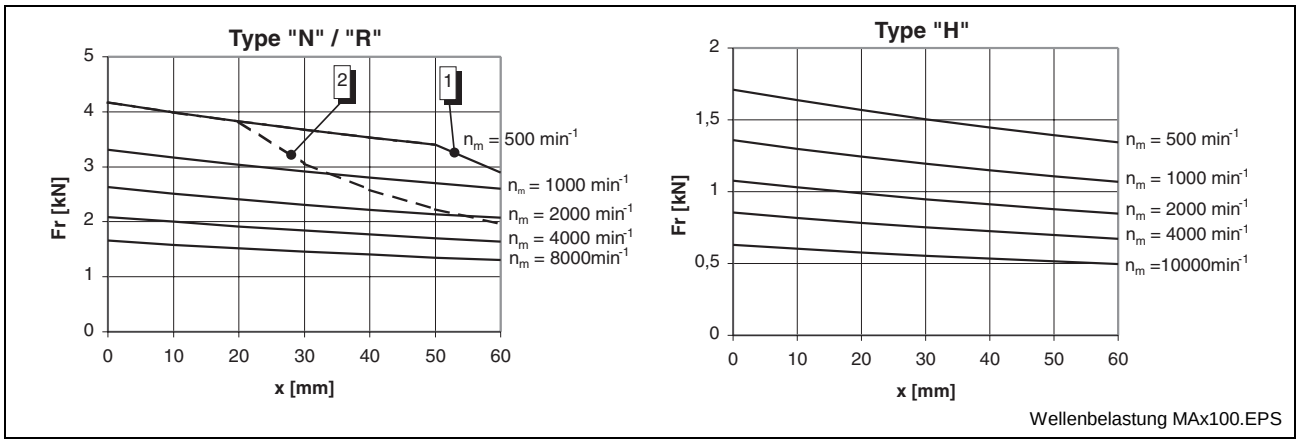
$$n_{1m} = \frac{\frac{n_1}{2} \bullet t_{H1} + n_1 \bullet t_1 + \frac{n_2}{2} \bullet t_{H2} + n_2 \bullet t_2}{t_{H1} + t_1 + t_{B1} + t_{11} + t_{H2} + t_2 + t_{B2} + t_{22}}$$

n_{1m}:	mean speed in section 1	n_{2m}:	mean speed in section 2
n_{1m}:	processing speed	n_2:	processing speed
t_{H1}:	run-up time	t_{H2}:	run-up time
t_1:	processing time	t_2:	processing time
t_{B1}:	braking time	t_{B2}:	braking time
t_{11}:	standstill time	t_{22}:	standstill time

Fig. 9-32: MAD mean speed

A complete processing cycle can consist of several sections with different speeds. In this case, the average is to be generated from all the sections.

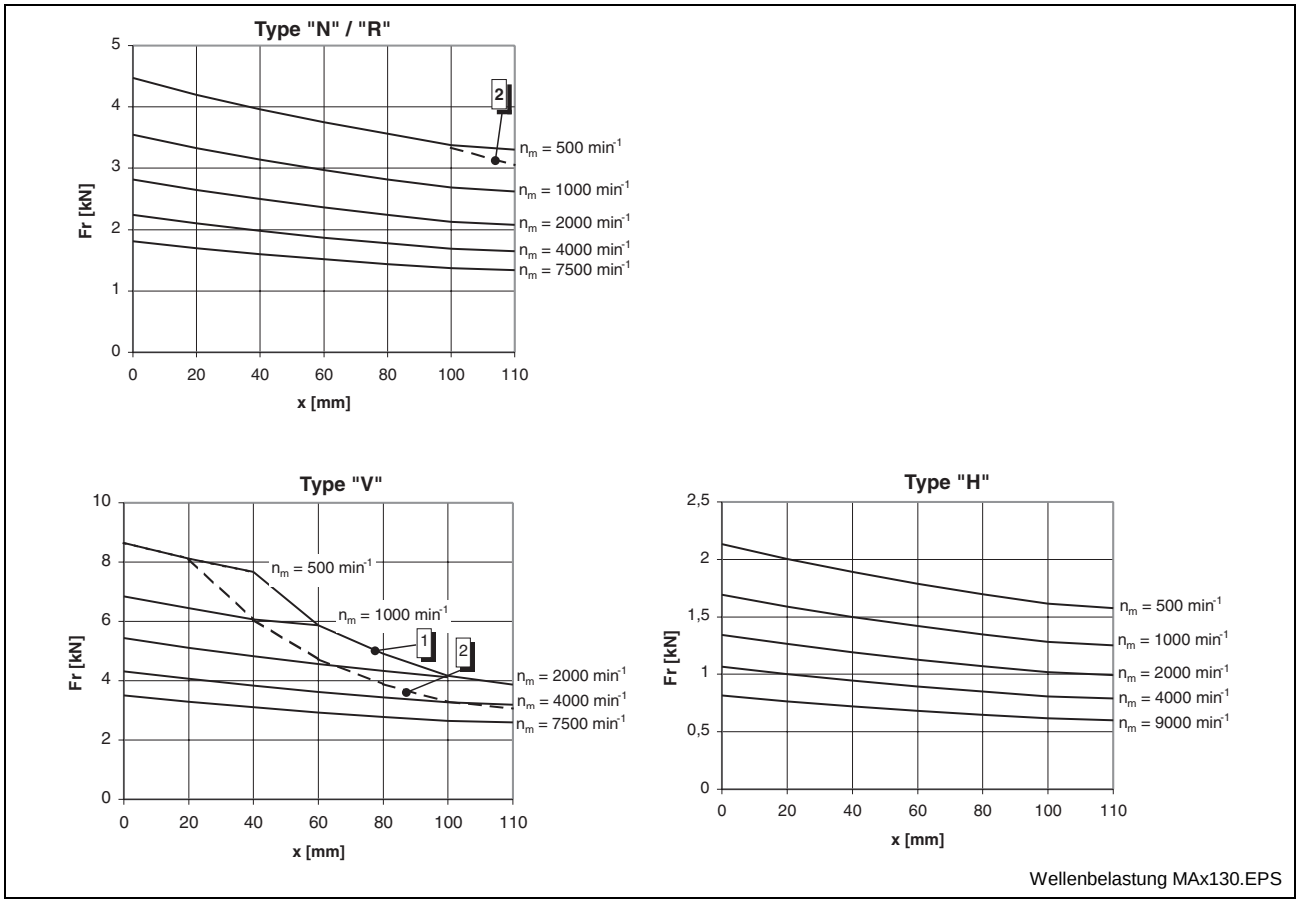
Shaft load frame size 100



"N":	Standard bearings
“R“:	Bearing for coupling connection
”H”:	High-speed bearing
(1):	Load limit for drive shaft without key
(2):	Load limit for drive shaft with key
n_m:	Mean speed

Fig. 9-33: Shaft load frame size 100 (L_h=30,000 operating hours)

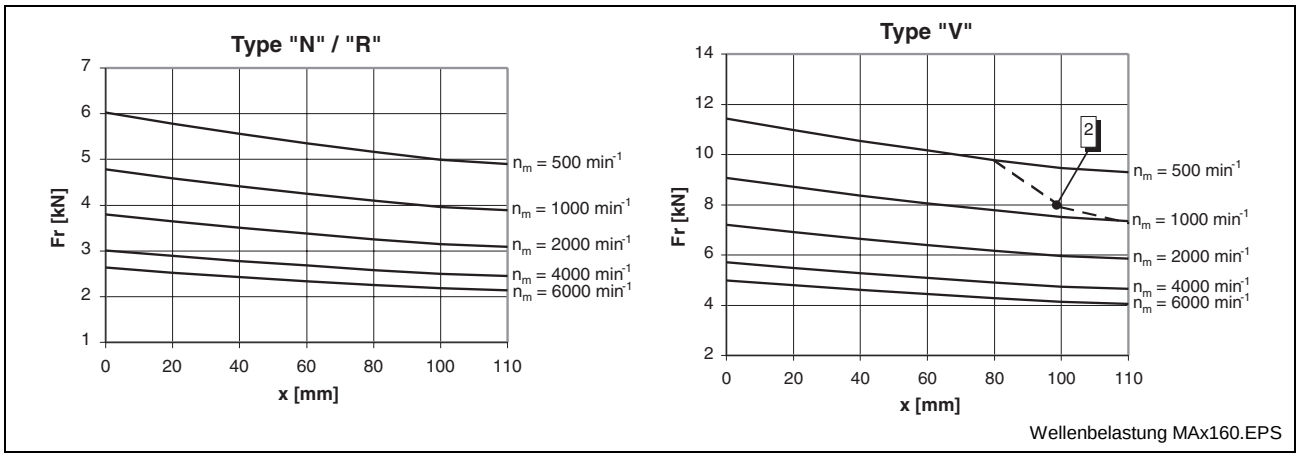
Shaft load frame size 130



"N":	Standard bearings	"V":	Reinforced bearing
“R“:	Bearing coupling connection	”H”:	High-speed bearing
(1):	Load limit for drive shaft without key		
(2):	Load limit for drive shaft with key		
n_m:	Mean speed		

Fig. 9-34: Shaft load frame size 130 (L_h=30,000 operating hours)

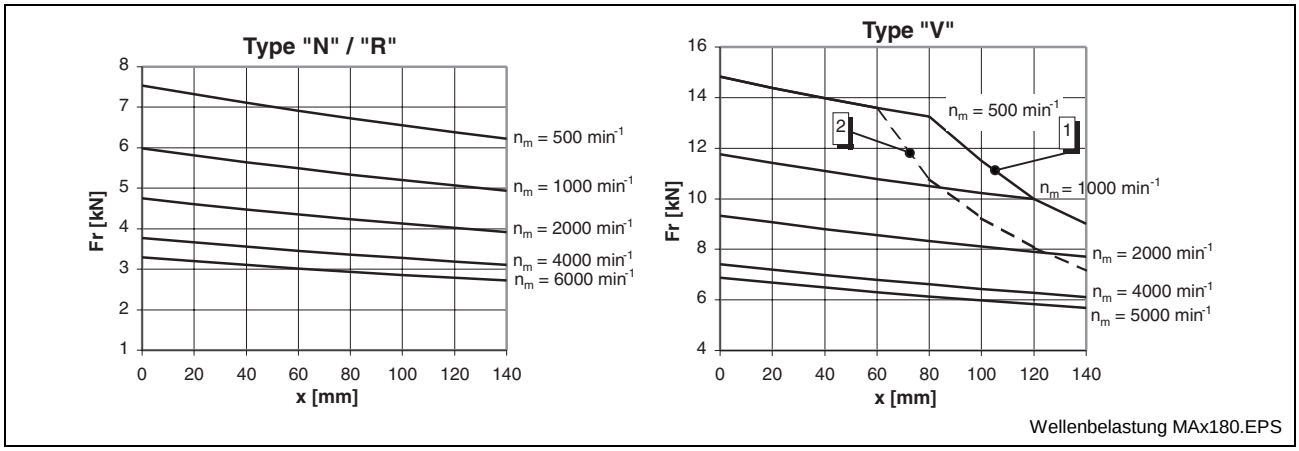
Shaft load frame size 160



"N":	Standard bearings
“R“:	Bearing for coupling connection
"V":	Reinforced bearing
(1):	Load limit for drive shaft without key
(2):	Load limit for drive shaft with key
n_m:	Mean speed

Fig. 9-35: Shaft load frame size 160 (L_h=30,000 operating hours)

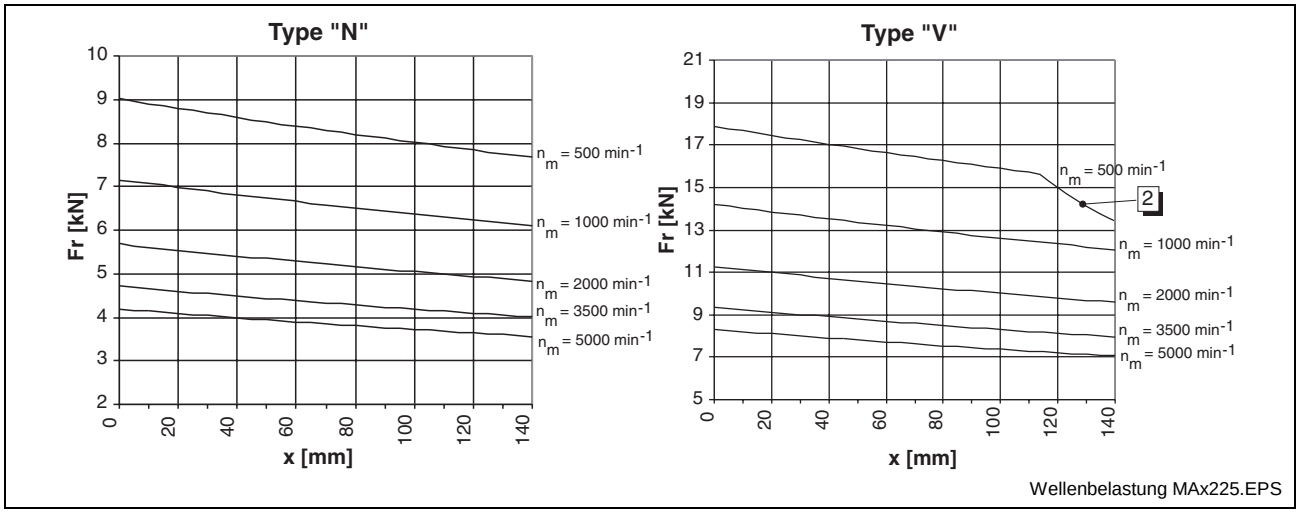
Shaft load frame size 180



"N": Standard bearings
"R": Bearing for coupling connection
"V": Reinforced bearing
(1): Load limit for drive shaft without key
(2): Load limit for drive shaft with key
n_m: Mean speed

Fig. 9-36: Shaft load frame size 180 (L_h=30,000 operating hours)

Shaft load frame size 225



"N": Standard bearings
"V": Reinforced bearing
(2): Load limit for drive shaft with key
n_m: Mean speed

Fig. 9-37: Shaft load frame size 225 (L_h=30,000 operating hours)

9.14 Attachment of Drive Elements

For all attachments of drive elements to the drive shaft, such as

- gearboxes
- couplings
- pinions

it is imperative that the following notes are observed.

Redundant bearings

Generally, overtermined bearings are to be avoided by all means when connecting drive elements. The tolerances inevitably present in such cases will lead to additional forces acting on the bearing of the motor shaft and, should the occasion arise, to a distinctly reduced service life of the bearing and/or to fatigue transverse rupture/vibration rupture of the motor shaft.

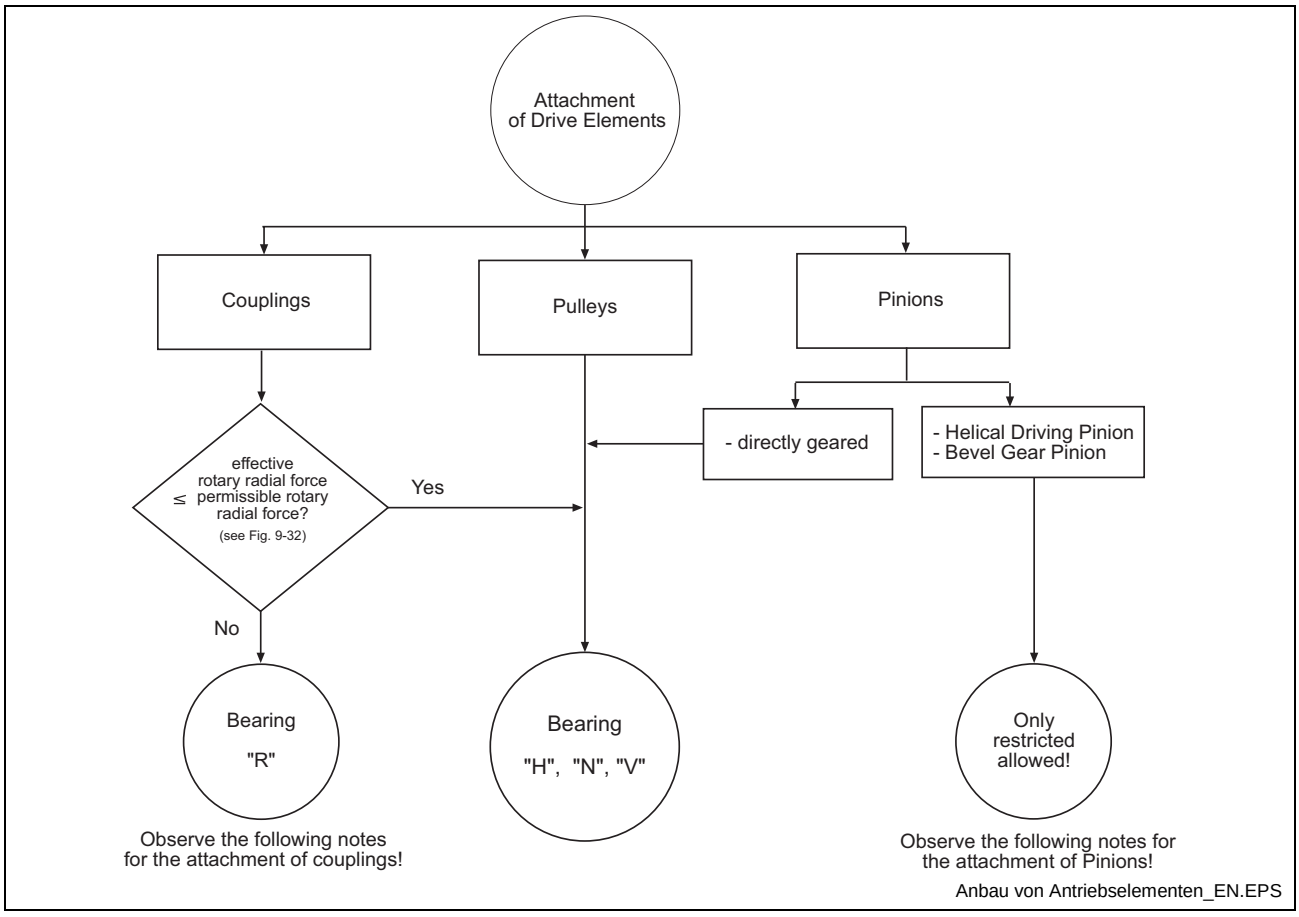


Fig. 9-38: Application of drive elements

Note: If redundant attachment cannot be avoided, it is absolutely necessary to consult with Bosch Rexroth.

Couplings

Couplings are attached to transmit torques of two separate shaft ends. Usually, shaft offset, angle errors or axial distances must be offset. When an excessively stiff coupling is attached, a rotating radial force (= one which constantly causes change of angle position) may occur on the shaft end. This rotating radial force can cause an impermissibly high stress on the bearing seat and thus a significant reduction of bearing lifetime.

Note: For coupling attachment to IndraDyn A motors, Rexroth offers bearing variant “R”.

When bearing “R“ is used, higher rotating radial forces can be absorbed. Furthermore, couplings with higher radial stiffness can be used.

Motor size MAD/MAF...	Permitted rotating radial forces	
	with bearing “R”	with bearing “N”, “H”, “V”
100B	800 N	25 N
100C	800 N	25 N
100D	800 N	30 N
130B	1000 N	40 N
130C	1000 N	50 N
130D	1000 N	55 N
160B	1300 N	65 N
160C	1300 N	65 N
180C	1600 N	95 N
180D	1600 N	100 N
225C	not available	120 N

Fig. 9-39: Permitted rotating radial forces

Note: When bearing “R“ is used, a limited maximum speed is available.

For information on maximum speed of the respective motor, please refer to chapter 4 "Technical Data".

Coupling recommendations

Rexroth recommends that you use axially offsetting couplings in connection with bearing “B”, for example

- Spring flange couplings with two sets of springs (double cardanic)
- Metal bellow couplings

These coupling variants are backlash-free and have a high torsion stiffness along with low radial spring stiffness.

Note: Should you be unable to use the recommended coupling variants, it is imperative that you contact Bosch Rexroth.

We recommend e.g. the following manufacturers of the above-named couplings:

- A. Friedrich Flender GmbH
  Alfred Flender Strasse 77
  46395 Bocholt, Germany
  Phone: +49 (0) 2871 920
  Fax +49 (0) 2871 922 596
  Web: www.flender.com
- JAKOB GmbH&CoKG
  Daimler Ring 42
  63839 Kleinwallstadt, Germany
  Web: www.jakobantriebstechnik.de
  Phone: +49 (0) 6022 2208 0
  Fax +49 (0) 6022 2208 22
- R+W Antriebselemente GmbH
  Alexander-Wiegand-Strasse 8
  63911 Klingenberg, Germany
  Phone: +49 (0) 9372 9864 0
  Fax +49 (0) 9372 9864 20
  Web: www.rw-kupplungen.de

Skew Bevel Driving Pinions

Owing to thermal effects, the flange-sided end of the output shaft may shift by 0.6 mm in relation to the motor housing. If skew bevel driving pinions directly attached to the output shaft are used, this change in position will lead to

- a shift in the position of the axis to be driven.

Note: It is generally not permitted to directly attach skew bevel driving pinions. With skew bevel driving pinions, only drive elements with their own bearings may be used which are connected to the motor shaft via axially compensating couplings.

Bevel Gear Pinions

Owing to thermal effects, the flange-sided end of the output shaft may shift by 0.6 mm in relation to the motor housing. If bevel gear pinions directly attached to the output shaft are used, this change in position will lead to

- a thermally depend ent component of the axial force if the driving pinions are defined axially on the machine side. This causes the risk of exceeding the maximum permissible axial force or of the play within the gears increasing to an impermissible degree.

For this reason, bevel gear pinions must not be attached directly to the motor shaft. With bevel gear pinions, only drive elements with their own bearings may be used which can be connected to the motor shaft via axially compensating couplings.

Note: Direct attachment of bevel gear pinions to the motor shaft is not permitted.

9.15 Bearing Lifetime

The bearing lifetime is an important criterion for the availability of IndraDyn motors. When the lifetime is considered, the "mechanical lifetime" of bearing components and materials is differentiated from the "grease lifetime" of the bearing lubricant.

If IndraDyn motors are operated within the limits specified for radial and axial loads, the mechanical service life of the bearings is as follows:

Mechanical service life of bearings

L_{10h} = 30,000 operating hours

(calculated according to ISO 281, ed. 1993.01)

This applies to all IndraDyn motors based on the following:

- The permitted load of the motor from chapter 9.13 "Shaft Load" is never exceeded.
- The motor is operated under the permitted conditions for use and in the permitted ambient temperature range of 0° C to +40° C.
- The “mean speed” driven over the entire processing cycle conforms with the characteristic curves for the grease lifetime, whereby

$$n_m < n_{m(t_f = 30000\,h)}$$

n_m: mean speed
$n_{m(tf)}$: mean speed for which a grease lifetime of 30,000 h can be expected.

Fig. 9-40: Mean speed

Differing loads can have the following effects:

- Premature failure of the bearing due to increased wear or mechanical damage.
- Reduction of the grease lifetime, leading to premature failure of the bearing.

⇒ Avoid exceeding the load limits.

Mechanical bearing lifetime with increased radial force

In other cases, the bearing lifetime is reduced as follows:

$$L_{10h} = \left(\frac{F_{radial}}{F_{radial\_ist}} \right)^3 \cdot 30000$$

L_{10h}: (Bearing lifetime according to ISO 281, ed. 12/1990)
F_{radial}: Determined permissible radial force in N (Newtons)
F_{radial_act}: Actually acting radial force in N (Newtons)

Fig. 9-41: Calculation of the bearing service life L_{10h} if the permissible radial force F_{radial} is exceeded

Note: Under no circumstances may the actually acting radial force F_{radial_act} be higher than the maximum permissible radial force F_{radial_max}.

9.16 Grease Service Life

Grease service life (t_f) is defined as the time from start-up until breakdown of a bearing as a consequence of lubrication failure.

Note that unfavorable operating and ambient conditions reduce the grease service life. When calculating the grease service life to be expected (T_{fq}), consider certain reduction factors for unfavorable operating and ambient conditions for each individual application. The following table indicates the reduction factors in accordance with the publication no. WL 81 115/4 DA by FAG Kugelfischer AG.

Reduction factors

Description	Description	Influence	Factor	Comment
Influence of dust and moisture at the function surfaces of the bearing	f_1	moderate	0,9....0,7	For this environment, Rexroth offers the option “radial shaft sealing ring”. When this option is used, $f_1 = 1$
		strong	0,7....0,4	
		very strong	0,4....0,1	
Influence of impact load, vibrations and oscillations	f_2	moderate	0,9....0,7	e.g. for machine tools and printing presses
		strong	0,7....0,4	e.g. for materials-handling technology (portals)
		very strong	0,4....0,1	e.g. for punches, presses
Influence of higher bearing temperatures	f_3	moderate (up to 75°C)	0,9....0,6	The bearing temperature depends on the motor load. Use of a special high-temperature grease results in - load 0...70% $f_3 = 1$ - load 71...100% $f_3 = 0.99...0.7$
		strong (75...85°C)	0,6....0,3	
		strong (85..120°C)	0,3....0,1	
Influence of high load	f_4	P/C=0.1...0.15	1,0....0,7	With corresponding load of the shaft/bearing according to the respective shaft load diagram, the following applies to IndraDyn A motors - load 0...70% $f_4 = 1$ - load 71...100% $f_4 = 0.99...0.7$
		P/C=0.15...0.25	0,7....0,4	
		P/C=0.25...0.35	0,4....0,1	
Influence of air flows through the bearing	f_5	insignificant flows	0,7....0,5	With correct operation, there is no influencing air flow in the motor $f_5 = 1$
		significant flows	0,5....0,1	
With centrifugal effect or vertical shaft depending on sealing	f_6	vertical	0,7....0,5	With horizontal motor installation $f_6 = 1$

Fig. 9-42: Reduction factors for grease service life

Calculation

$$t_{fq} = t_f \times f_1 \times f_2 \times f_3 \times f_4 \times f_5 \times f_6$$

Fig. 9-43: Calculation of the expected grease service life

Note: Ensure that the permitted loads from chapter 9.13 "Shaft Loads“ are not exceeded.

If the deployment duration of the motor is limited by the expected grease service life, the deployment duration of the motor can be increased in marginal cases by using the standard bearing in place of the reinforced

bearing in exceptional cases. In this case, the expected grease service life increases. However, the increased loading of the standard bearing reduces the available mechanical lifetime below 30000 operating hours.

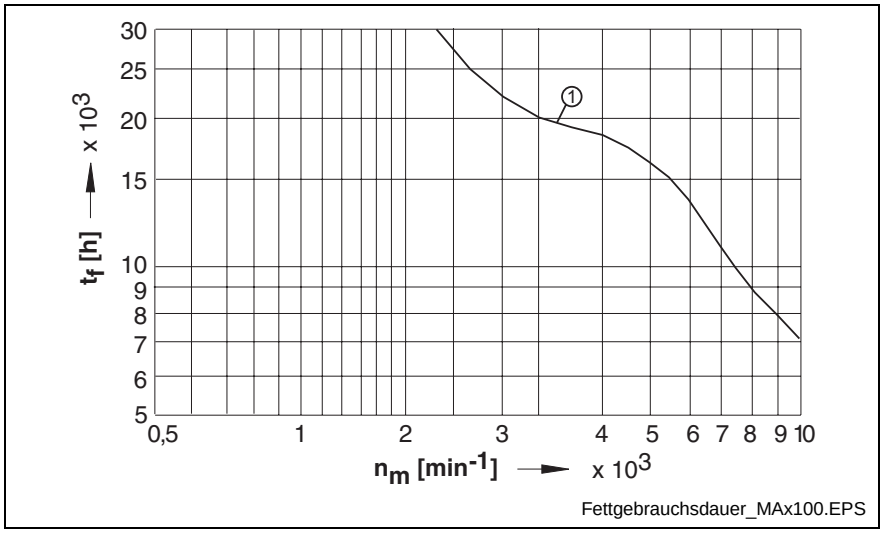
⇒ This requires subsequent calculation of the bearing lifetime by Rexroth. In this case, contact one of our branch offices and explain your application with all relevant application data (load cycle, axial and radial loads, speeds).

The calculation and dimensioning of the bearing is based on standard DIN ISO 281.

See the diagrams below for the available grease service life of the deep-groove ball bearings and cylindrical roller bearings in IndraDyn A motors.

The diagrams show different characteristic curves depending on bearing type, standard, high-speed, or reinforced bearing, and bearing for the coupling connection.

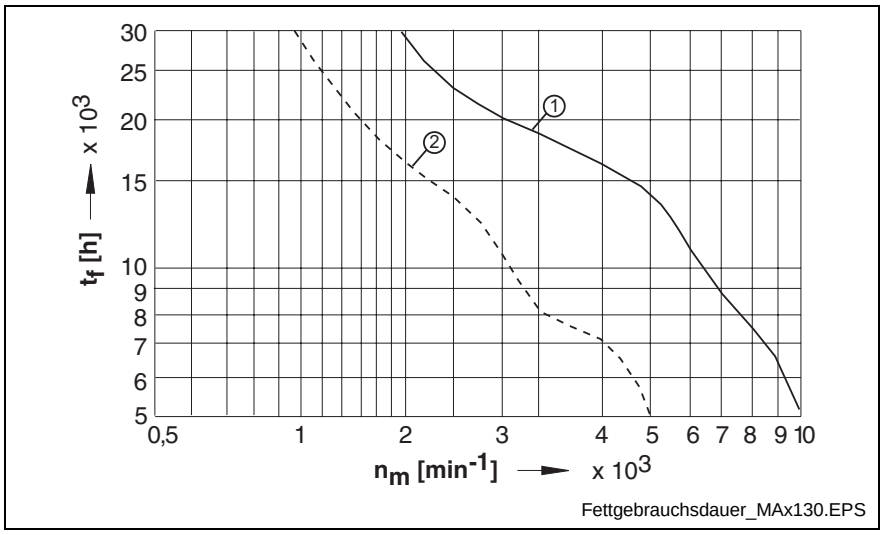
Grease service life frame size 100



t_f: Grease service life (without reduction factors)
(1): Standard and high-speed bearings, and bearing for coupling connection
n_m: mean speed (calculation see Fig. 9-40)

Fig. 9-44: Grease service life frame size 100

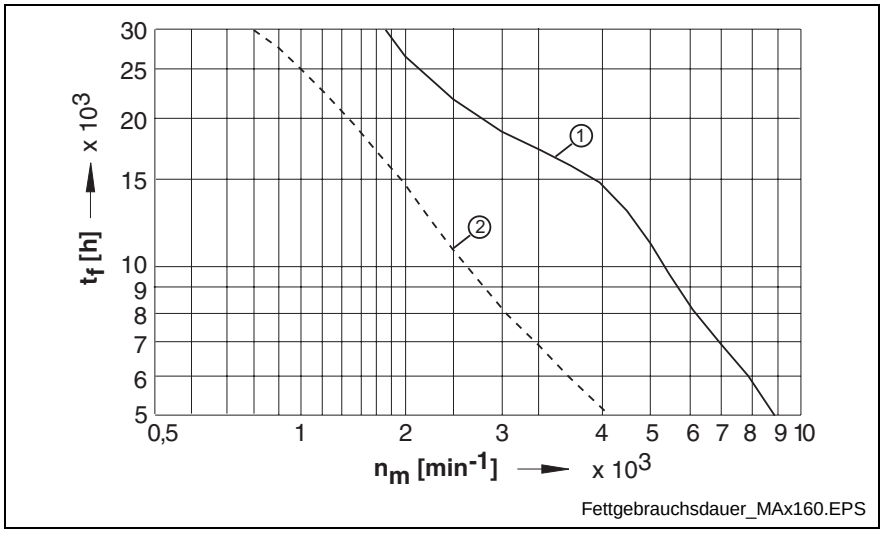
Grease service life frame size 130



t_f: Grease service life (without reduction factors)
n_m: mean speed (calculation see Fig. 9-40)
(1): Standard and high-speed bearings, and bearing for coupling connection
(2): Reinforced bearing

Fig. 9-45: Grease service life frame size 130

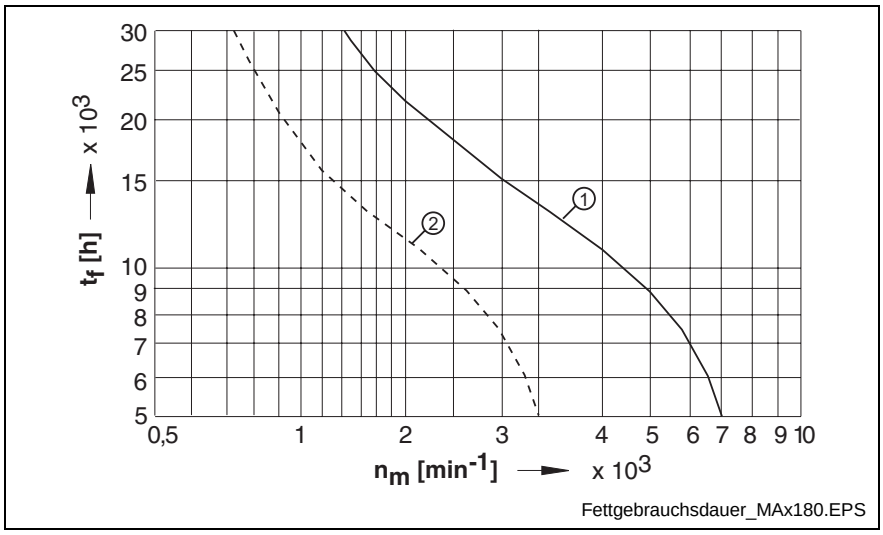
Grease service life frame size 160



t_f: Grease service life (without reduction factors)
n_m: mean speed (calculation see Fig. 9-40)
(1): Standard bearing and bearing for coupling connection
(2): Reinforced bearing

Fig. 9-46: Grease service life frame size 160

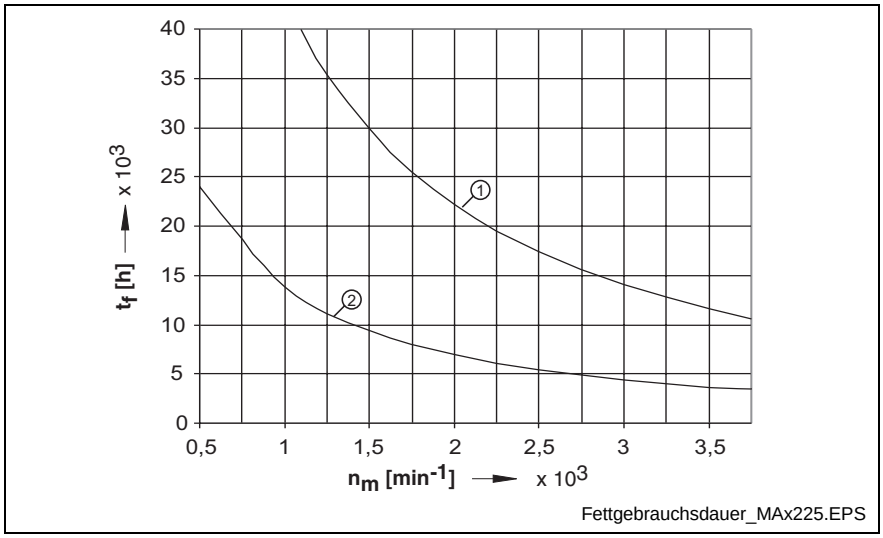
Grease service life frame size 180



t_f: Grease service life (without reduction factors)
n_m: mean speed (calculation see Fig. 9-40)
(1): Standard bearing and bearing for coupling connection
(2): Reinforced bearing

Fig. 9-47: Grease service life frame size 180

Grease service life frame size 225



t_f: Grease service life (without reduction factors)
n_m: mean speed (calculation see Fig. 9-40)
(1): Standard bearing
(2): Reinforced bearing

Fig. 9-48: Grease service life frame size 225

9.17 Bearing Variants

Depending on the frame size of the IndraDyn A motors, the following bearing variants are available:

- Standard bearing **"N"** = deep-groove ball bearing
- Reinforced bearing **"V"** = deep-groove ball bearing + cylindrical roller bearing
- high-speed bearing “**H**“ = deep-groove ball bearing, light construction
- bearing for coupling connection “**R**“ = deep-groove ball bearing + special bearing seat

Standard bearing

Universal bearing (type key option “N"), suitable for taking up low to medium radial and axial forces.

Advantages:

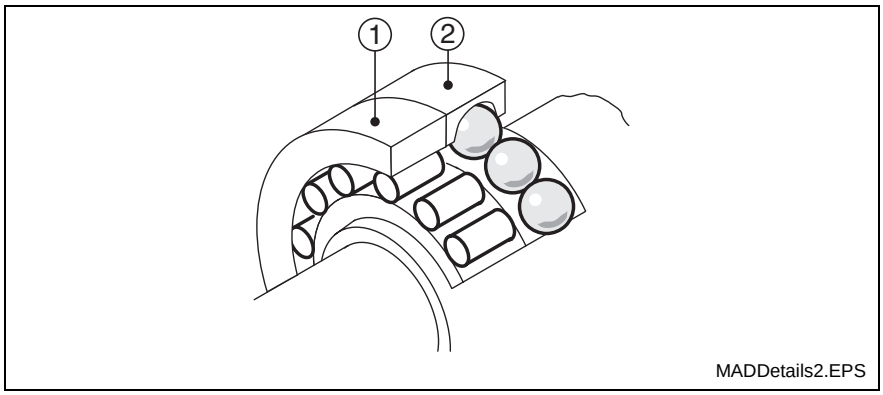
- Easily available and high lifetime
- Suitable for high speeds
- Low-noise running

Disadvantage:

- Suitable only for low to medium radial and axial loads.

Reinforced bearing

The reinforced bearing (type code option "V") is equipped with an additional cylindrical roller bearing on the drive side.



(1): Cylindrical roller bearing
(2): Deep-groove ball bearing

Fig. 9-49: Reinforced bearing

Advantage:

- Can absorb higher radial forces

Disadvantage:

- The grease service life of reinforced bearing is reduced to half of the standard value.
- In certain motors, a reduction of the maximum permitted speed results.

- Motors with a reinforced bearing may be operated only with a permanent radial load (see Fig. 9-50). The bearings could be damaged by resulting sliding friction

Motors with a reinforced bearing must be operated as a minimum with the following radial loads.

Frame size	130	160	180	225
Minimum radial load [kN]	1	1,5	2	

Fig. 9-50: Minimum radial load with reinforced bearing

High-speed bearing

The high-speed bearing (type code option "H") permits very high speeds due to a deep-groove ball bearing with an accordingly low-weight construction.

Advantage:

- Very high speeds are possible

Disadvantage:

- Can only be used with low radial load
- Use in motor frame sizes 100…130 only
  - with horizontal motor installation position, and
  - without shaft sealing ring at the output shaft

Bearing for coupling connection

Bearing for coupling connection (type code option “R”) allows for absorption of higher rotating radial forces which can occur when the motor is operated in connection with a coupling.

Advantages:

- Couplings with higher radial stiffness can be used.
- High resistance to rotating radial forces which may occur when the motor is operated with coupling

Disadvantage:

- The available maximum motor speed is reduced

Tips for Selection

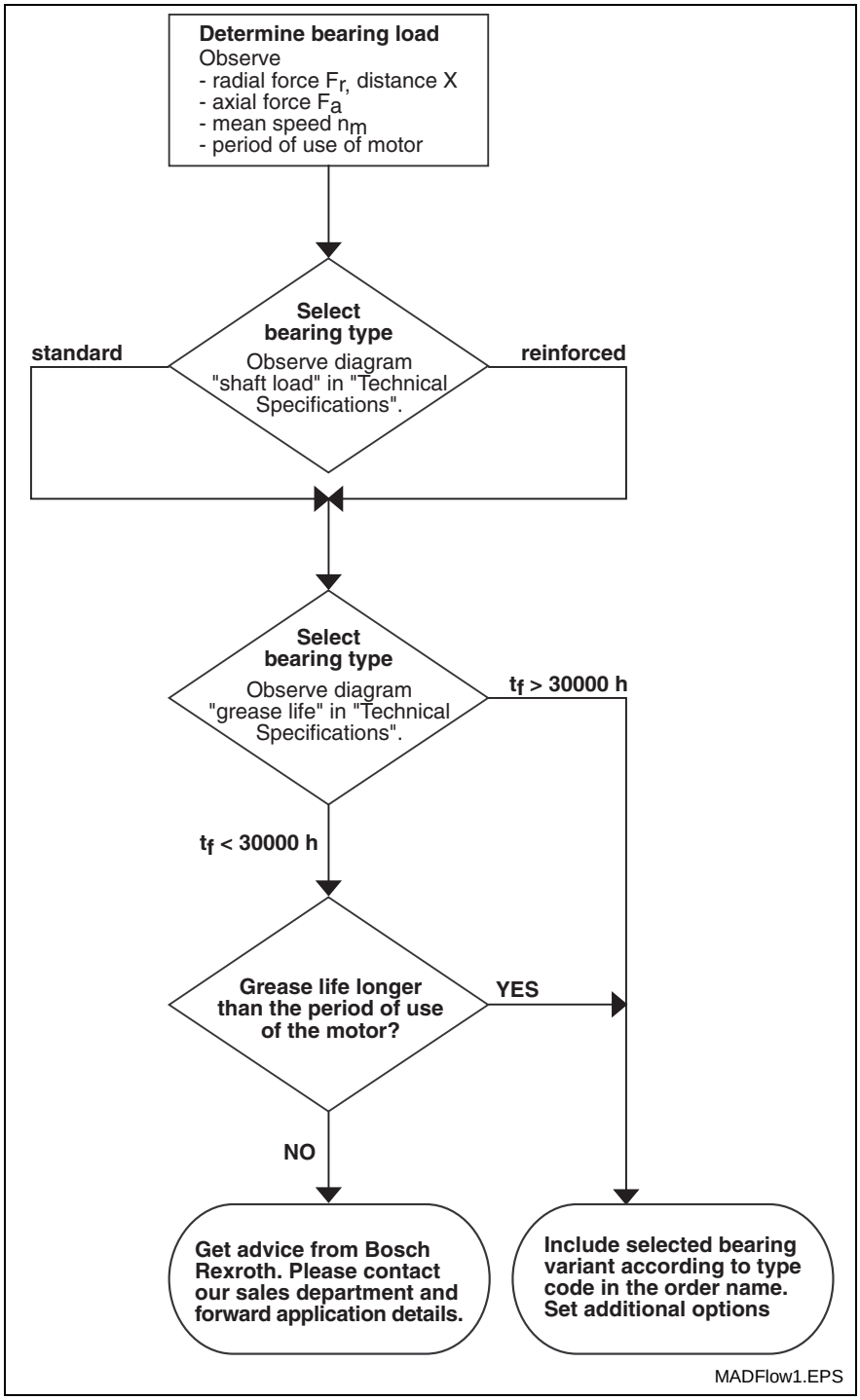


Fig. 9-51: Bearing selection process

9.18 Vibration Severity Level

IndraDyn A motors are dynamically balanced according to DIN ISO 2373.

Vibration severity step R is standard for all IndraDyn A motors. Steps S and S1 are available for certain motors in case of special demands on the mechanical running smoothness. Pay attention to the limitations in the individual type codes.

Vibr. sev. step	Effective vibration speed V_{eff} in [mm/s]								
	MAD/MAF100...130					MAD/MAF160...180			
	Speed n [rpm]					Speed n [rpm]			
	600-1800	1800-3600	3600-6000	6000-9000	9000-12000	600-1800	1800-3600	3600-6000	6000-9000
R	0,71	1,12	1,8	2,8	4,5	1,8	1,8	2,8	4,5
S	0,45	0,71	1,12	1,8	2,8	0,71	1,12	1,8	1,8
S1	0,28	0,45	0,71	1,12	1,8	0,45	0,71	1,12	1,8

Fig. 9-52: Effective vibration speed

The vibration behavior of attached or driven machine elements can cause repercussions on the motor; in unfavorable cases, they can cause premature deterioration or loss.

Due to the system-specific influences on the vibration behavior of the system as a whole, the machine manufacturer must determine the specific circumstances.

In certain cases, the machine elements may need to be balanced in such a manner that no resonance or repercussions occur.

⇒ Already take the vibration behavior of the motor and the machine elements into account when designing the system.

9.19 Explosion Protection

CAUTION

Danger of explosion! Invalidation of warranty!

⇒ The motor admitted for operation in hazardous areas and labeled accordingly is merely a part of a drive concept. Commissioning of the motors in such areas may be carried out only with a control device that is classified and permitted according to the conditions of the areas subject to explosions.

⇒ It is imperative that you pay attention to the information and notes in respect of project planning for the selected control device for motor scavenging already during project planning and before commissioning the system.

Under certain preconditions, IndraDyn A motors are admitted for use in hazardous areas. However, the ATEX motors (components for Group II, Category 2G, ATEX guideline 94/9/EG, Appendix II, Section 2.2.1) may only be used in certain defined environments. In this respect, please note the required selection criteria in the type code of the respective motor, as well as the additional information e.g. on selection, protection principle and required labeling of the motors in chapter 13, “IndraDyn A for Hazardous Areas”.

The motors with the explosion-protection design are merely a part of a drive system which provides explosion protection only in combination with a control device for motor scavenging.

EEx p control device

The control device, which is required to safely operate the motor in an area subject to explosions, does not belong to the Bosch Rexroth scope of delivery and must be provided by the user.

Note: For detailed information on selection, intended use and commissioning of ATEX motors, please see chapter 13, "IndraDyn A for Hazardous Areas".

9.20 Acceptances and Authorizations

CE symbol

Declarations of conformity which confirm the construction and compliance with the valid EN standards are available for the IndraDyn A motors. If necessary, these certificates of conformity can be requested from the responsible sales office.

The CE symbol is applied to the motor type label of IndraDyn A motors.

Fig. 9-53: CE symbol

UR, cUR Listing

IndraDyn A motors have been presented to and approved by the UL authorities “Underwriters Laboratories Inc.®”.

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

Fig. 9-54: cUR mark

Certificate of Conformity for ATEX Motors

A declaration of conformity which confirms the construction and compliance with the valid EN standards is available for the IndraDyn A motors in ATEX version. A copy of the Certificate of Conformity is enclosed in chapter 13.12, “Certificate of Conformity”.

10 Handling and Transport

10.1 Supplied Condition

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

CAUTION

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

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

On delivery from the factory, the motor drive shaft and the connectors have protective sleeves. Remove the protective sleeves just before assembly.

Factory Inspection

All IndraDyn A motors undergo the following inspections, among others, at the factory:

Electrical test

- High-voltage test according to EN 60034-1 (= VDE 0530-1).
- Insulation resistance according to EN 60204-1/1.92, Section 20.3.
- Ground terminal connection according to EN 60204-1/1.92, Section 20.3.

Mechanical test

- Concentricity and position tolerances of shaft end and fastening flange according to DIN 42955.
- Vibration measurement according to DIN 2373.

Inspection by Customer

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

CAUTION

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

⇒ Avoid repeated inspections.

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

10.2 Identification

The total scope of a delivery can be seen in the delivery note or waybill. However, the contents of a delivery can be distributed over several packages.

Each individual package can be identified using the shipment label attached to the outside.

Each device has an individual name plate containing the device designation and technical information.

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

10.3 Designation

The type designation of the complete product results from the options selected. These designations, along with additional product data, are impressed on the name plate.

Using the designation and the serial number, every Bosch Rexroth product can be uniquely identified.

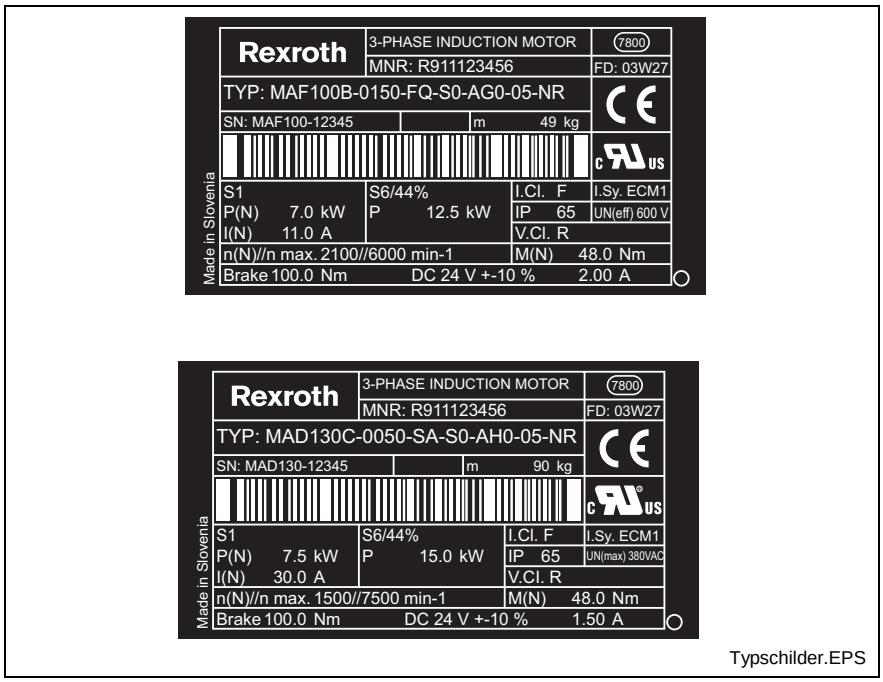


Fig. 10-1: IndraDyn A type labels

IndraDynA motors are supplied with 2 name plates each.

Attach the second name plate to an easily visible portion of the machine. Thus, you will be able to read the motor data at any time without having to get into inaccessible places where the built-in motor may be situated.

Before sending questions to Bosch Rexroth, always specify the full type identification data and serial number of the products involved.

10.4 Transport and Storage

General Information

CAUTION

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

⇒ Protect the products from dampness and corrosion.

⇒ Avoid mechanical stressing, throwing, tipping or dropping of the products.

⇒ Only use lifting equipment suitable for the weight of the motor.

⇒ Never lift the motor out of the fan housing.

⇒ Use suitable protective equipment and wear protective clothing during transport.

Notes:

- Permitted **transport temperature range**: -20°C to +80°C.
- Permitted **storage temperature range**: 0°C to +45°C.
- After storage of one to five years, the motor must warm up for one hour at 1000 rpm before starting normally.
- The max. permitted **storage duration** of the motors is 5 years. After the max. storage duration is exceeded, the bearing grease must be replaced.
- Also observe the notes regarding storage and transport on the packages.

Notes for Transport

To protect the motor from dirt, dust etc., Bosch Rexroth recommends to transport the motor

- to the intended installation site and
- to keep it until the actual time of installation into the machine

in the packaging in which it has been delivered from Rexroth.

To lift the motor from the transport crate or to install it into the machine, use the transport or lifting eye bolts at the motor.

The lifting eye bolts comply with the requirements of DIN 580 as a minimum. Before each transport, ensure that the lifting eye bolts are screwed down fully to the stop face and that your selected lifting equipment and lifting method will not overload the lifting eye bolts.

Note: Please note the DIN 580 standard on transport of motors by means of the attached lifting eye bolts. Non-observance of the information in this standard may cause overload of the lifting eye bolts and result in injury to persons or damage to products.

Information on Storage

Ambient Mechanical Conditions

According to EN60721-3-2 (1997) class 2M2, the IndraDyn A motors should not exceed the following load limit during transport and storage.

Random noise spectrum		
Spectral acceleration data	1 m^2/s^3	0.3 m^2/s^3
Frequency range	10–2000 Hz	200–2000 Hz

Fig. 10-2: Mechanical ambient conditions during transport or storage

When delivered, IndraDyn A motors are equipped with protective sleeves and covers. During transport and storage, the protective sleeves must remain on the motor.

⇒ Remove the protective sleeves just before assembly.

⇒ Also use the protective sleeves if you return the goods.

11 Installation

11.1 Safety

WARNING

Risk of injuries due to live parts! Lifting of heavy loads!

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

⇒ Use suitable lifting equipment and protective equipment and wear protective clothing during transport.

⇒ Do not lift or move the motor by the fan unit.

⇒ Please note the safety information from the preceding chapters, and in particular the notes on transport of motors in chapter 10, "Handling and Transport".

Carry out all working steps especially carefully. In this way, you minimize the risk of accidents and damage.

IndraDyn A motors from frame size 130 have additional threaded holes on their long sides for inserting eyelets (for details, see the dimension sheet). Additional eyelets can simplify handling and transport.

11.2 Mechanical Attachment

Fastening screws

To attach the motors correctly and safely to the machine, Bosch Rexroth recommends the following screws and washers for motor mounting.

⇒ **Motor frame size 100**

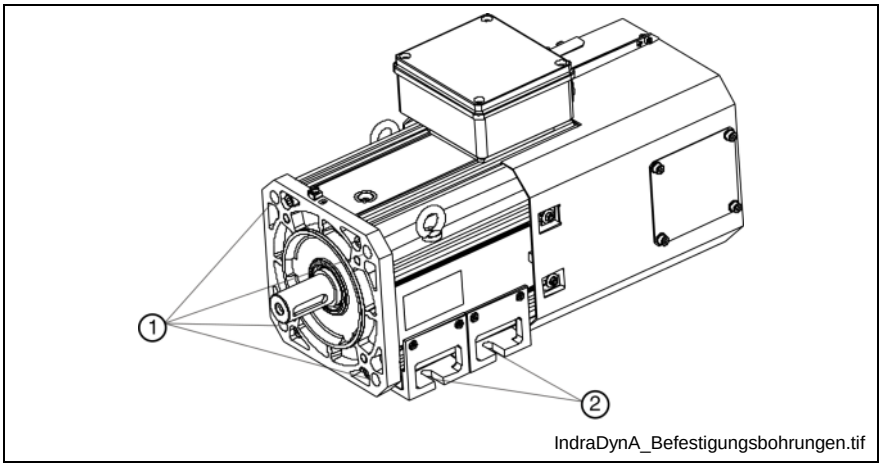
- pan-head machine screw DIN 912 - M12 x … - 8.8
- washer ISO 7092 - 12 - 200 HV

⇒ **Motor frame size 130...225**

- hexagonal screws DIN 931 - M... x ... - 8.8 or
- pan-head machine screw DIN 912 - M... x ... - 8.8
- washer ISO 7090 - ... - 200 HV

Note: If other screws and washers than those listed in this recommendations are used, the property class of the screws and the hardness class of the washers must be equivalent to allow for transmission of the required tightening torques (see Fig. 11-2).

Fastening Types



(1): Flange assembly
(2): Foot assembly

Fig. 11-1: Motor fastening types

IndraDyn A motors are manufactured either for flange assembly (B05) or for foot assembly (B35). Details for the fastening holes can be found in the corresponding dimension sheet. For fastening, the following general assignment applies:

	B05 (flange assembly)			B35 (Foot assembly)		
	Hole	Thread (8.8)		Hole	Thread (8.8)	
MAD/MAF	Ø [mm]	Type	M_{GA} [Nm]	Ø [mm]	Type	M_{GA} [Nm]
100	14	M12	87	11	M10	51
130	18	M16	215	12	M10	51
160				14	M12	87
180				14,5		
225				21	M20	415
M_{GA} = Torque given in Newton meters.						

Fig. 11-2: Fastening holes and tightening torques of the screws

Foot assembly

Before fastening IndraDyn A motors by means of foot assembly, please pay attention to the distance from motor shaft center to lower foot edge specified in the respective motor dimension sheet. Compare this value with the connection dimension present on the machine side.

Note: Before fastening the motor to the machine, it must be aligned so that the center line of the motor shaft is in true alignment with the center line of the connection shaft.

Additionally, please observe the information in chapter 9.6 on foot assembly.

For foot assembly of the motors, we recommend to proceed as follows:

1. With MAD130...225: Dismount the lower air plates on the side to get free access to the mounting holes.
2. Align the motor so that the center line of the motor shaft is in true alignment with the center line of the connection shaft of the machine. To align the motor, use lengths of steel plate as a base.
3. Tightly connect the motor to the machine (tightening torques see Fig. 11-2)

4. With MAD130...225: Re-install the fan shrouds dismounted at the beginning to the motor.

Frame size	Type of motor fastening	Number of mounting holes	Peak-to-valley height of the screwing surface to the machine
100	Assembly feet (4)	4	Rz32
130	Feet plates (2)		
160	Assembly feet ()		
180...225	via stator profile		

Fig. 11-3: Overview foot assembly

Assembly Preparation

⇒ Log all measures taken in the commissioning log.

Prepare motor assembly as follows:

1. Check the components for visible damage. Defective components may not be mounted.
2. Ensure that dimensions and tolerances on the system side are suitable for motor attachment (for details, see the dimension sheet).
3. Ensure that mounting can be done in a dry, clean and dust-free environment.
4. Keep tools and auxiliary material, as well as measuring and testing equipment, ready at hand.
5. Check whether all components, assembly surfaces and threads are clean.
6. Ensure that the holder for the motor flange on the machine side has no burrs.
7. Remove the protective sleeve of the motor drive shaft. Retain the sleeve for later use.

Motor Assembly

⇒ Mount the motor.

Note:

⇒ With flange assembly: Avoid clamping or jamming the centering bundle on the motor side.

⇒ With flange assembly: Avoid damage to the insertion fitting on the system side.

⇒ With foot assembly: Align the center line of the motor shaft in true alignment to the connection shaft. Please note the information in section ‘Foot Assembly’ in this chapter.

⇒ Connect the motor to the machine (tightening torques see Fig. 11-2).

⇒ Check the fit and accuracy of the connection before you proceed.

After having mounted the motor mechanically as prescribed, establish the electrical connections.

11.3 Electrical Connection

Use preferably ready-made connection cables by Bosch Rexroth. These cables provide a number of advantages, such as extreme load capability and resistance as well as a design suitable for EMC.

⇒ Complete the electrical connection of the IndraDyn A motors according to the information in chapter 8 "Connection Techniques", or for ATEX motors according to chapter 13 "Motors for Hazardous Areas".

Notes:

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

Additional Grounding Wire at MAF225C

When connecting the MAF225C, note that this motor must be equipped with an additional grounding wire. See chapter 8.2 "Power Connection" for information on this additionally required grounding wire.

12 Operating IndraDyn A Motors

12.1 Commissioning

CAUTION

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

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

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

⇒ Damaged products may not be operated!

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

The following notes on commissioning refer to IndraDyn A motors as part of a drive system with drive and control devices.

Preparation

1. Keep the documentation of all applied products ready.
2. Log all measures taken in the commissioning log.
3. Check the products for damage.
4. Check all mechanical and electrical connections.
5. Activate the safety and monitoring equipment of the system.

Execution

When all prerequisites have been fulfilled, proceed as follows:

1. Activate the fan at the MAD or the external cooling system for supply of the MAF motors, and check for regular condition. Heed the notes of the manufacturer.
2. Carry out the commissioning of the drive system according to the instructions of the corresponding product documentation. You can find the respective information in the functional description of the drive control device.
3. Log all measures taken in the commissioning report.

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

12.2 Deactivation

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

1. Observe the instructions of the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power and control voltage of the drive device.
4. **Only for MAD**: Switch off the motor protection switch for the motor fan.
5. Switch off the main switch of the machine.
6. Secure the machine against accidental movements and against unauthorized operation.
7. Wait for the discharge time of the electrical systems to elapse and then disconnect all electrical connections.
8. Before dismantling, secure the motor and fan unit against falling or movement before disconnecting the mechanical connections.
9. Log all measures taken in the commissioning report.

12.3 Dismantling

DANGER

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

⇒ Do not work on unsecured and operating machines.

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

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

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

12.4 Maintenance

Asynchronous motors of the IndraDyn A series operate without wear within the given operating conditions and service life. However, operation under unfavorable conditions can lead to limitations in availability.

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

⇒ Log all maintenance measures in the machine maintenance plan.

Measures

DANGER

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

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

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

⇒ Do not work on hot surfaces.

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

Measure	Interval
Only for MAF: Check the functioning of the coolant system	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Only for MAD: Check the functioning of the motor fan and the air circulation.	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Check the mechanical and electrical connections.	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Check the machine for smooth running, vibrations and bearing noises.	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Remove dust, chips and other dirt from the motor housing, cooling fins and the connections.	Depending on the degree of soiling, but after one operating year at the latest.

Fig. 12-1: Maintenance measures

MAD – Motor Fan

It may become necessary to dismantle the fan unit for maintenance measures or troubleshooting.

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

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

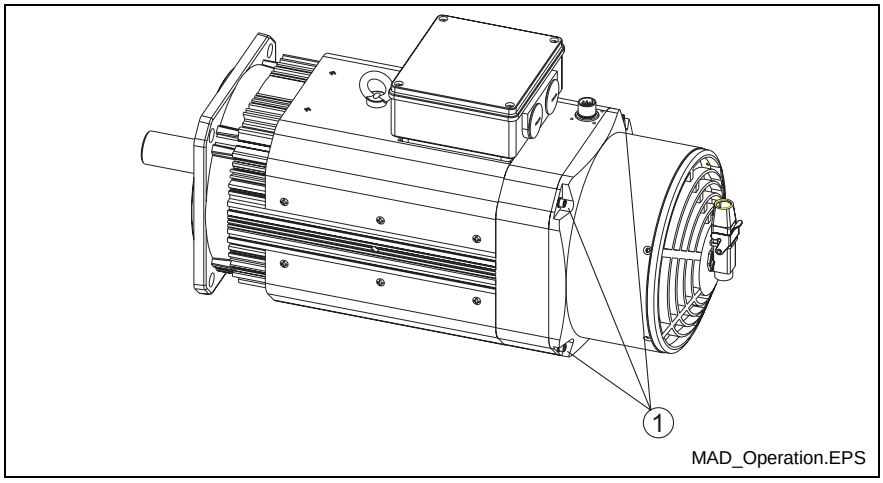
⇒ During dismantling, keep the strips, screws and nuts with which the fan units are fastened.

Parts of the fan unit housings consist of several elements that are screwed together. Remove only the indicated screws.

The fastening and basic housing of the fan unit are essentially identical for axial and radial fans.

General procedure for maintaining the fan:

1. Switch off the system and disconnect the electrical fan connection.
2. Before loosening the fixing screws, make sure the fan unit does not drop; carefully remove the fan unit from the motor.
3. After completing cleaning or troubleshooting, reattach the fan unit. Secure the fastening screws with "LOCTITE 243 screw fastener" and reestablish the connections.
4. Check the functioning of the motor fan and the air circulation.
5. Log all maintenance measures in the machine maintenance plan.



(1): Fastening screws (also on rear)

Fig. 12-2: MAD fan

MAF – Coolant Supply

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

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

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

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

Maintaining Holding Brakes

In order to ensure proper functioning of the holding brake, it must be checked before the motor is installed.

Before initial startup

Measure the holding torque of the brake; grind in the holding brake, if necessary.

Proceed as follows:

1. De-energize the motor and secure it against re-energization.
2. Measure the transmittable holding torque of the holding brake using a torque wrench. The holding torque of the brakes is specified in the data sheets.
3. If the holding torque specified in the data sheets is attained, the holding brake is ready for operation.
   If the holding torque specified in the data sheets **is not attained**, the holding brake must be ground in as described in step 4.
4. **Grinding in:**

Recommendation for grinding in	
Interval	1x
Grinding-in speed	100 rpm / 30s duration
Program	500ms, clocked
Ambient temperature	-20°C to +50°C

Fig. 12-3: Recommended procedure for grinding in motor holding brakes

⇒ If the holding torque specified in the data sheets is attained, the holding brake is ready for operation.

⇒ If the holding torque specified in the data sheets **is not attained**, repeat step 4 (grinding-in process).

⇒ If the specified holding torque is not attained after the second grinding-in process, the holding brake is not operable. Notify Bosch Rexroth Service.

During operation

If holding brakes are required only sporadically (braking cycle >48 h) during operation, film rust may develop on the brake friction surface.

To prevent the holding torque from dropping below the specified holding torque, we recommend the grinding procedure described below:

Recommendation for grinding in	
Interval	Once in 48 h
Grinding-in speed	100 rpm
Number of grinding-in revolutions	1
Ambient temperature	-20°C to +50°C

Fig. 12-4: Recommended procedure for grinding in motor holding brakes

Note: The option of automatically implementing the grinding-in routine in the program run is described in the documentation of the particular drive controllers.

During normal operation, it is not necessary to grind in the brake. It is sufficient if the brake is activated twice a day by removing the controller enable signal.

12.5 Troubleshooting

DANGER

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

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

⇒ Switch off the control device and the machine and wait for the discharging time of the electric systems to elapse.

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

⇒ Do not work on hot surfaces.

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

- Motor-cooling circuit, fan function and temperature curve
- internal temperature sensor
- motor encoder or encoder connection
- mechanical damage of the motor
- mechanical connection to machine

The encoder connection and the temperature sensor are controlled by the drive controller or control unit; corresponding diagnoses are indicated. Observe the notes in the corresponding documentation.

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

Excess Temperature of Motor Housing

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

CAUTION

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

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

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

Possible causes

1. Loss or malfunction in the fan or cooling system.
2. Original operating cycle has been changed.
3. Original motor parameters have been changed.
4. Motor bearings worn or defective.

Measures

1. With **MAD,** check fan function. Clean if necessary. In the case of a malfunction, contact Bosch Rexroth Service. With **MAF,** check the cooling system. Clean or rinse the cooling circuit if required. Contact the machine manufacturer if the coolant system malfunctions.
2. Check the layout of the drive for changed requirements. If overloading occurs, stop operation. Danger of damage!
3. Reset to the original parameters. Check the layout of the drive in the case of changed requirements.
4. Contact the machine manufacturer.

High Motor Temperature Values, but Housing Temperature is Normal

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

Possible causes

1. Wiring error or cable break in sensor cable.
2. Diagnostics system defective.
3. Winding temperature sensor malfunction (PTC).

Measures

1. Check the wiring and connection of the temperature sensor according to the terminal diagram.
2. Check the diagnostics system on the drive device or the control unit.
3. Check the resistance value of the temperature sensor using a multimeter.
   - Set the measuring instrument to resistance measurement.
   - Shut down the system and wait for the discharging time to elapse. Separate the temperature sensor connection from the drive device and connect the wire pair with the measuring instrument (this includes the sensor cable in the test). Check values according to the characteristic curve in Fig. 9-18.

Motor or Machine Table Generate Vibrations

Status

Audible or tactile vibrations occur on the motor.

Possible causes

1. Driven machine elements are insufficiently coupled or damaged.
2. Motor bearings worn or defective. Available bearing lifetime or grease lifetime elapsed.
3. Motor mount loose.
4. Drive system is instable from a control point of view.

Countermeasures

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

Specified Position is not Attained

Status

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

Possible causes

1. Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be switched.
2. Insufficient shielding of encoder cable against interference.
3. Incorrect encoder parameters set in drive controller.
4. Motor-machine connection loose.
5. Encoder defective.

Countermeasures

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

Waste Disposal

Manufacturing process

The products are manufactured such that the associated manufacturing process saves energy and raw material to an optimum extent while simultaneously permitting recycling and utilization of incidental waste.

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

Application

Bosch Rexroth products do not contain any kind of dangerous substances which could be released with proper use. Normally, negative effects on the environment must not be expected.

Forbidden substances

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

Material composition

Basically our motors contain

- steel
- aluminum
- copper
- brass
- magnetic materials
- Electronic components and assemblies
- Insulation material

Recycling

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

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

Returns

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

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

The products must be delivered free domicile to the following address:

Bosch Rexroth AG

Electric Drives and Controls

Buergermeister-Dr.-Nebel-Straße 2

97816 Lohr am Main, Germany

Packaging

High-quality products need optimal packaging. The packaging material consists of paper, wood and polystyrene. They can be recycled everywhere.

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

13 Motors for Hazardous Areas

13.1 General Information

EX motors themselves are not certified as explosion-protected components, but are only prepared as a part of an overall system.Any additionally required safety equipment as described in this chapter is to be provided by the user.

According to ATEX regulation 94/9/EC, Rexroth IndraDyn A EX motors are equipment of

⇒ device group II
- device category 2G
- device category 3G

and suitable for application in the following hazardous areas:

⇒ Zone 1

⇒ Zone 2

When delivered from the factory, operating Instructions are included with the EX motors. These operating instructions form a part of the product and must be kept by the user of motors over the entire operation and lifetime of the product. If the product is passed on or sold, these instructions must also be passed on to each new owner or user.

Note: The operating instructions are available in several languages. Should you not have the operating instructions in your language, contact your Bosch Rexroth sales partner before installing the motor.

You must not install or commission EX motors without having read and understood the enclosed documentation, and without having implemented the described measures.

Device group / device category

Device group II, device category 2G

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment in this category is intended for use in areas which has to be calculated that an explosive atmosphere of dust/air mixture can occur **occasionally**. The means of protection relating to equipment in this category ensure the requisite level of protection, even in the event of frequently occurring disturbances or equipment faults which normally have to be taken into account.

Device group II, device category 3G

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment in this category is intended for use in areas in which explosive atmospheres caused by dust/air mixtures are unlikely to occur or, if they do occur, are likely to do so **only infrequently and for a short period only.** Equipment in this category ensures the requisite level of protection during normal operation.

Zones of hazardous areas

Note: The following information is based on EN 60079-14: 2003 and the BGBI: 1996 Part 1, page 1914. It is referred to this scripts for detailed information.

Hazardous areas are classified into the following zones in accordance with the probability that an explosive atmosphere is present:

Zone 0 ... includes areas in which an explosive atmosphere which contains a mixture of air and gas, vapors and mists exists permanently, over a long period, or frequently.

Electrical equipment is only allowed for zone 0 if it complies with the specifications according to EN 50020: 1994 (self-security ”i”).

Zone 1 ... comprises areas in which an explosive atmosphere of gas, vapors or mists is to be expected occasionally.
Electrical equipment is permissible for use in zone 1 if it is designed according to the requirements for zone 0 or for one of the degrees of protection described in Fig. 13-2.

Zone 2 ... comprises areas in which the presence of an explosive atmosphere caused by gas, vapors or mists is not to be expected, or - should it still occur - in all likelihood rarely or for a short period of time.

Electrical equipment is permissible for use in zone 2 if it:

- is designed according to the requirements for zone 0 or 1;
- is specifically designed for zone 2.
- corresponds to the requirements of a recognized standard for industrial electrical equipment and has no ignitable hot surfaces when in undisturbed operation.

Device groups, types of protection, and temperature classes

The electrical equipment for hazardous areas is classified into:

Device groups

- **Group I:** Electrical equipment for mines susceptible to fire damp.
- **Group II:** Electrical equipment for paces with a potentially explosive athmosphere, other than mines susceptible to fire damp.

The electrical equipment of Group II can be further classified according to the character of the explosive atmosphere for which they are intended.

For the degree of protection pressure resistant casing “d” and intrinsic safety category “i” all electrical apparatus of Group Ii are classified in IIA, IIB and IIC (see appendix A according to EN 50014:1992).

Classification of the gases and vapors

Explosion sub-group	Gases and vapors			
IIA	Ammonia methane ethane propane	Ethanol cyclohexane n-butane	Gasolines in general I.P. fuel n-hexane	Acetaldehyde
IIB	Town gas acrylonitrile	Ethylene ethylenoxide	Ethylene glycol hydrogen sulphide	Ethylene ether
IIC	Hydrogen	Ethine (acetylene)	Carbo-bisulphide	

Fig. 13-1: Explosion sub-group gases and vapors

For all types of protection, the equipment of Group II must be labeled in accordance with their maximum surface temperature as shown in Fig. 13-3.

Types of protection

The electrical equipment is designed according to the type of protection. The requirements are stipulated in special standards.

Type of protection	Designation	Standard (predecessor)
Pressure-resistant casing	EEx d	EN 60079-1 (EN 50018)
Increased safety	EEx e	EN 60079-7 (EN 50019)
Intrinsic safety	EEx i	EN 60079-11 (EN 50020)
Pressurizing	EEx p	EN 60079-2 (EN 50016)
Encapsulation	EEx m	EN 60079-18 (EN 50028)
Oil immersion	EEx o	EN 60079-6 (EN 50015)
Powder filling	EEx q	EN 60079-5 (EN 50017)
Degree of protection 'n'	EEx n	EN 60079-15 (EN 50021)

Fig. 13-2: Degree of protection

Electrical equipment of these degree of protection are certified by way of a prototype test by a neutral body.

Temperature classes

Electrical equipment of group II must be labeled according to EN 60079-0:2004, chapter 5.3.2.2, and either

- classified (preferably) in a temperature class in compliance with Fig. 13-3, or
- labeled with the respective maximum surface temperature, or
- if applicable, restricted to the action of a specific gas for which the equipment is intended.

Temperature class	Maximum surface temperature [°C]
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Fig. 13-3: Classification of the maximum surface temperature in classes for electrical equipment of Group II

13.2 Appropriate Use

Note: IndraDyn A EX motors themselves are not certified as explosion-protected devices, but are only prepared for acceptance as a part of an overall system. Please also observe the notes in Chapter 13.6 ”Additional Components”.

Necessary safety equipment is to be prepared by the user.

Range of application

The motors described here (components for Group II, Category 2G, ATEX guideline 94/9/EG, Appendix II, Section 2.2.1) may only be used in an environment in which

- **no explosive atmosphere** due to gases, vapors or mist/fog is likely to develop, or
- **an explosive atmosphere** due to gases, vapors or mist/fog can occasionally occur.

The system and the components must thus be designed and manufactured by the user in such a manner that sources of ignition are avoided assuming that device malfunctions occur frequently and that operating states occur that are usually unexpected.

13.3 Conditions for Application

DANGER

Danger of explosion!

⇒ To ensure protection from explosion, only use scavenging devices with an ATEX protection type suitable for the motor, or higher.

⇒ The values indicated on the identification label (Fig. 13-5), for example for scavenging volume, scavenging gas, initial pressure, excess pressure etc. must be ensured and monitored by the scavenging device.

Connection specifications

The motors may only be operated with Bosch Rexroth drive control devices of the IndraDrive series. Control devices from other manufacturers are not permitted. The connector terminals in the terminal box must be screwed on tightly. Do not disconnect or connect connectors when they are energized due to the danger of sparking within hazardous areas!

Grounding

Speed-controlled drive systems contain unavoidable discharge currents above ground. For this reason the motors have to be grounded over the motor cable and over a separate ground wire with min. 4mm² cross-section, as specified in the connection diagram. Check that the position of the grounded conductor is fixed before commissioning.

If the grounded connector in the motor cable and the second separate grounded connector on the motor housing are not connected or are interrupted by corrosion or other defects during their lifetime, the discharge current flows (as leakage current) over conducting housing parts. This must be prevented using the measures mentioned above (ATEX guideline 94/9/EG, Appendix II, Chapters 1.2.3, 1.3.3, and 1.4).

Danger of corrosion

Corrosion of the motor housing due to aggressive substances (such as certain coolants, lubricants, cutting oils or salt mists) is to be prevented.

Emergency stop

Energies stored in the drive device must be discharged or isolated as quickly as possible when the **emergency-stop device** is pressed so that the risk that the danger zone is affected during a malfunction is reduced (ATEX guideline 94/9/EG, Appendix II, section 1.6.2)

There are for example the following options:

- discharge of the energies via an intermediate circuit short-circuit
- disconnect the power to the cables and motors before the transition to the area subject to explosions in order to isolate the energies from the area subject to explosions.

Other environmental influences

Heed the following regarding dangers caused by other disturbances:

- Operation only inside the specified ambient conditions,
- Maximum vibration and impact loads
- Protect the ground conductor connection from dirt, corrosion, humidity and/or aggressive substances, ...
- ...

Internal Motor Brake (optional)

In **normal operation**, use the brake located within the motor only when at a standstill and when performing the drive-internal brake check. In these cases, only low temperatures (<100° C) occur and no sparks are generated because critical grinding of the brake linings does not occur.

Brake control

The brake's control mechanism must ensure this function in normal operation. **Under the least favorable installation conditions for the power supply cables to the brake and under the least favorable load condition for the power supply, a supply voltage of 24 V +/- 10% must be supplied to the motor**. If a voltage divergence occurs due to a failure during operation, this failure must be identified and corrected immediately. The failure can be identified, for example, using a monitoring device for undervoltage.

Malfunctions

Only during a **malfunction**, i.e. in the case of a fault in the system, may the brake be activated when the motor is turning to, for example, prevent dangerous dropping of vertical axes. In this case, sparks may be generated in the brake and increased temperatures may occur within the motor. When a malfunction occurs, the operator must eliminate it immediately.

Functional test

Before commissioning and in operation in periodic intervals (e.g. every 8 hours), the functioning of the brake is to be checked with an appropriate braking test. By applying a defined amount of motor torque, the brake is tested for slippage. For certain drive control devices, it is possible to carry out an integrated brake test using the Brake Monitor command. Further information can be found in the respective firmware operation manual for the drive control device.

13.4 Residual Risks

Failure of the protective equipment

If the scavenging device and the monitor for maintaining the protective measures fail simultaneously, explosion protection in a hazardous area is no longer ensured and a danger of explosion exists.

Overloading

When the motor is overloaded, including the case where errors in the mechanical or electrical equipment of the machine occur, high temperatures that result in the danger of explosions can occur.

Grounding and discharge currents

Variable-speed drive systems cause unavoidable discharge currents. If the grounded connector in the motor cable and the second separate grounded connector on the motor housing are not connected as specified or are interrupted by corrosion or other defects during their lifetime, the discharge current flows (as leakage current) over conducting housing parts, resulting in the dangers of sparking at joints and, if explosive materials are present, explosions. Therefore, check the proper conditions of both grounded conductors in regular intervals.

Material aging

The periods of action and penetration of explosive materials depend on the application. They depend on the aging of the seals, the mechanical design of the motor, the characteristics of the explosive materials and the average temperature that occurs during the operating time as a consequence of the load cycles.

13.5 Selection and Labeling of Ex-Motors

Selection of the motors

If an Ex version of a motor is required, the motor must be selected and ordered on the basis of a predefined encoder type in the respective motor type code.

Ex motors are defined by way of selecting the encoder option

- **M6**
- **S6**

in the motor type code.

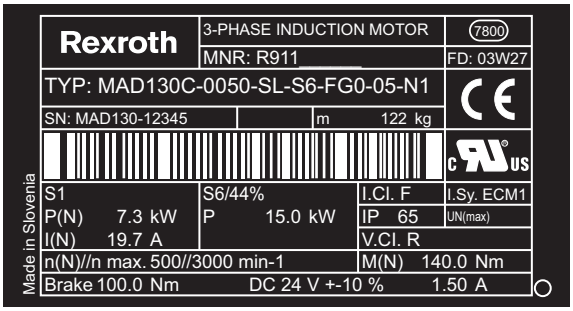
Accordingly, the figure **6** on the 18th position of the type code signifies an explosion-protected motor. This applies to the following motors:

- **MAD1**□□□-□□□□-□□-□**6**-□□□-□□-□□
- **MAF1**□□□-□□□□-□□-□**6**-□□□-□□-□□

Labeling

IndraDyn A motors in EX design have an additional label that is located on the side of the motor housing, next to the motor type label. It shows:

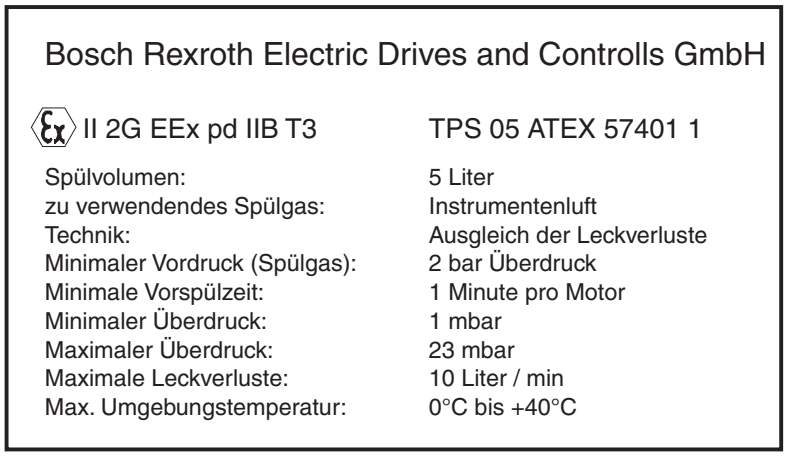
- the classification of the motor according to ATEX
- important details for adjusting the motor scavenging device.



Motortypenschild.EPS

Fig. 13-4: Motor type label (example: MAD-motor)

Additional designation label on the EX motor



Typenschild2_ATEX.EPS

CE:	CE symbol
0102:	code number of the test authority
Ex:	ATEX symbol
II:	Device Group II, which is suitable for all hazardous areas except mines susceptible to firedamp
2G:	Device Category 2: the device is suitable only for explosion-endangered atmospheres that are caused by gas that can occur occasionally
EEx:	the European standard for explosion protection has been applied
p:	ignition protection class p means that an explosion-endangered atmosphere is kept away from the ignition source (EN 50016)
d:	ignition protection class d means that an explosion cannot be transferred to the outside (EN 50018)
IIB:	Explosion sub-group of certain gases and vapors
T3:	the max. permitted surface temperature (inside and outside of the housing) is 155° C
TPS***:	motor registration number

Fig. 13-5: Type label of EX motors

13.6 Additional Components

To operate a motor as part of an overall system within an explosion-protected area, further components are necessary. Not all required components are in the scope of delivery of Bosch Rexroth. Components that are not available from Bosch Rexroth are signified as additional components and have to be ordered by the manufacturer of the system.

An overall system mainly consists of:

1. Bosch Rexroth components
   - MAD or MAF EX motors
   - IndraDrive motor drive
   - connection cable

2. Additional components of other manufacturers to be provided
   - Scavenging equipment and monitoring unit with connection hoses, accepted as an overall system and certified for the required protection class.
   - For MAF motors: External cooling system (liquid cooling) For specification refer to the motor project planning manual
   - For MAD motors: External cooling system (fan) For specification refer to motor project planning manual and the following notes.

Motor Fan

Cool the MAD motors for explosion-protected areas during operation with a forced ventilation. We recommend using a radial fan, which must be mounted outside of the hazardous area (see Fig. 13-13). Mounting a fan directly on the motor is not permitted within hazardous areas. Observe the information in the project planning manual regarding motor cooling when calculating and selecting a suitable motor fan.

Note: Fans, an air hose and the small parts required for connection (hose clamps, etc.) do not belong to the Bosch Rexroth scope of delivery.

EEx p Control Device for Motor Scavenging

The IndraDyn A motor with the explosion-protection design is merely a part of a drive system which provides explosion protection only in combination with an EEx p control device for motor scavenging.

WARNING

Danger of explosion!
Danger to life and high material damage by improper handling!

⇒ The motor within hazardous areas may only be commissioned as an overall system with a control device for motor scavenging. The control device must be classified and certified according to a protection class that is the same as or higher than that of the motor.

Note: The control device, which is required to safely operate the motor in an area subject to explosions, does not belong to the

Bosch Rexroth scope of delivery and must be provided by the user.

Certification of the motors according to the ignition protection class

- EEx d (encoder housing)
- EEx p (motor housing)

according to EN 50018:2001 and EN 50016:2003 was made using a control device of **type 07-3711-2213/1002**, manufactured by

⇒ **BARTEC GmbH**
Max-Eyth-Str. 16
97980 Bad Mergentheim, Germany
Tel. +49 (0)7931 597-0
Fax +49 (0)7931 597-119
Email info@bartec.de

PO Box 1166
97961 Bad Mergentheim, Germany

Observe the notes of the manufacturer when selecting and commissioning the control device when designing the drive system.

Connection cable

Thermal stability

Use cables with a thermal stability of at least **80°C (176°F)** to operate the motor in hazardous areas.

Bosch Rexroth provides suitable ready-made connection cables for the motors. They are checked on conformity with the ATEX guidelines and relevant DIN and EN standards. When selecting cables, use the following documentation: **DOK-CONNEC-CABLE-*STAND-AUxx-EN-P** (MNR R911282688).

13.7 Mechanical Attachment

Preparation

Before installing the motor, check whether the required information is present on the type label of the motor, such as the

- device group and device category,
- explosion subgroup,
- maximum permitted surface temperature,

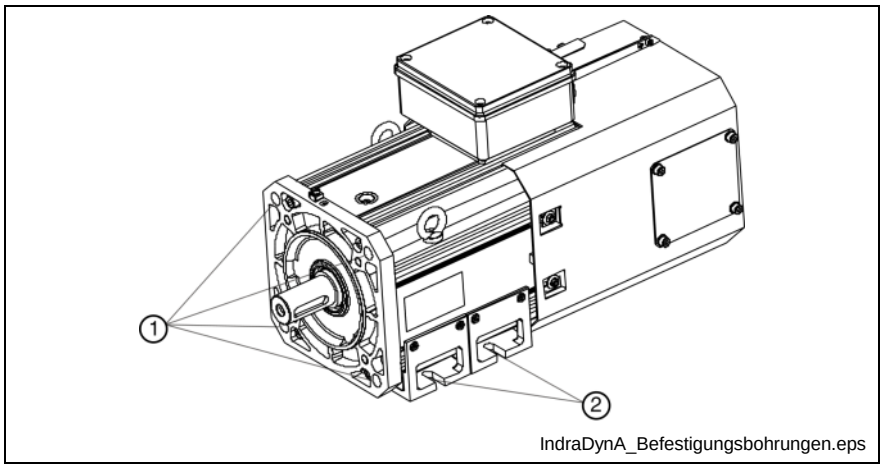
correspond to the local permitted conditions for use in hazardous areas.

Check the components for visible damage. Defective components may not be mounted.

Before installation, ensure that the environmental conditions at the location of use, such as the ambient temperature, the humidity, the vibration, and shock stresses do not exceed the details in the project planning manual of the motor.

Mounting

IndraDyn A motors are manufactured either for flange assembly (design 05) or for foot assembly (design 35). You can find details regarding the fastening holes in the motor dimension sheet in the project planning manual. For fastening, the following general assignment applies:



(1): Holes for flange assembly
(2): Assembly feet (on both sides) for foot assembly

Fig. 13-6: Motor mounting holes

	B05 (flange assembly)			B35 (Foot assembly)		
	Hole	Thread 1)		Hole	Thread 1)	
MAD/MAF	Ø [mm]	Type	M_{GA} [Nm]	Ø [mm]	Type	M_{GA} [Nm]
100	14	M12	87	11	M10	51
130	18	M16	215	12	M10	51
160				14	M12	87
180				14,5		
1) Recommended torques for bolts of fastening class 8.8 class 8.8. M_{GA} = Torque given in Newton meters.						

Fig. 13-7: Mounting holes

Notes: Avoid...

- pinching or jamming the centering (pilot) diameter on the shaft side of the motor installation.
- damaging the insertion fitting on the system side.

Check the fit and precision of the connection before carrying out the electrical connection.

13.8 Connection Techniques

DANGER

Danger of explosion due to improper handling when connecting the motor!

⇒ Ensure that the power is off and that the motor is connected only in an atmosphere that is not capable of explosions.

⇒ Before working on the system, always use a suitable measuring instrument (e.g. multimeter) to check whether parts are still under a residual voltage (e.g. due to the residual energies of capacitors in filters, drive devices, etc.); let their discharge times elapse.

⇒ The connection between the ground-reference lug and the grounding conductor must be made before any other connections.

⇒ In particular, heed a sorted and de-energized laying of the connection cables within the terminal box to avoid abrasion or pressure marks on the cables.

⇒ The connection points to or on the control device must be located outside of the hazardous area.

⇒ The motors may be operated only with Rexroth IndraDrive drive control devices. Control devices from other manufacturers are not permitted.

The motors have to be grounded over the motor cable and over a separate grounding wire (potential equalization) with min **4 mm²** cross-section (see Fig. 13-10).

The power connection is located on the top and is provided only as a terminal box in the case of explosion-protected motors.

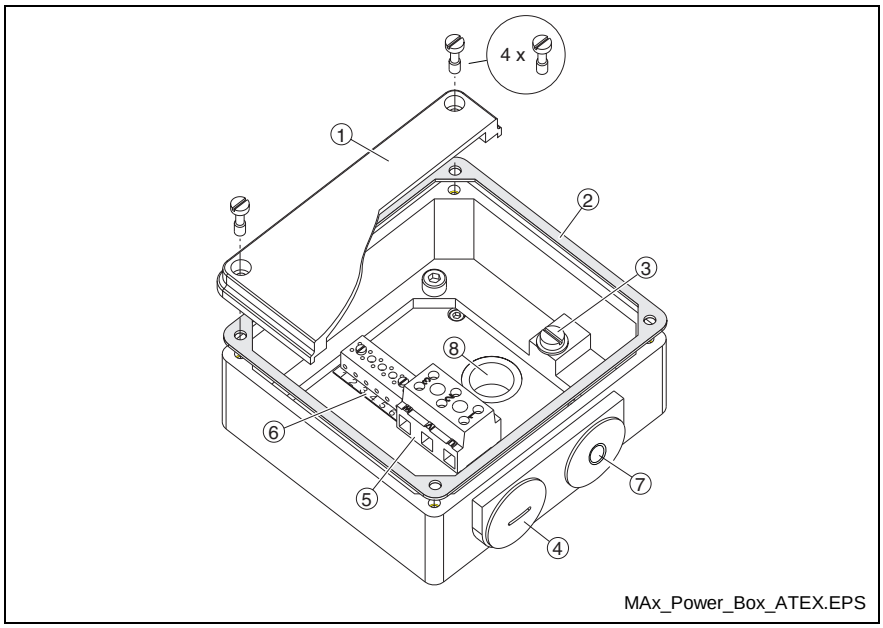
The following connections must be made to ensure safe operation of the motors:

- power connection (incl. temperature sensor and holding brake)
- Encoder Connection
- equipotential bonding conductor connection (according to EN 50014:2000, Chapter 15)
- Coolant Connection
- Connection of the scavenging device with safety control.

Power Connection

Proceed as follows to connect the power cable in the terminal box of the motor:

1. Unscrew and remove the 4 fastening bolts on the lid (1) of the terminal box and open the lid.



(1):	Lid	(2):	Gasket
(3):	PE connection	(4):	Cable entry
(5):	U-V-W power connection	(6):	Terminal strip
(7):	Scavenging hole	(8):	Through hole

Fig. 13-8: Terminal box

2. Remove the screw plug (4) of the metric screw on the side of the terminal box and guide the power cable through this opening and into the terminal box. Attach the power cable to the terminal box. Use the cable gland located on the power cable. Connect the wires of the power cables with the appropriate junction within the terminal box. The wires are arranged according to Fig. 13-10.MAx_Power_Connect_ATEX_EN.EPS
3. Screw down the connections of the wires with the wire end ferrules sufficiently tight. The connections of the wires with the ring cable lugs must be tightened with the following tightening torques:

Thread	M6	M8	M10
Tightening torque	4 Nm	9 Nm	18 Nm

Fig. 13-9: Tightening torque for power connection

4. Fasten the lid (1) of the terminal box using all 4 fastening bolts secured with Loctite 243. Before tightening the bolts, make sure that the gasket (2) between the lid and the terminal box housing is correctly positioned.

Notes:

- The brake connections are assigned only if the motor was manufactured with the "brake" option.
- Only one of the PTC thermistor connector pairs (3-4 or 5-6) in the motor cable should be connected to the motor; the other one pairs serves a spare.
- Do not remove or damage the gasket located in the lid.
- Observe the size of the screwed cable connection and connection thread for the cable inlet into the terminal box.
- The connections of the motor-windings in the terminal box must not be removed.
- The through hole (8) in the motor housing may not be closed or sealed off.

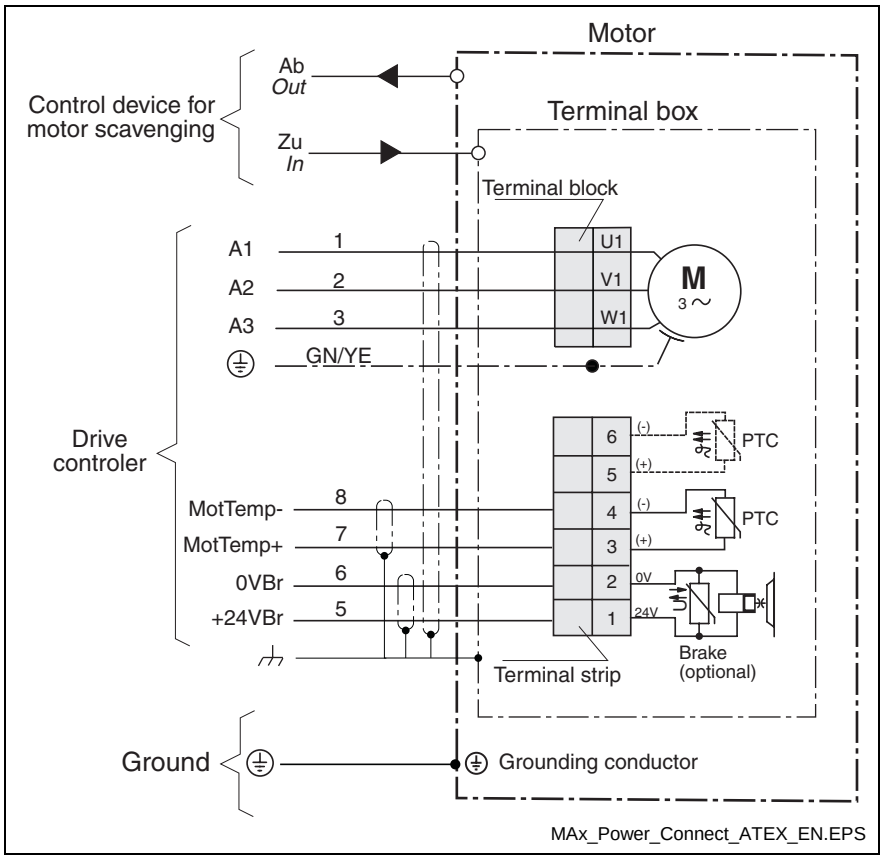


Fig. 13-10: Connection diagram for explosion-protected areas

Encoder Connection

A 15 meter-long connection cable is connected with the explosion-protected motors. This connection cable has been connected with the encoder at the factory. After motor assembly, this cable must be connected with the drive device.

DANGER

Danger of explosion due to improper handling when connecting the encoder!

⇒ The junction to/on the motor drive device must be located outside of the area subject to explosions.

Notes: Observe the following when connecting the encoder:

- The encoder housing on the motor may no longer be opened! Do not remove any of the screws on the encoder housing. The connection cable has already been connected with the motor encoder at the factory.
- Work may be carried out only if the electrical system is not under power.
- Heed the information on projecting planning in respect of the drive device, and the information on connector assignment in chapter 8.7 “Encoder Connection”.

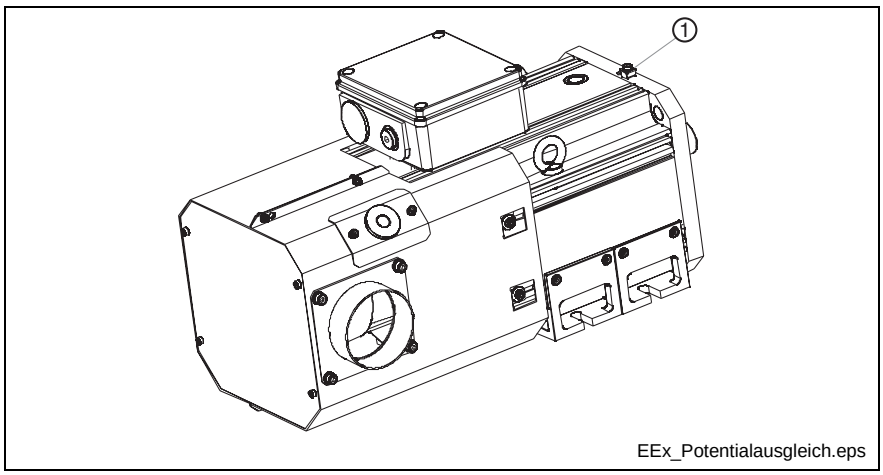
Grounding Conductor

DANGER

Danger of explosion due to improper handling when connecting the motor!

⇒ The ground conductor on the motor must be additionally connected to the protective conductor with a separate cable with 4 mm² cross-section.

The motors for areas subject to explosions have an additional ground lug on the motor flange for this purpose. Use the grounding cable to connect the ground-reference lug of the motor with the ground reference of the machine or system and tighten the screw connection.



(1): Terminal for grounding conductor

Fig. 13-11: Grounding conductor

Protective conductor terminal on motor size	Nominal cross-section	Terminal area
100...130	4 mm²	4 mm² (finely stranded) 6 mm² (single-wire)
160...180	10 mm²	10 mm² (finely stranded) 10 mm² (single-wire)

Fig. 13-12: Terminal for grounding conductor

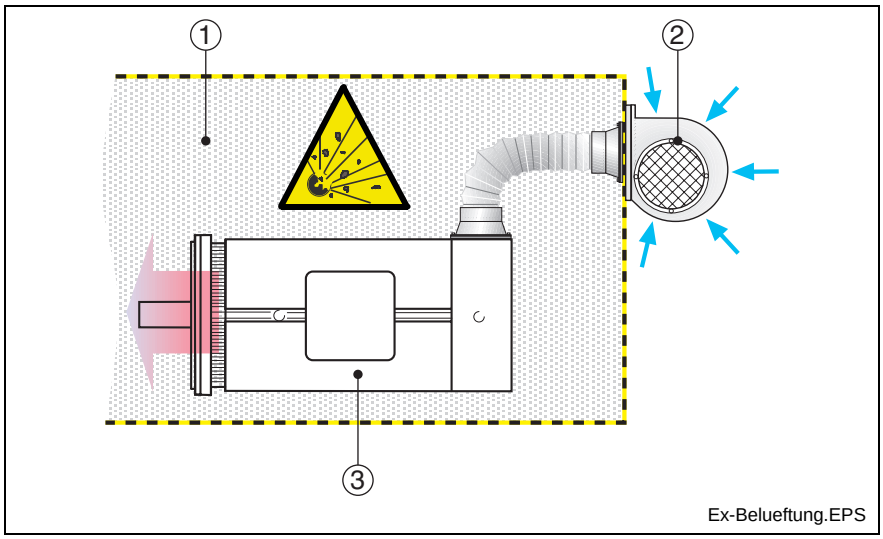
Coolant Connection to MAD Motors

MAD motors with explosion-protection design are prepared with a fan cowl for operation with an external fan.

Note: The required fan and corresponding connection materials (air hose, connection clamps, etc.) do not belong to the scope of delivery of the motor; these must be provided by the machine manufacturer.

MAD motors may be operated only if the fan provides the specified minimum amount of air flow on the motor side. Therefore, when selecting radial fans or central ventilation systems, already take the installed hose

or air duct length, as well as the air baffles, into account. Please also observe the notes in Chapter 9.8 ”Motor Cooling”.



(1): Explosion-endangered area
(2): Radial fan (not included in scope of delivery)
(3): MAD motor in EX version

Fig. 13-13: Fan connection in the explosion-protected area

Coolant Connection to MAF Motors

Regarding the coolant connection to MAF motors, please heed the information in chapter 8, Connection Techniques.

Purging Connections

The connection of an EX motor with an EEx p control device has to be done with a pipe or a tube with a maximum internal diameter of 8 mm.

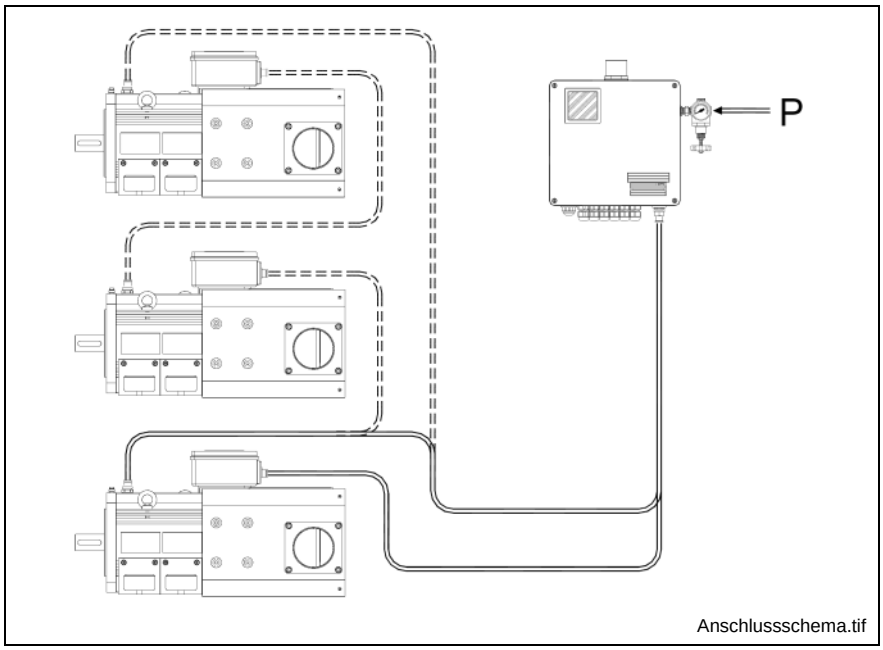
If plastic pipes are used, the maximum outer diameter is 13 mm.

CAUTION

Possible electrostatic discharge from plastic pipes!

⇒ Use only plastic pipes that are certified for use in explosion-protected areas.

Connect the pneumatic purging gas lines by heeding the **maximum permitted bending cycles** according to Fig. 13-14.



p: Maximum permitted input pressure on EEx p control device = **3 bar**

Fig. 13-14: Purging gas connection layout

Note: To operate more than one motor with a control device, apply them in a row when connecting the scavenging lines (Fig. 13-14).

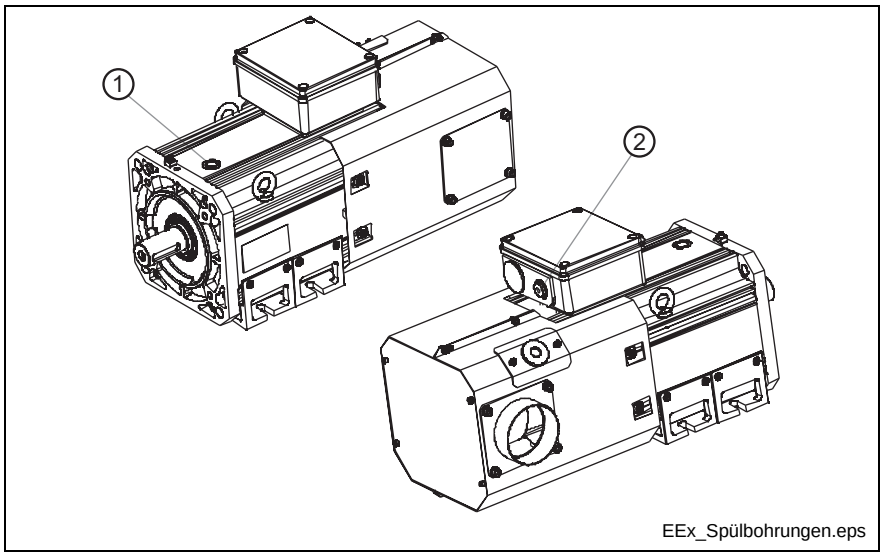
The motor scavenging lines are screwed directly to the corresponding connecting threads. The connecting threads have been covered with protective caps at the factory. Remove the protective caps just before assembly.

Motor size MAD/MAF...	Connecting threads for scavenging gas
100 ... 180	G1/4"

Fig. 13-15: Connection thread of the scavenging holes

When connecting the scavenging lines, pay attention to the specified flow directions:

- inflow (IN) via scavenging hole on terminal box.
- outflow (OUT) via scavenging hole on motor housing.



(1): Scavenging hole on motor housing (OUT)
(2): Scavenging hole on terminal box (IN)

Fig. 13-16: Connection for scavenging gas at EX motors

Connection of scavenging gas lines

Proceed as follows to connect the scavenging gas lines:

1. Remove the protective caps on both scavenging holes.
2. Fasten the scavenging lines in the appropriate connection threads on the motor.
   When connecting the scavenging lines, pay attention to the correct flow direction.
3. Firmly tighten the connection.

Scavenging gas

Only inert gas or cleaned and dried industrial air is permitted to be used as scavenging gas. In any case, a filter must be installed upstream if the quality in terms of foreign particles cannot be ensured.

Note: Also observe the manufacturer's information regarding the assembly and commissioning of the control device.

13.9 Commissioning

Warning

Danger of explosion due to failure to accept the overall system!

⇒ Taking the correspondent national regulations into account, EX motors may be commissioned only by a skilled electrician.

⇒ Commissioning in explosion-protected areas is prohibited until it has been ascertained that the overall system corresponds to the demands and certification conditions for explosion protection.

⇒ After repairs and disassembly in the course of the maintenance of safety-relevant motor parts, the motor must be tested individually again according to EN 50014:1997 (section 26) and EN 50016 if the explosion-protection characteristics were changed due to the repairs or disassembly.

CAUTION

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

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

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

⇒ Check the holding brake (option) functions before commissioning.

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

Purging time of the overall system

A specified preliminary purging time of the overall system must be maintained each time the motors are started. The purging time can be determined according to the following information:

Determination of the purging time

- 60 seconds purging time per connected motor
- 30 seconds purging time per each 10 m of connection hose.

Example:

Connected motors: 2 2	 x 60 seconds	Purging time 120 sec.
Length of the scavenging gas lines 14 m 2	 x 30 seconds	Purging time 60 sec.
Minimum purging time to be set on the control device		**180 sec.**

Fig. 13-17: Example for calculation of the purging time of the overall system

Pressure switching values to be set

The BARTEC type 07-3711-2213/1002 has been preset at the factory. This preset can be used to operate a drive system consisting of

- up to 5 motors with
- up to 20 m purging gas lines

Are devices of other manufacturers used, the following pressure switching values are checked on location. The operator must ensure that the pressure switching values are checked on location.

Description	Pressure switching value
DIFF A / DIFF B (flow rate on pressure control device)	2.0 mbar
Min A / MIN B (minimum internal housing pressure, deactivation-value)	1.0 mbar
MIN P (freely selectable preliminary alarm)	2.0 mbar
DP 1 (minimum or command operating pressure)	2.5 mbar
MAX (maximum internal housing pressure)	23.0 mbar
MAX 1 (maximum purging pressure)	20.0 mbar

Fig. 13-18: Pressure switching values

Preparation

1. Keep the documentation of all applied products ready.
2. Check the products for damage.
3. Check all mechanical and electrical connections (incl. the grounding conductor!).
4. Activate the safety and monitoring equipment of the system.

Execution

When all prerequisites have been fulfilled, proceed as follows:

1. Activate the fan for the MAD motor or
   the external cooling system to supply the MAF motor.
   Check the function.
2. Check the motor scavenging settings at the control device. Refer to the type label at the motor housing to see the values to be set e.g. for minimum purging times or excess pressure (Fig. 13-5).

Note: The pressurized system must only be operated with the setting values specified on the type label.

3. Activate the control device of the motor purging.
   Check the function.
   Check the values shown on the type label on the motor such as the purging volume, the scavenging gas, the purging time, etc. These values must be reached and maintained. Heed the details of the manufacturer of the control device.
4. Carry out the commissioning of the drive system according to the instructions of the corresponding product documentation. You can find the respective information in the functional description of the drive-devices.
5. Log all measures taken in the commissioning log.

Commissioning of drive controllers and the control unit may require additional steps. The inspection of the functioning and performance of the systems is not discussed in these operating instructions; instead, it is carried out within the framework of the commissioning of the machine as a whole. Observe the information and regulations of the machine manufacturer.

13.10 Dismantling

DANGER

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

⇒ Do not work on unsecured and operating machines.

⇒ Before touching the motor, let it cool sufficiently after switching it off. A cooling time **up to 140 minutes** can be necessary!

⇒ Ensure that the power is off and that the motor is disconnected only in an atmosphere that is not capable of explosions.

⇒ Before working on the system, always use a suitable measuring instrument (e.g. multimeter) to check whether parts are still under a residual voltage (e.g. due to the residual energies of capacitors in filters, drive devices, etc.); let their discharge times elapse.

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

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

In the case of malfunctions, maintenance or deactivation of the motors, proceed as follows:

1. Use the control commands to bring the drive to a controlled standstill.
2. Switch off the power and control voltage of the drive device.
3. **Only for MAD**: Switch off the motor protection switch for the motor fan.

   Only for MAF: Switch off of the power supply of the external cooling system.
4. Switch off the control device for the motor purging system (observe the notes of the manufacturers regarding deactivation).
5. Switch off the main switch of the machine.
6. Secure the machine against accidental movements and against unauthorized operation.
7. Wait for the cooldown times of the motor and the discharge time of the electrical systems to elapse.
8. Disconnect all electrical connections. Disconnect the scavenging lines from the motor at the connection threads
9. Before dismantling, secure the motor and power supply against falling or movement before disconnecting the mechanical connections.
10. Dismantle the motor from the machine. At the MAF motor, also empty the coolant channels.
11. Log all measures taken in the commissioning log.

13.11 Maintenance / Repairs

Increase availability with regular preventive maintenance measures. Notice the information in the maintenance schedule of the machine manufacturer and the following details regarding maintenance measures and intervals for the motor.

WARNING

Danger of explosion!
Death by electrocution possible due to live parts with more than 50V!

⇒ Working on parts that are under power while the danger of explosions exists is strictly prohibited.

⇒ Before starting work that has to be carried out, observe the important safety regulations according to DIN VDE 530, such as releasing the power; securing against restarting; ensuring that the system is not under power; grounding and short-circuiting; and covering or fencing off neighboring parts that are under power.

⇒ Ensure that the measures mentioned above cannot be repealed before the work is completed.

Maintenance

Measure	Interval
Only for MAF: Check the functioning of the coolant system	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Only for MAD: Check the functioning of the fan and the air circulation.	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Check the mechanical and electrical connections.	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Check the air hoses of the motor purging device for correct positioning and leaks	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. **Note:** If the control device issues an error message regarding a loss of pressure in the excess pressure capsule, this can indicate that the shaft sealing ring is worn.
Check the machine for smooth running, vibrations and bearing noises.	According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours.
Remove dust, chips and other dirt from the motor housing, cooling fins and the connections.	Depending on the degree of soiling, but after one operating year at the latest.

Fig. 13-19: Maintenance measures

Repairs

WARNING

Danger of explosion due to improper repairs!

⇒ Repairs on EX motors may only be carried out by Bosch Rexroth or an authorized workshop.

⇒ If Rexroth EX motors are repaired, modified or retrofitted in a workshop other than at Bosch Rexroth Electric Drives and Control GmbH, IEC 20034-1 dictates that an additional label is to be attached to the motor after every repair of modification indicating the name of the workshop or of the repairman, the year of the repair and the modifications made.

⇒ After repairs and disassembly in the course of the maintenance of safety-relevant motor parts, the motor must be tested individually again according to EN 50014:1997 (section 26) and EN 50016 if the explosion-protection characteristics were changed due to the repairs or disassembly.

Defective EX motors must be sent back to the place of manufacture or to a Bosch Rexroth authorized workshop for EX motors for repairs such as

- Replacing the motor encoder
- Replacing the radial shaft sealing ring
- ...

In no case may they be dismantled or repaired by a workshop not authorized by Bosch Rexroth.

13.12 Declaration of Conformity

Industrial Hydraulics | **Electric Drives and Controls** | Linear Motion and Assembly Technologies | Pneumatics | Service Automation | Mobile Hydraulics

Rexroth
Bosch Group

Konformitätserklärung

Im Sinne der EG-Richtlinie 94/9/EG
Produkt/Product/produit: MAD/ MAF für ATEX

RNC 87411-700
2006-02-08

Declaration of Conformity as per EC directive 94/9/EG
Déclaration du fabricant conformément à la directive "CE" 94/9/EG

Hiermit erklären wir, dass das Produkt — We herewith declare that the product — Par la présente nous déclarons que le produit

1. **Produkt:** / **Product:** / **Produit:** — AC-Motor / AC motor / Moteur AC
2. **Hersteller:** / **Manufacturer:** / **Constructeur:** — Bosch Rexroth Electric Drives and Controls GmbH, Bürgermeister-Dr.-Nebel-Straße 2, 97816 Lohr a. Main / Germany
3. **Typ / Type:** — MAD...-...-...-S6-... ; MAF...-...-...-S6-... MAD...-...-...-M6-... ; MAF...-...-...-M6-...
4. **ab Herstelldatum:** / **from date of manufacture:** / **à partir de la date de fabrication:** — 2006-04-01
5. **Angewendete Normen / Applicable standard / Normes utilisées**

Norm / Standard / Norme	Titel / Title / Titre	Ausgabe / Edition
EN 50014 + A1 + A2	Electrical apparatus for potentially explosive atmospheres - General requirements	1997/ 1999
EN 50018 + A1	Electrical apparatus for potentially explosive atmospheres - Flameproof enclosure „d“	2000 / 2002
EN 50016	Electrical apparatus for potentially explosive atmospheres - Pressurized apparatus „p“	2002

6. **Baumusterprüfbescheinigungen / Type Examination Certificate / Attestation d'examen de type**
TPS 05 ATEX 57401 1 — EG-Baumusterprüfbescheinigung des TUEV Product Service TUEV Sued, Germany mit Prüfbericht 70096392, betreffend MAD/ MAF

den Bestimmungen der EG-Richtlinie 94/9/EG vom 23. März 1994 entspricht. Die Produkte sind ausschließlich zum Einbau in eine Maschine mit funktionierenden und zugelassenen Schutz- und Überwachungseinrichtungen für den Explosionsschutz bestimmt. Die Verwendung der in der Baumusterprüfbescheinigung angegebenen Sicherheitseinrichtungen und Komponenten unter den dort genannten Betriebsbedingungen und Normen wird vorausgesetzt.

complies with the provisions of EC Directive 94/9/EC dated 23rd March 1994. The product is intended solely for installation in a machine with working and approved safety and monitoring equipment for the explosion protection. As a prerequisite, the safety devices and components specified in the Type Examination Certificate must be used under the operating conditions and standards mentioned in this certificate.

satisfait aux dispositions de la Directive CE 94/9 CE du 23 mars 1994. Les produits sont tous, sans exception, destinés et étre intégrés á une machine avec l'équipement immatriculé de securité et protection explosive. Il est présupposé que les dispositifs de sécurité et composants indiqués dans l'Attestation d'examen de type sont utilisés sous les conditions de foncionnement et normes mentionnées dans l'Attestation d'examen.

RNC-87416-000_KOE_N_D3_2003-11-26.doc

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Konformitätserklärung.tif

Fig. 13-20: Declaration of conformity (1/2)

Für das Gesamtsystem ist eine Zulassung einschließlich der Schutz- und Überwachungseinrichtungen für den Explosionsschutz erforderlich, in der die Anforderungen der Normen auf Einhaltung im Gesamtsystem geprüft wurden.	The approval of the overall system with the safety and monitoring equipment for the explosion protection included is required. The requirements of the standards must be approved for compliance in the overall system.	La certification du système entier avec l'équipement de securité et protection explosive compris est nécessaire. L'observation des exigences normatives dans le système entier doit avoir été vérifiée.
Die Inbetriebnahme des Produktes ist solange untersagt, bis festgestellt wurde, dass die Maschine, in die das Produkt eingebaut werden soll, den Bestimmungen der EG-Richtlinie entspricht.	It is prohibited to put the product into operation until it has been established that the machine in which the product is to be installed complies with the provisions of the EC Directive.	La mise en service du produit est proscrite tant qu´il n´a pas été constaté que la machine dans laquelle ce produit doit étre monté, répond aux dispositions de la directive CE.
Erläuterungen: Der bestimmungsgemässe Gebrauch des Produktes setzt die Einhaltung der Benutzungs-bestimmungen und Anwendungs-bedingungen, die in der Dokumentation *„MAD/ MAF Motoren für explosionsgefährdete Bereiche nach ATEX – Betriebsanleitung“* (Dokumentationstyp DOK-MOTOR*-IDYN*A*ATEX-IB02-D5-..) angegeben werden, durch den Anwender voraus.	**Explanations:** For the product to be used as intended the user must comply with the provisions of use and conditions of application laid down in the documentation *„MAD/ MAF motors for hazardous areas in accordance with ATEX – Project Planning Manual“* (documentation type DOK-MOTOR*-IDYN*A*ATEX-IB02-D5-P).	**Explications:** L´utilisation correcte du produit, c´est-á-dire en conformité avec sa destination, présuppose le respect par son utilisateur des prescriptions d´utilisation et conditions d´application stipulées dans la documentation *„MAD/ MAF Moteurs pour atmosphéres explosibles suivant ATEX – Guide de projet“* (Type de documentation DOK-MOTOR*-IDYN*A*ATEX-IB02-D5-P).
Der Motor hat die folgende Kennzeichnung:	The motor has the following markings:	Le moteur a la caractérisation suivante:
CE Ex II 2 G EEx p d IIB T3	**CE Ex II 2 G EEx p d IIB T3 X**	**CE Ex II 2 G EEx p d IIB T3 X**

Lohr a. Main , den 2006-02-17
Ort/place/lieu Datum/date

i.V. Michael Steinbrecher
Leiter Qualitäts-Management/
Head of Quality Management/
Directeur Gestion Qualité

i.V. Norbert Nellen
Produktsicherheitsbeauftragter/
Product Safety Supervisor/
Responsable Sécurité des Produits

Änderungen im Inhalt der Konformitätserklärung sind vorbehalten. Derzeit gültige Ausgabe auf Anfrage.
We reserve the right to make changes in the conformity declaration. Presently applicable edition can be obtained upon request.
Le fabricant se réserve le droit de modifier le contenu de la déclaration de conformité. Edition actuellement en vigueur sur demande.

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Fig. 13-21: Declaration of conformity (2/2)

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