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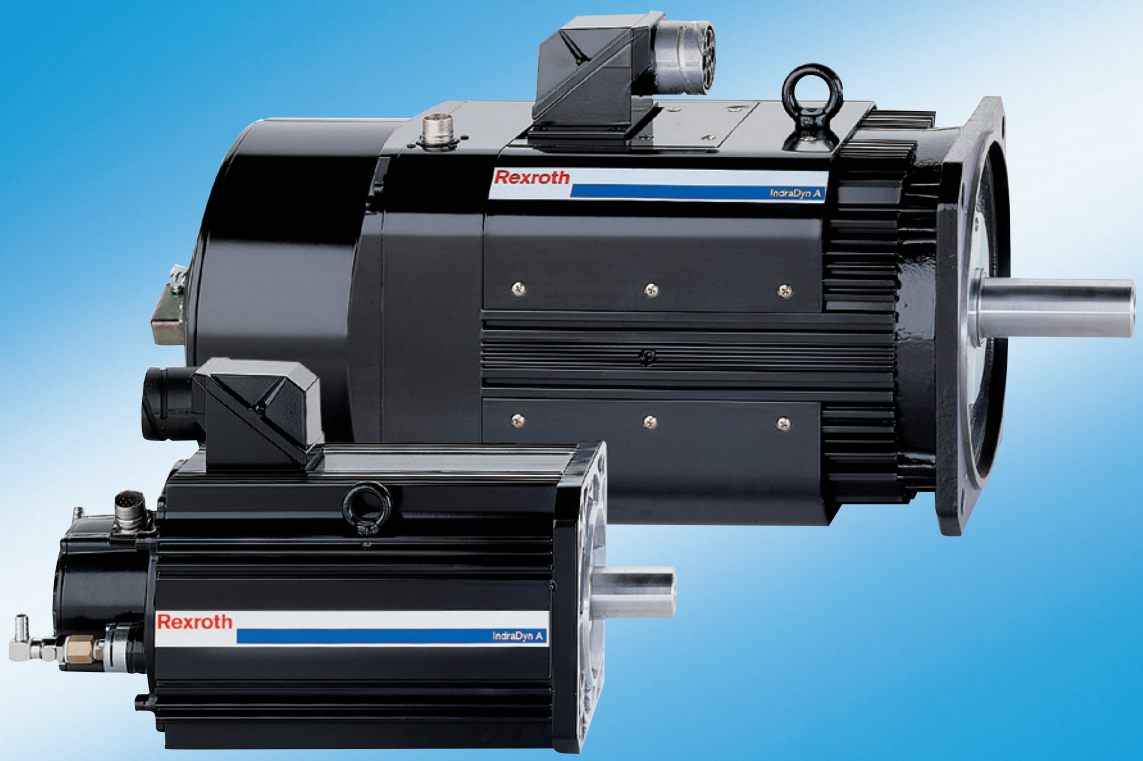
Rexroth Bosch Group

Rexroth IndraDyn A Series Asynchronous Motors MAD/MAF

R911295781
Edition 02

Project Planning Manual



Title
Rexroth IndraDyn A Series
Asynchronous Motors MAD/MAF

Type of Documentation
Project Planning Manual

Document Typecode
DOK-MOTOR*-MAD/MAF****-PR02-EN-P

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- Document Number 120-1500-B321-02/EN

Purpose of Documentation
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.

Record of Revisions

Description	Release Date	Notes
DOK-MOTOR*-MAD/MAF****-PR01-EN-P	11.2003	1st edition
DOK-MOTOR*-MAD/MAF****-PR02-EN-P	02.2005	1st reprint

Validity
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Published by
Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2 • D-97816 Lohr a. Main
Tel +49 (0)93 52 / 40-0 • Tx 68 94 21 • Fax +49 (0)93 52 / 40-48 85
http://www.boschrexroth.com/
Dept. EDM1 (FS)

Note
This document has been printed on chlorine-free bleached paper.

Table of Contents

1 Introduction to the Product

The IndraDyn A series consists of housed, asynchronous motors from Bosch Rexroth. The two versions of IndraDyn A differ by their method of cooling.

- The **MAD version** is air-cooled by a firmly-attached fan unit, which forces the ambient air across the surface of the motor.

Fig. 1-1: Illustration example MAD130

- The **MAF version** is internally cooled by liquid.

Fig. 1-2: Illustration example MAF130

IndraDyn A motors can be used either as main-spindle motors or as servo motors for all rotary drive applications.

The optimized design has international protection class IP65 for both motor and fan which allows for operation in adverse conditions. The easy-to-service construction reduces maintenance frequency and even allows maintenance during operation.

Combined with digital control devices from the IndraDrive series, 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 setup provides an overview of the contents of this documentation.

Sect.	Title	Content	
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 projectors
5	Dimension Sheets		
6	Type Codes		
7	Accessories	Practice	for operating and maintenance personnel
8	Connection Techniques		
9	Application notes		
10	Handling & Transport		
11	Installation		
12	Operation		
13	Service and Support		
14	Index	Additional information	

Fig. 1-3: Chapter structure

Supplementary Documentation

To project planning the drive-systems of the IndraDyn A motor series, you may need additional documentation depending on the devices used in your case. Rexroth provides all product documentation on CD in a PDF-format. To project planning a system, you will not need all the documentations included on the CD.

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

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

Fig. 1-4: Supplementary 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 particular manufacturers.

For information on the manufacturers see Chapter 9 ”Application Notes”.

Feedback

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

Rexroth Indramat GmbH
Dep. BRC/EDM1
Bürgermeister-Dr.-Nebel-Strasse 2
D-97816 Lohr, Germany

Fax +49 (0) 93 52 / 40-43 80

Standards

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BEUTH Verlag GmbH
Burggrafenstrasse 6
10787 Berlin

Phone +49-(0)30-26 01-22 60, Fax +49-(0)30-26 01-12 60
Internet: http://www.din.de/beuth postmaster@beuth.de

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 Introduction

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

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

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

WARNING

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

3.2 Explanations

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

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

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

3.3 Hazards by Improper Use

DANGER

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

DANGER

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

WARNING

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

WARNING

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

CAUTION

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

CAUTION

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

CAUTION

Risk of injury due to incorrect handling of batteries!

3.4 General Information

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

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

3.5 Protection Against Contact with Electrical Parts

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

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

DANGER

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

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.
- Follow general construction and safety regulations when working on high voltage installations.
- Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the ground wire is not permanently connected to the points of the components provided for this purpose.
- Before working with electrical parts with voltage higher than 50 V, the equipment must be disconnected from the mains voltage or power supply. Make sure the equipment cannot be switched on again unintended.
- The following should be observed with electrical drive and filter components:
- Wait thirty (30) minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
- Never touch the electrical connection points of a component while power is turned on.
- Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.
- A residual-current-operated protective device (RCD) must not be used on electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.
- Electrical components with exposed live parts and uncovered high voltage terminals must be installed in a protective housing, for example, in a control cabinet.

To be observed with electrical drive and filter components:

DANGER

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

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

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

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

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

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

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

WARNING

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

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

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

3.7 Protection Against Dangerous Movements

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

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

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

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

DANGER

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

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

WARNING

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

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

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

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

3.9 Protection Against Contact with Hot Parts

CAUTION

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

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

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

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

3.10 Protection During Handling and Mounting

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

CAUTION

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

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

⇒ Use appropriate mounting and transport equipment.

⇒ Take precautions to avoid pinching and crushing.

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

⇒ Use lifting devices and tools correctly and safely.

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

⇒ Never stand under suspended loads.

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

3.11 Battery Safety

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

CAUTION

Risk of injury by incorrect handling!

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

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

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

= Do not damage electrical components installed in the equipment.

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

3.12 Protection Against Pressurized Systems

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

CAUTION

Danger of injury by incorrect handling of pressurized systems !

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

= Observe the operation instructions of the respective manufacturer.

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

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

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

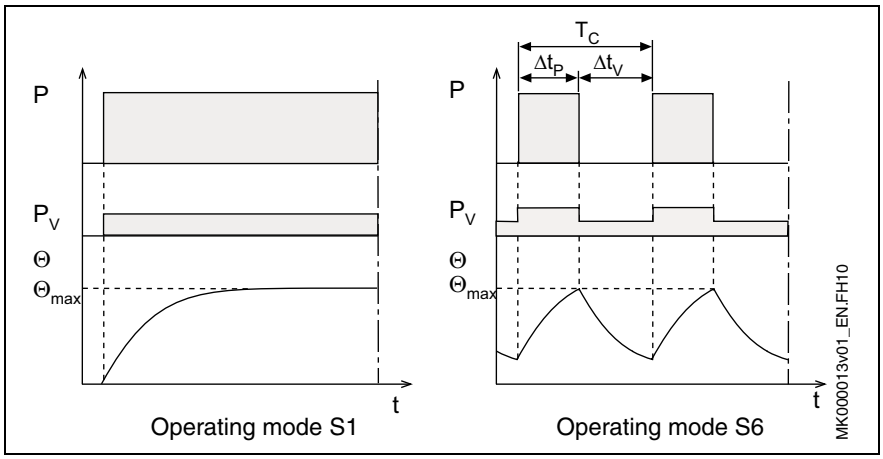
Note: Environmental protection and disposal! The media used in the operation of the pressurized system equipment may not be environmentally compatible. Media that are damaging the environment must be disposed separately from normal waste. Observe the legal requirements in the country of installation.

Notes

4 Technical Data

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 the operating mode S1 (continuous operation) and S6 (periodic operation), each cooled with either surface cooling via directly-connected blower units or with liquid cooling.



P: Power
P_V: Electric losses
Θ: Temperature
$Θ_{max}$: Highest temperature (stator)
t: Time
T_C: Duty cycle time
$Δt_P$: Operating time with constant power
$Δt_V$: Idle time

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

ON Time

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

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

ED: Cyclic duration factor in %
T_C: Duty cycle time
$Δt_P$: Operating time with constant capacity

Fig. 4-2: Cyclic duration factor

4.2 Operating Behavior

The following section describes the parameters, characteristic curves and the explanations of the motor data found in the technical data sheets of the IndraDyn A series.

Parameters

Rated Torque M_{nenn} Available torque at the rated speed in operating mode S1 (continuous operation). Unit: Newton meters (Nm).

Rated Speed n_{nenn} Typical working speed defined by the manufacturer. Depending on the particular application, other working speeds are possible (see speed-torque characteristic curve).

Rated Power P_{nenn} Power output of the motor at the rated speed and capacity with rated torque, specified in kilowatts (kW).

Rated Current I_{nenn} Phase current of the motor at the rated speed and load with rated torque, specified as root-mean-square value in ampere (A).

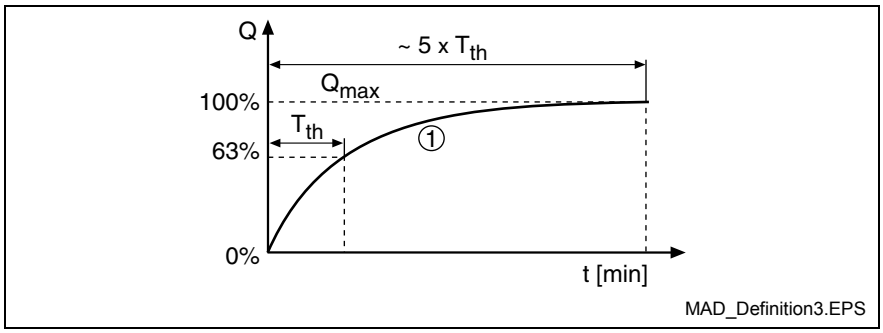
Torque Constant at Rated Point K_{M_nenn} Ratio of increase of torque to the torque-forming current of the motor. Unit: Nm/A. Valid up to the rated current I_N.

Rotor Moment of Inertia J_{rot} The moment of inertia of the rotor without bearings and encoder. Unit: kgm².

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

Maximum Speed n_{max} Maximum allowed speed of the motor in (rpm). Normally restricted by mechanical factors like centrifugal force or bearing stress.

Thermal Time Constant T_{th} The time it takes for the temperature to rise to 63% of the final temperature of the motor under load with rated torque in S1-operation and surface ventilation by directly-connected blower units.



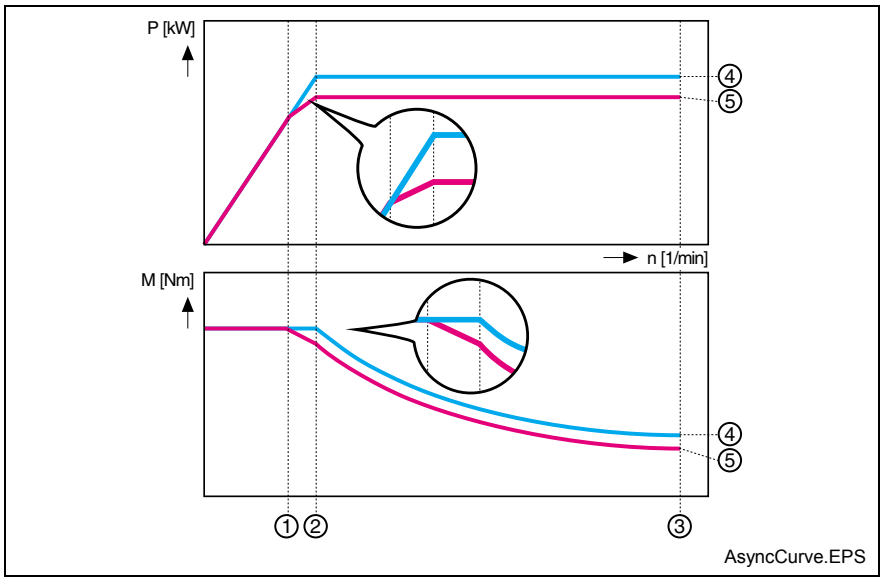
(1): Path of the motor temperature over time
T_{th}: Thermal time constant

Fig. 4-3: Thermal time constant

Duty Cycle Time T_C Duration of the cycle in S6 operating mode until the steady-state temperature is reached and the maximum temperature equals the final temperature in S1 operation (see Fig. Fig. 4-1).

Number of Pole Pairs p Quantity of pole pairs of the motor.

Characteristic Curve



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

Fig. 4-4: IndraDyn A sample characteristic curves

Explanation:

(1) Derating Speed

Derating is present when there is a drop in torque and power before reaching the **rated speed n_{nenn}**. This only occurs in some types of motor windings.

The **continuous stand-still current, I_{n1}**, is applied to the motor until the derating speed is reached.

If there is no derating, $I_{n1} = I_{nenn}$.

The **continuous stand-still torque, M_1,** is available for S1 operation up to the derating speed.

If there is no derating, $M_{n1} = M_{nenn}$.

Derating is in effect only while operating at speeds between (1) and (2) (see Fig. 4-4). Both the power and the torque are reduced in this range.

(2) Rated Speed

With no derating in effect, induction motors provide a constant torque (the rated torque) until the rated speed. Then, starting at the rated speed, constant power (the rated power) is available.

(3) Maximum Speed

The speed up to which a motor can safely be operated. This is normally limited by the mechanical construction, e.g. by the type of bearings used or by the use of a holding brake.

4.3 Technical Data Sheet for MAD100B

Description	Symbol	Unit	MAD100B				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	34	31	28	28	25
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	1.8	3.2	4.4	5.9	6.5
Rated current	I_{nenn}	A	5.3	8.9	11.8	14.6	16.2
Continuous torque at standstill	M_{n1}	Nm	-	34	31	30	28
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	9.4	12.5	15.3	16.8
Maximum speed	M_{max}	Nm	75	75	68	66	62
Torque constant at 20°C	K_{M_nenn}	Nm/A	7.66	4.31	3.03	2.41	2.11
Number of pole pairs	p		3				
Min. cross section of power cable [2])	A	mm²	2.5				
Rotor moment of inertia [3])	J_{rot}	kgm²	0.019				
Mass of motor [4])	m	kg	39				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	9000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	6000	6300		
Maximum speed with bearing... - reinforced	n_{max}	rpm	not available				
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000	11000 [7])	
Thermal time constant	T_{th}	min	30				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [5])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				

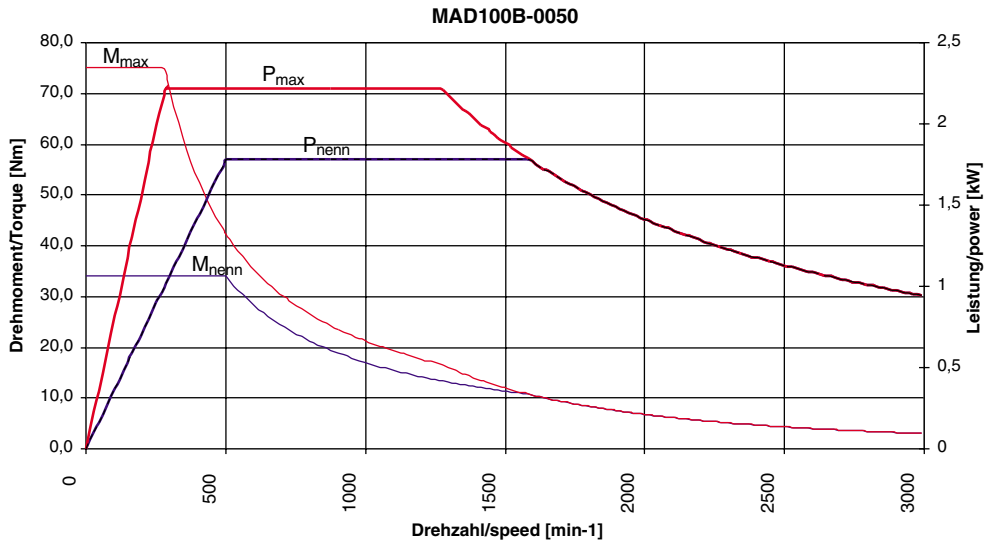
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**
Transmittable torque	M_4	Nm	30	24
Connection voltage	U_{Br}	V	DC 24 ± 10 %	
Rated current	I_{Br}	A	0.9	1.1
Moment of inertia	J_{Br}	kgm²	0.00056	
Max. permissible braking energy	W_{max}	Ws	20000	
Disengagement time	t_2	ms	50	90
Engagement time	t_1	ms	42	30
Maximum speed of brake	n_{Br_max}	rpm	10000	10000
Mass of brake	m	kg	2	1.6

Blower			**Axial blower**
Air current			B → A, blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	83 100
Blower current [6])	I_N	A	0.12
Average air flowrate	V	m³/h	230

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.
[7]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-5: Data sheet MAD100B

Characteristic Curves of MAD100B



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

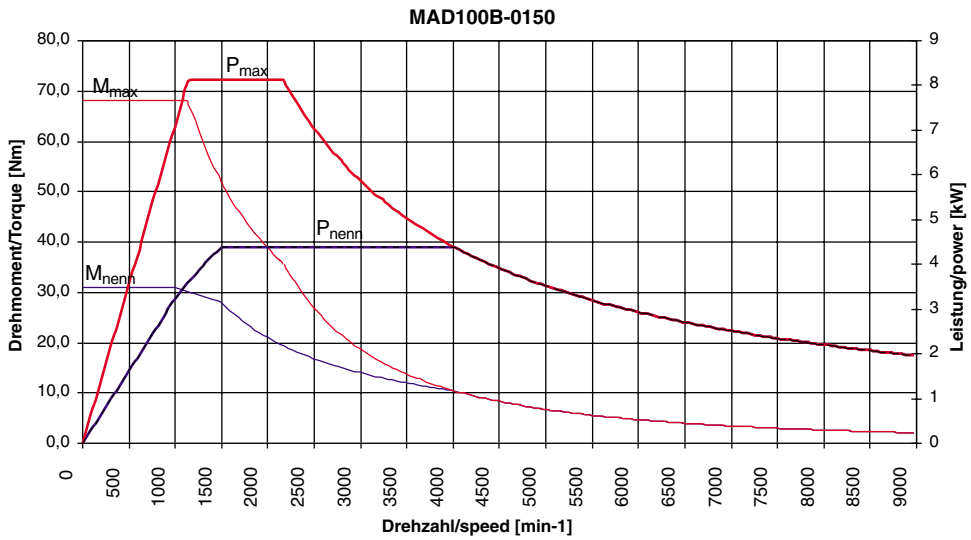
KENNL-MAD100B_0050.FH10

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

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

KENNL-MAD100B_0100.FH10

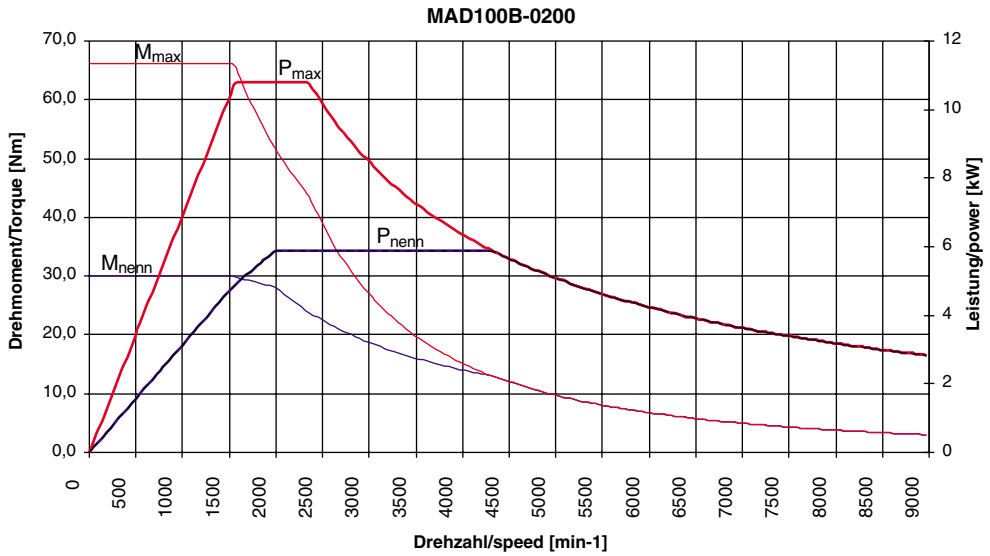
Fig. 4-7: Characteristic curve of MAD100B-0100



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD100B_0150.FH10

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



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD100B_0200.FH10

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

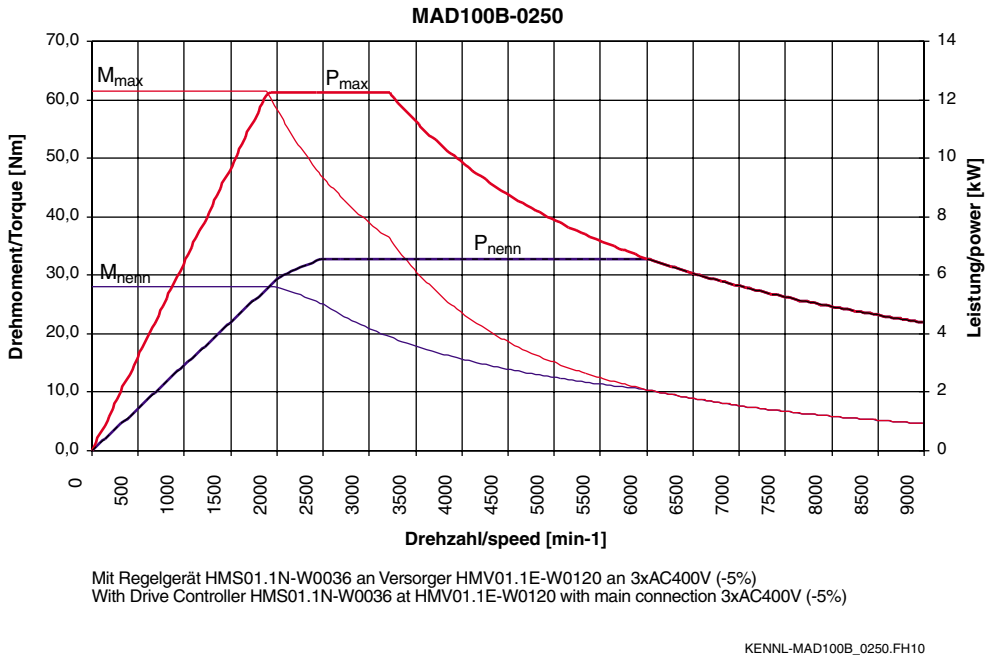


Fig. 4-10: Characteristic curve of MAD100B-0250

4.4 Technical Data Sheet for MAD100C

Description	Symbol	Unit	MAD100C				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	51	50	48	45	40
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	2.7	5.2	7.5	9.4	10.5
Rated current	I_{nenn}	A	8.2	13.2	19.7	25.7	27.8
Continuous torque at standstill	M_{n1}	Nm	-	54	50	48	45
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	13.8	20.3	26.7	28.3
Maximum speed	M_{max}	Nm	112	119	110	106	99
Torque constant at 20°C	K_{M_nenn}	Nm/A	7.4	4.94	2.94	2.41	2.23
Number of pole pairs	p		3				
Min. cross section of power cable [2])	A	mm²	2.5	2.5	2.5	4	4
Rotor moment of inertia [3])	J_{rot}	kgm²	0.0284				
Mass of motor [4])	m	kg	55				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	9000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	6000	6300		
Maximum speed with bearing... - reinforced	n_{max}	rpm	not available				
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000	11000 [7])	
Thermal time constant	T_{th}	min	30				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [5])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				

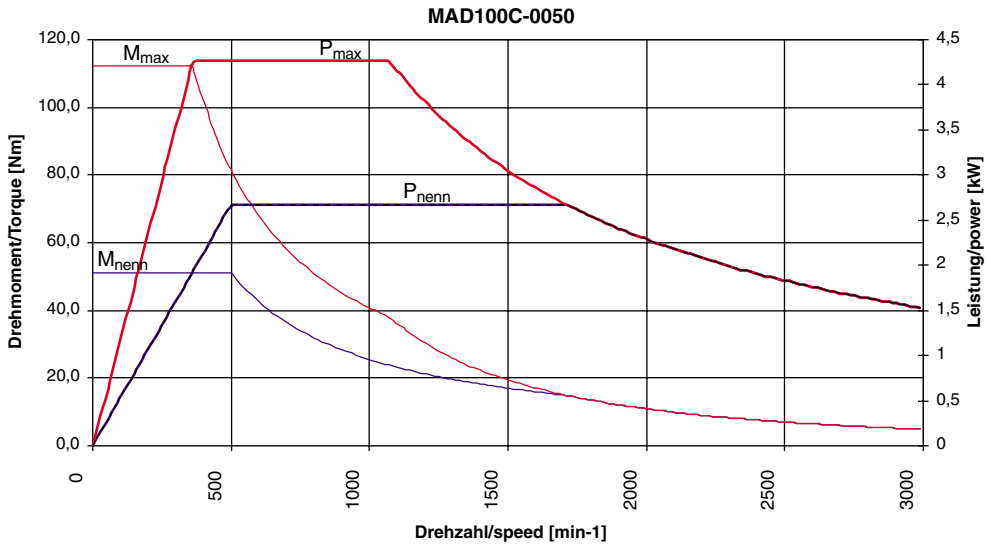
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**
Transmittable torque	M_4	Nm	30	24
Connection voltage	U_{Br}	V	DC 24 ± 10 %	
Rated current	I_{Br}	A	0.9	1.1
Moment of inertia	J_{Br}	kgm²	0.00056	
Max. permissible braking energy	W_{max}	Ws	20000	
Disengagement time	t_2	ms	50	90
Engagement time	t_1	ms	42	30
Maximum speed of brake	n_{Br_max}	rpm	10000	10000
Mass of brake	m	kg	2	1.6

Blower			**Axial blower**
Air current			B → A, blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	83 100
Blower current [6])	I_N	A	0.12
Average air flowrate	V	m³/h	230

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.
[7]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-11: Data sheet MAD100C

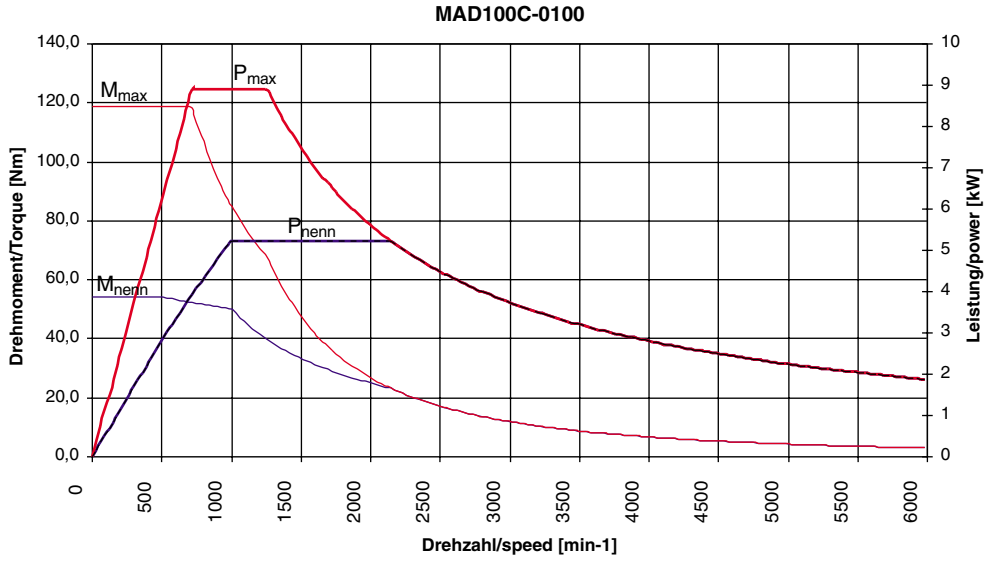
Characteristic Curves of MAD100C



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

KENNL-MAD100C_0050.FH10

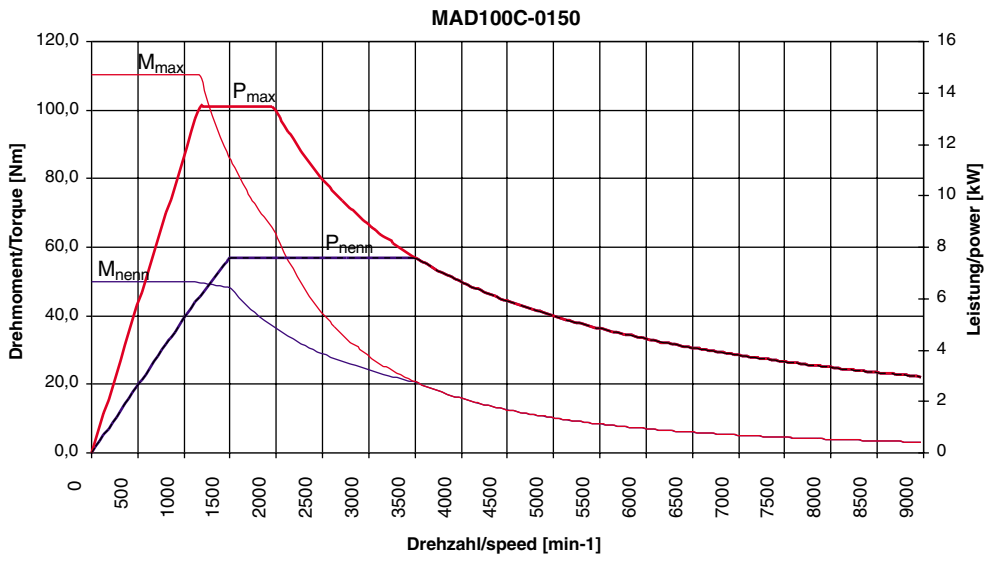
Fig. 4-12: Characteristic curve of MAD100C-0050



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD100C_0100.FH10

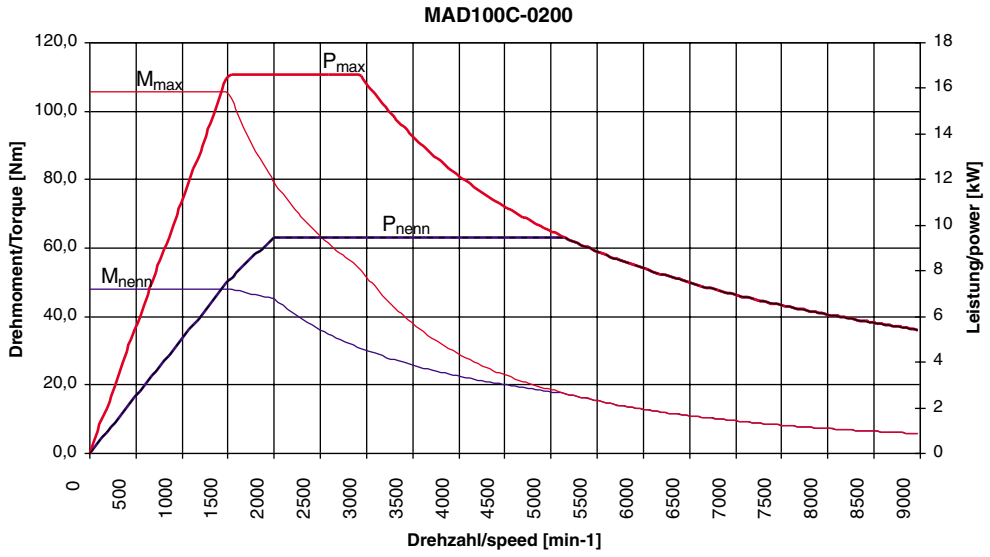
Fig. 4-13: Characteristic curve of MAD100C-0100



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

KENNL-MAD100C_0150.FH10

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



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

KENNL-MAD100C_0200.FH10

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

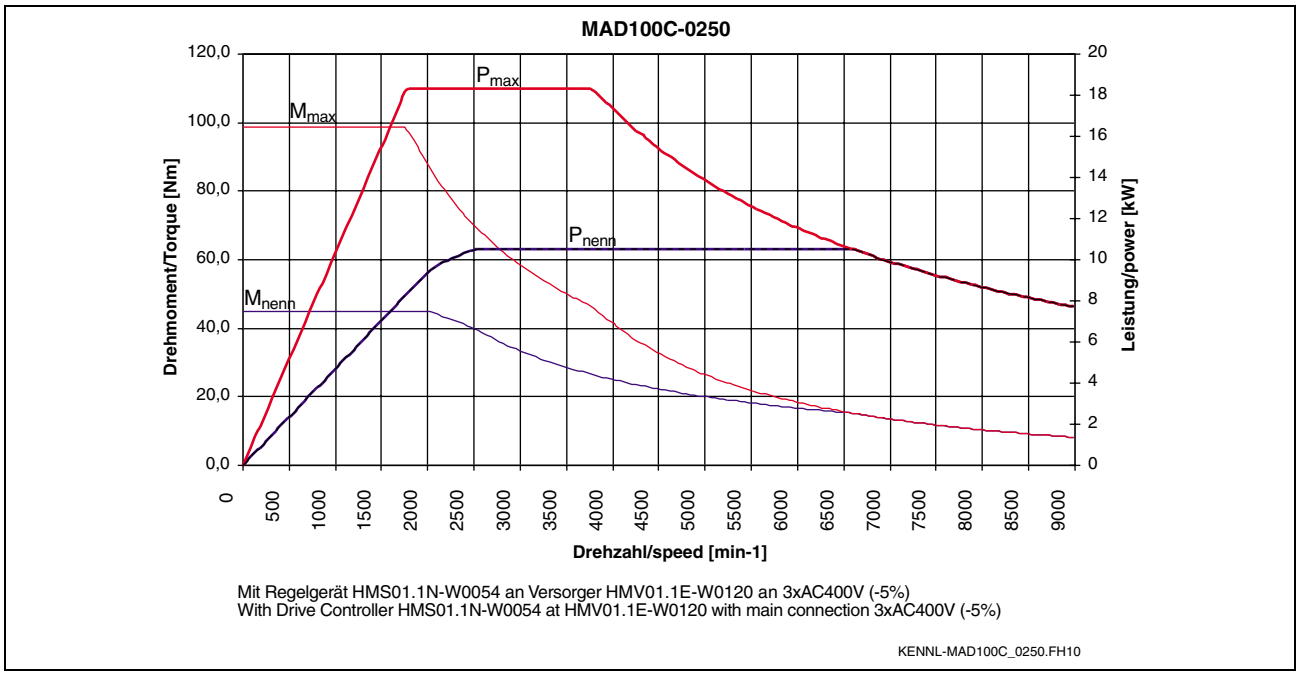


Fig. 4-16: Characteristic curve of MAD100C-0250

4.5 Technical Data Sheet for MAD100D

Description	Symbol	Unit	MAD100D				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	70	64	59	54	50
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	3.7	6.7	9.3	11.3	13.1
Rated current	I_{nenn}	A	10.1	18.0	25.6	27.2	32.4
Continuous torque at standstill	M_{n1}	Nm	-	70	64	59	54
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	19.0	26.8	28.7	34.7
Maximum speed	M_{max}	Nm	154	146	141	130	119
Torque constant at 20°C	K_{M_nenn}	Nm/A	8.52	4.5	3.19	2.62	2.21
Number of pole pairs	p		3				
Min. cross section of power cable [2])	A	mm²	2.5	2.5	4	4	6
Rotor moment of inertia [3])	J_{rot}	kgm²	0.038				
Mass of motor [4])	m	kg	60				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	9000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	6000	6300		
Maximum speed with bearing... - reinforced	n_{max}	rpm	not available				
Maximum speed with bearing... - High-speed	n_{max}	rpm	not available				
Thermal time constant	T_{th}	min	30				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [5])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				

Holding brake (optional)			**Electrically-clamped**	**Electrically-released**
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	
Disengagement time	t_2	ms	50	90
Engagement time	t_1	ms	42	30
Maximum speed of brake	n_{Br_max}	rpm	10000	10000
Mass of brake	m	kg	2	1.6

Blower			**Axial blower**
Air current			B → A, blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	83 100
Blower current [6])	I_N	A	0.12
Average air flowrate	V	m³/h	230

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.
[7]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-17: Data sheet MAD100D

Characteristic Curves of MAD100D

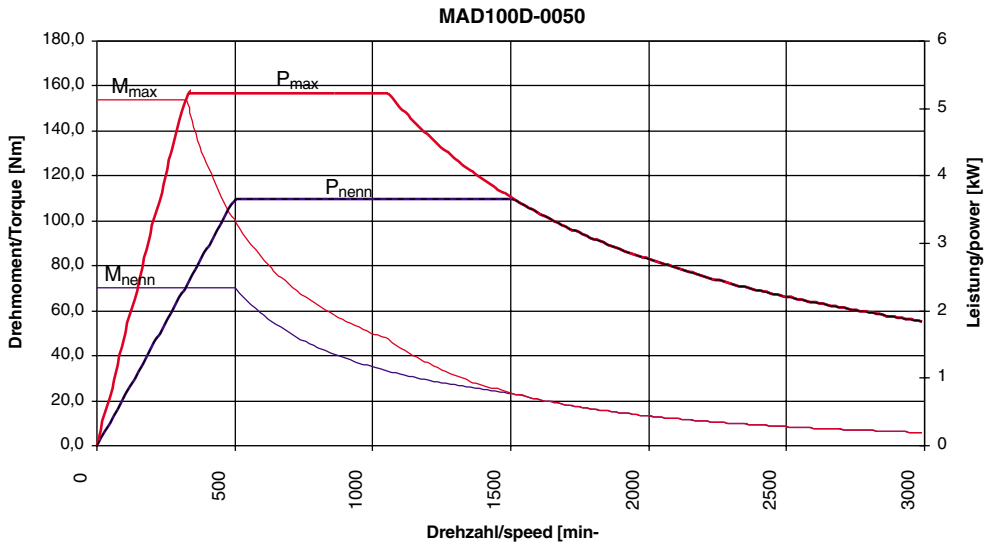


Fig. 4-18: Characteristic curve of MAD100D-0050

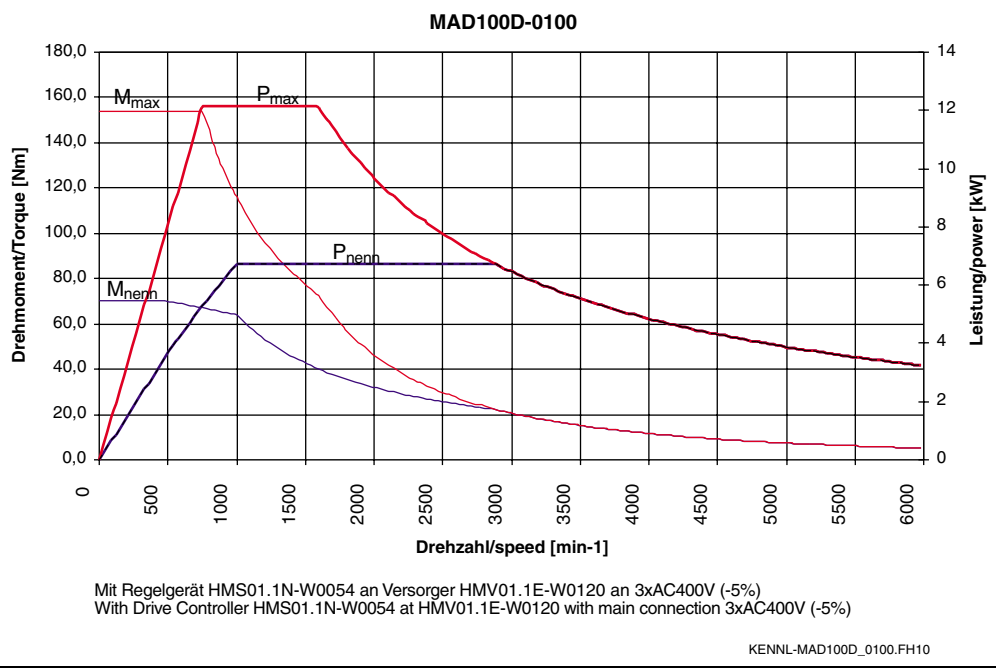


Fig. 4-19: Characteristic curve of MAD100D-0100

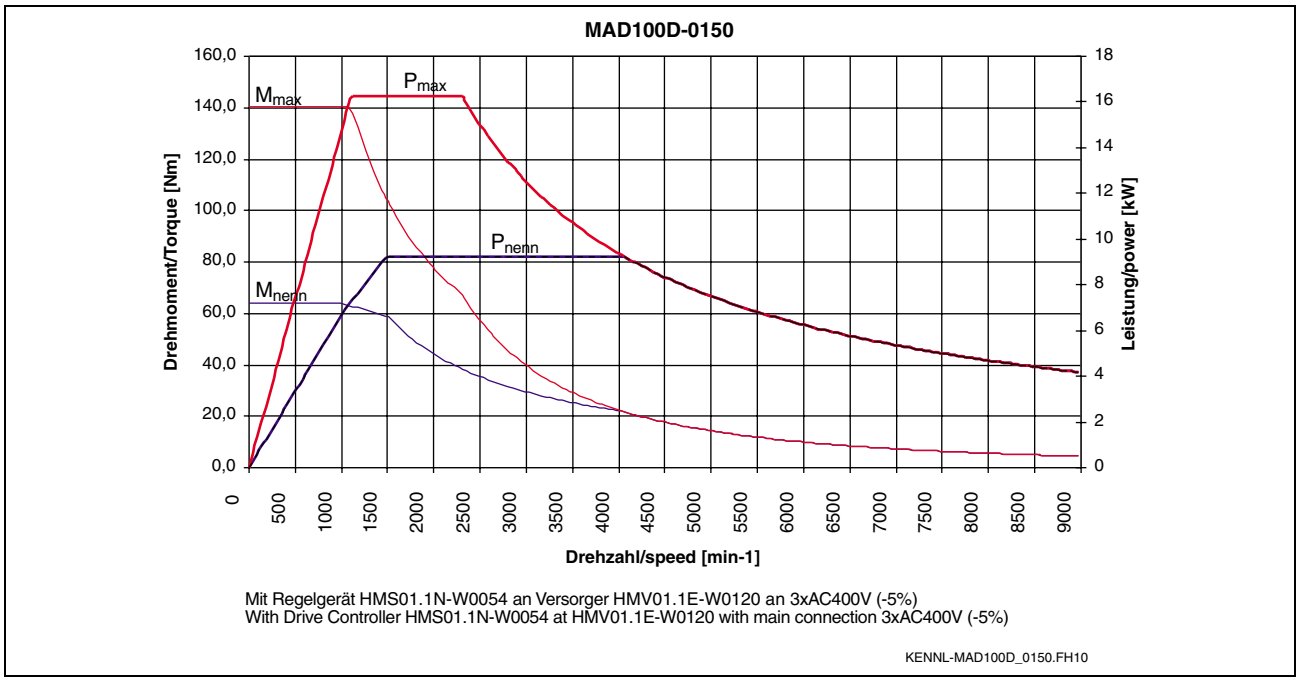


Fig. 4-20: Characteristic curve of MAD100D-0150

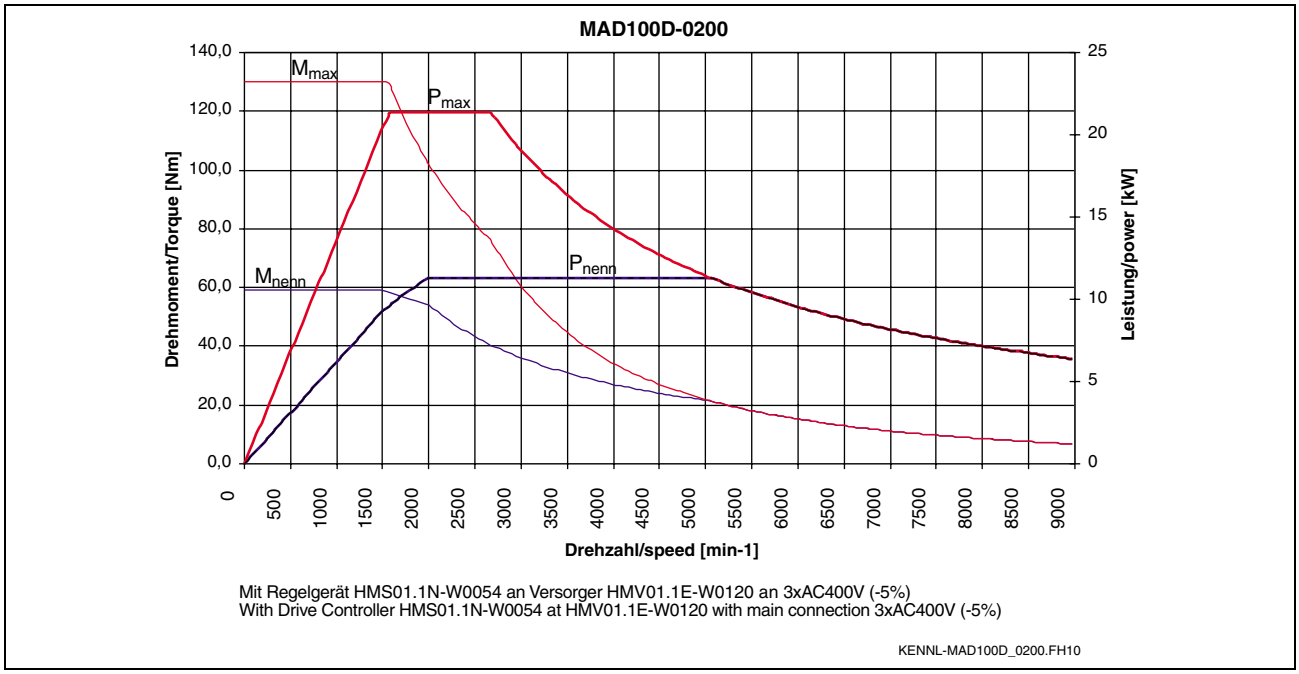


Fig. 4-21: Characteristic curve of MAD100D-0200

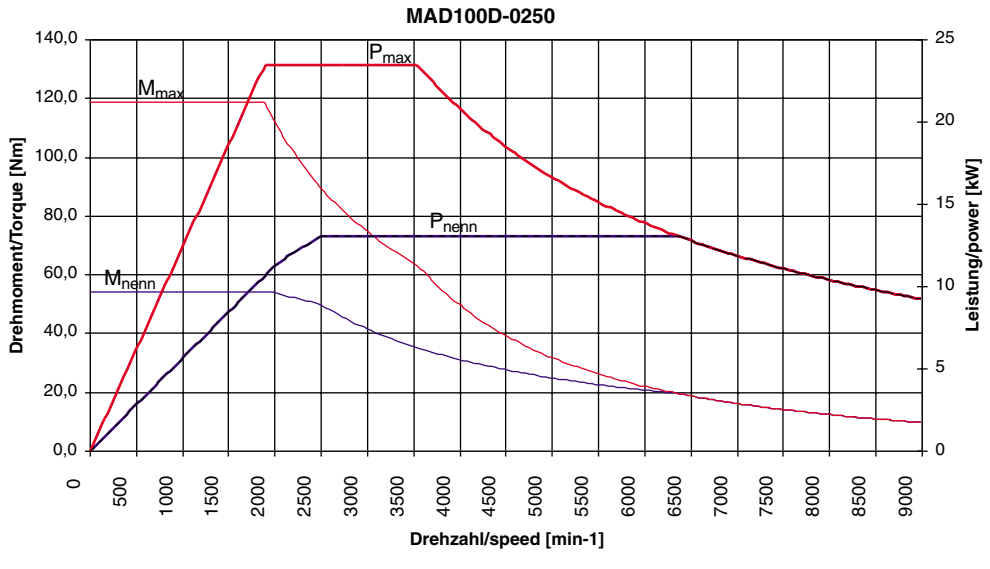


Fig. 4-22: Characteristic curve of MAD100D-0250

4.6 Technical Data Sheet for MAD130B

Description	Symbol	Unit	MAD130B				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	95	88	80	80	75
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	5.0	9.2	12.6	16.8	19.6
Rated current	I_{nenn}	A	12.8	24.1	32.3	43.0	47.2
Continuous torque at standstill	M_{n1}	Nm	-	95	88	85	80
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	25.6	34.5	44.5	47.7
Maximum speed	M_{max}	Nm	209	209	193	187	176
Torque constant at 20°C	K_{M_nenn}	Nm/A	8.49	4.26	2.96	2.47	2.18
Min. cross section of power cable [2])	A	mm²	2.5	4	6	10	10
Number of pole pairs	p		3				
Rotor moment of inertia [3])	J_{rot}	kgm²	0.084				
Mass of motor [4])	m	kg	92				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	5250			
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000 [7])	10000 [7])	
Thermal time constant	T_{th}	min	45				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [5])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				

Holding brake (optional)			Electrically-clamped	Electrically-released
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	
Disengagement time	t_2	ms	65	140
Engagement time	t_1	ms	110	50
Maximum speed of brake	n_{Br_max}	rpm	8000	8000
Mass of brake	m	kg	8	

Blower			Axial blower
Air current			B → A, blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	139 208
Blower current [6])	I_N	A	0.20 .... 0.25
Average air flowrate	V	m³/h	1000

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.
[7]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-23: Data sheet MAD130B

Characteristic Curves of MAD130B

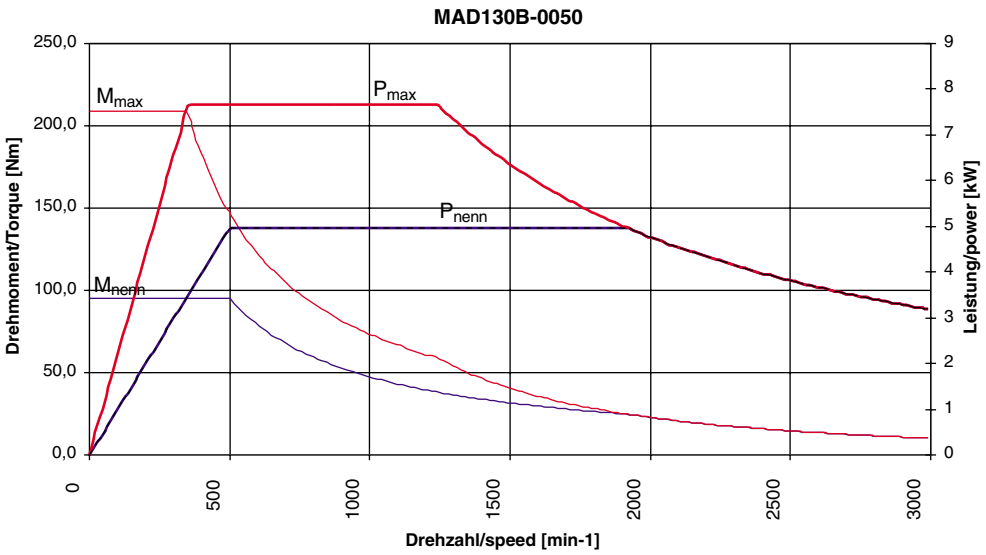


Fig. 4-24: Characteristic curve of MAD130B-0050

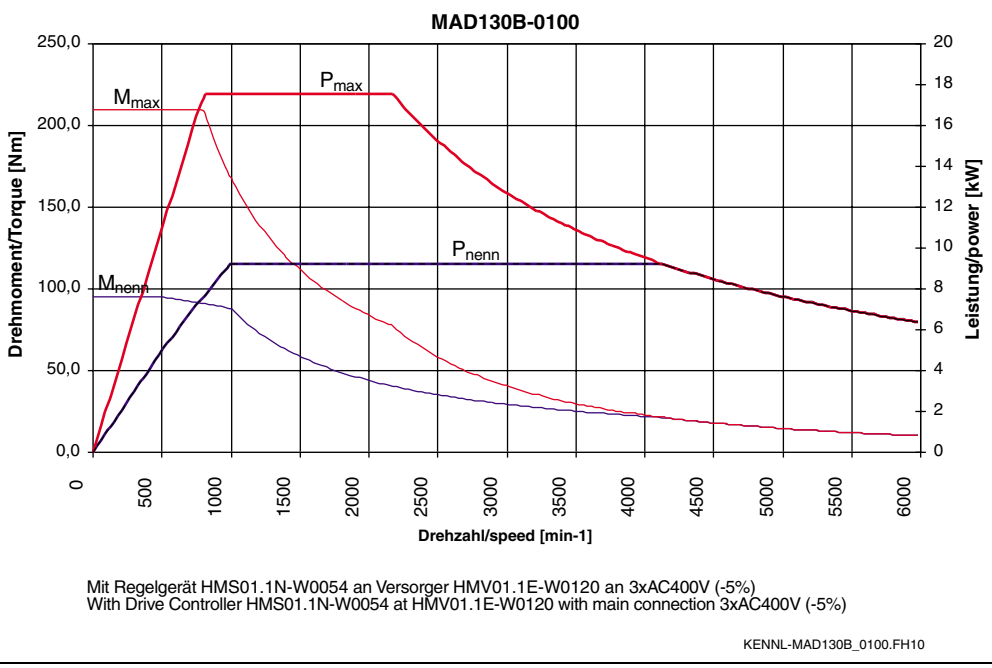


Fig. 4-25: Characteristic curve of MAD130B-0100

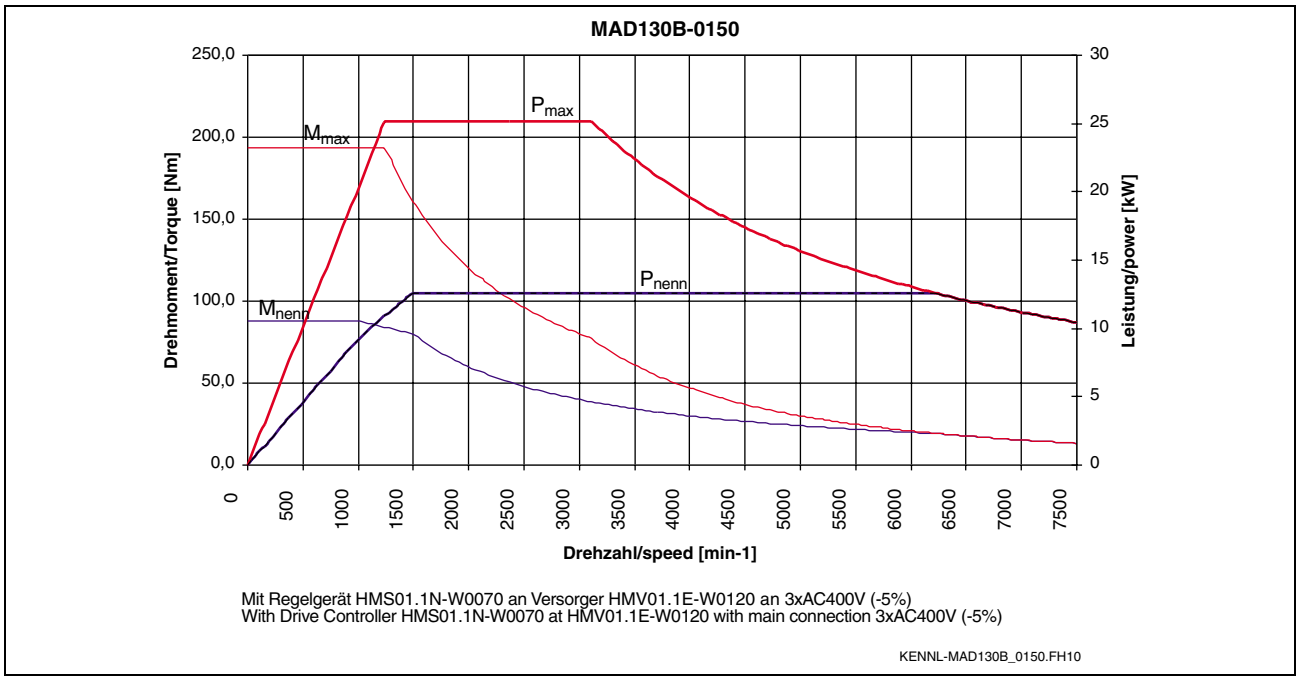


Fig. 4-26: Characteristic curve of MAD130B-0150

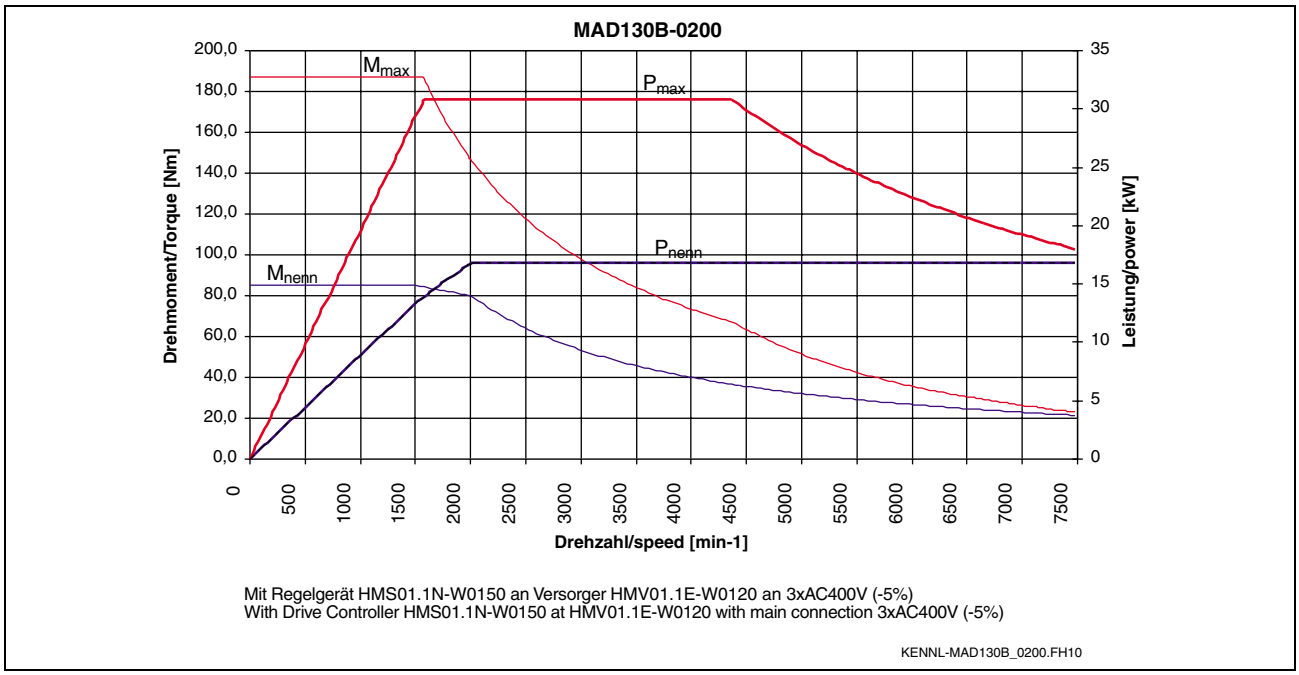


Fig. 4-27: Characteristic curve of MAD130B-0200

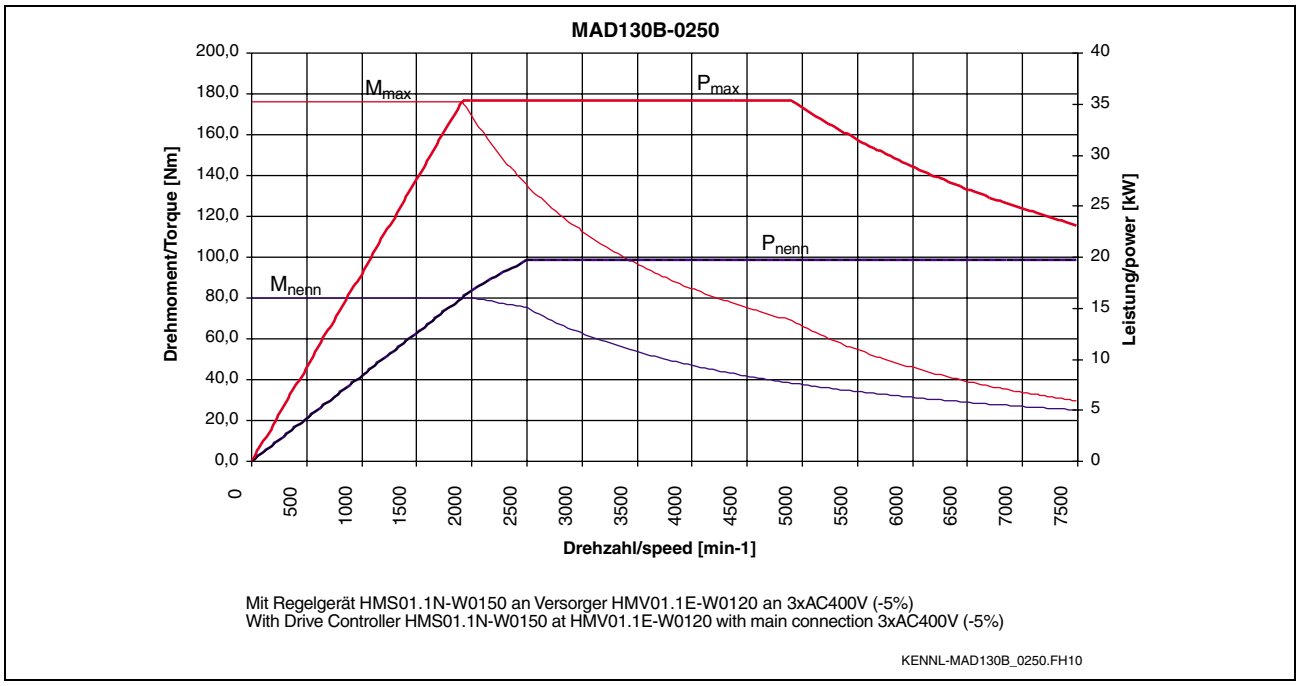


Fig. 4-28: Characteristic curve of MAD130B-0250

4.7 Technical Data Sheet for MAD130C

Description	Symbol	Unit	MAD130C				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	140	125	117	110	100
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	7.3	13.1	18.4	23.0	26.2
Rated current	I_{nenn}	A	19.7	36.4	48.9	57.0	67.0
Continuous torque at standstill	M_{n1}	Nm	-	140	125	115	110
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	39.2	51.0	59.6	67.5
Maximum speed	M_{max}	Nm	308	308	275	253	241
Torque constant at 20°C	K_{M_nenn}	Nm/A	9.31	4.33	3.1	2.64	2.1
Min. cross section of power cable [2])	A	mm²	2.5	6	10	16	16
Number of pole pairs	p		3				
Rotor moment of inertia [3])	J_{rot}	kgm²	0.115				
Mass of motor [4])	m	kg	119				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	5250			
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000 [7])	10000 [7])	
Thermal time constant	T_{th}	min	50				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [5])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				

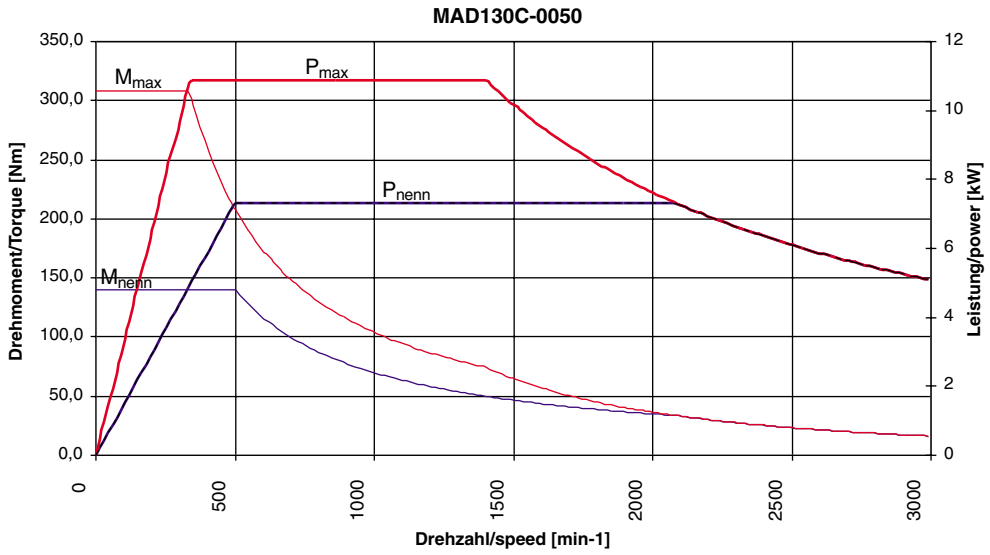
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**
Transmittable torque	M_4	Nm	100	80
Connection voltage	U_{Br}	V	DC 24 ± 10 %	
Rated current	I_{Br}	A	1.5	1.6
Moment of inertia	J_{Br}	kgm²	0.002	
Max. permissible braking energy	W_{max}	Ws	30000	
Disengagement time	t_2	ms	65	140
Engagement time	t_1	ms	110	50
Maximum speed of brake	n_{Br_max}	rpm	8000	8000
Mass of brake	m	kg	8	

Blower			**Axial blower**
Air current			B → A, blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	139 208
Blower current [6])	I_N	A	0.20 .... 0.25
Average air flowrate	V	m³/h	1000

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.
[7]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-29: Data sheet MAD130C

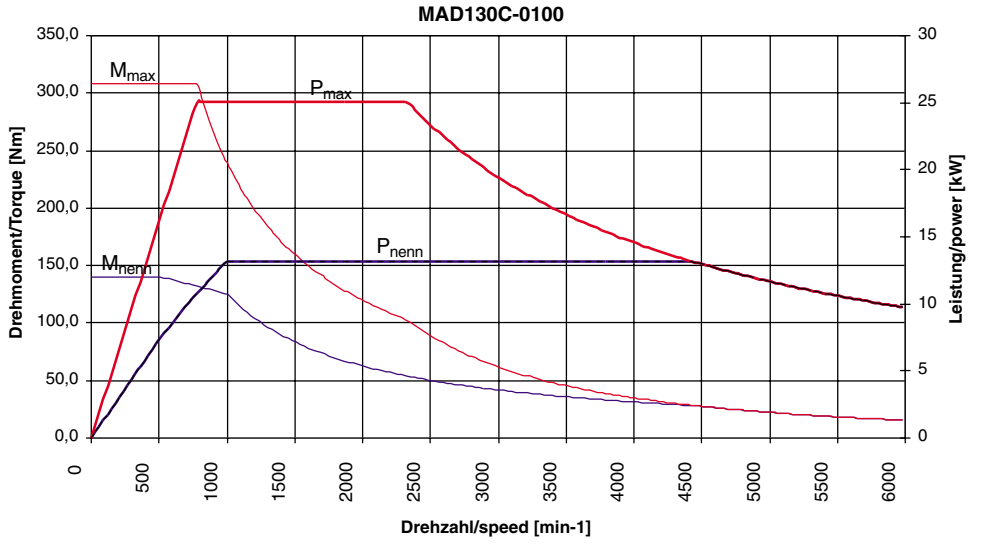
Characteristic Curves of MAD130C



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

KENNL-MAD130C_0050.FH10

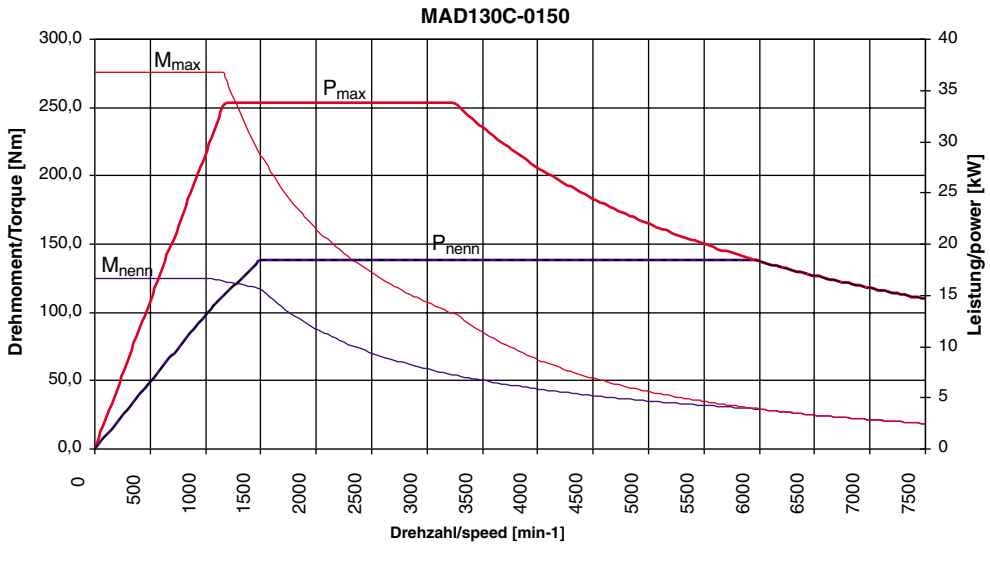
Fig. 4-30: Characteristic curve of MAD130C-0050



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

KENNL-MAD130C_0100.FH10

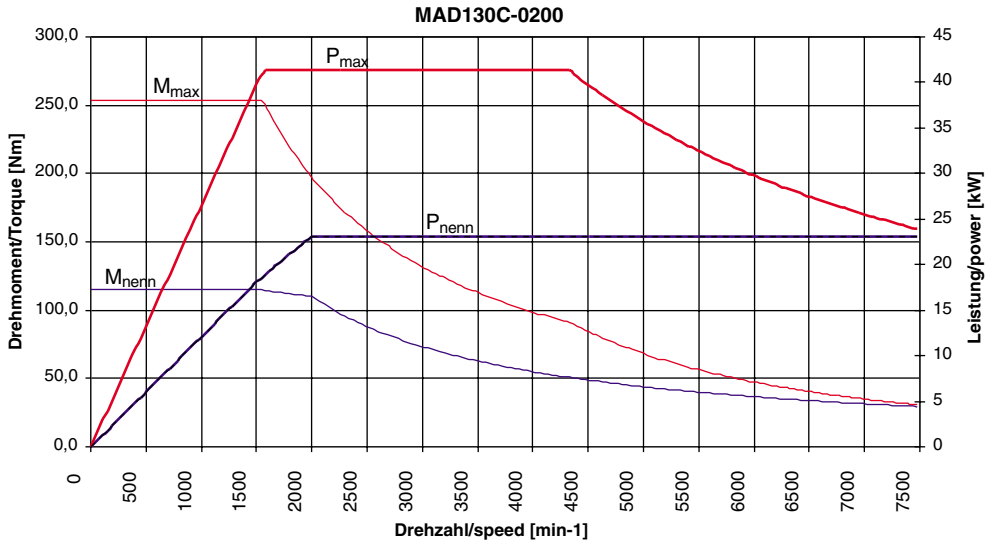
Fig. 4-31: Characteristic curve of MAD130C-0100



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD130C_0150.FH10

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



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD130C_0200.FH10

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

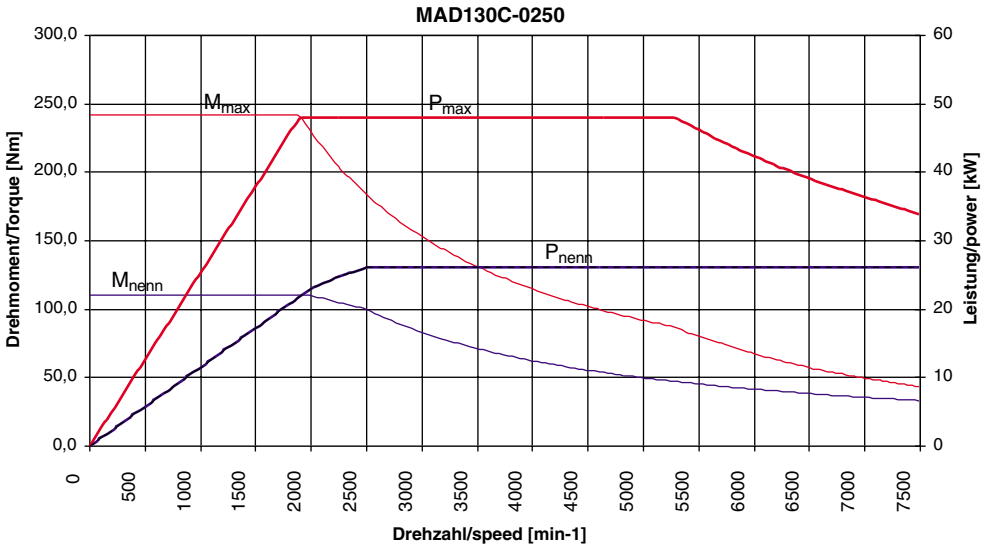


Fig. 4-34: Characteristic curve of MAD130C-0250

4.8 Technical Data Sheet for MAD130D

Description	Symbol	Unit	MAD130D				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	180	170	155	150	135
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	9.4	17.8	24.3	31.4	35.3
Rated current	I_{nenn}	A	24.2	43.7	61.5	71.3	86.5
Continuous torque at standstill	M_{n1}	Nm	-	190	170	155	150
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	47.8	64.1	72.8	87
Maximum speed	M_{max}	Nm	396	418	375	341	330
Torque constant at 20°C	K_{M_nenn}	Nm/A	8.75	4.72	3.09	2.62	2.1
Min. cross section of power cable [2])	A	mm²	4	10	16	16	25
Number of pole pairs	p		3				
Rotor moment of inertia [3])	J_{rot}	kgm²	0.164				
Mass of motor [4])	m	kg	164				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	5250			
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000	7500		
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000 [7])	10000 [7])	
Thermal time constant	T_{th}	min	55				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [5])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				

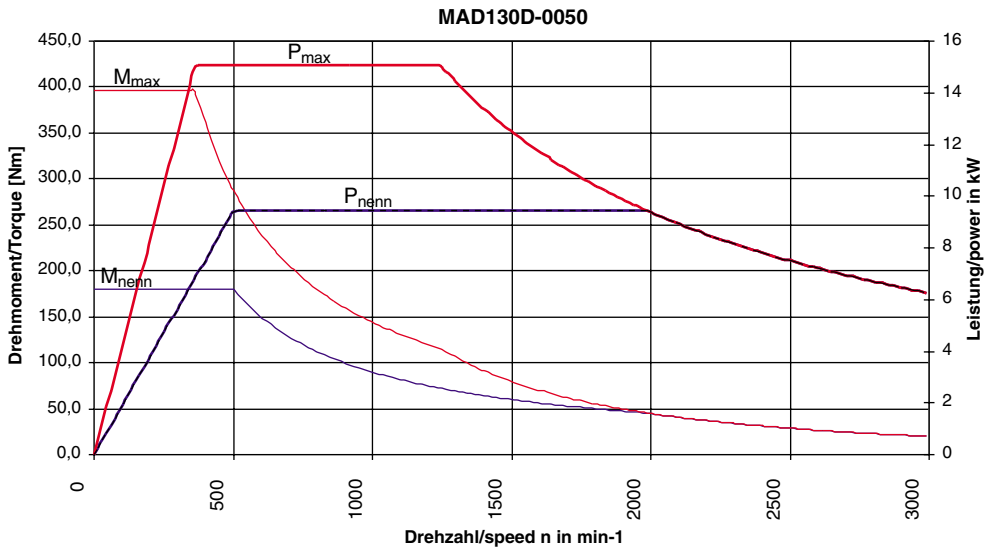
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**
Transmittable torque	M_4	Nm	100	80
Connection voltage	U_{Br}	V	DC 24 ± 10 %	
Rated current	I_{Br}	A	1.5	1.6
Moment of inertia	J_{Br}	kgm²	0.002	
Max. permissible braking energy	W_{max}	Ws	30000	
Disengagement time	t_2	ms	65	140
Engagement time	t_1	ms	110	50
Maximum speed of brake	n_{Br_max}	rpm	8000	8000
Mass of brake	m	kg	8	

Blower			**Axial blower**
Air current			B → A, blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	139 208
Blower current [6])	I_N	A	0.20 .... 0.25
Average air flowrate	V	m³/h	1000

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.
[7]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-35: Data sheet MAD130D

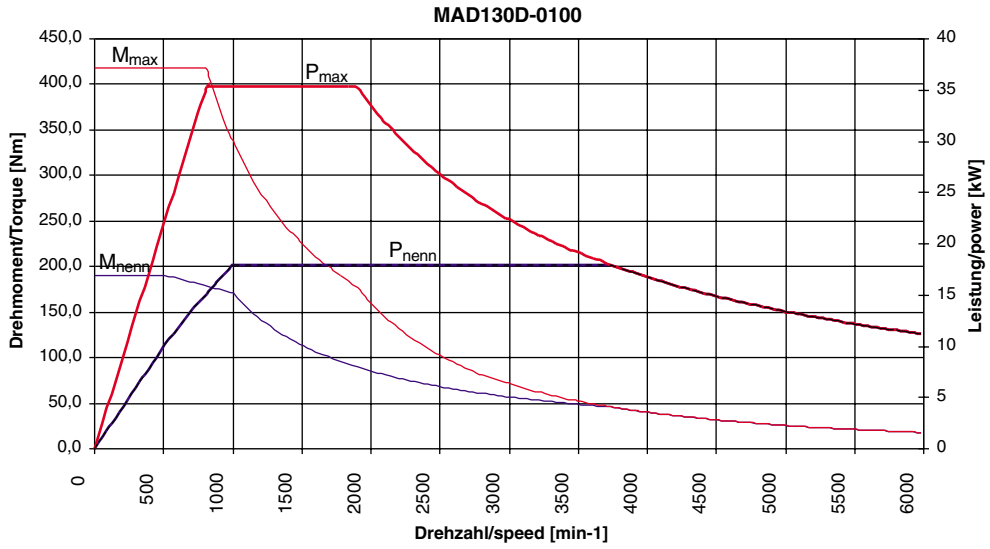
Characteristic Curves of MAD130D



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

KENNL-MAD130D_0050.FH10

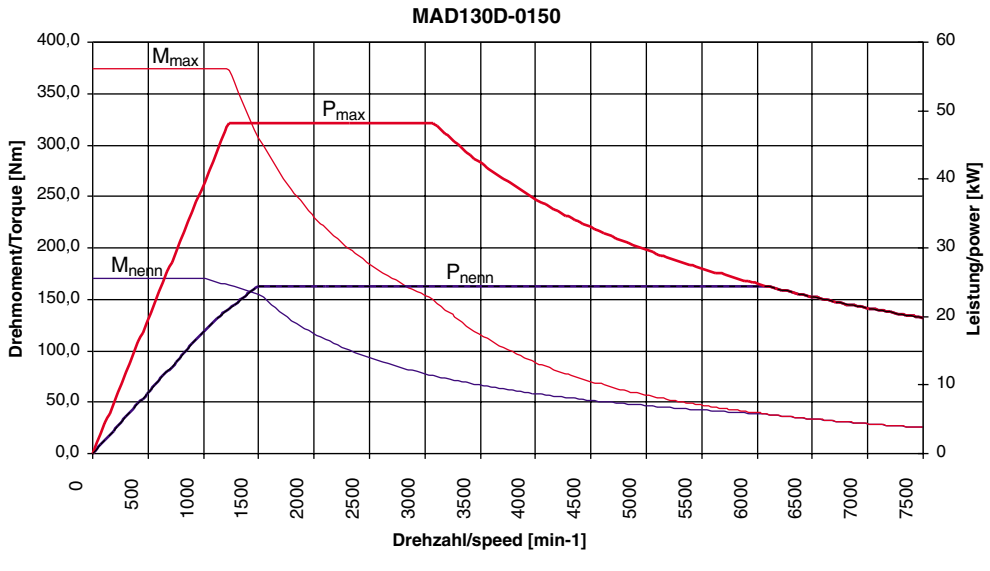
Fig. 4-36: Characteristic curve of MAD130D-0050



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD130D_0100.FH10

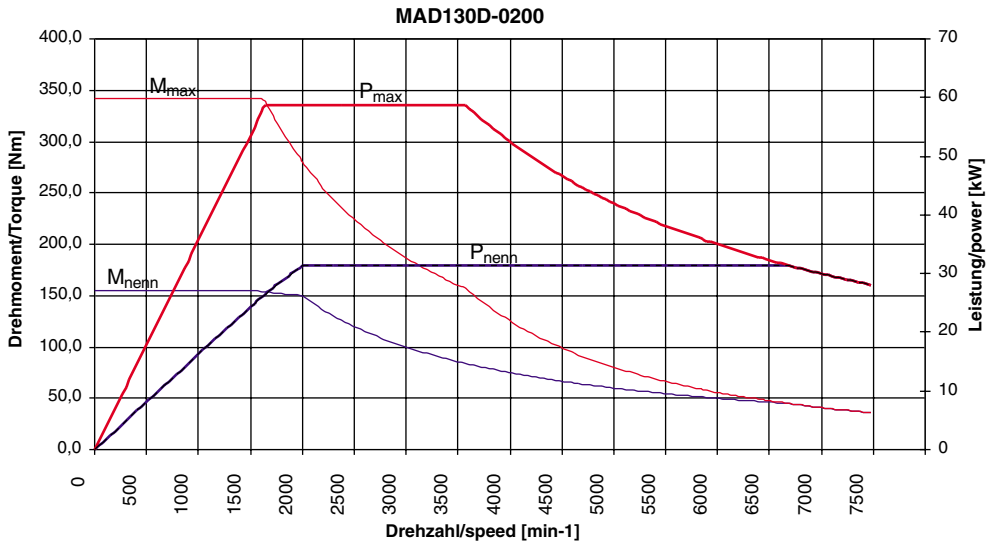
Fig. 4-37: Characteristic curve of MAD130D-0100



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD130D_0150.FH10

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



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD130D_0200.FH10

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

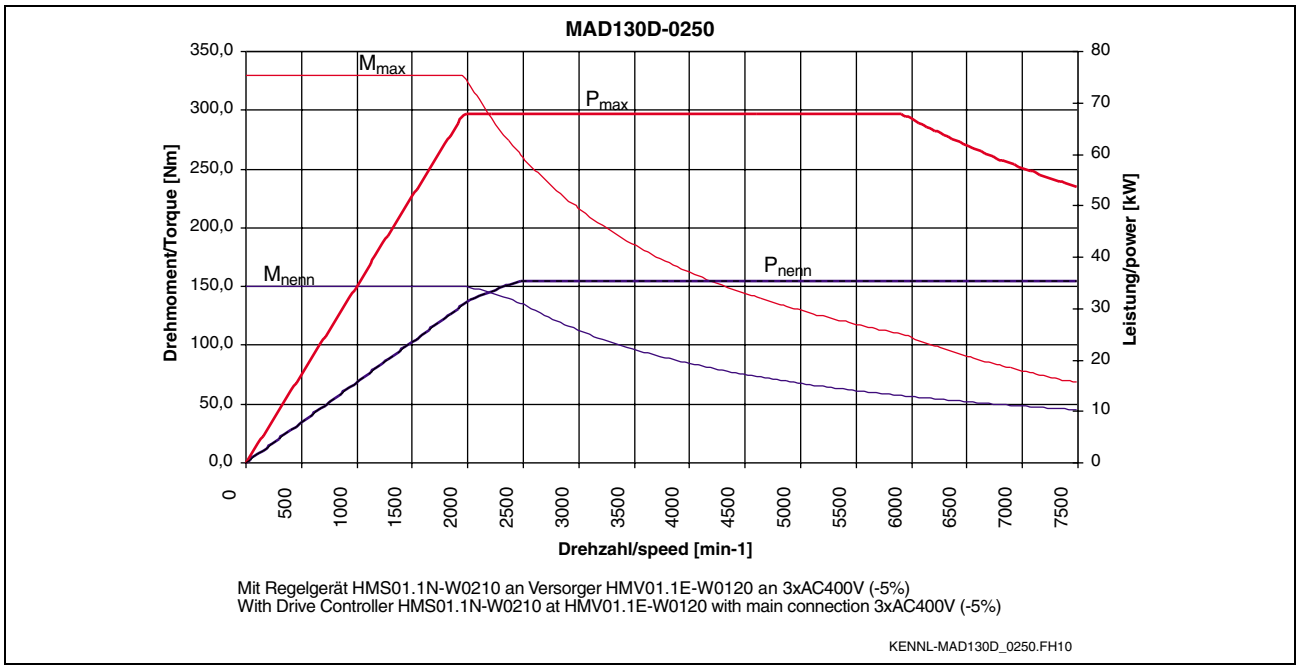


Fig. 4-40: Characteristic curve of MAD130D-0250

4.9 Technical Data Sheet for MAD160B

Description	Symbol	Unit	MAD160B			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_{nenn}	Nm	210	200	185	160
Rated speed	n_{nenn}	rpm	500	1000	1500	2000
Rated power	P_{nenn}	kW	11	20.9	29.1	33.5
Rated current	I_{nenn}	A	26.1	43.5	55.6	75.8
Continuous torque at standstill	M_{n1}	Nm	-	210	200	170
Derating speed	n_1	rpm	-	500	1000	1500
Continuous current at standstill	I_{n1}	A	-	45	58.7	80.9
Maximum speed	M_{max}	Nm	484	461	440	375
Torque constant at 20°C	K_{M_nenn}	Nm/A	10.96	5.47	4.06	2.54
Min. cross section of power cable [2])	A	mm²	4	10	16	25
Number of pole pairs	p		2			
Rotor moment of inertia [3])	J_{rot}	kgm²	0.24			
Mass of motor [4])	m	kg	197			
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	4200		
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - High-speed	n_{max}	rpm	not available			
Thermal time constant	T_{th}	min	60			
Duty cycle time (S6-44%)	T_C	min	i.p.			
Noise level [5])	p_{Schall}	dB(A)	75 (+3)			
Permissible ambient temperature	T_{um}	°C	0....+40			
Permissible storage and transport temperature	T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1			F			
International Protection class			IP65			

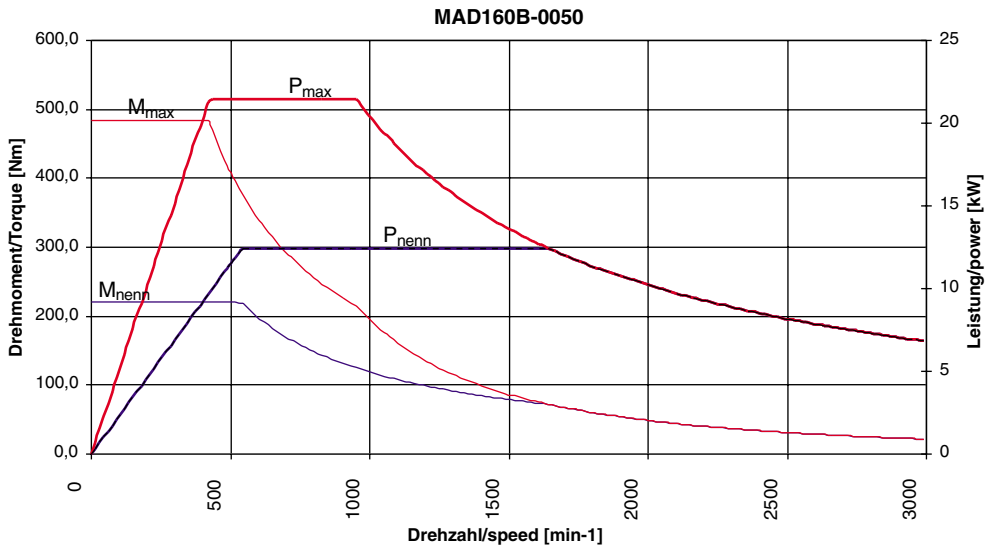
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**	**Electrical-released - reinforced**
Transmittable torque	M_4	Nm	100		240
Connection voltage	U_{Br}	V	DC 24 ± 10 %		
Rated current	I_{Br}	A	1.8	2.0	1.87
Moment of inertia	J_{Br}	kgm²	0.0065		0.0188
Max. permissible braking energy	W_{max}	Ws	40000		70000
Disengagement time	t_2	ms	100	190	300
Engagement time	t_1	ms	85	12	30
Mass of brake	m	kg	20		25

Blower			**Axial blower**
Air current			B → A blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	132 175
Blower current [6])	I_N	A	0.19 .... 0.21
Average air flowrate	V	m³/h	1000

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.

Fig. 4-41: Data Sheet MAD160B

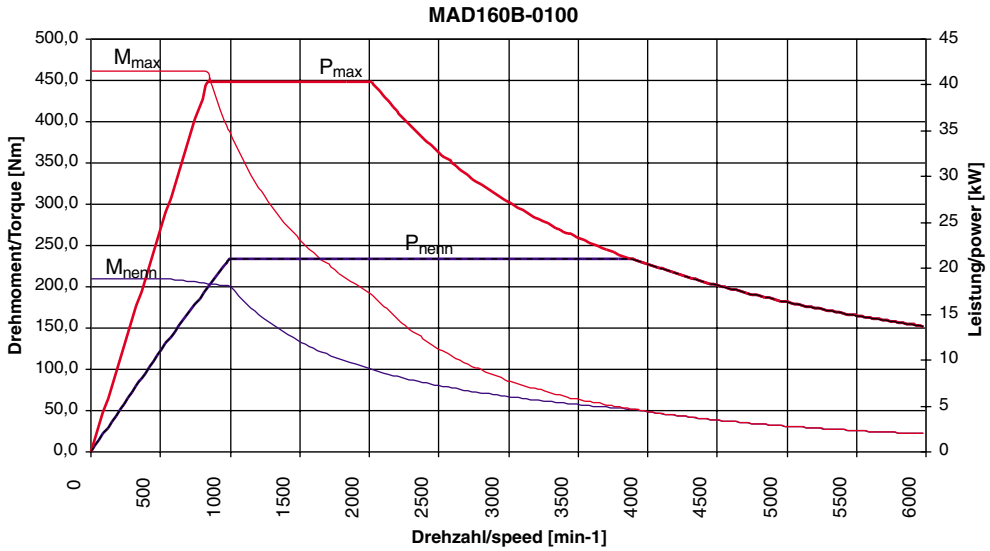
Characteristic Curve of MAD160B



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

KENNL-MAD160B_0050.FH10

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



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD160B_0100.FH10

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

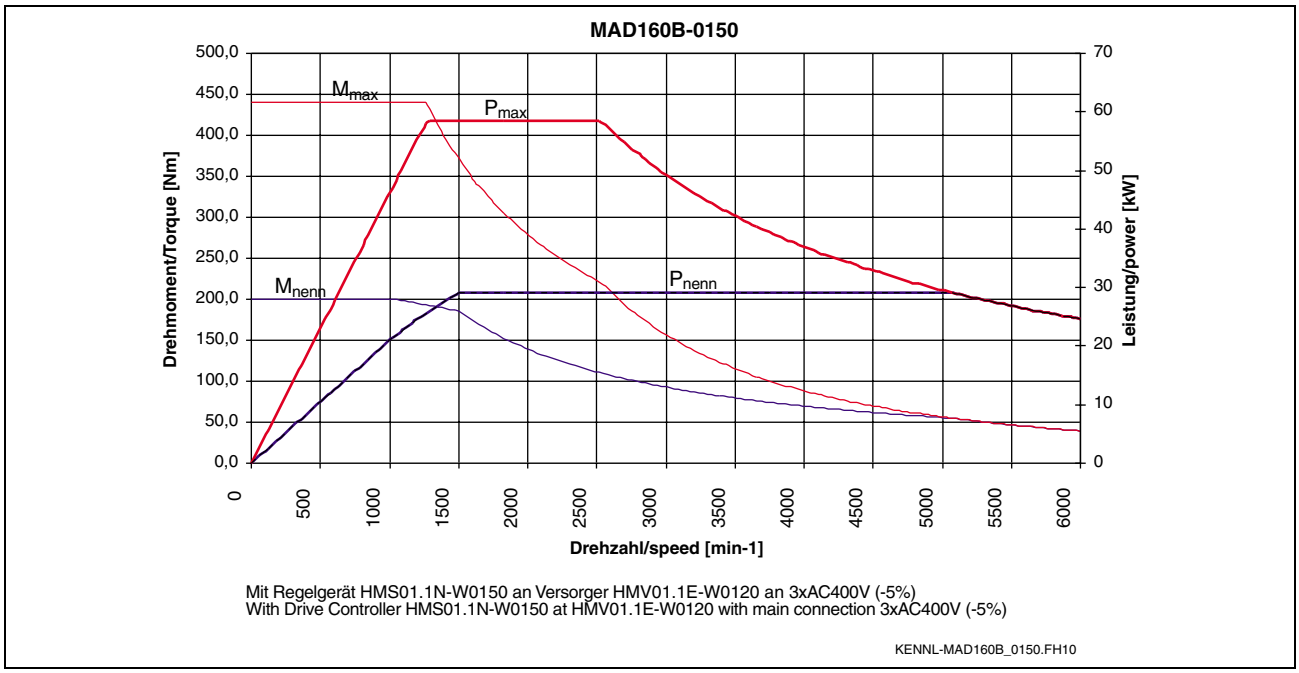


Fig. 4-44: Characteristic curve of MAD160B-0150

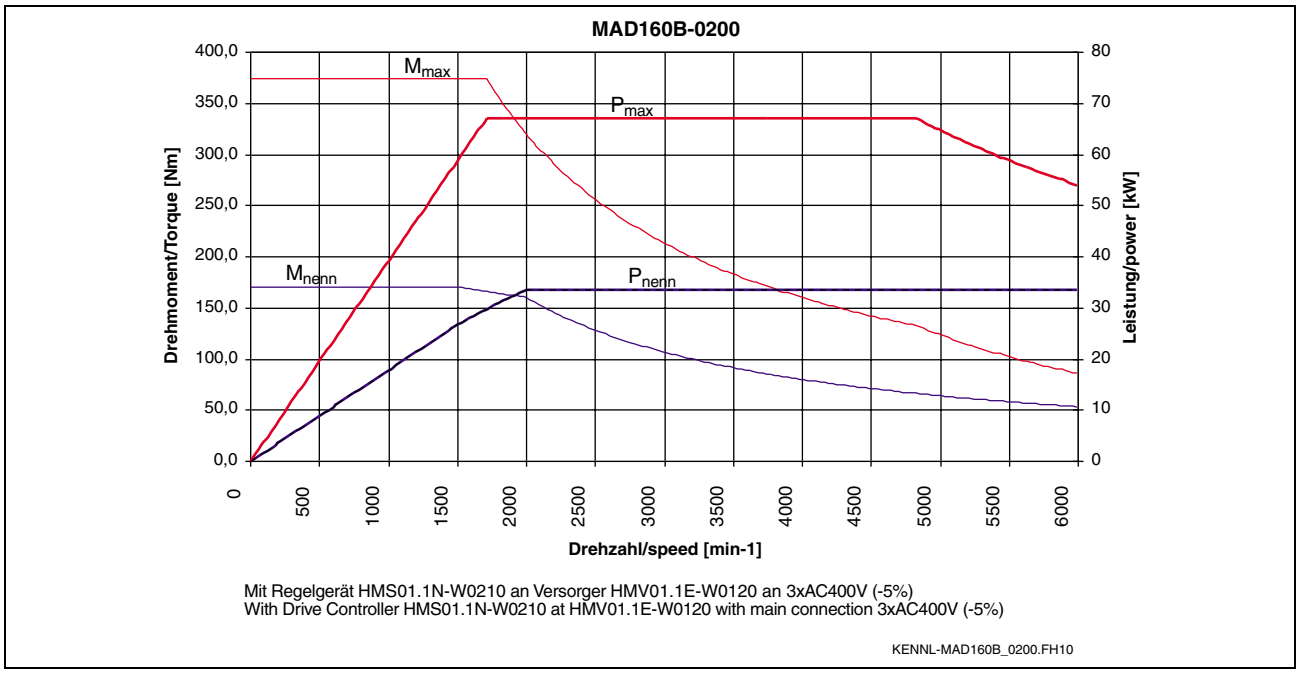


Fig. 4-45: Characteristic curve of MAD160B-0200

4.10 Technical Data Sheet for MAD160C

Description	Symbol	Unit	MAD160C			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_{nenn}	Nm	240	225	215	210
Rated speed	n_{nenn}	rpm	500	1000	1500	2000
Rated power	P_{nenn}	kW	12.6	23.6	33.8	44
Rated current	I_{nenn}	A	27.6	52.6	75.3	93.9
Continuous torque at standstill	M_{n1}	Nm	-	240	225	225
Derating speed	n_1	rpm	-	500	1000	1500
Continuous current at standstill	I_{n1}	A	-	55.2	77.8	100
Maximum speed	M_{max}	Nm	528	527	496	494
Torque constant at 20°C	K_{M_nenn}	Nm/A	9.95	4.97	3.36	2.63
Min. cross section of power cable [2])	A	mm²	6	16	25	25
Number of pole pairs	p		2			
Rotor moment of inertia [3])	J_{rot}	kgm²	0.311			
Mass of motor [4])	m	kg	233			
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	4200		
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - High-speed	n_{max}	rpm	not available			
Thermal time constant	T_{th}	min	70			
Duty cycle time (S6-44%)	T_C	min	i.p.			
Noise level [5])	p_{Schall}	dB(A)	75 (+3)			
Permissible ambient temperature	T_{um}	°C	0....+40			
Permissible storage and transport temperature	T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1			F			
International Protection class			IP65			

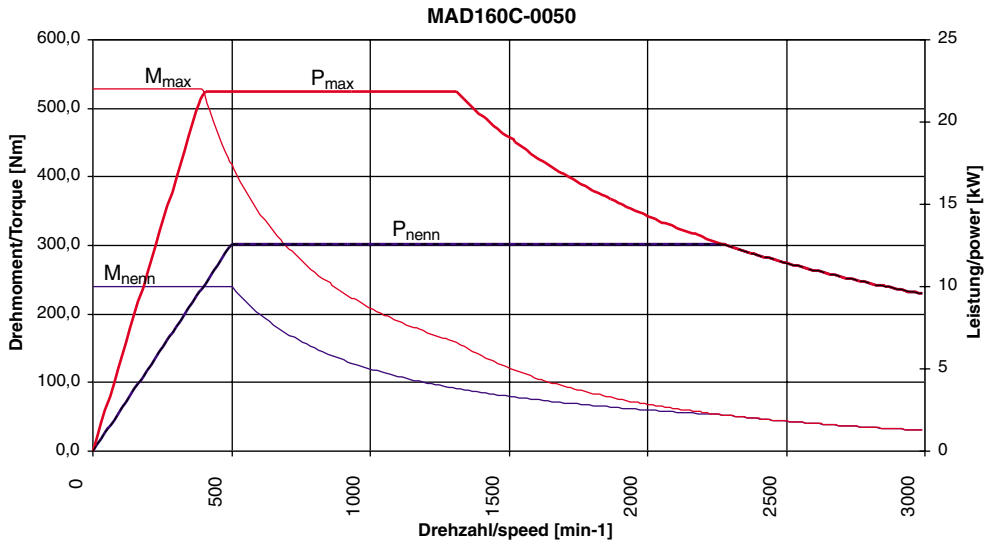
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**	**Electrically-released - reinforced**
Transmittable torque	M_4	Nm	100		240
Connection voltage	U_{Br}	V	DC 24 ± 10 %		
Rated current	I_{Br}	A	1.8	2.0	1.87
Moment of inertia	J_{Br}	kgm²	0.0065		0.0188
Max. permissible braking energy	W_{max}	Ws	40000		70000
Disengagement time	t_2	ms	100	190	300
Engagement time	t_1	ms	85	12	30
Mass of brake	m	kg	20		25

Blower			**Axial blower**
Air current			B → A blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	132 175
Blower current [6])	I_N	A	0.19 .... 0.21
Average air flowrate	V	m³/h	1000

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.

Fig. 4-46: Data Sheet MAD160C

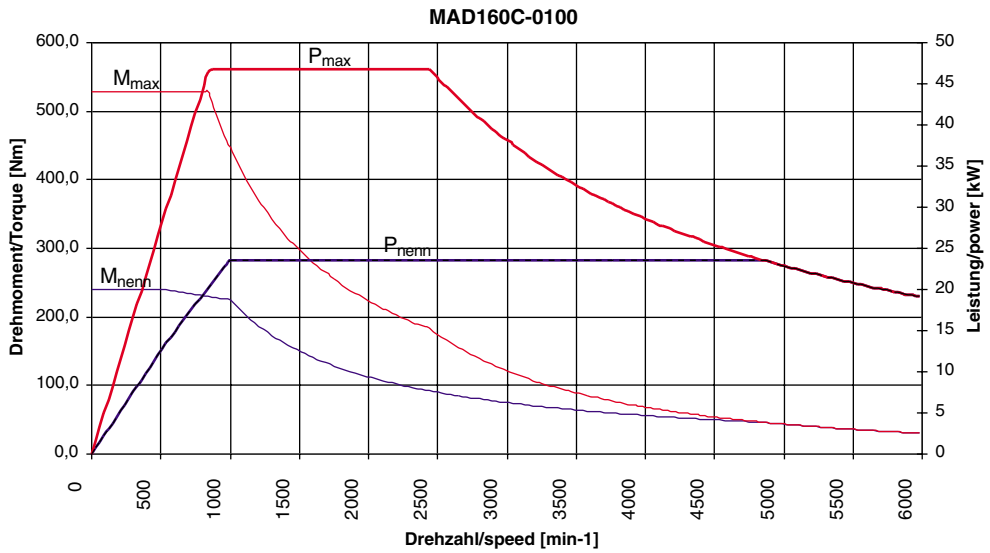
Characteristic Curves of MAD160C



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

KENNL-MAD160C_0050.FH10

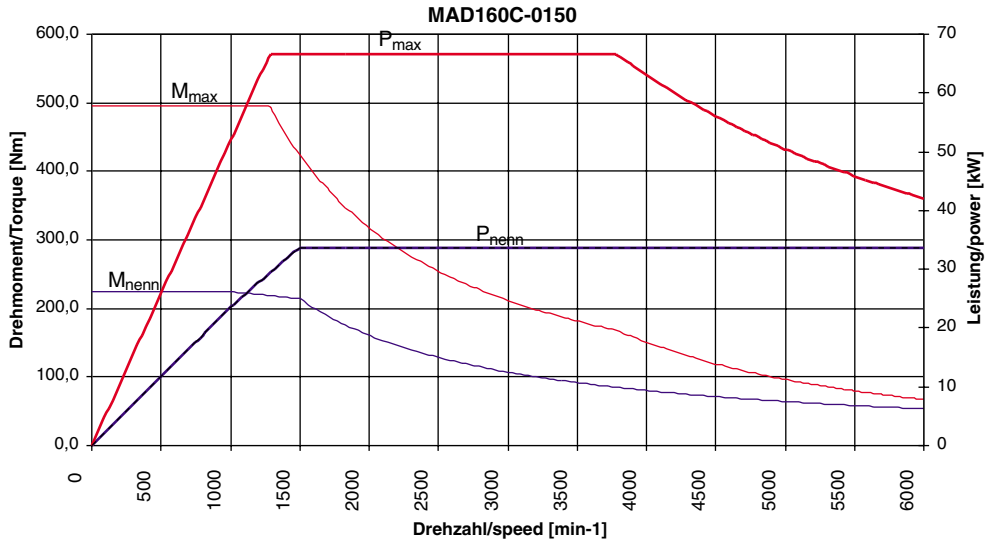
Fig. 4-47: Characteristic curve of MAD160C-0050



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD160C_0100.FH10

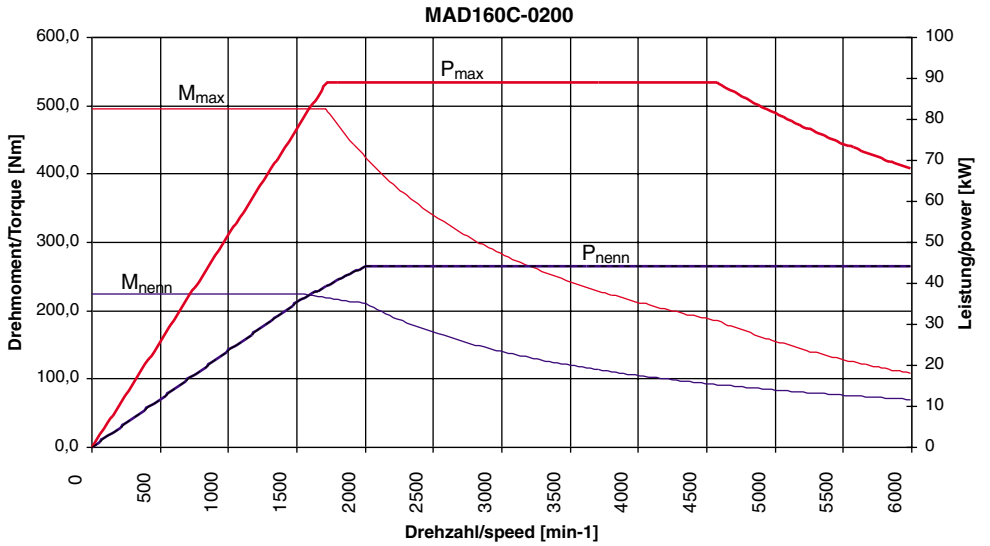
Fig. 4-48: Characteristic curve of MAD160C-0100



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD160C_0150.FH10

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



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD160C_0200.FH10

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

4.11 Technical Data Sheet for MAD180C

Description	Symbol	Unit	MAD180C			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_{nenn}	Nm	325	300	270	250
Rated speed	n_{nenn}	rpm	500	1000	1500	2000
Rated power	P_{nenn}	kW	18.8	34.6	47.1	52.4
Rated current	I_{nenn}	A	41.4	77.4	108.2	104.6
Continuous torque at standstill	M_{n1}	Nm	-	325	300	270
Derating speed	n_1	rpm	-	500	1000	1500
Continuous current at standstill	I_{n1}	A	-	82.9	116.2	110
Maximum speed	M_{max}	Nm	715	792	658	594
Torque constant at 20°C	K_{M_nenn}	Nm/A	9.77	4.88	3.25	3.01
Min. cross section of power cable [2])	A	mm²	10	25	35	35
Number of pole pairs	p		2			
Rotor moment of inertia [3])	J_{rot}	kgm²	0.458			
Mass of motor [4])	m	kg	334			
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	4200		
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - High-speed	n_{max}	rpm	not available			
Thermal time constant	T_{th}	min	60			
Duty cycle time (S6-44%)	T_C	min	i.p.			
Noise level [5])	p_{Schall}	dB(A)	78 (+3)			
Permissible ambient temperature	T_{um}	°C	0....+40			
Permissible storage and transport temperature	T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1			F			
International Protection class			IP65			

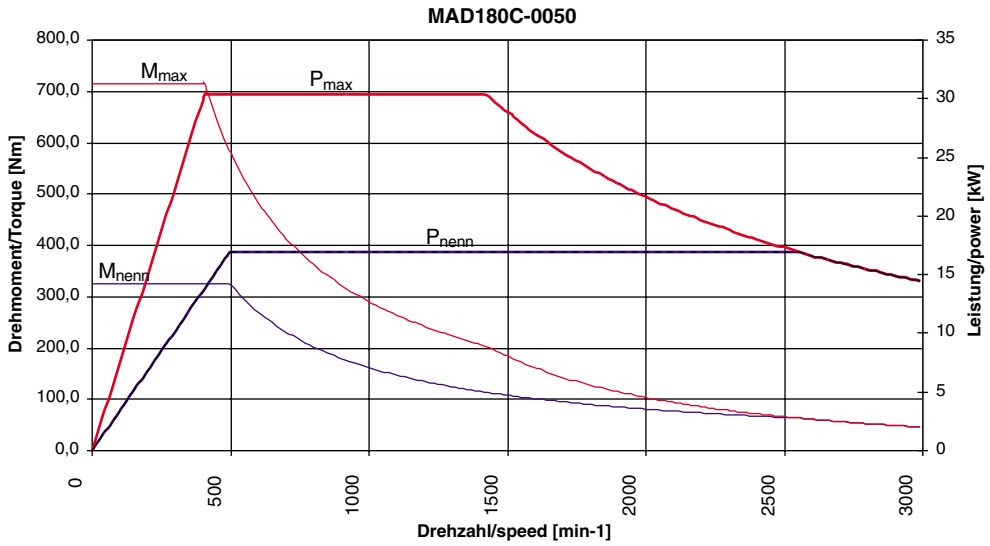
Holding brake (optional)			**Electrically-clamped**	**Electrically- released**
Transmittable torque	M_4	Nm	300	240
Connection voltage	U_{Br}	V	DC 24 ± 10 %	
Rated current	I_{Br}	A	2	1.87
Moment of inertia	J_{Br}	kgm²	0.0188	
Max. permissible braking energy	W_{max}	Ws	70000	
Disengagement time	t_2	ms	90	300
Engagement time	t_1	ms	150	30
Mass of brake	m	kg	25	

Blower			**Axial blower**
Air current			B → A blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	242 382
Blower current [6])	I_N	A	0.35 .... 0.46
Average air flowrate	V	m³/h	1500

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Werte ohne Haltebremse.
[4]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.

Fig. 4-51: Data Sheet MAD180C

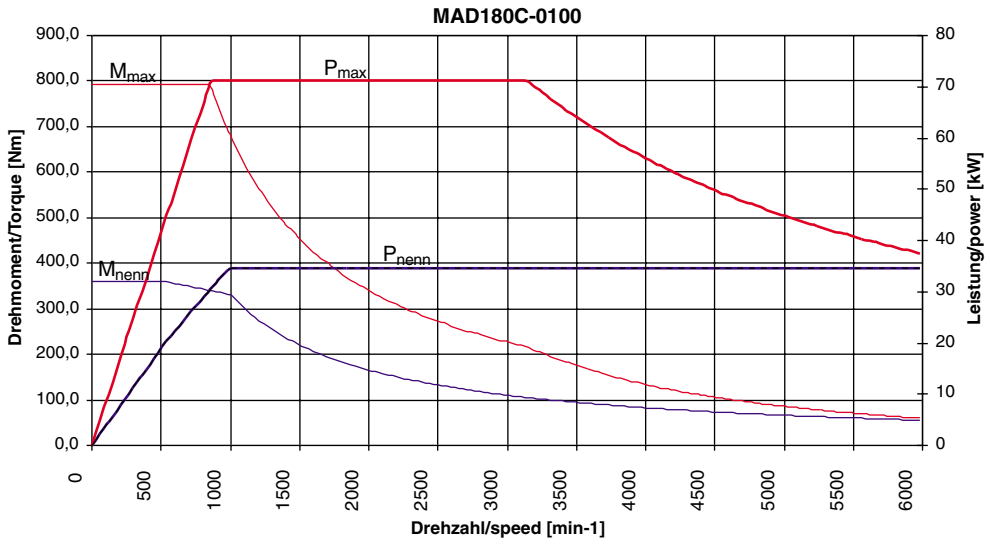
Characteristic Curves of MAD180C



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD180C_0050.FH10

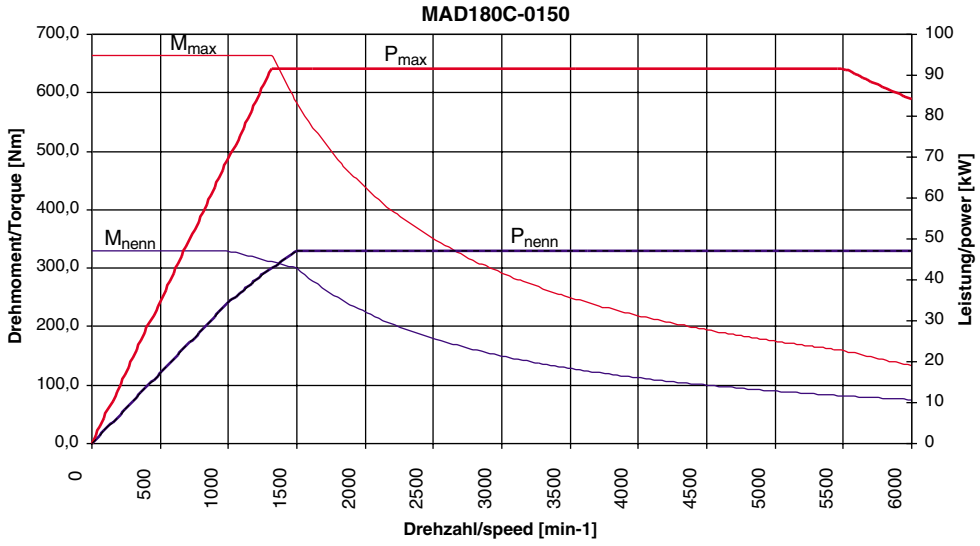
Fig. 4-52: Characteristic curve of MAD180C-0050



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD180C_0100.FH10

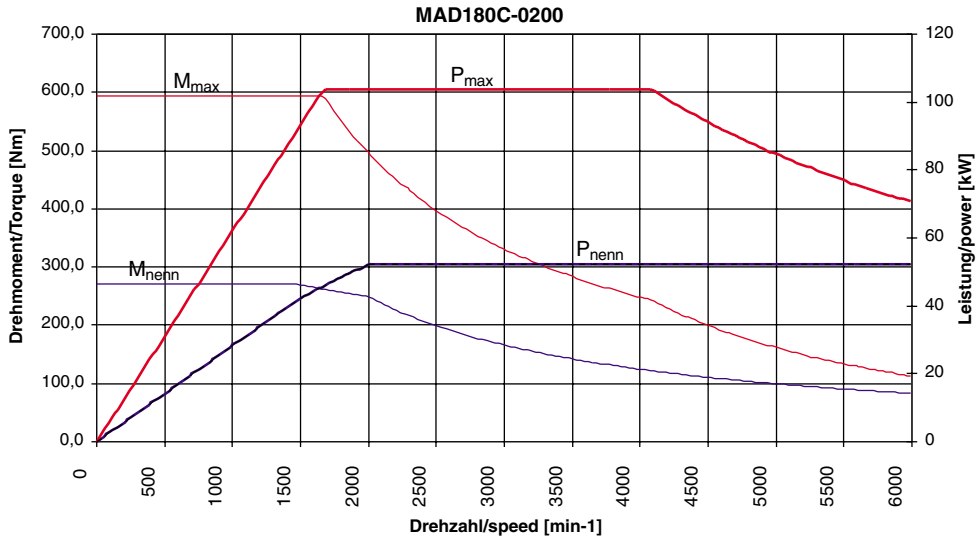
Fig. 4-53: Characteristic curve of MAD180C-0100



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD180C_0150.FH10

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



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD180C_0200.FH10

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

4.12 Technical Data Sheet for MAD180D

Description		Symbol	Unit	MAD180D			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_{nenn}	Nm	390	370	340	300
Rated speed		n_{nenn}	rpm	500	1000	1500	2000
Rated power		P_{nenn}	kW	20.4	38.7	53.4	62.8
Rated current		I_{nenn}	A	39.7	82.4	107.8	117.4
Continuous torque at standstill		M_{n1}	Nm	-	410	360	350
Derating speed		n_1	rpm	-	500	1000	1500
Continuous current at standstill		I_{n1}	A	-	90.0	112.3	132.6
Maximum speed		M_{max}	Nm	858	901	793	768
Torque constant at 20°C		K_{M_nenn}	Nm/A	11.31	5.66	3.77	2.92
Min. cross section of power cable [2])		A	mm²	10	25	35	35
Number of pole pairs		p		2			
Rotor moment of inertia [3])		J_{rot}	kgm²	0.594			
Mass of motor [4])		m	kg	395			
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000		
	- coupling attachment	n_{max}	rpm	3000	4200		
	- reinforced	n_{max}	rpm	3000	6000		
	- High-speed	n_{max}	rpm	not available			
Thermal time constant		T_{th}	min	70			
Duty cycle time (S6-44%)		T_C	min	i.p.			
Noise level [5])		p_{Schall}	dB(A)	78 (+3)			
Permissible ambient temperature		T_{um}	°C	0....+40			
Permissible storage and transport temperature		T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1				F			
International Protection class				IP65			

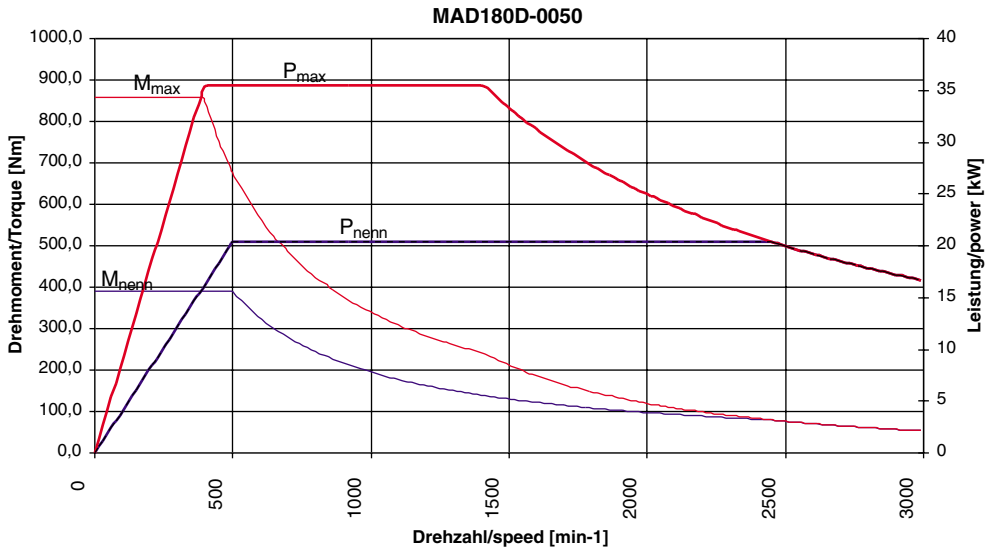
Holding brake (optional)			**Electrically-clamped**	**Electrically-released**
Transmittable torque	M_4	Nm	300	240
Connection voltage	U_{Br}	V	DC 24 ± 10 %	
Rated current	I_{Br}	A	2	1.87
Moment of inertia	J_{Br}	kgm²	0.0188	
Max. permissible braking energy	W_{max}	Ws	70000	
Disengagement time	t_2	ms	90	300
Engagement time	t_1	ms	150	30
Mass of brake	m	kg	25	

Blower			**Axial blower**
Air current			B → A blowing
Connection voltage	U_N	V	3 x 400V ± 15 %, 50/60 Hz .... 3 x 480V ± 10 %, 50/60 Hz
Power consumption	S_N	VA	242 382
Blower current [6])	I_N	A	0.35 .... 0.46
Average air flowrate	V	m³/h	1500

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) Values without holding brake, with blower.
[5]) at 1m distance, with PWM = 4 kHz
[6]) From I_N + 20%, blowers should be monitored.

Fig. 4-56: Data Sheet MAD180D

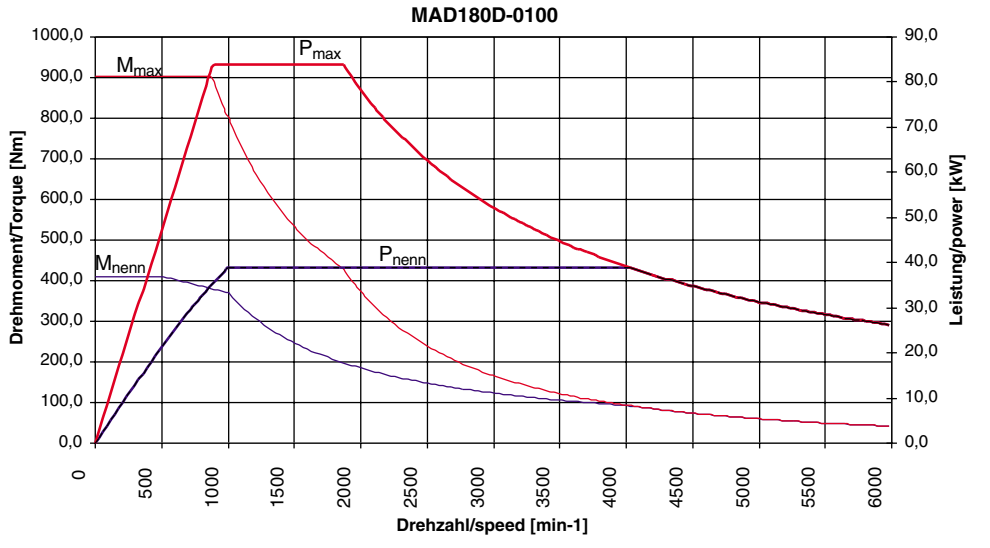
Characteristic Curves of MAD180D



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD180D_0050.FH10

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



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAD180D_0100.FH10

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

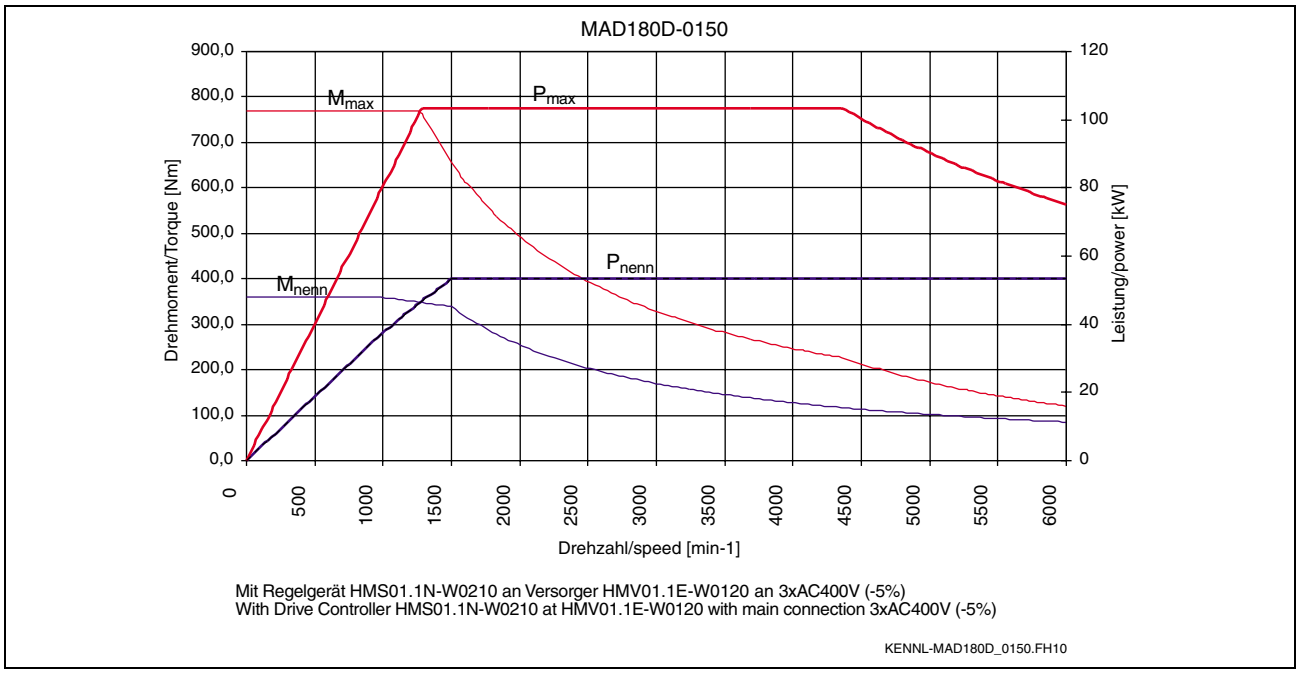


Fig. 4-59: Characteristic curve of MAD180D-0150

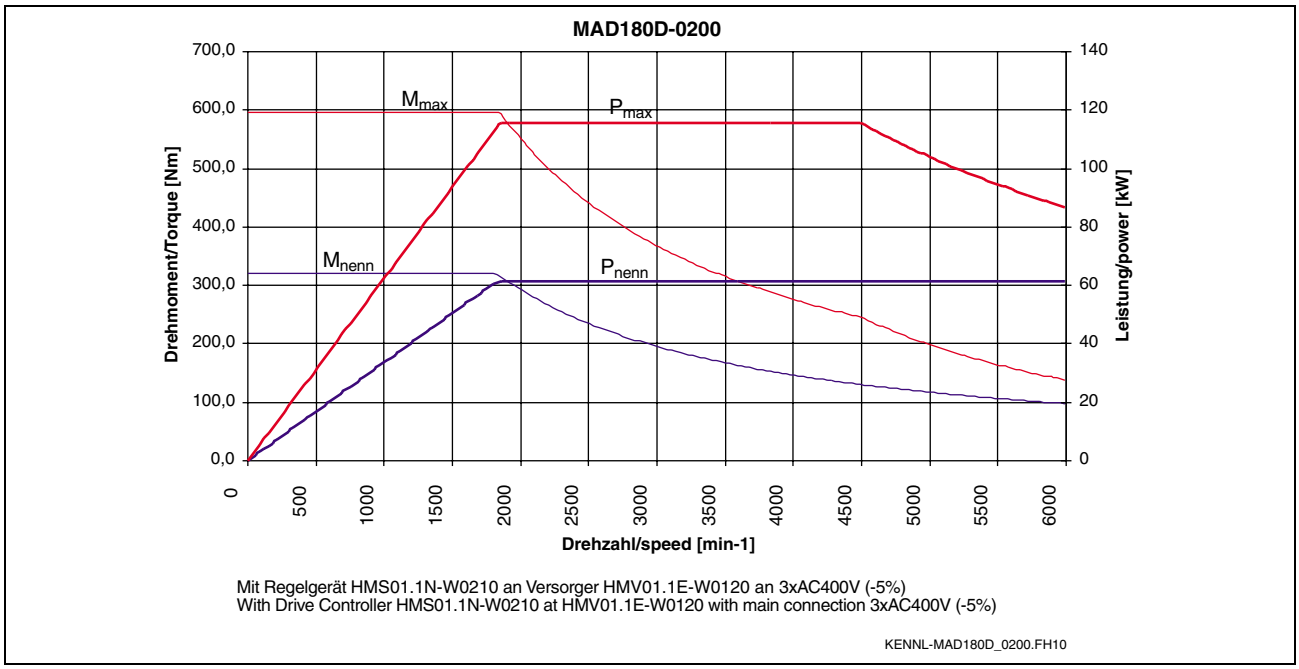


Fig. 4-60: Characteristic curve of MAD180D-0200

4.13 Technical Data Sheet for MAF100B

Description		Symbol	Unit	MAF100B				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_{nenn}	Nm	50	46	42	38	33
Rated speed		n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power		P_{nenn}	kW	2.6	4.8	6.6	8.0	8.6
Rated current		I_{nenn}	A	8.5	14.3	18.1	23.9	26
Continuous torque at standstill		M_{n1}	Nm	-	50	46	42	38
Derating speed		n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill		I_{n1}	A	-	17.9	22.7	25.8	26.5
Maximum speed		M_{max}	Nm	110	110	101	92	84
Torque constant at 20°C		K_{M_nenn}	Nm/A	6.68	3.73	2.76	1.84	1.49
Min. cross section of power cable [2])		A	mm²	2.5	2.5	4	4	4
Number of pole pairs		p		3				
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.019				
Motor mass [3])		m	kg	56				
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000	9000		
	- coupling attachment	n_{max}	rpm	3000	6000	6300		
	- reinforced	n_{max}	rpm	not available				
	- High-speed	n_{max}	rpm	3000	6000	9000	11000 [6])	
Thermal time constant		T_{th}	min	10				
Duty cycle time (S6-44%)		T_C	min	i.p.				
Noise level [4])		p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature		T_{um}	°C	0....+40				
Permissible storage and transport temperature		T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1				F				
International Protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	1.0				
Cooling agent temperature	Cooling agent inlet	T_{ein}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.4				
	with fast coupling	Δp_{diff}	bar	0.8				
Required flow of coolant at P_V		Q_{min}	l/min	1.45				
Permissible inlet pressure		p_{max}	bar	3				
Holding brake (optional)				**Electrically-clamped**			**Electrically-released**	
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				
Disengagement time		t_2	ms	50			90	
Engagement time		t_1	ms	42			30	
Maximum speed of brake		n_{Br_max}	rpm	10000			10000	
Mass of brake		m	kg	2			1.6	

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.
[6]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-61: Data sheet MAF100B

Characteristic Curves of MAF100B

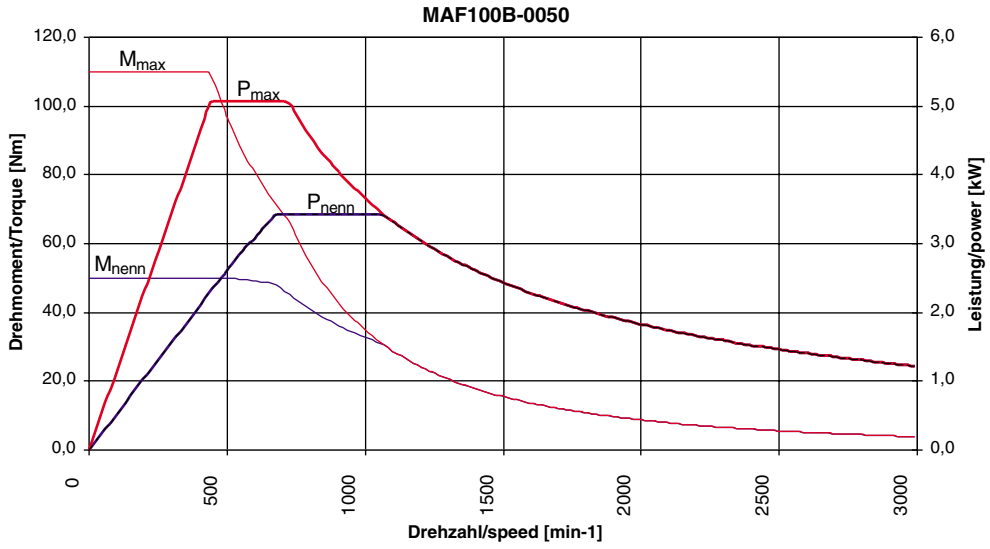


Fig. 4-62: Characteristic curve of MAF100B-0050

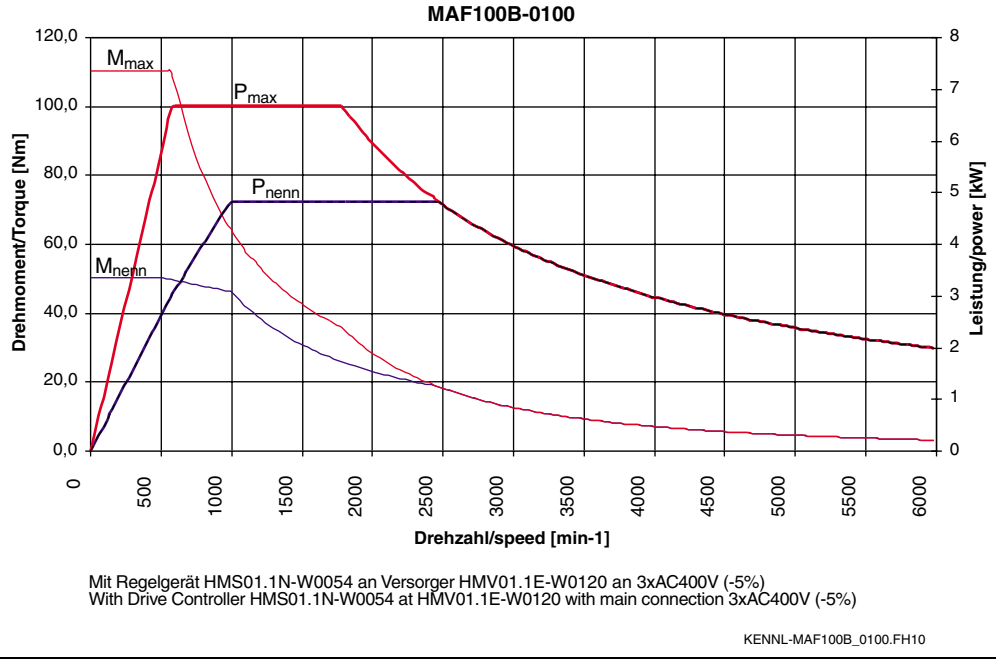


Fig. 4-63: Characteristic curve of MAF100B-0100

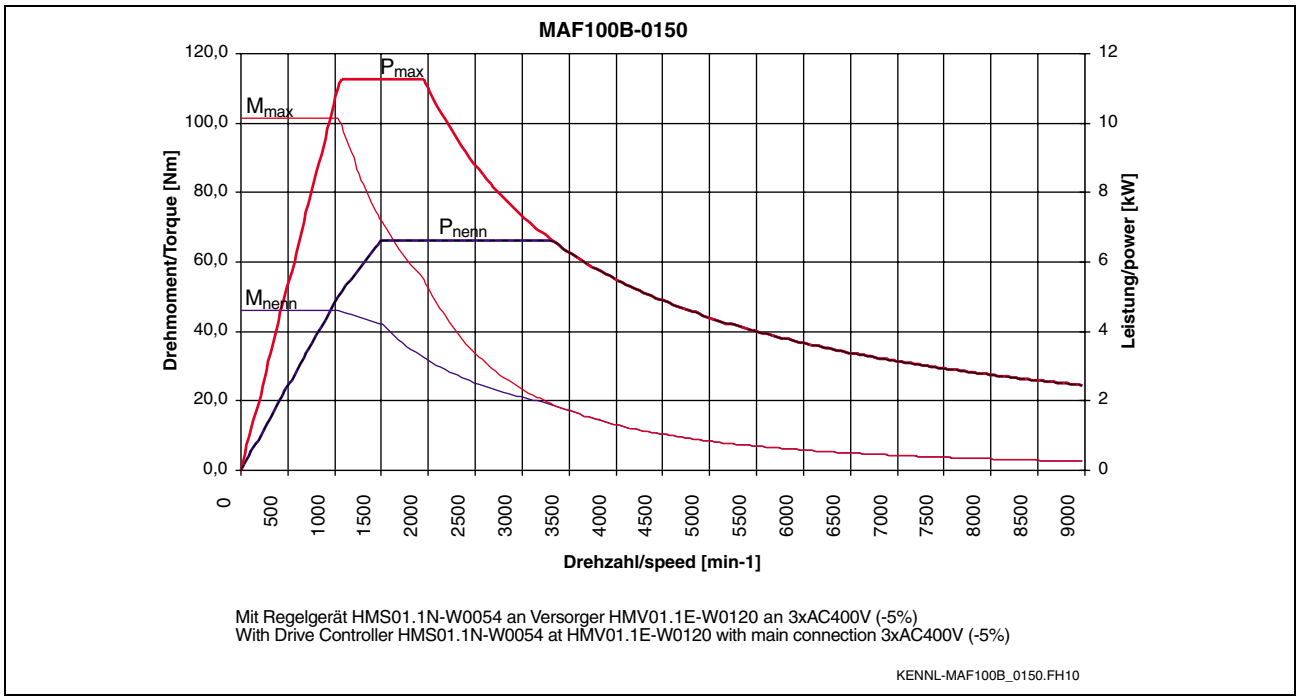


Fig. 4-64: Characteristic curve of MAF100B-0150

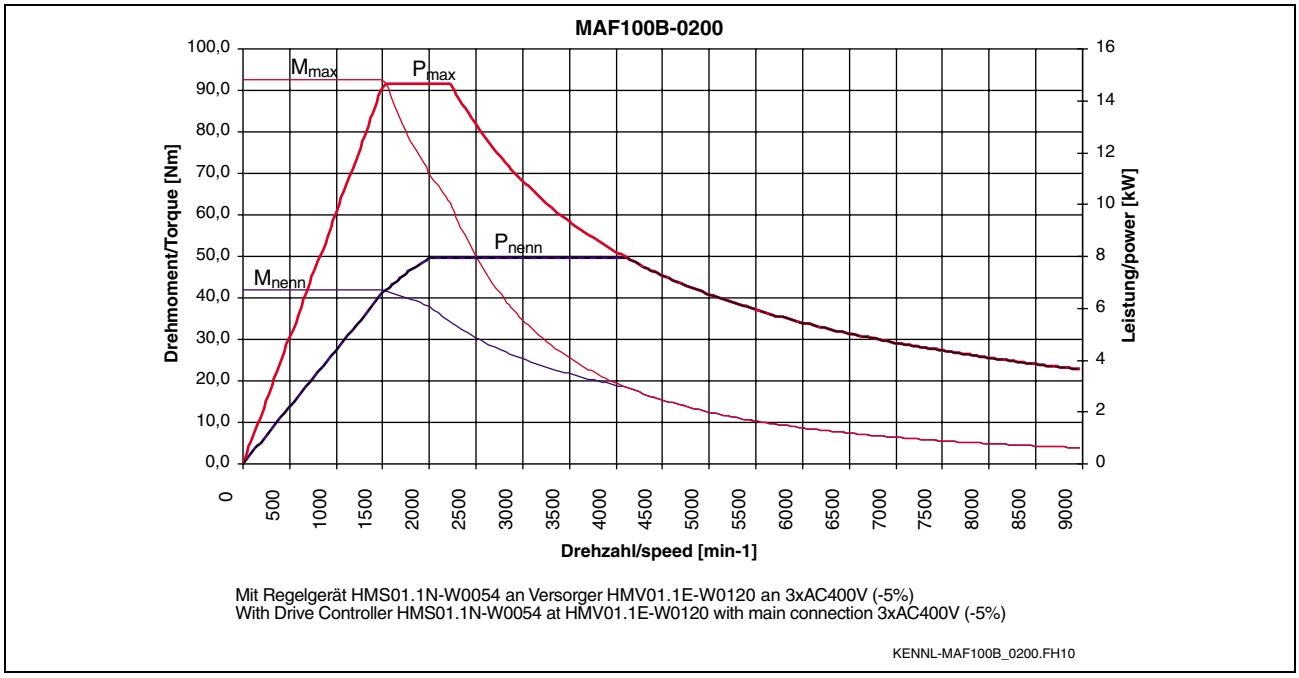
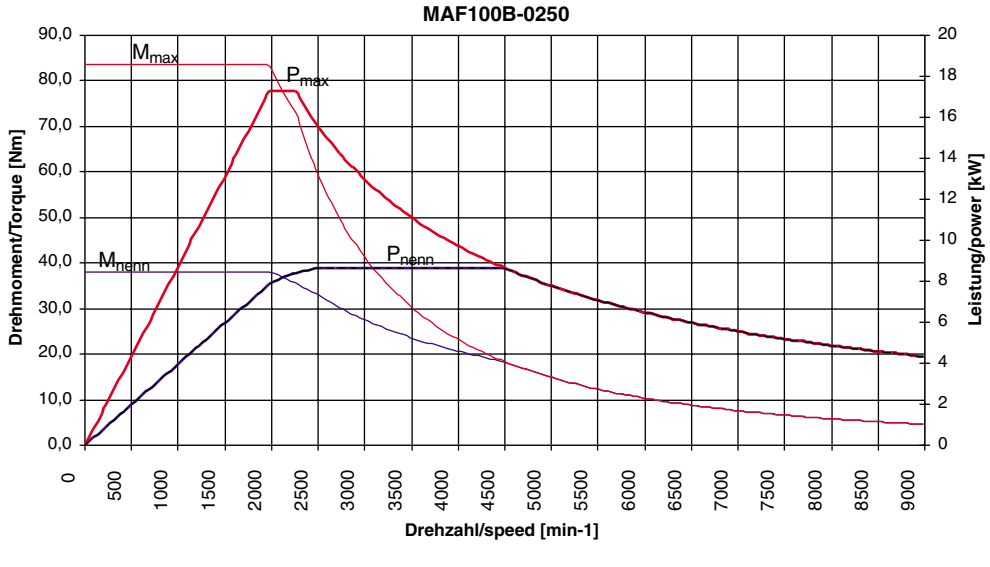


Fig. 4-65: Characteristic curve of MAF100B-0200



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

KENNL-MAF100B_0250.FH10

Fig. 4-66: Characteristic curve of MAF100B-0250

4.14 Technical Data Sheet for MAF100C

Description	Symbol	Unit	MAF100C				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	70	68	66	64	62
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	3.9	7.5	10.4	13.4	16.2
Rated current	I_{nenn}	A	12.1	19	27.9	36.7	40.2
Continuous torque at standstill	M_{n1}	Nm	-	70	68	66	64
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	19.5	28.6	37.6	45
Maximum speed	M_{max}	Nm	154	154	149	145	138
Torque constant at 20°C	K_{M_nenn}	Nm/A	6.06	3.77	2.5	1.91	1.55
Min. cross section of power cable [2])	A	mm²	2.5	2.5	4	6	10
Number of pole pairs	p		3				
Moment of inertia of rotor [3])	J_{rot}	kgm²	0.0284				
Mass [3])	m	kg	70				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	9000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	6000	6300		
Maximum speed with bearing... - reinforced	n_{max}	rpm	not available				
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000	11000 [6])	
Thermal time constant	T_{th}	min	10				
Duty cycle time (S6-44%)	T_C	min	i.p.				
Noise level [4])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International Protection class			IP65				
Liquid cooling [5])							
Power loss to be dissipated	P_V	kW	1.1		1.2	1.3	1.9
Cooling agent temperature: Cooling agent inlet	T_{ein}	°C	+10....+40				
Cooling agent temperature: Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_{min}: without fast coupling	Δp_{diff}	bar	0.6				
Decompression at Q_{min}: with fast coupling	Δp_{diff}	bar	1.2				
Required flow of coolant at P_V	Q_{min}	l/min	1.6		1.75	1.9	2.8
Permissible inlet pressure	p_{max}	bar	3				
Holding brake (optional)			**Electrically-clamped**		**Electrically-released**		
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				
Disengagement time	t_2	ms	50		90		
Engagement time	t_1	ms	42		30		
Maximum speed of 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.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.
[6]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-67: Data sheet MAF100C

Characteristic Curves of MAF100B

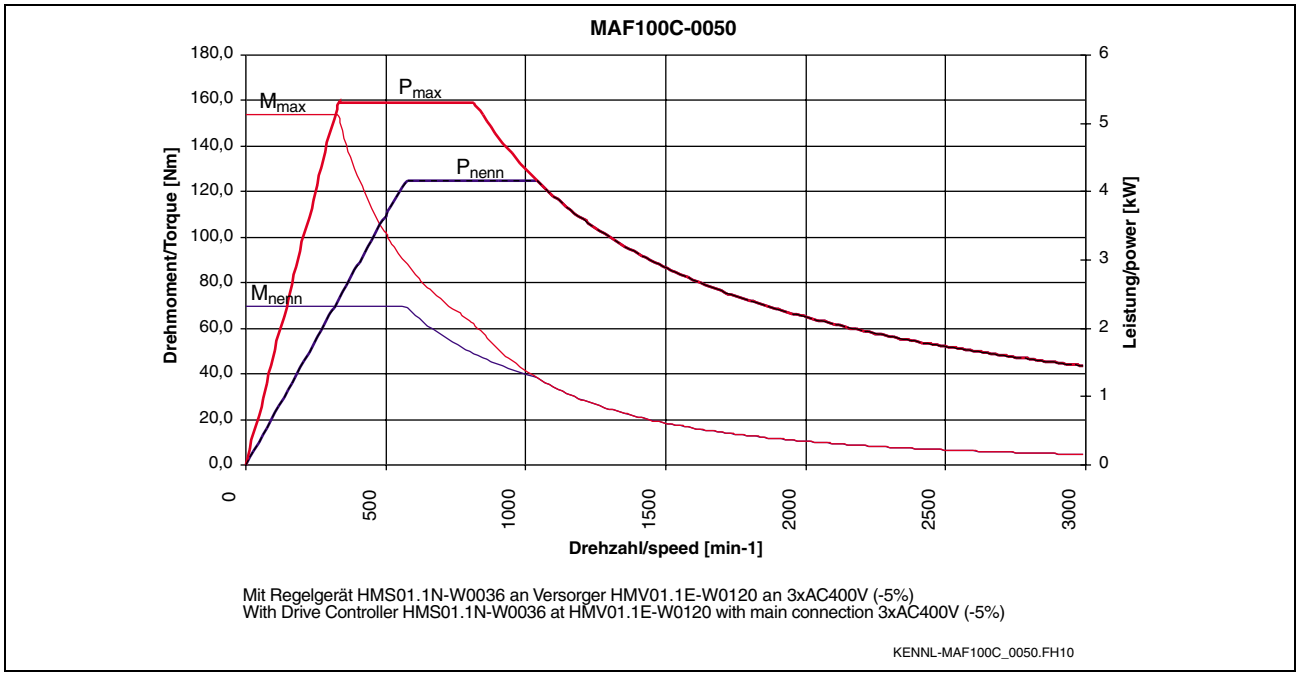


Fig. 4-134: Characteristic curve of MAF100C-0050

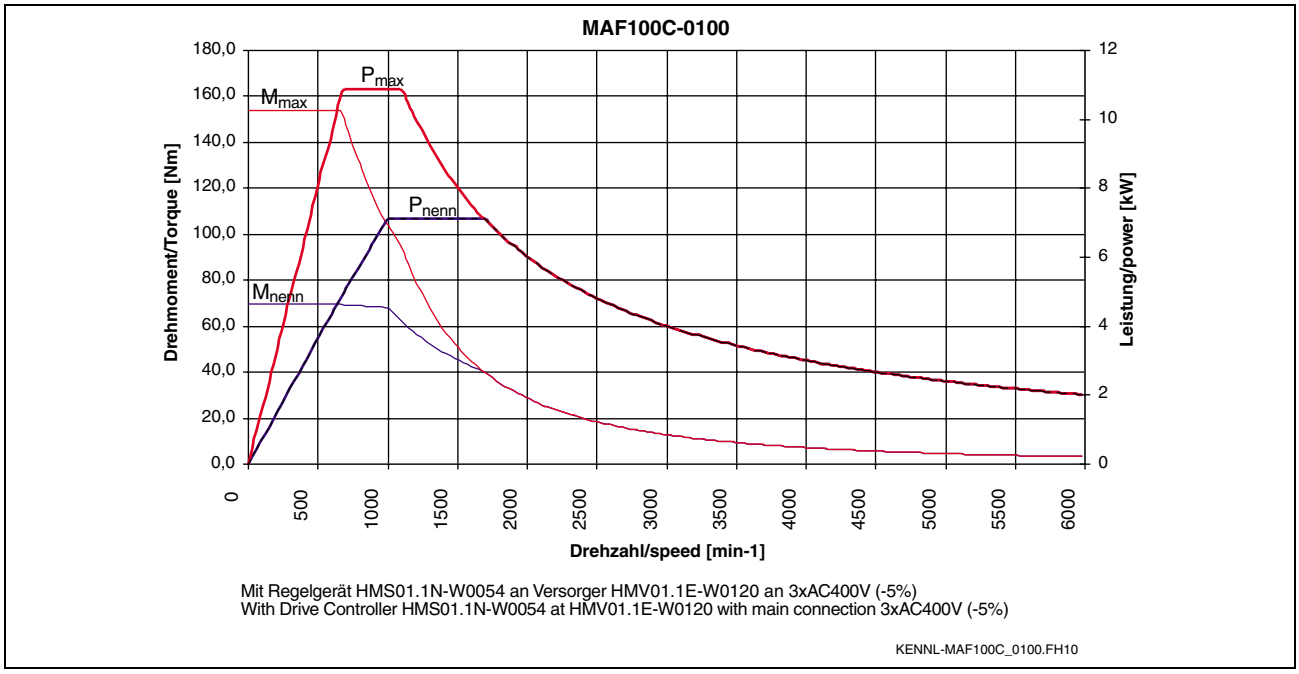


Fig. 4-135: Characteristic curve of MAF100C-0100

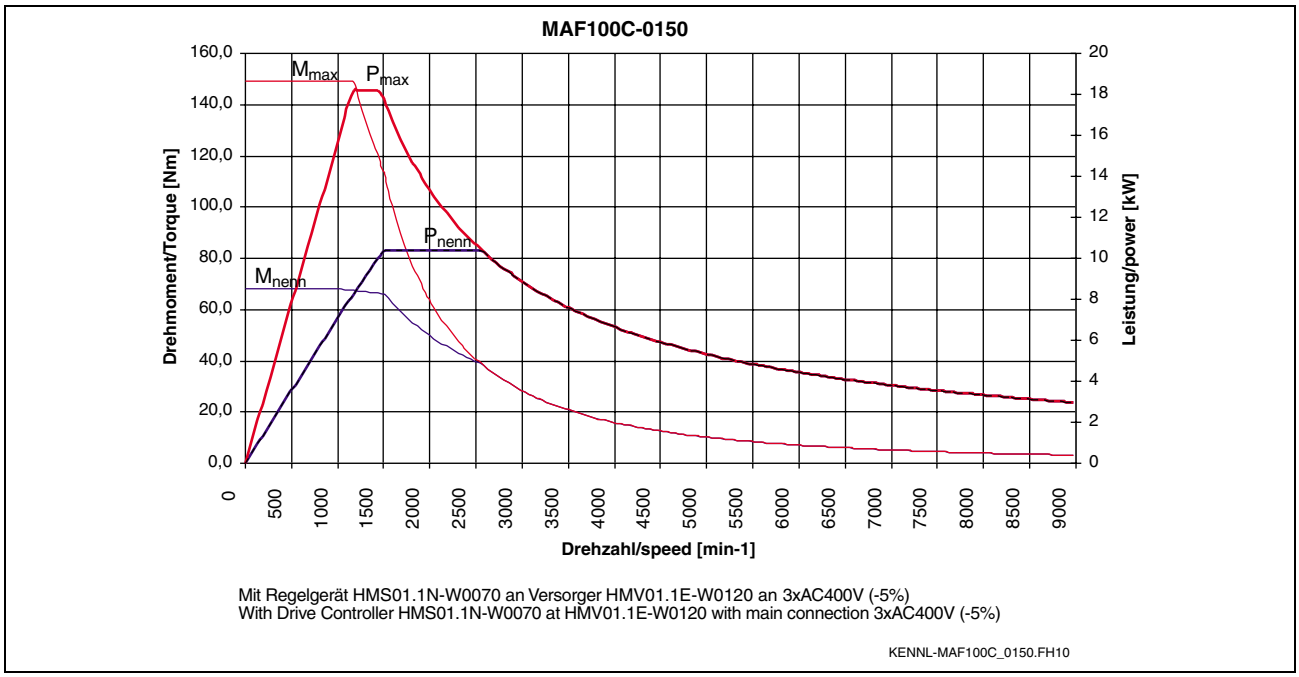


Fig. 4-136: Characteristic curve of MAF100C-0150

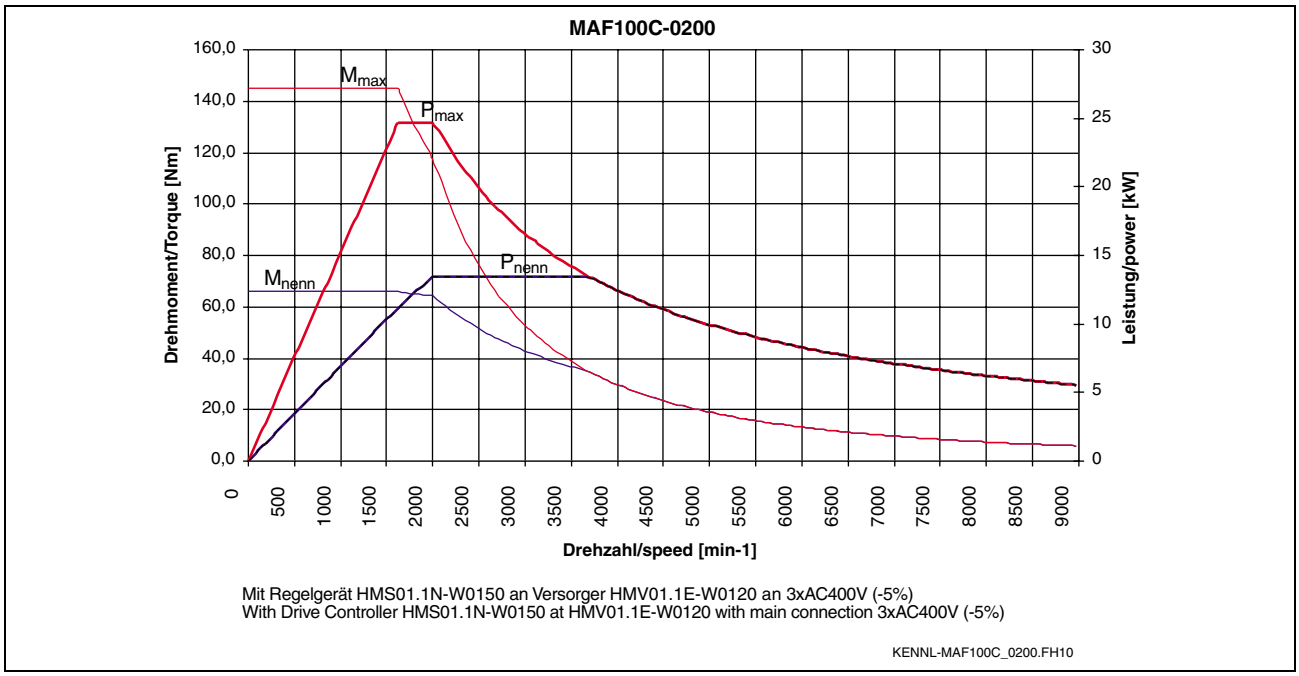


Fig. 4-137: Characteristic curve of MAF100C-0200

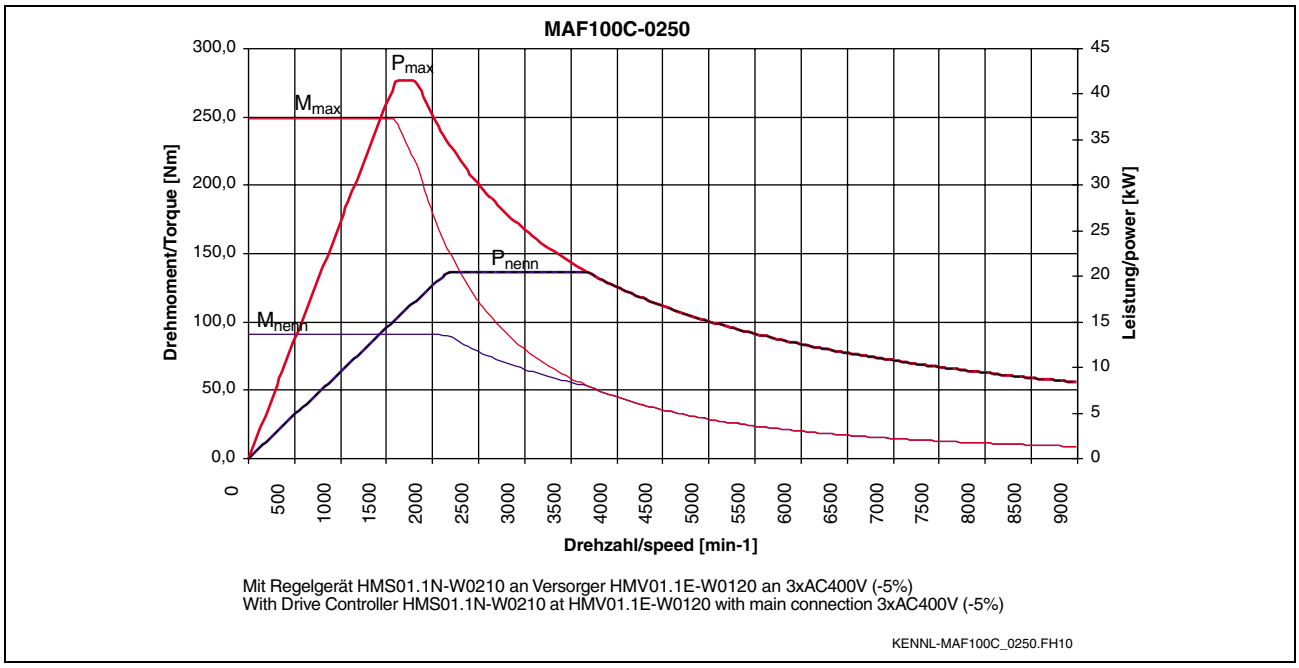


Fig. 4-138: Characteristic curve of MAF100C-0250

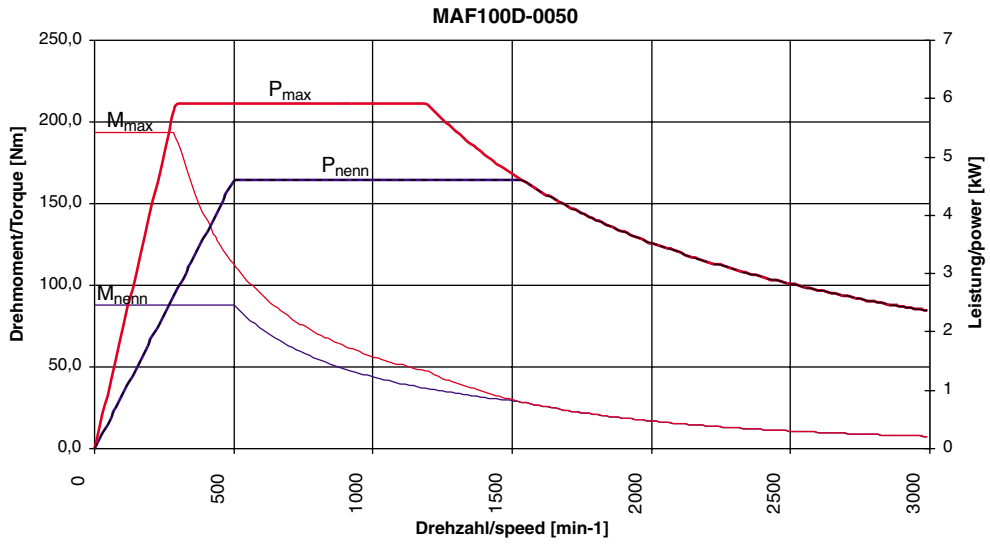
4.15 Technical Data Sheet for MAF100D

Description	Symbol	Unit	MAF100D				
Motor data [1])							
Winding			0050	0100	0150	0200	0250
Rated torque	M_{nenn}	Nm	88	84	79	80	75
Rated speed	n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power	P_{nenn}	kW	4.6	8.8	12.4	16.8	19.6
Rated current	I_{nenn}	A	14.5	25.1	32.7	43.1	45.8
Continuous torque at standstill	M_{n1}	Nm	-	88	84	83	80
Derating speed	n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill	I_{n1}	A	-	26.1	34.3	44.4	56.1
Maximum speed	M_{max}	Nm	193	194	185	182	177
Torque constant at 20°C	K_{M_nenn}	Nm/A	6.79	3.78	2.77	2.08	1.55
Min. cross section of power cable [2])	A	mm²	2.5	4	6	10	16
Number of pole pairs	p		3				
Moment of inertia [3])	J_{rot}	kgm²	0.032				
Mass [3])	m	kg	88				
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000	9000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	6000	6300		
Maximum speed with bearing... - reinforced	n_{max}	rpm	not available				
Maximum speed with bearing... - High-speed	n_{max}	rpm	3000	6000	9000	11000 [6])	
Thermal time constant	T_{th}	min	10				
Duty cycle time (S6-44%)	T_C:	min	i.p.				
Noise level [4])	p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature	T_{um}	°C	0....+40				
Permissible storage and transport temperature	T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1			F				
International 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_{ein}	°C	+10....+40				
Cooling agent temperature: Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_{min}: without fast coupling	Δp_{diff}	bar	1.0				
Decompression at Q_{min}: with fast coupling	Δp_{diff}	bar	1.9				
Required flow of coolant at P_V	Q_{min}	l/min	2	2.1	2.2	2.3	2.8
Permissible inlet pressure	p_{max}	bar	3				
Holding brake (optional)			**Electrically-clamped**			**Electrically-released**	
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				
Disengagement time	t_2	ms	50			90	
Engagement time	t_1	ms	42			30	
Maximum speed of 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.
[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.
(1993) bei 40 °C Umgebungstemperatur.
[3]) Values without holding brake.
[4]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data.
Observe instructions on coolant inlet temperature in chapter 9.8.
[6]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-139: Data Sheet MAF100D

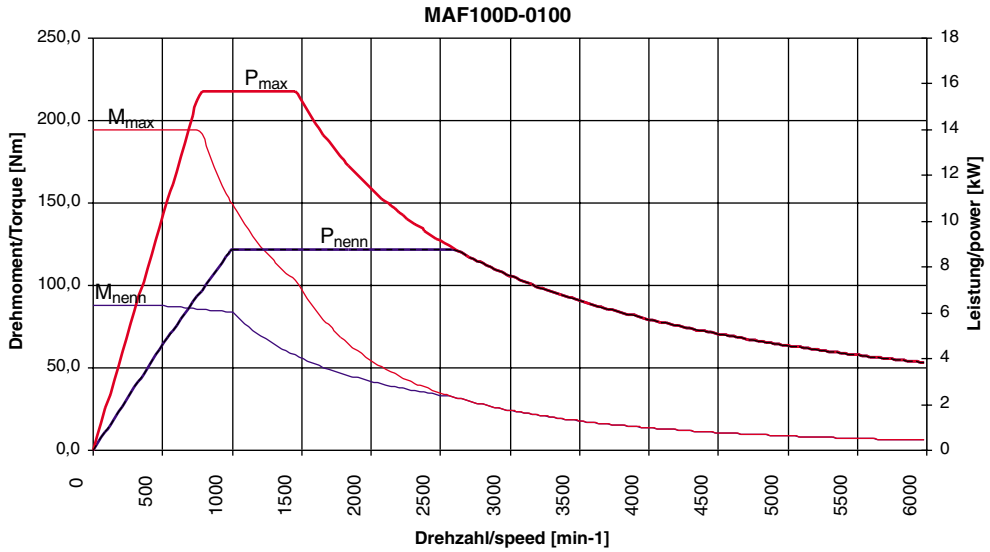
Characteristic Curves of MAF100D



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF100D_0050.FH10

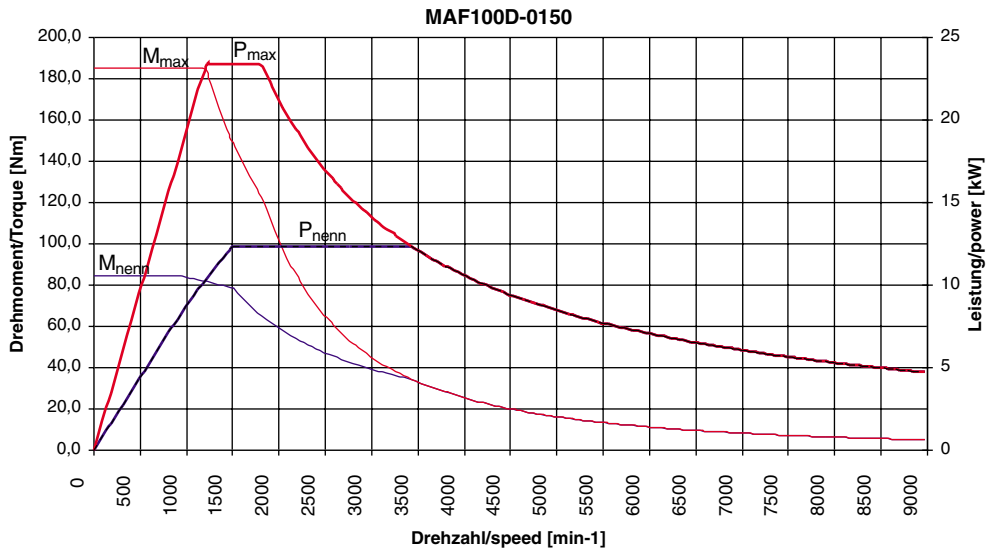
Fig. 4-140: Characteristic curve of MAF100D-0050



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

KENNL-MAF100D_0100.FH10

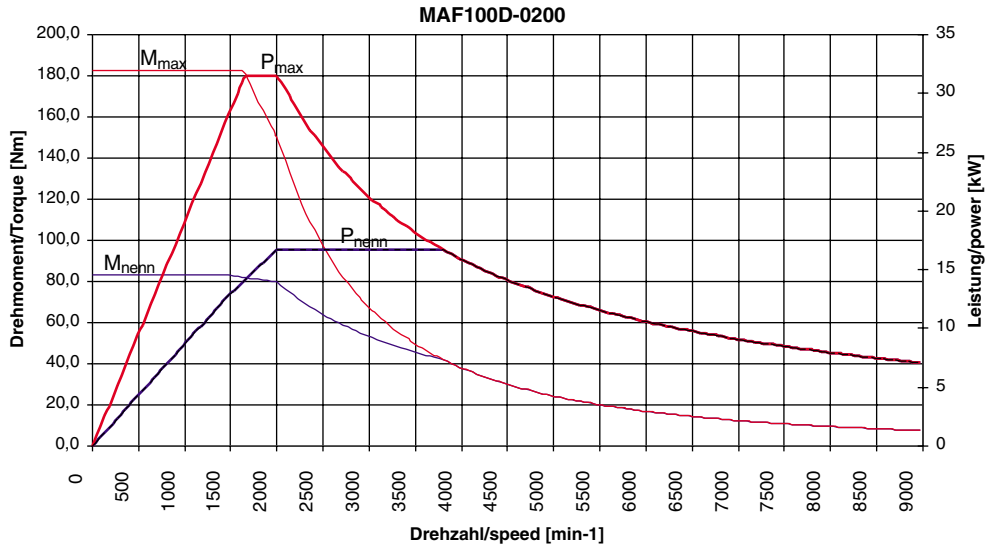
Fig. 4-141: Characteristic curve of MAF100D-0100



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

KENNL-MAF100D_0150.FH10

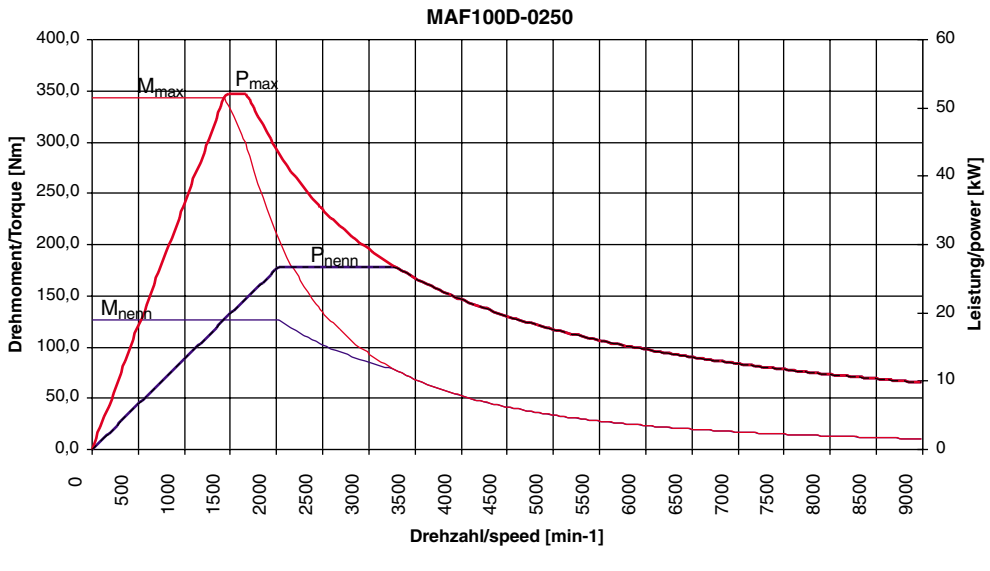
Fig. 4-142: Characteristic curve of MAF100D-0150



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF100D_0200.FH10

Fig. 4-143: Characteristic curve of MAF100D-0200



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF100D_0250.FH10

Fig. 4-144: Characteristic curve of MAF100D-0250

4.16 Technical Data sheet for MAF130B

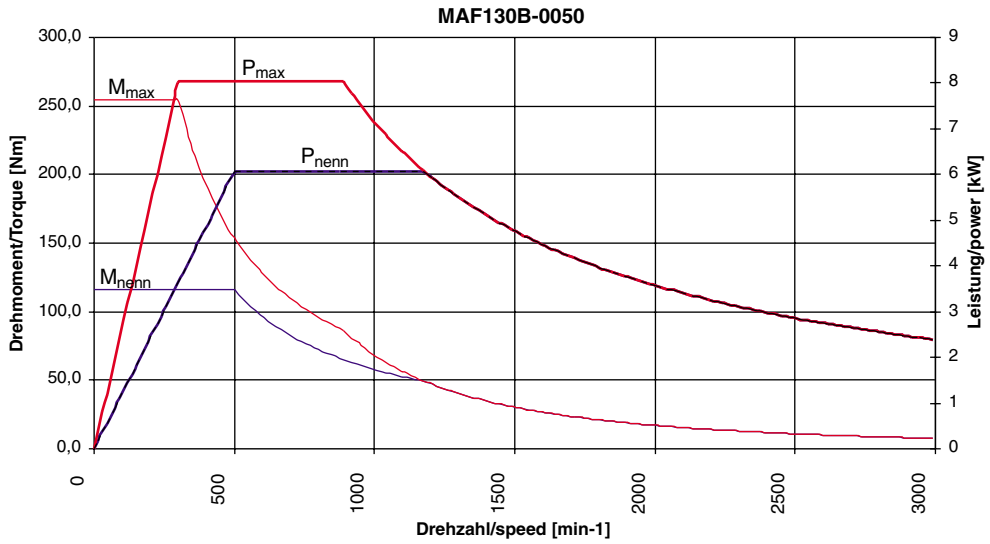
Description		Symbol	Unit	MAF130B				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_{nenn}	Nm	116	112	115	100	90
Rated speed		n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power		P_{nenn}	kW	6.1	11.7	18.1	20.9	23.6
Rated current		I_{nenn}	A	14.7	28.4	43.7	51.7	55.5
Continuous torque at standstill		M_{n1}	Nm	-	116	120	108	100
Derating speed		n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill		I_{n1}	A	-	29.3	45.3	55.2	56.1
Maximum speed		M_{max}	Nm	255	255	264	238	221
Torque constant at 20°C		K_{M_nenn}	Nm/A	8.46	4.25	2.83	2.12	1.83
Min. cross section of power cable [2])		A	mm²	6	6	10	10	16
Number of pole pairs		p		3				
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.079				
Motor mass [3])		m	kg	93				
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000	7500		
	- coupling attachment	n_{max}	rpm	3000	5250			
	- reinforced	n_{max}	rpm	3000	6000	7500		
	- High-speed	n_{max}	rpm	3000	6000	9000 [6])	10000 [6])	
Thermal time constant		T_{th}	min	15				
Duty cycle time (S6-44%)		T_C	min	i.p.				
Noise level [4])		p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature		T_{um}	°C	0....+40				
Permissible storage and transport temperature		T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1				F				
International 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_{ein}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.3				
	with fast coupling	Δp_{diff}	bar	0.6				
Required flow of coolant 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-clamped	Electrically-released
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	
Disengagement time	t_2	ms	65	140
Engagement time	t_1	ms	110	50
Maximum speed of 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.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.
[6]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-68: Data Sheet MAF130B

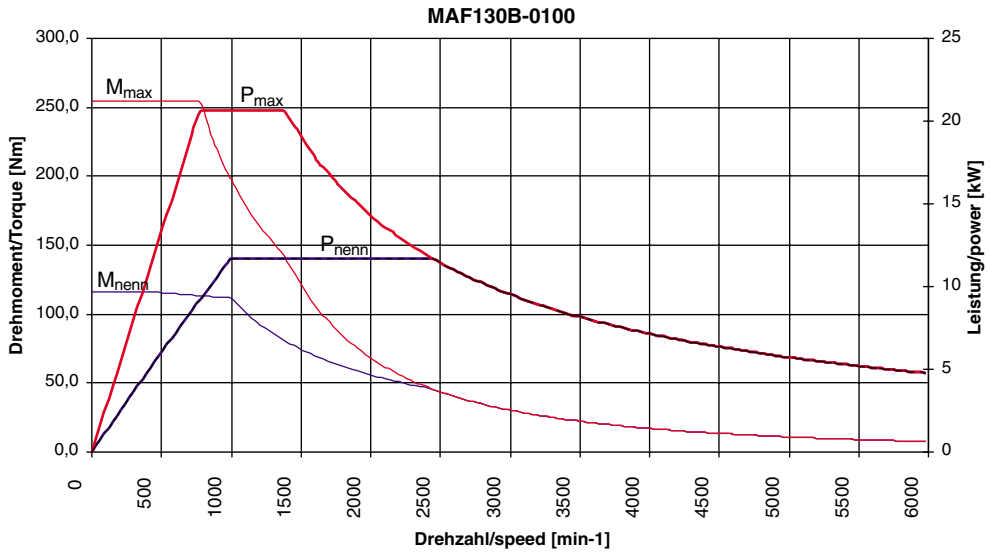
Characteristic Curves of MAF130B



Mit Regelgerät HMS01.1N-W0036 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0036 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130B_0050.FH10

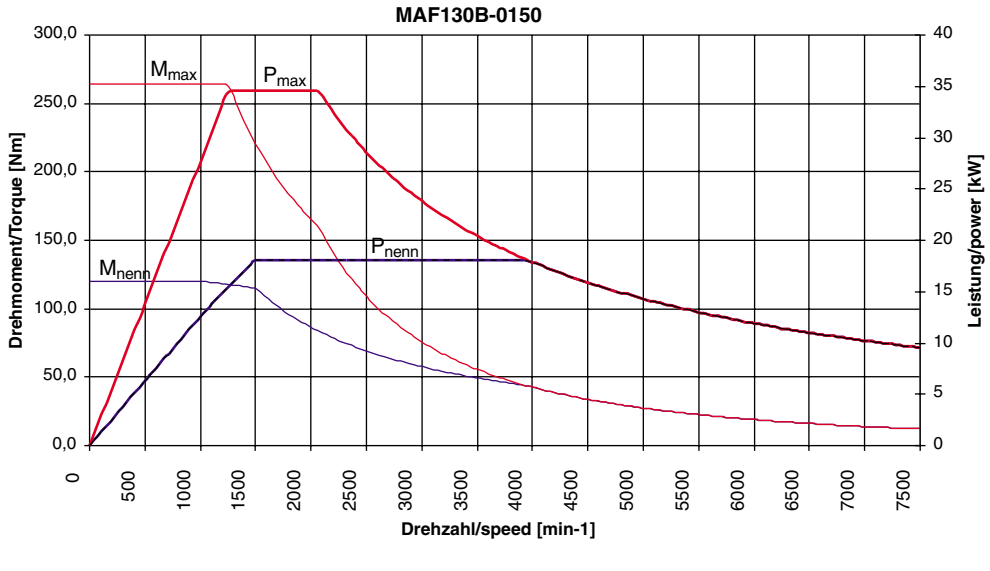
Fig. 4-69: Characteristic curve of MAF130B-0050



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

KENNL-MAF130B_0100.FH10

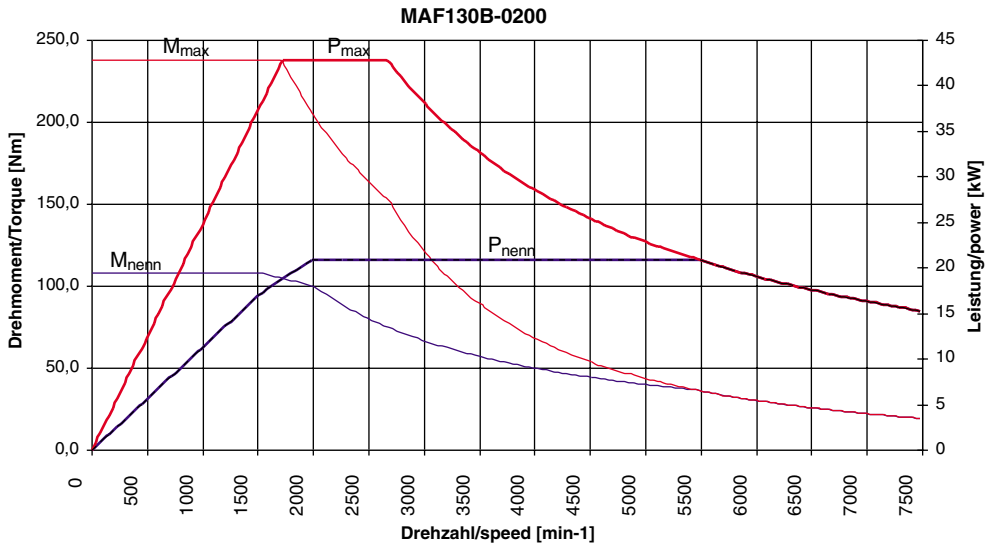
Fig. 4-70: Characteristic curve of MAF130B-0100



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130B_0150.FH10

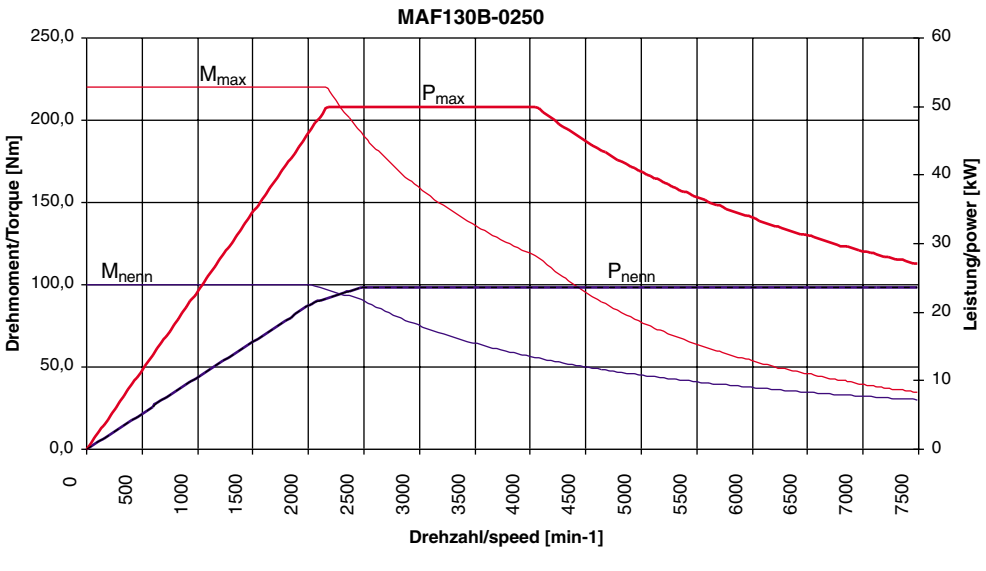
Fig. 4-71: Characteristic curve of MAF130B-0150



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130B_0200.FH10

Fig. 4-72: Characteristic curve of MAF130B-0200



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130B_0250.FH10

Fig. 4-73: Characteristic curve of MAF130B-0250

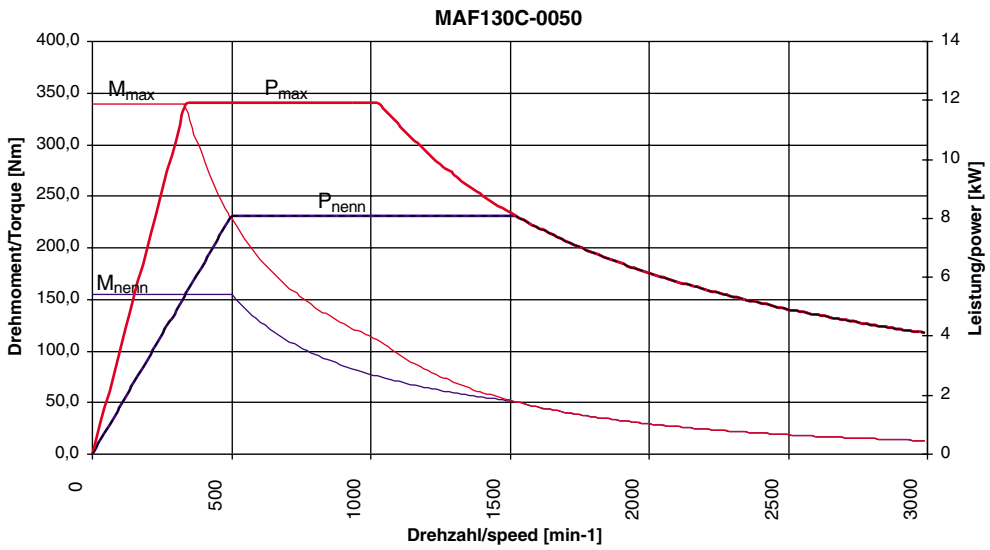
4.17 Technical Data Sheet for MAF130C

Description		Symbol	Unit	MAF130C				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_{nenn}	Nm	155	150	145	135	125
Rated speed		n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power		P_{nenn}	kW	8.1	15.7	22.8	28.3	33.7
Rated current		I_{nenn}	A	21	38	53.2	69.8	75.5
Continuous torque at standstill		M_{n1}	Nm	-	155	150	143	135
Derating speed		n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill		I_{n1}	A	-	39	54.7	71.2	76.1
Maximum speed		M_{max}	Nm	340	340	330	315	298
Torque constant at 20°C		K_{M_nenn}	Nm/A	8.04	4.38	3.04	2.19	1.88
Min. cross section of power cable [2])		A	mm²	6	6	16	16	25
Number of pole pairs		p		3				
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.101				
Motor mass [3])		m	kg	110				
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000	7500		
	- coupling attachment	n_{max}	rpm	3000	5250			
	- reinforced	n_{max}	rpm	3000	6000	7500		
	- High-speed	n_{max}	rpm	3000	6000	9000 [6])	10000 [6])	
Thermal time constant		T_{th}	min	15				
Duty cycle time (S6-44%)		T_C	min	i.p.				
Noise level [4])		p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature		T_{um}	°C	0....+40				
Permissible storage and transport temperature		T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1				F				
International Protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	2.3				
Cooling agent temperature	Cooling agent inlet	T_{ein}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.4				
	with fast coupling	Δp_{diff}	bar	0.8				
Required flow of coolant at P_V		Q_{min}	l/min	3.3				
max. system pressure		p_{max}	bar	3				
Holding brake (optional)				**Electrically-clamped**			**Electrically-released**	
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				
Disengagement time		t_2	ms	65			140	
Engagement time		t_1	ms	110			50	
Maximum speed of brake		n_{Br_max}	rpm	8000			8000	
Mass of brake		m	kg	8				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.
[6]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-74: Data Sheet MAF130C

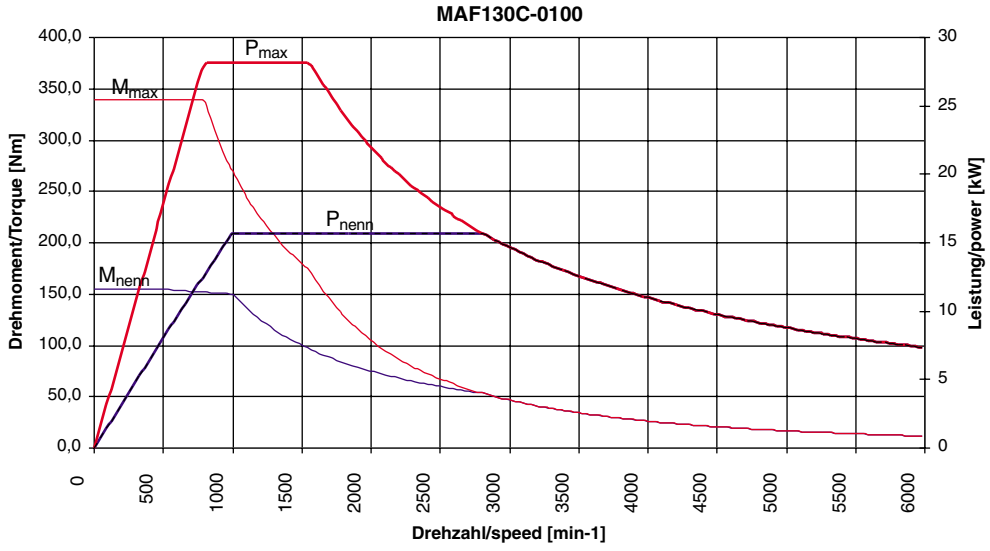
Characteristic Curves of MAF130C



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

KENNL-MAF130C_0050.FH10

Fig. 4-75: Characteristic curve of MAF130C-0050



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130C_0100.FH10

Fig. 4-76: Characteristic curve of MAF130C-0100

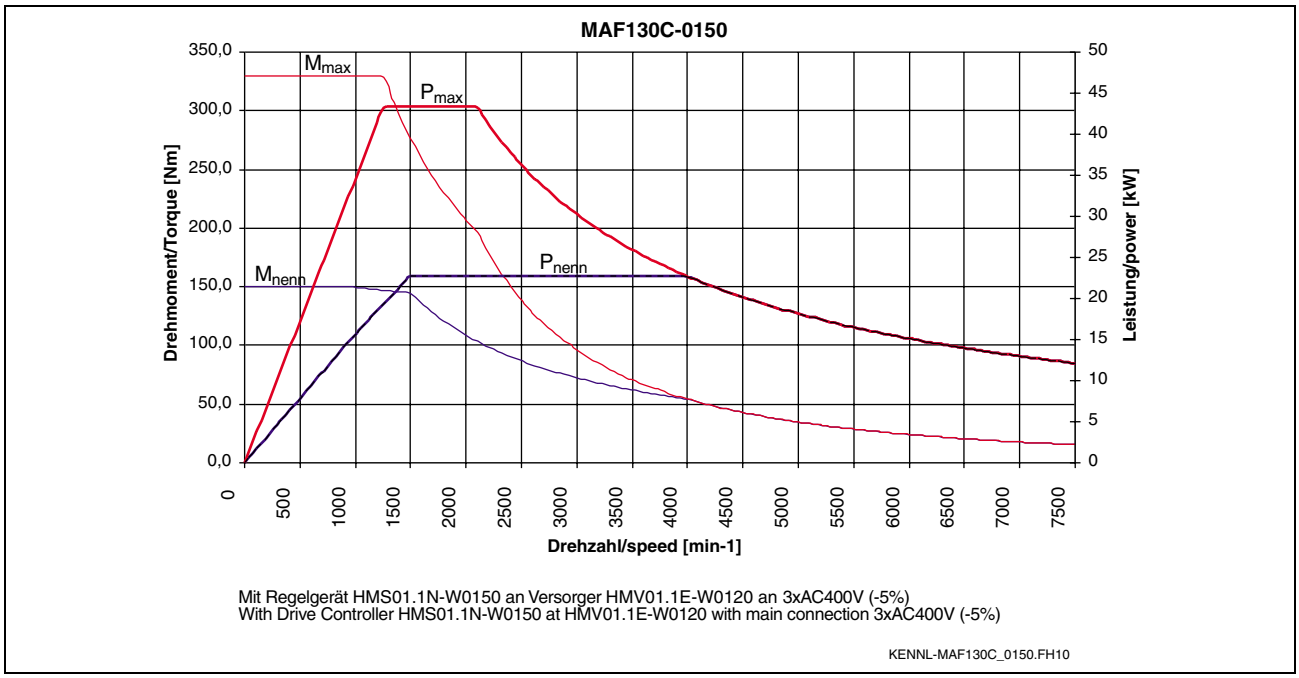


Fig. 4-77: Characteristic curve of MAF130C-0150

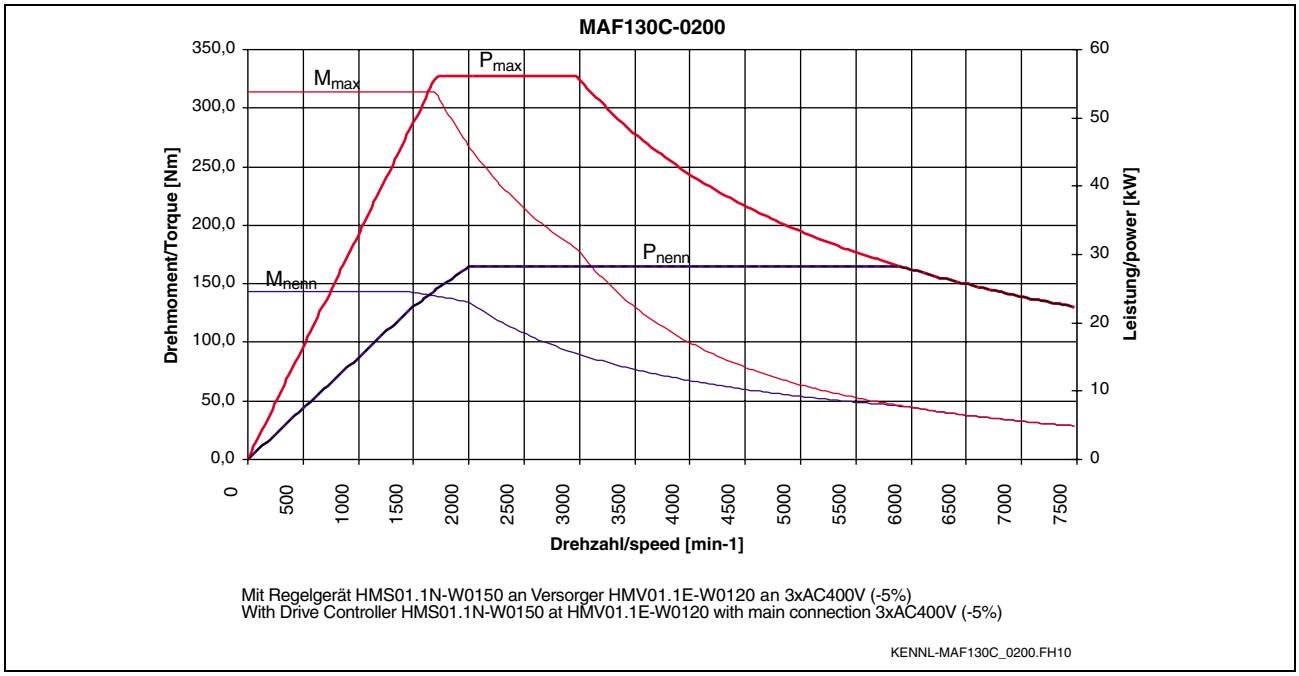


Fig. 4-78: Characteristic curve of MAF130C-0200

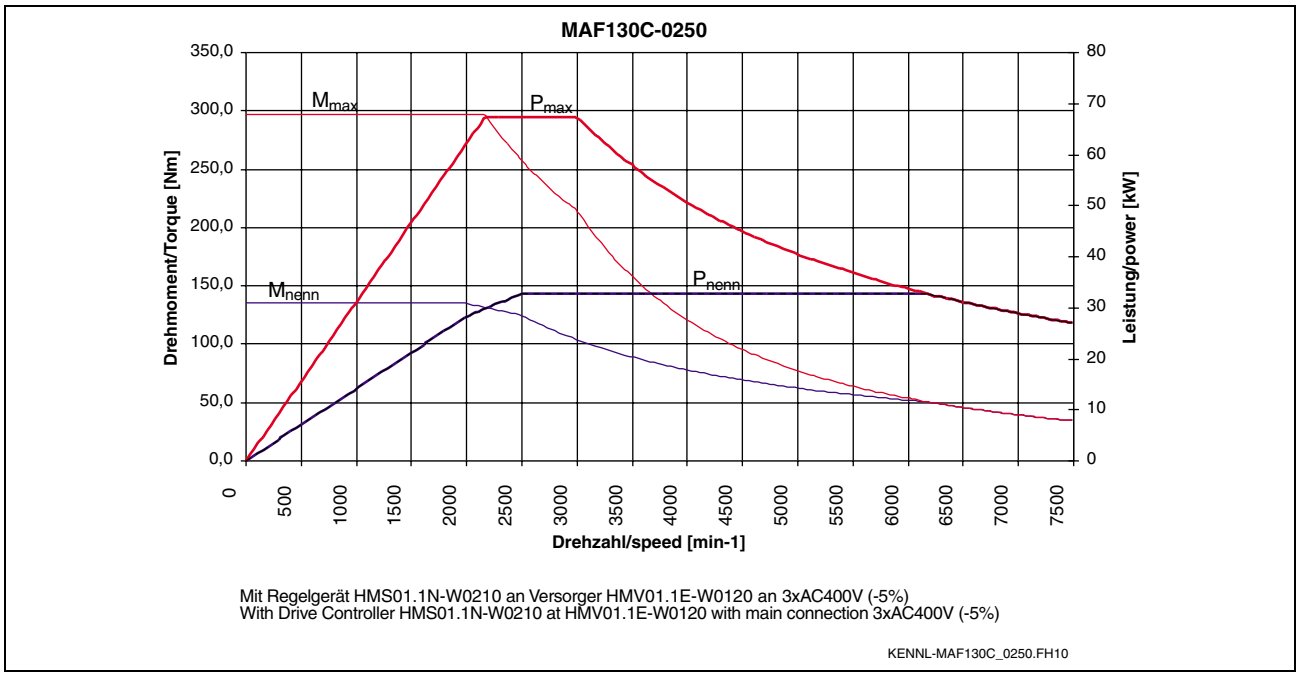


Fig. 4-79: Characteristic curve of MAF130C-0250

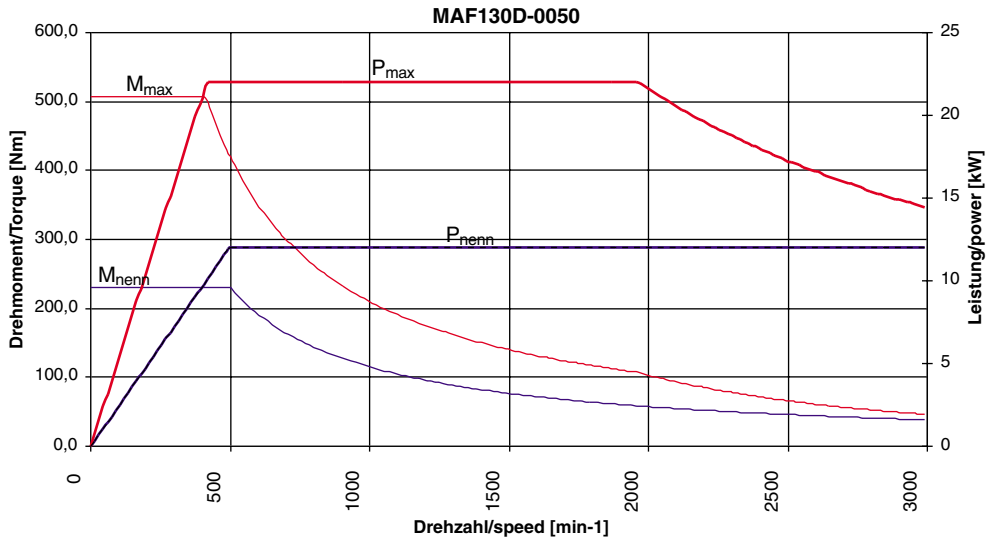
4.18 Technical Data Sheet for MAF130D

Description		Symbol	Unit	MAF130D				
Motor data [1])								
Winding				0050	0100	0150	0200	0250
Rated torque		M_{nenn}	Nm	230	220	200	200	190
Rated speed		n_{nenn}	rpm	500	1000	1500	2000	2500
Rated power		P_{nenn}	kW	12	23	31.4	41.9	49.7
Rated current		I_{nenn}	A	32.3	52	72.6	93.9	113
Continuous torque at standstill		M_{n1}	Nm	-	230	220	210	200
Derating speed		n_1	rpm	-	500	1000	1500	2000
Continuous current at standstill		I_{n1}	A	-	53.8	78	97.5	113.6
Maximum speed		M_{max}	Nm	506	506	484	461	432
Torque constant at 20°C		K_{M_nenn}	Nm/A	7.71	4.81	3.21	2.51	2.04
Min. cross section of power cable [2])		A	mm²	6	10	25	25	35
Number of pole pairs		p		3				
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.179				
Motor mass [3])		m	kg	145				
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000	7500		
	- coupling attachment	n_{max}	rpm	3000	5250			
	- reinforced	n_{max}	rpm	3000	6000	7500		
	- High-speed	n_{max}	rpm	3000	6000	9000 [6])	10000 [6])	
Thermal time constant		T_{th}	min	15				
Duty cycle time (S6-44%)		T_C	min	i.p.				
Noise level [4])		p_{Schall}	dB(A)	70 (+3)				
Permissible ambient temperature		T_{um}	°C	0....+40				
Permissible storage and transport temperature		T_{lager}	°C	-20....+80				
Insulation class according to DIN VDE 0530-1				F				
International Protection class				IP65				
Liquid cooling [5])								
Power loss to be dissipated		P_V	kW	3.3				
Cooling agent temperature	Cooling agent inlet	T_{ein}	°C	+10....+40				
	Permissible increase at P_V	ΔT_{diff}	K	10				
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.7				
	with fast coupling	Δp_{diff}	bar	1.4				
Required flow of coolant at P_V		Q_{min}	l/min	4.8				
max. system pressure		p_{max}	bar	3				
Holding brake (optional)				**Electrically-clamped**			**Electrically-released**	
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				
Disengagement time		t_2	ms	140			110	
Engagement time		t_1	ms	110			70	
Maximum speed of brake		n_{Br_max}	rpm	8000			8000	
Mass of brake		m	kg	8				

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.
[6]) Value is without a holding brake. This value may be limited by a holding brake.

Fig. 4-80: Data Sheet MAF130D

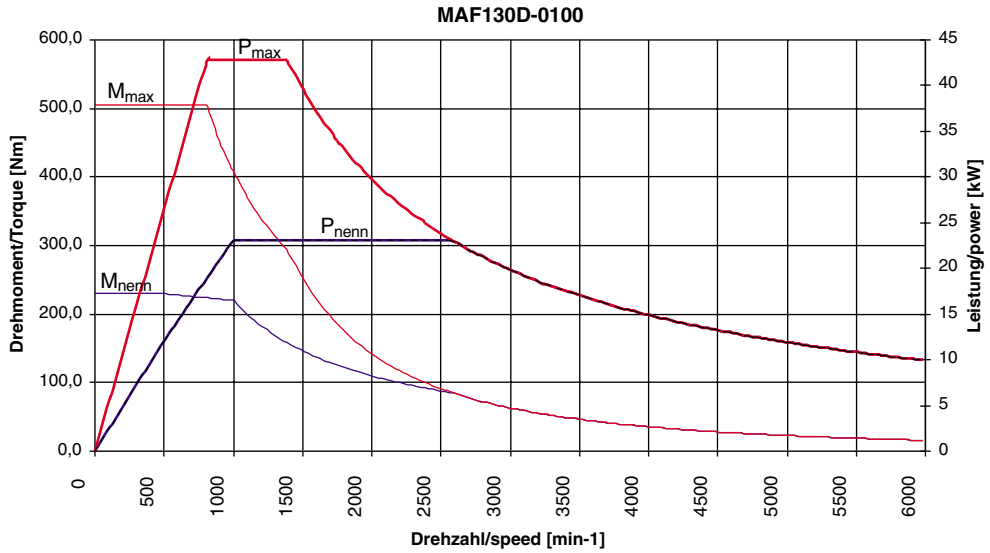
Characteristic Curves of MAF130D



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

KENNL-MAF130D_0050.FH10

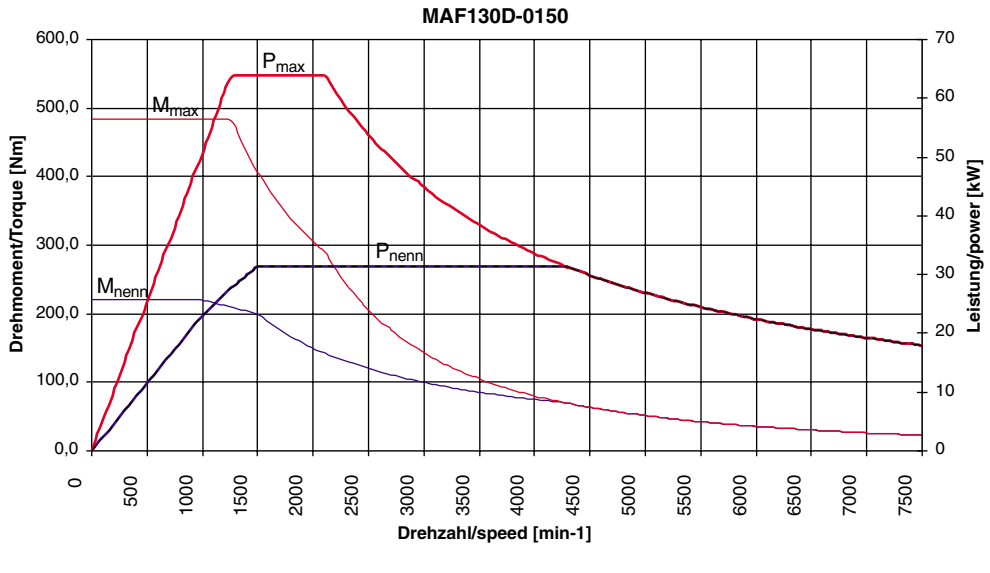
Fig. 4-81: Characteristic curve of MAF130D-0050



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130D_0100.FH10

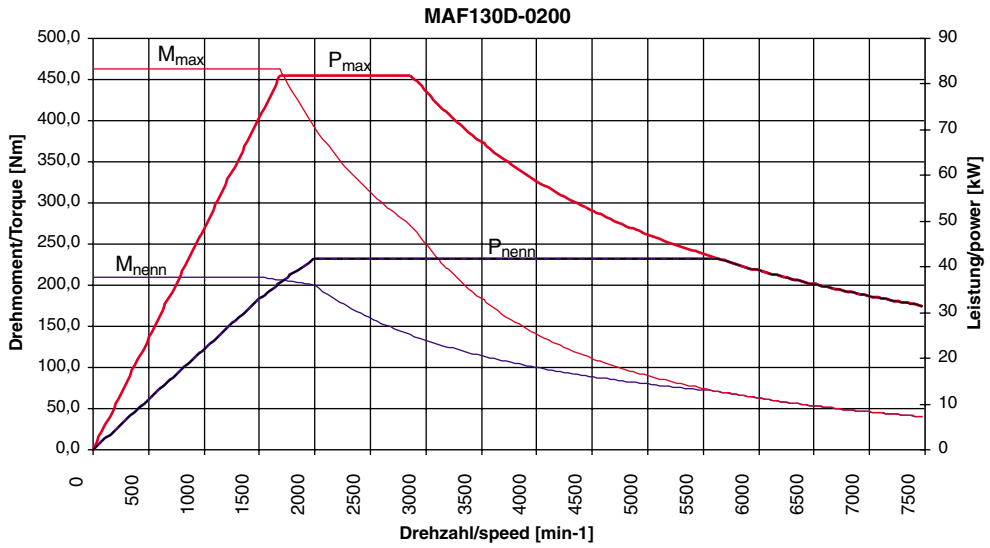
Fig. 4-82: Characteristic curve of MAF130D-0100



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130D_0150.FH10

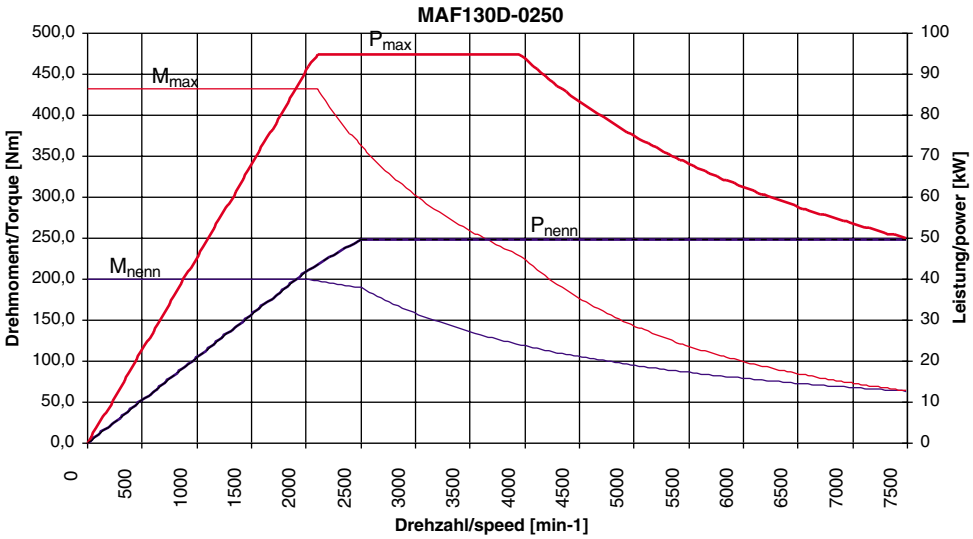
Fig. 4-83: Characteristic curve of MAF130D-0150



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130D_0200.FH10

Fig. 4-84: Characteristic curve of MAF130D-0200



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF130D_0250.FH10

Fig. 4-85: Characteristic curve of MAF130D-0250

4.19 Technical Data Sheet for MAF160B

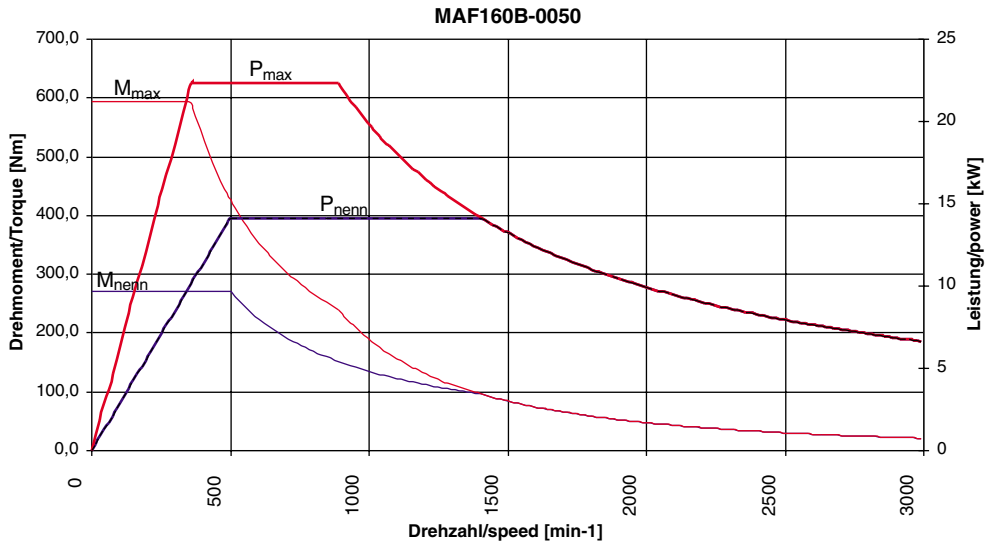
Description	Symbol	Unit	MAF160B			
Motor data [1])						
Winding			0050	0100	0150	0200
Rated torque	M_{nenn}	Nm	270	260	250	240
Rated speed	n_{nenn}	rpm	500	1000	1500	2000
Rated power	P_{nenn}	kW	14.1	27.2	39.3	50.3
Rated current	I_{nenn}	A	37.9	73.7	89.5	108.5
Continuous torque at standstill	M_{n1}	Nm	-	270	260	250
Derating speed	n_1	rpm	-	500	1000	1500
Continuous current at standstill	I_{n1}	A	-	75.8	92.1	112.3
Maximum speed	M_{max}	Nm	594	593	571	550
Torque constant at 20°C	K_{M_nenn}	Nm/A	8.25	4.13	3.3	2.4
Min. cross section of power cable [2])	A	mm²	6	25	25	35
Number of pole pairs	p		3			
Moment of inertia of rotor [3])	J_{rot}	kgm²	0.23			
Motor mass [3])	m	kg	195			
Maximum speed with bearing... - Standard	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - coupling attachment	n_{max}	rpm	3000	4200		
Maximum speed with bearing... - reinforced	n_{max}	rpm	3000	6000		
Maximum speed with bearing... - High-speed	n_{max}	rpm	not available			
Thermal time constant	T_{th}	min	20			
Duty cycle time (S6-44%)	T_C	min	i.p.			
Noise level [4])	p_{Schall}	dB(A)	72 (+3)			
Permissible ambient temperature	T_{um}	°C	0....+40			
Permissible storage and transport temperature	T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1			F			
International 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_{ein}	°C	+10....+40			
Cooling agent temperature: Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_{min}: without fast coupling	Δp_{diff}	bar	0.4			
Decompression at Q_{min}: with fast coupling	Δp_{diff}	bar	0.8			
Required flow of coolant at P_V	Q_{min}	l/min	3.8	5.8		6.5
max. system pressure	p_{max}	bar	3			

Holding brake (optional)			**Electrically-clamped**	**Electrically-released**	**Electrically-released - 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
Disengagement time	t_2	ms	100	190	300
Engagement time	t_1	ms	85	12	30
Mass	m	kg	20		25

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.

Fig. 4-86: Data Sheet MAF160B

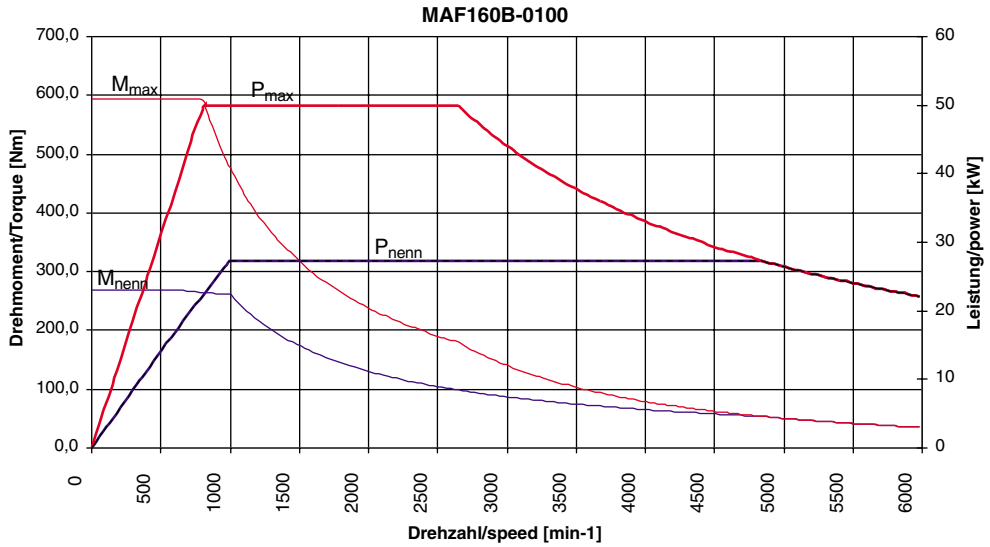
Characteristic Curves of MAF160B



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

KENNL-MAF160B_0050.FH10

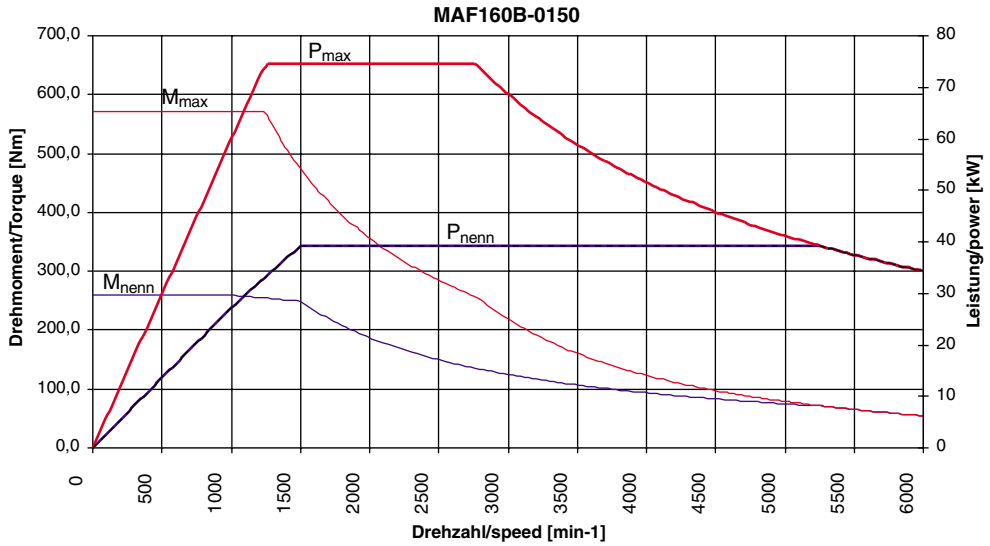
Fig. 4-87: Characteristic curve of MAF160B-0050



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF160B_0100.FH10

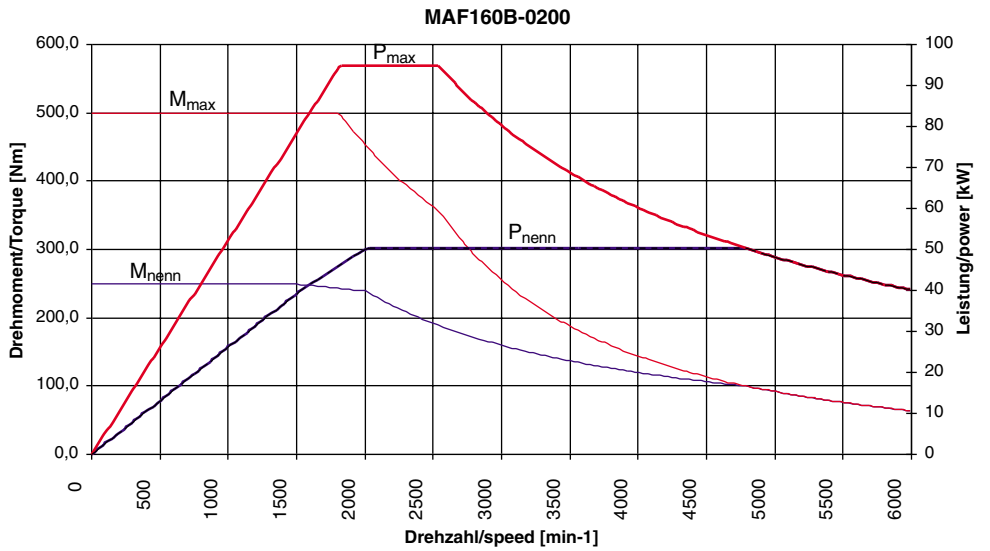
Fig. 4-88: Characteristic curve of MAF160B-0100



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF160B_0150.FH10

Fig. 4-89: Characteristic curve of MAF160B-0150



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF160B_0200.FH10

Fig. 4-90: Characteristic curve of MAF160B-0200

4.20 Technical Data Sheet for MAF160C

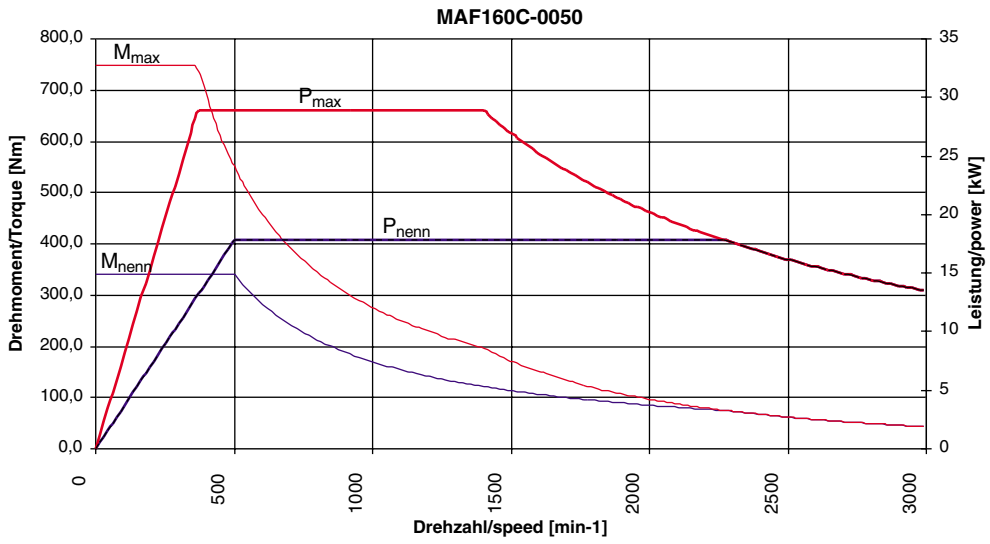
Description		Symbol	Unit	MAF160C			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_{nenn}	Nm	340	325	300	285
Rated speed		n_{nenn}	rpm	500	1000	1500	2000
Rated power		P_{nenn}	kW	17.8	34	47.1	59.7
Rated current		I_{nenn}	A	47.4	91.2	109.5	136
Continuous torque at standstill		M_{n1}	Nm	-	340	310	295
Derating speed		n_1	rpm	-	500	1000	1500
Continuous current at standstill		I_{n1}	A	-	94.8	111.9	141.4
Maximum speed		M_{max}	Nm	748	746	681	658
Torque constant at 20°C		K_{M_nenn}	Nm/A	7.76	3.88	3.37	2.3
Min. cross section of power cable [2])		A	mm²	10	25	35	2x16
Number of pole pairs		p		3			
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.311			
Motor mass [3])		m	kg	233			
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000		
	- coupling attachment	n_{max}	rpm	3000	4200		
	- reinforced	n_{max}	rpm	3000	6000		
	- High-speed	n_{max}	rpm	not available			
Thermal time constant		T_{th}	min	20			
Duty cycle time (S6-44%)		T_C	min	i.p.			
Noise level [4])		p_{Schall}	dB(A)	72 (+3)			
Permissible ambient temperature		T_{um}	°C	0....+40			
Permissible storage and transport temperature		T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1				F			
International 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_{ein}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.6			
	with fast coupling	Δp_{diff}	bar	1.2			
Required flow of coolant at P_V		Q_{min}	l/min	6.5		5.5	6
max. system pressure		p_{max}	bar	3			

Holding brake (optional)			**Electrically-clamped**	**Electrically-released**	**Electrically-released - 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
Disengagement time	t_2	ms	100	190	300
Engagement time	t_1	ms	85	12	30
Mass	m	kg	20		25

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.

Fig. 4-91: Data Sheet MAF160C

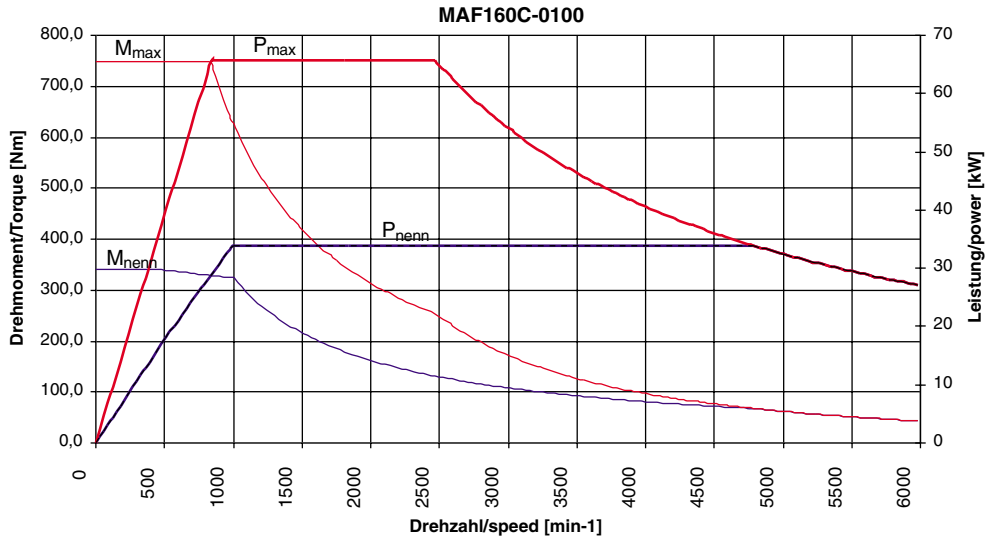
Characteristic Curves of MAF160C



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF160C_0050.FH10

Fig. 4-92: Characteristic curve of MAF160C-0050



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF160C_0100.FH10

Fig. 4-93: Characteristic curve of MAF160C-0100

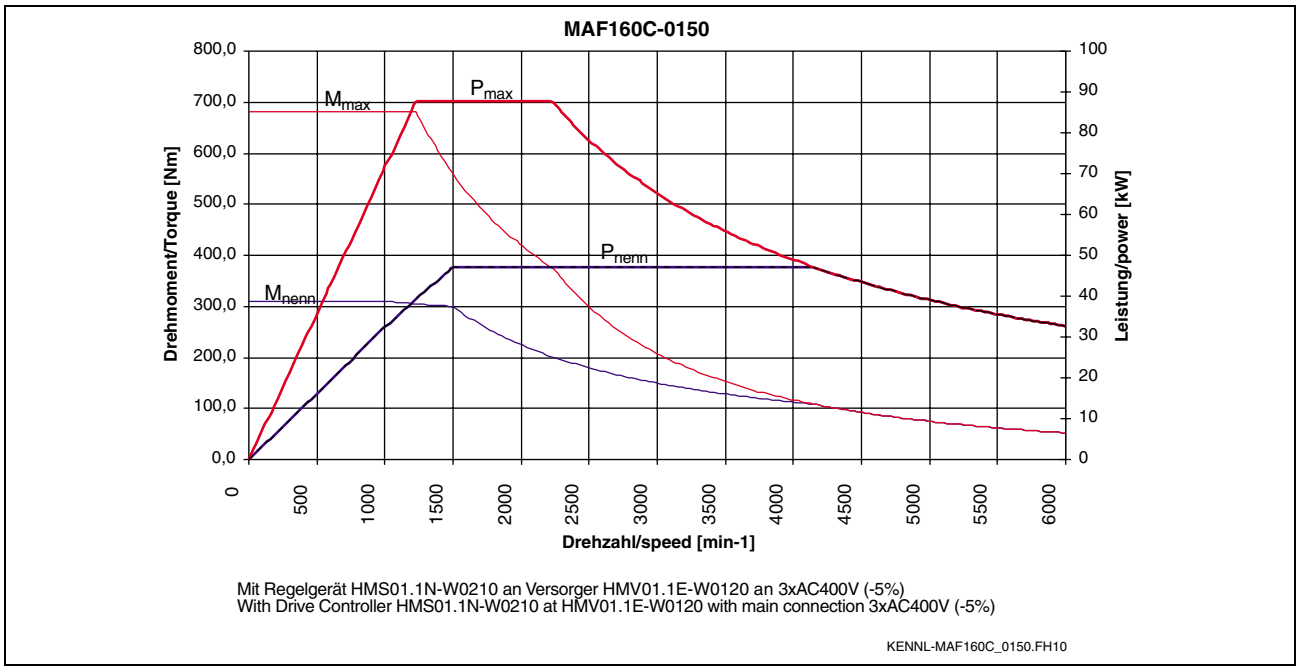


Fig. 4-94: Characteristic curve of MAF160C-0150

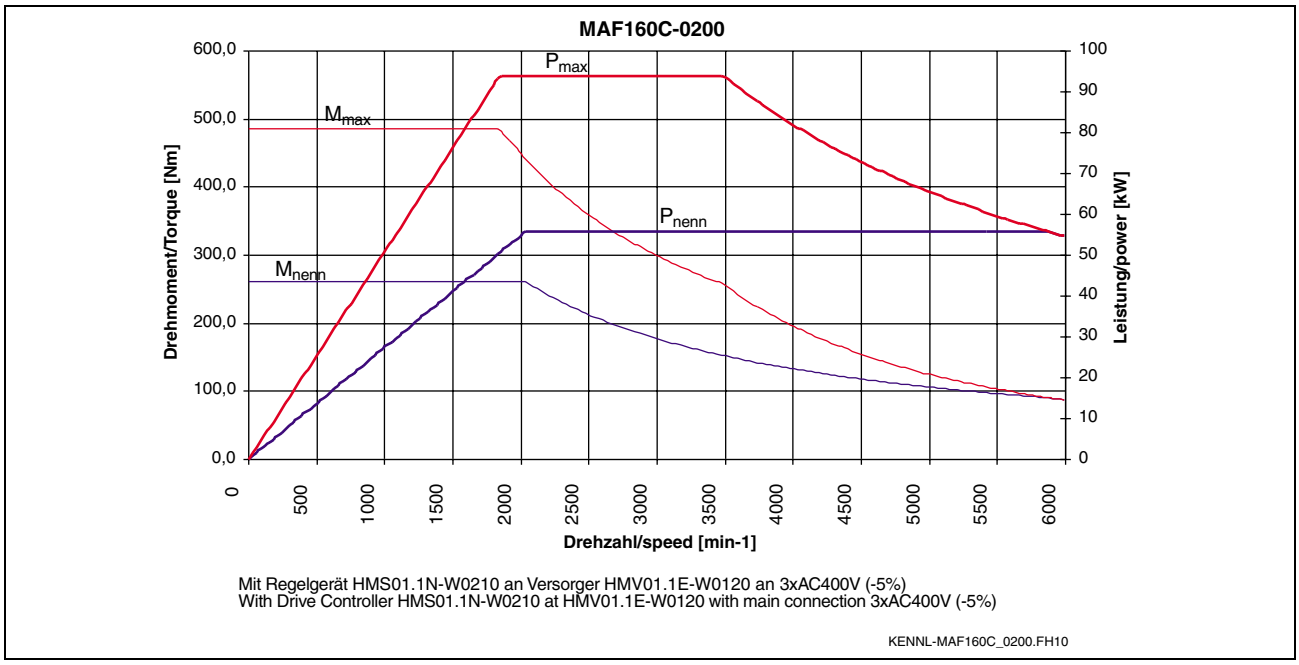


Fig. 4-95: Characteristic curve of MAF160C-0200

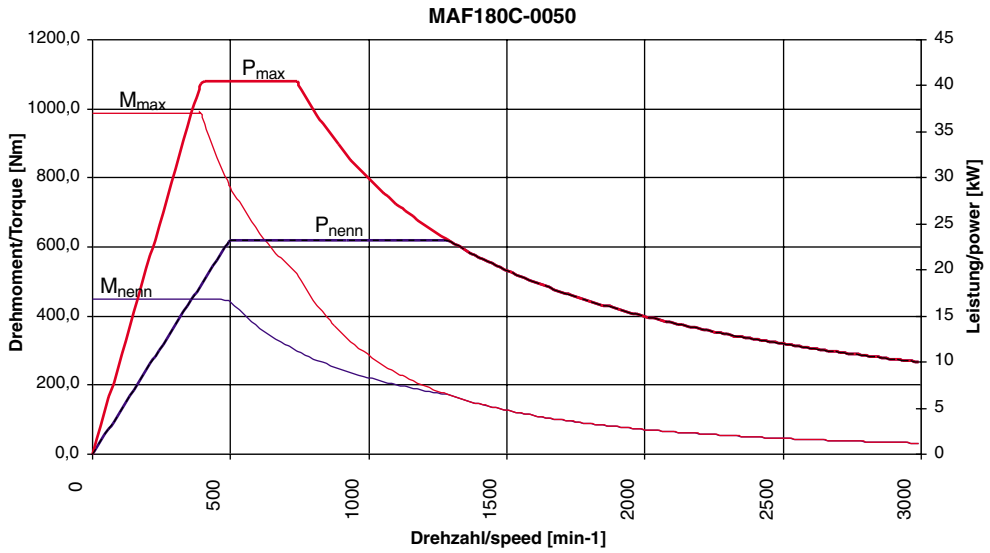
4.21 Technical Data Sheet for MAF180C

Description		Symbol	Unit	MAF180C			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_{nenn}	Nm	435	390	365	318
Rated speed		n_{nenn}	rpm	500	1000	1500	2000
Rated power		P_{nenn}	kW	22.8	40.8	57.3	66.6
Rated current		I_{nenn}	A	49.8	90.7	128.8	154
Continuous torque at standstill		M_{n1}	Nm	-	435	390	336
Derating speed		n_1	rpm	-	500	1000	1500
Continuous current at standstill		I_{n1}	A	-	99.7	136.1	160.5
Maximum speed		M_{max}	Nm	986	957	858	739
Torque constant at 20°C		K_{M_nenn}	Nm/A	9.61	4.67	3.11	2.39
Min. cross section of power cable [2])		A	mm²	10	25	2x16	2x25
Number of pole pairs		p		3			
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.49			
Motor mass [3])		m	kg	312			
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000		
	- coupling attachment	n_{max}	rpm	3000	4200		
	- reinforced	n_{max}	rpm	3000	6000		
	- High-speed	n_{max}	rpm	not available			
Thermal time constant		T_{th}	min	25			
Duty cycle time (S6-44%)		T_C	min	i.p.			
Noise level [4])		p_{Schall}	dB(A)	75 (+3)			
Permissible ambient temperature		T_{um}	°C	0....+40			
Permissible storage and transport temperature		T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1				F			
International Protection class				IP65			
Liquid cooling [5])							
Power loss to be dissipated		P_V	kW	4.5			
Cooling agent temperature	Cooling agent inlet	T_{ein}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.6			
	with fast coupling	Δp_{diff}	bar	1.2			
Required flow of coolant at P_V		Q_{min}	l/min	6.6			
max. system pressure		p_{max}	bar	3			
Holding brake (optional)				**Electrically-clamped**		**Electrically-released**	
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			
Disengagement time		t_2	ms	90		300	
Engagement time		t_1	ms	150		30	
Mass of brake		m	kg	25			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.

Fig. 4-96: Data Sheet MAF180C

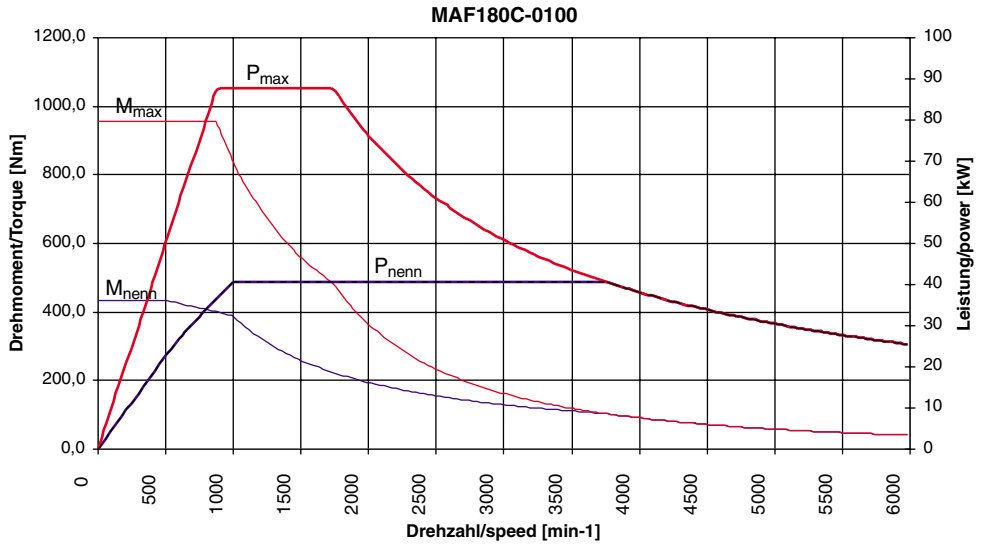
Characteristic Curves of MAF180C



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF180C_0050.FH10

Fig. 4-97: Characteristic curve of MAF180C-0050



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF180C_0100.FH10

Fig. 4-98: Characteristic curve of MAF180C-0100

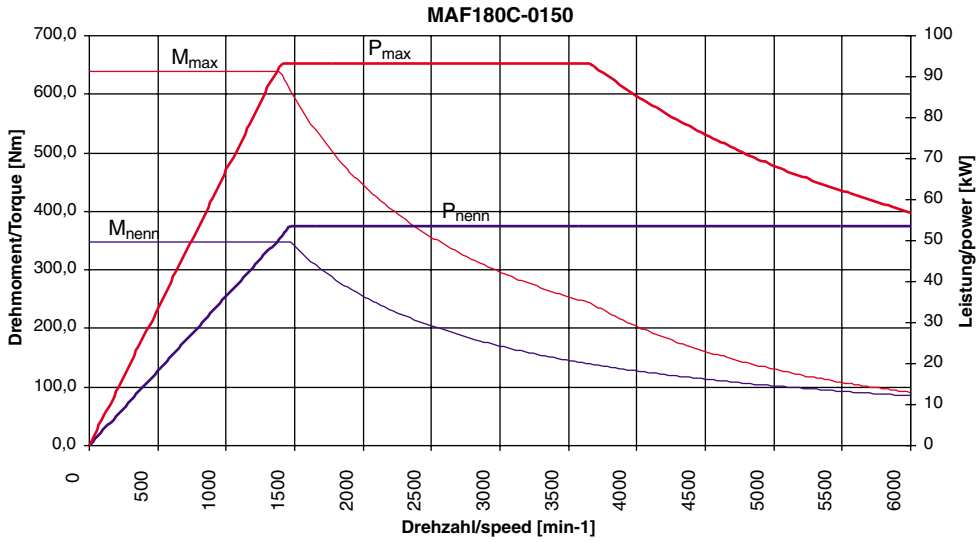


Fig. 4-99: Characteristic curve of MAF180C-0150

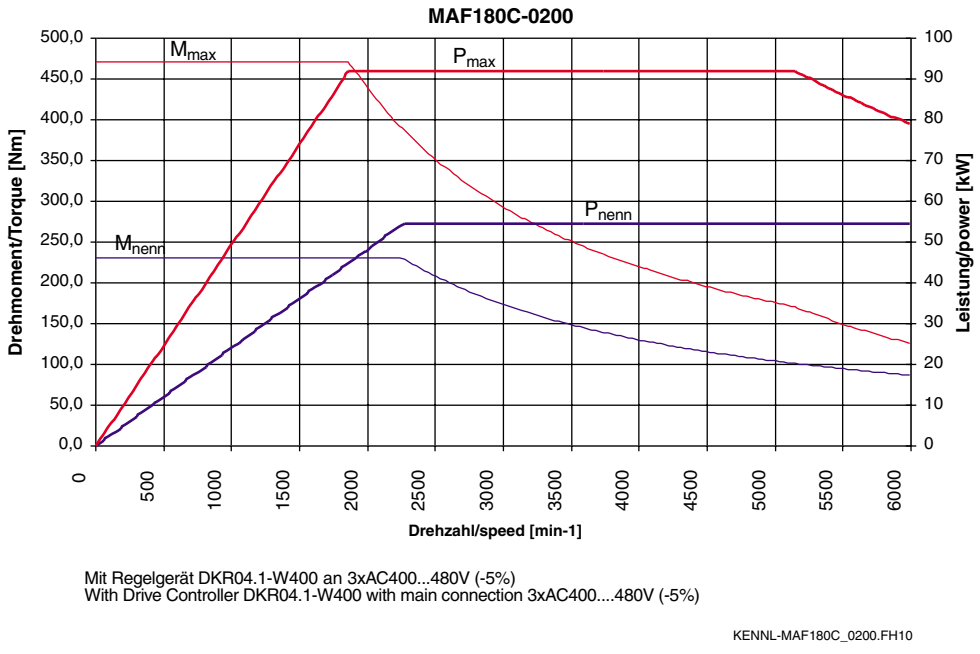


Fig. 4-100: Characteristic curve of MAF180C-0200

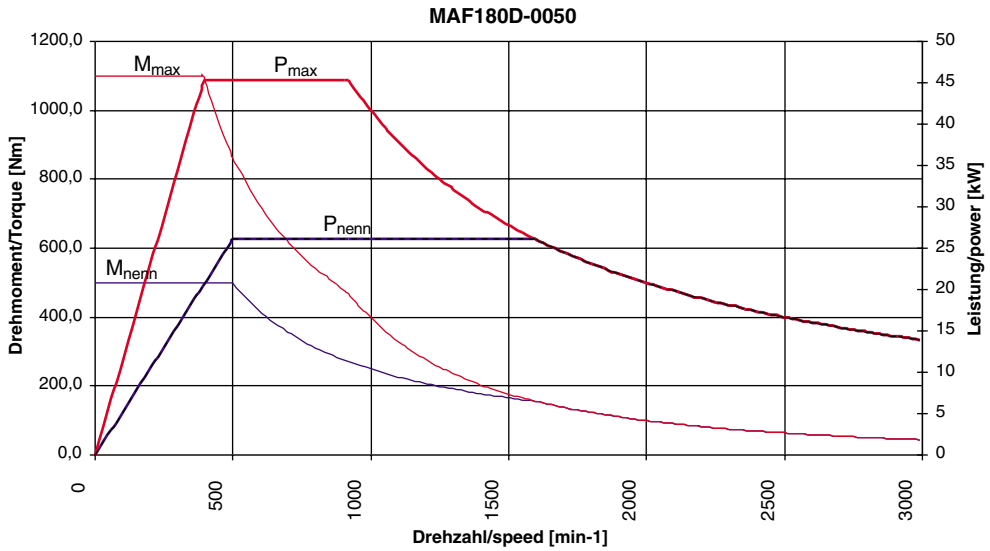
4.22 Technical Data Sheet for MAF180D

Description		Symbol	Unit	MAF180D			
Motor data [1])							
Winding				0050	0100	0150	0200
Rated torque		M_{nenn}	Nm	500	460	435	400
Rated speed		n_{nenn}	rpm	500	1000	1500	2000
Rated power		P_{nenn}	kW	26.1	48.1	68.3	83.8
Rated current		I_{nenn}	A	60.4	94.8	135.5	168.5
Continuous torque at standstill		M_{n1}	Nm	-	500	460	460
Derating speed		n_1	rpm	-	500	1000	1500
Continuous current at standstill		I_{n1}	A	-	101.9	142.1	187.3
Maximum speed		M_{max}	Nm	1100	1094	1013	1008
Torque constant at 20°C		K_{M_nenn}	Nm/A	10	5.23	3.49	2.75
Min. cross section of power cable [2])		A	mm²	16	35	2x16	2x25
Number of pole pairs		p		3			
Moment of inertia of rotor [3])		J_{rot}	kgm²	0.855			
Motor mass [3])		m	kg	381			
Maximum speed with bearing...	- Standard	n_{max}	rpm	3000	6000		
	- coupling attachment	n_{max}	rpm	3000	4200		
	- reinforced	n_{max}	rpm	3000	6000		
	- High-speed	n_{max}	rpm	not available			
Thermal time constant		T_{th}	min	25			
Duty cycle time (S6-44%)		T_C	min	i.p.			
Noise level [4])		p_{Schall}	dB(A)	75 (+3)			
Permissible ambient temperature		T_{um}	°C	0....+40			
Permissible storage and transport temperature		T_{lager}	°C	-20....+80			
Insulation class according to DIN VDE 0530-1				F			
International Protection class				IP65			
Liquid cooling [5])							
Power loss to be dissipated		P_V	kW	3.5			2.5
Cooling agent temperature	Cooling agent inlet	T_{ein}	°C	+10....+40			
	Permissible increase at P_V	ΔT_{diff}	K	10			
Decompression at Q_{min}	without fast coupling	Δp_{diff}	bar	0.6			
	with fast coupling	Δp_{diff}	bar	1.2			
Required flow of coolant at P_V		Q_{min}	l/min	5.1			3.6
max. system pressure		p_{max}	bar	3			
Holding brake (optional)				**Electrically-clamped**		**Electrically-released**	
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			
Disengagement time		t_2	ms	90		300	
Engagement time		t_1	ms	150		30	
Mass of brake		m	kg	25			

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values.
[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]) in 1 m distance, with PWN = 4kHz
[5]) Data refer to water as a cooling agent. If using other coolant, re-calculate the data. Observe instructions on coolant inlet temperature in chapter 9.

Fig. 4-101: Data Sheet MAF180D

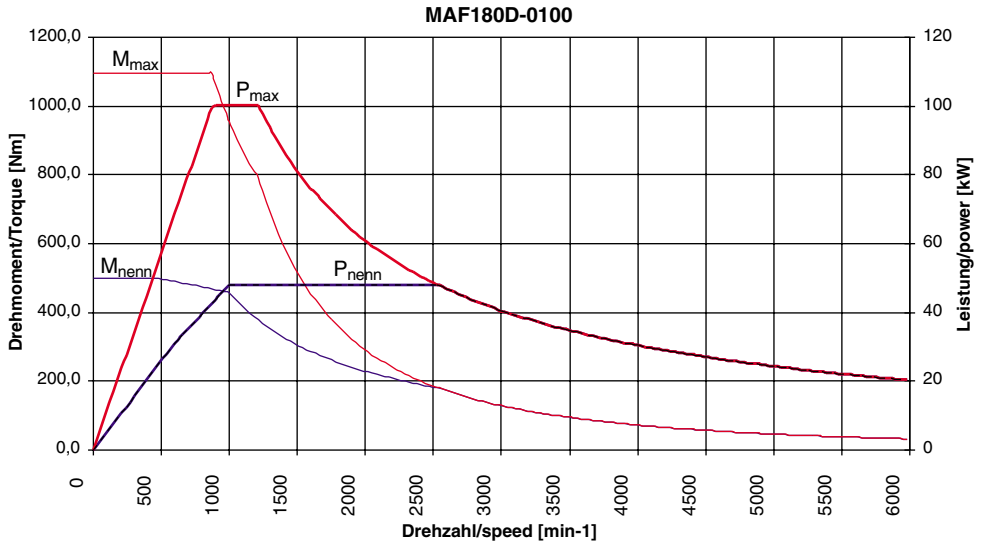
Characteristic Curves of MAF180D



Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF180D_0050.FH10

Fig. 4-102: Characteristic curve of MAF180D-0050



Mit Regelgerät HMS01.1N-W0210 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0210 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

KENNL-MAF180D_0100.FH10

Fig. 4-103: Characteristic curve of MAF180D-0100

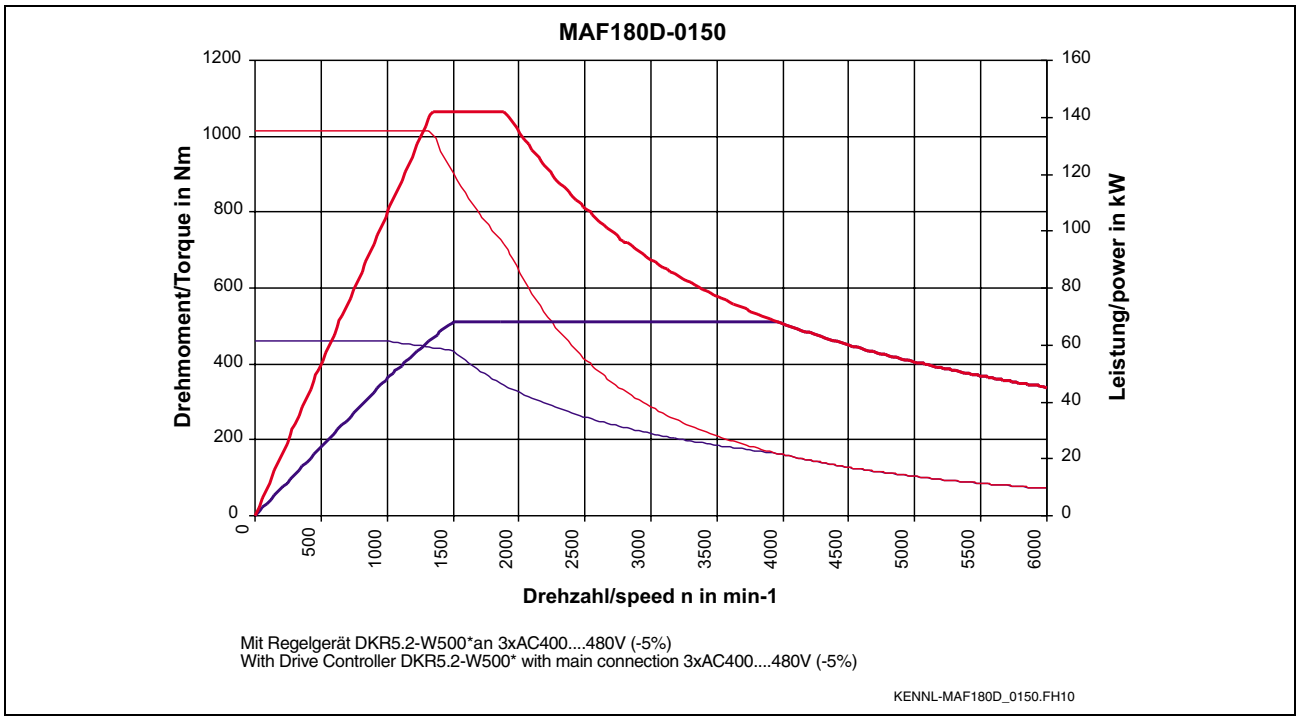


Fig. 4-104: Characteristic curve of MAF180D-0150

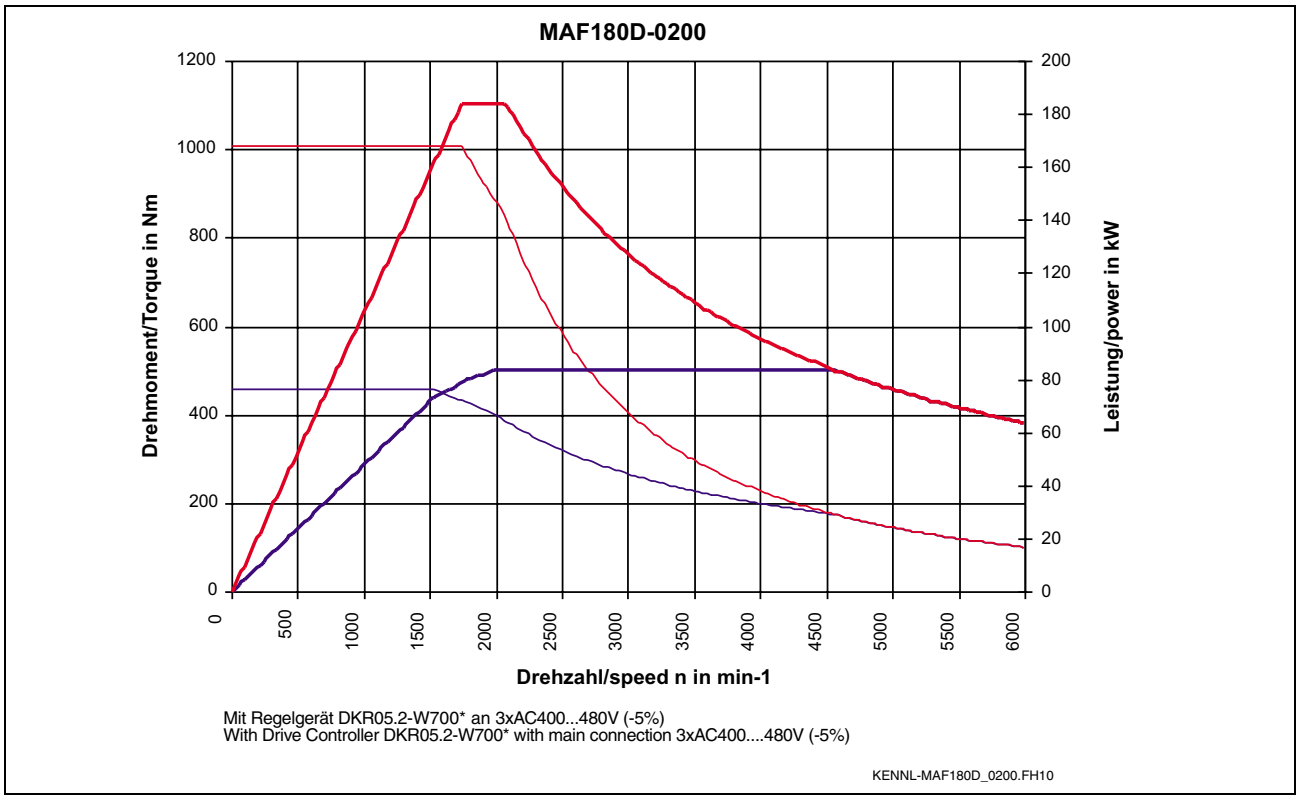
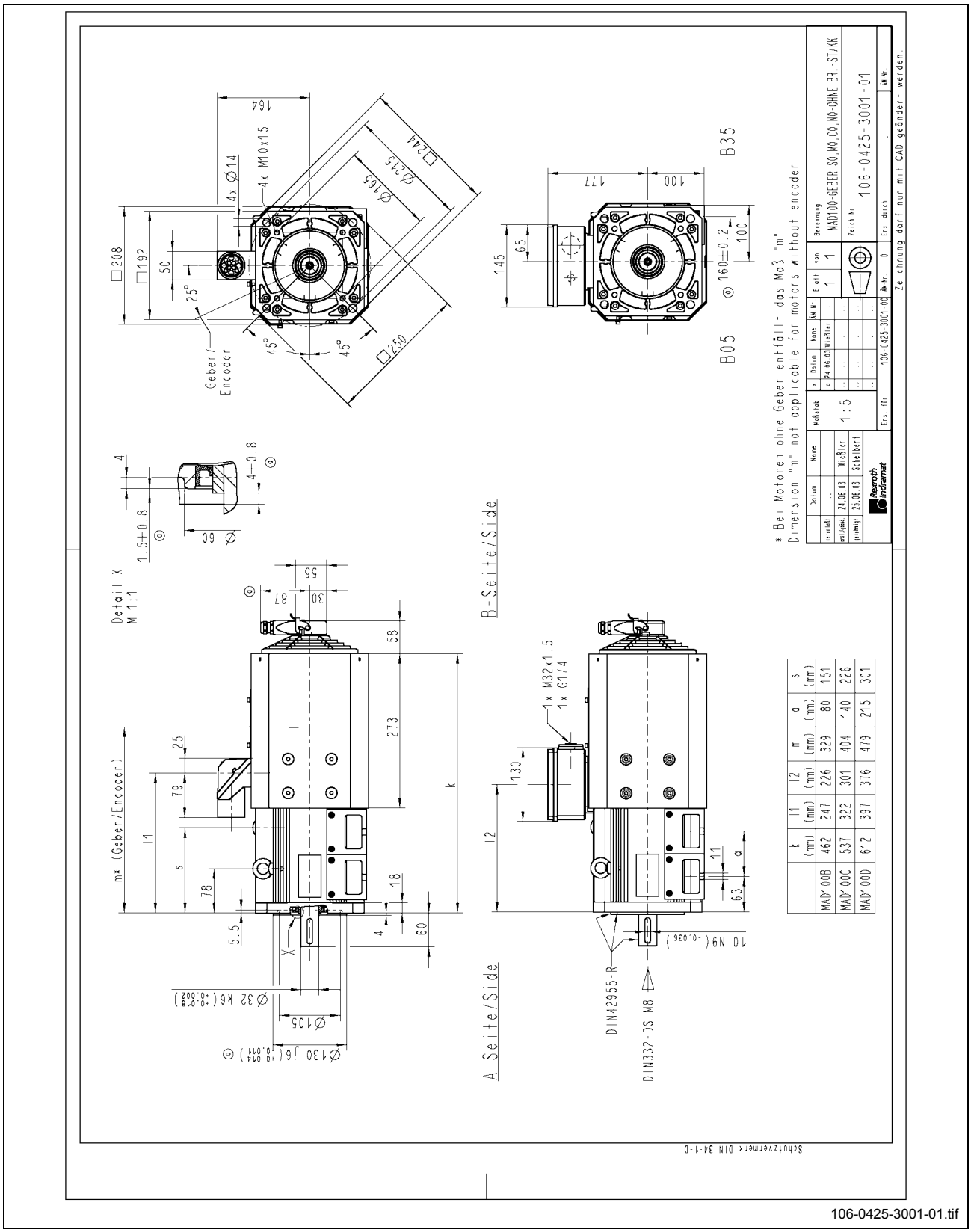


Fig. 4-105: Characteristic curve of MAF180D-0200

5 Dimension Sheets

5.1 Dimension Sheet for MAD100, without Brake

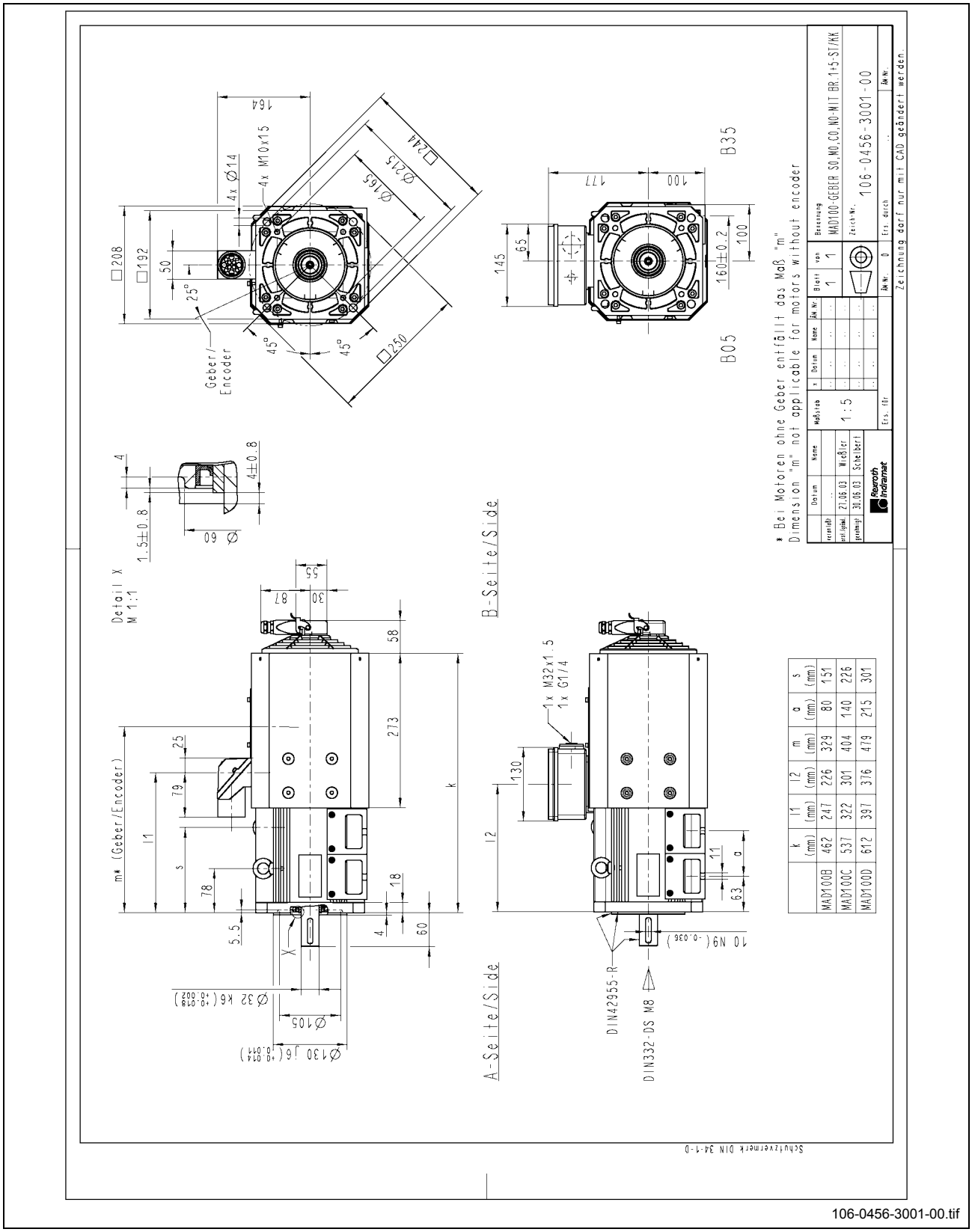


106-0425-3001-01.tif

	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

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

5.2 Dimension Sheet for MAD100, with Brakes 1 and 5

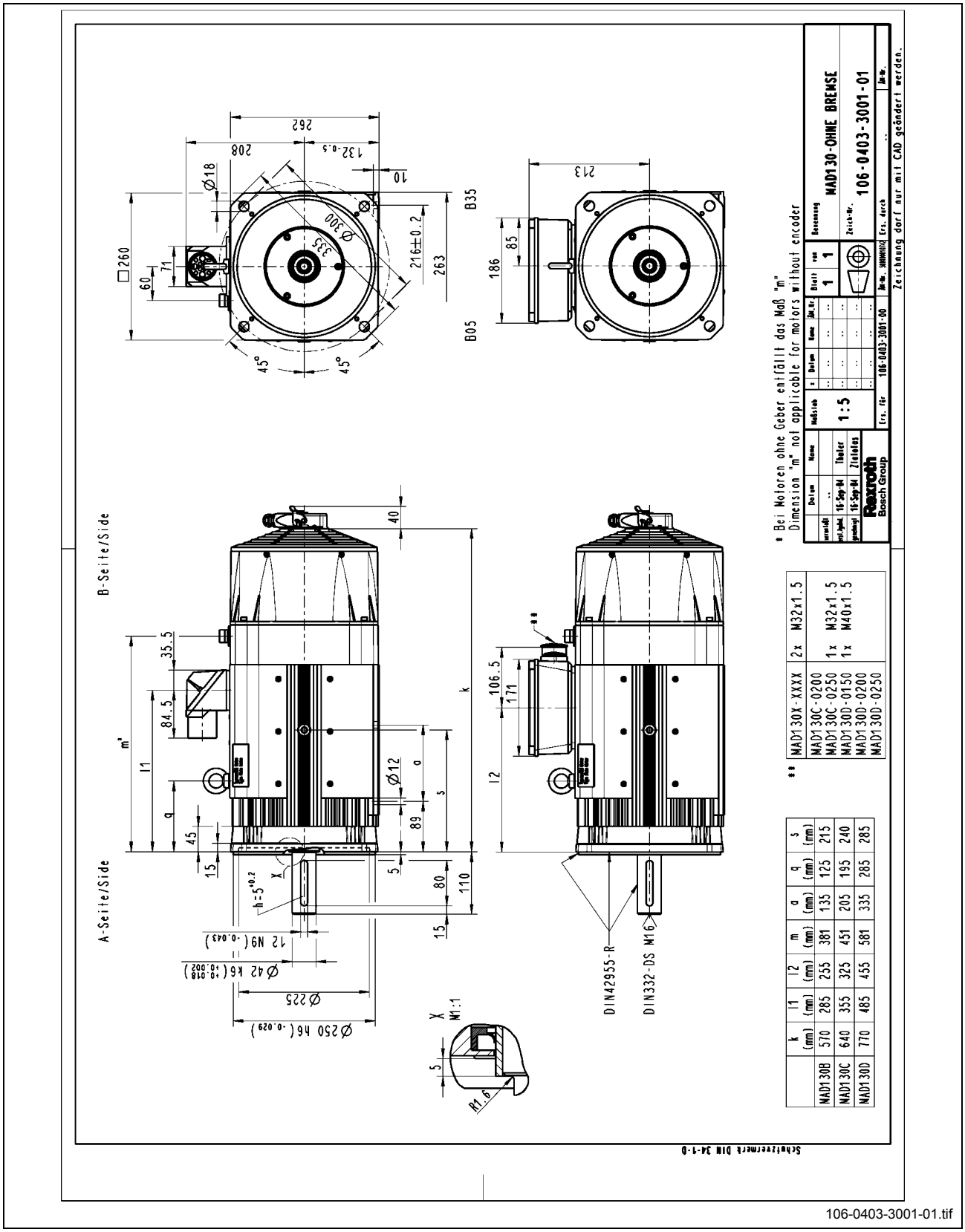


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAD100B	462	247	226	329	80	151
MAD100C	537	322	301	404	140	226
MAD100D	612	397	376	479	215	301

106-0456-3001-00.tif

Fig. 5-2: Dimension sheet for MAD100, with brakes 1 and 5

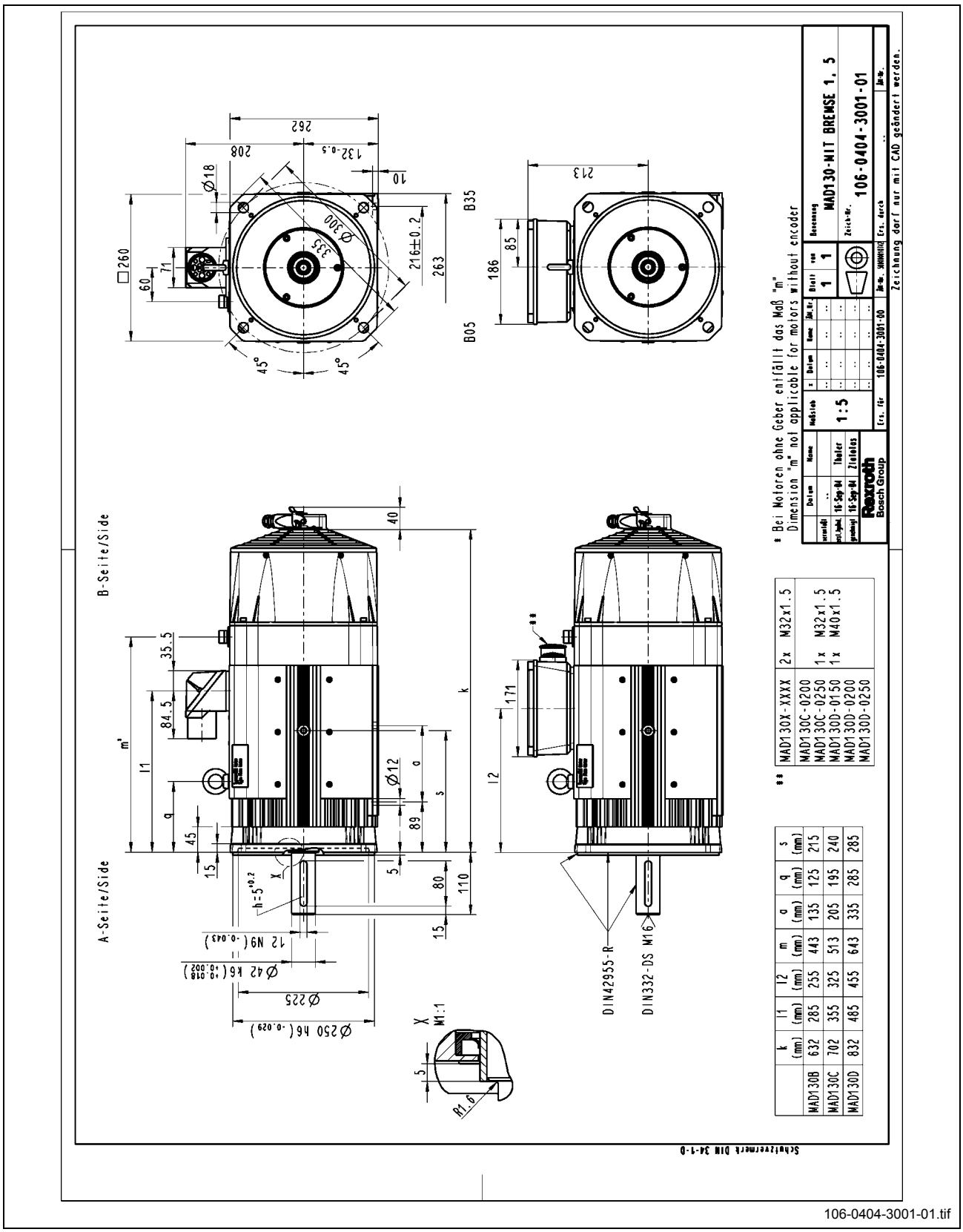
5.3 Dimension Sheet for MAD130, without Brake



106-0403-3001-01.tif

Fig. 5-3: Dimension sheet for MAD130, without brake

5.4 Dimension Sheet for MAD130, with Brakes 1 and 5



	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (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

MAD130X-XXXX	2x M32x1.5	
MAD130C-0200		
MAD130C-0250	1x	M32x1.5
MAD130D-0150	1x	M40x1.5
MAD130D-0200		
MAD130D-0250		

106-0404-3001-01.tif

Fig. 5-4: Dimension sheet for MAD130, with brakes 1 and 5

5.5 Dimension Sheet for MAD160, without Brake

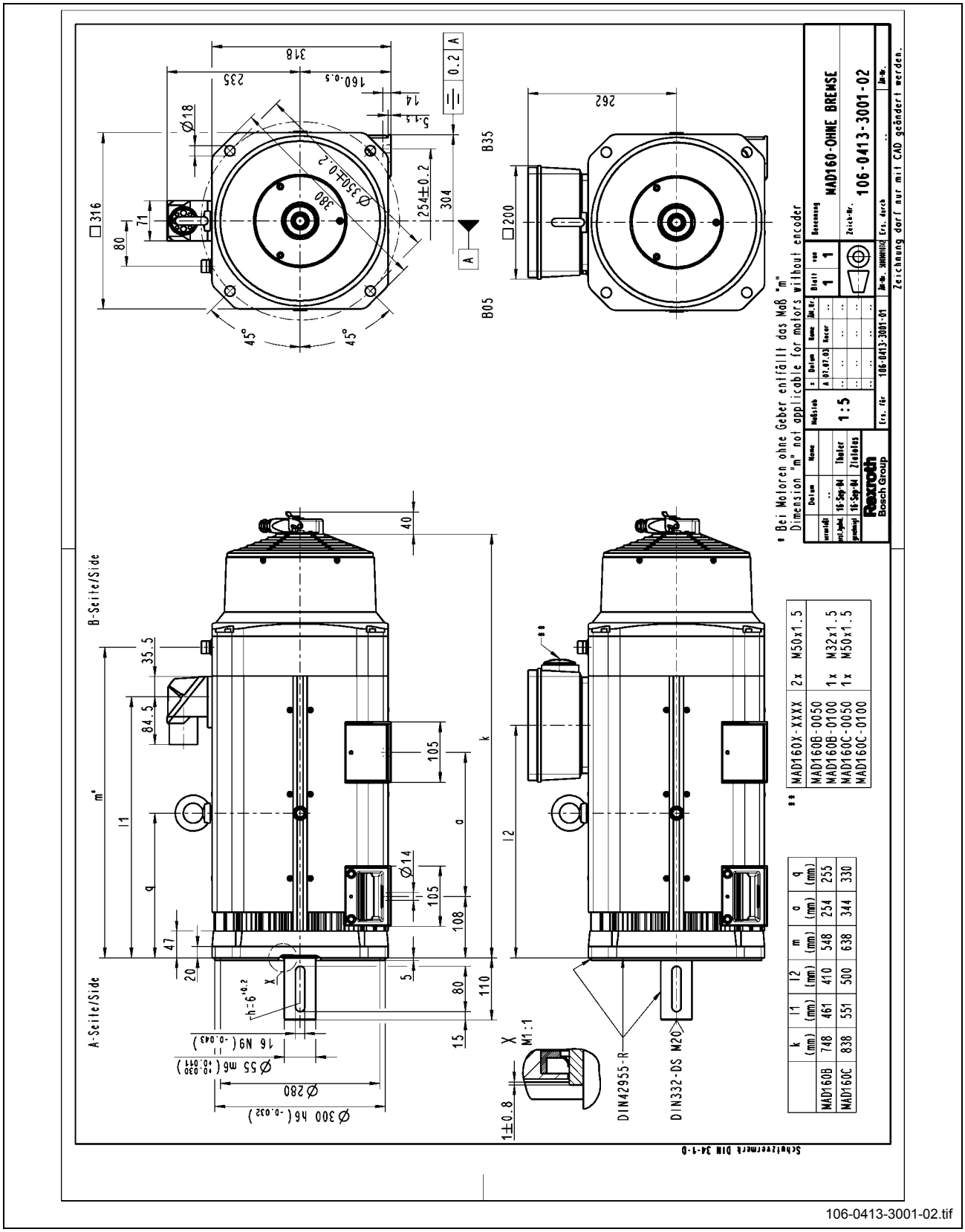


Fig. 5-5: Dimension sheet for MAD160, without brake

5.6 Dimension Sheet for MAD160, with Brakes 1 and 5

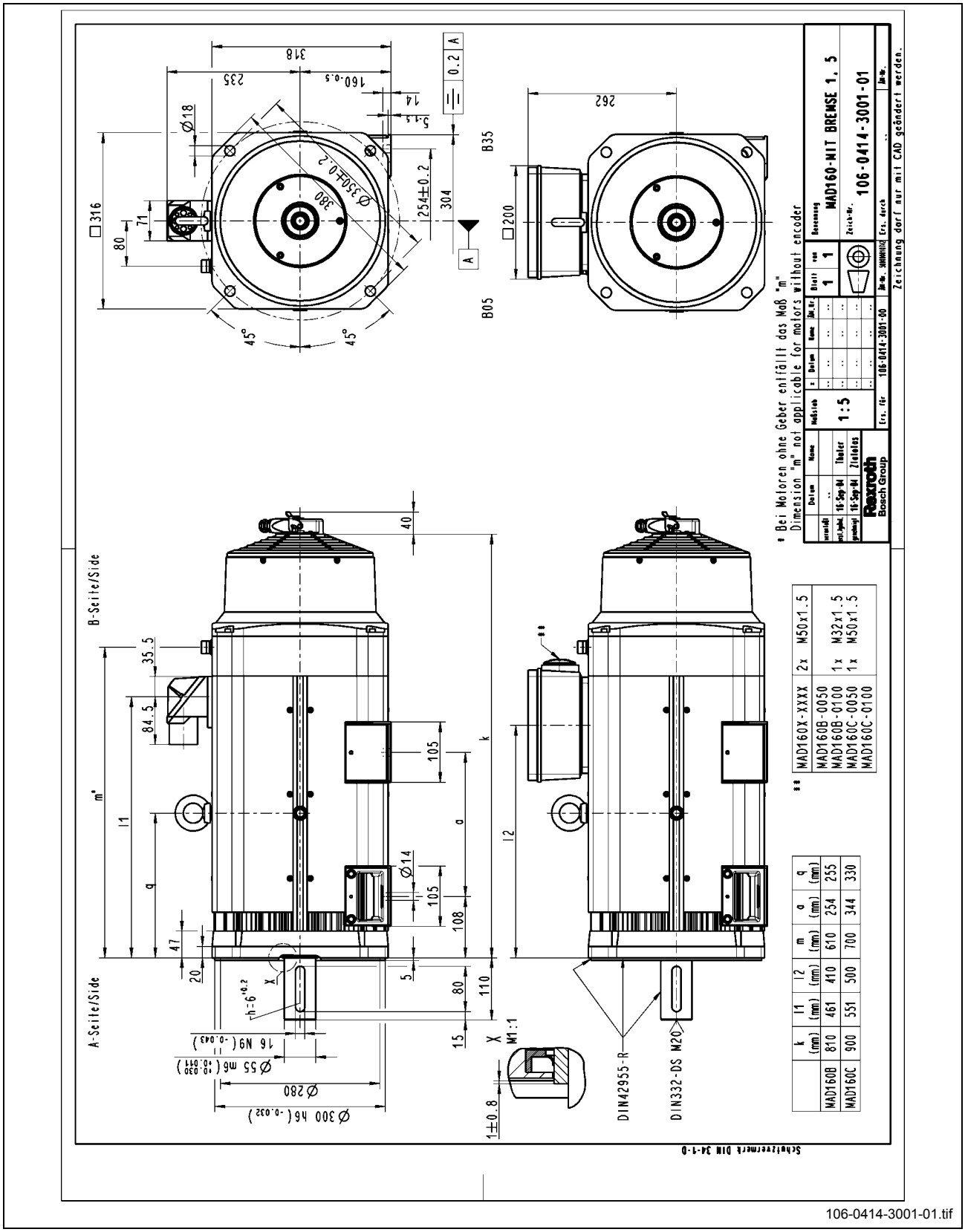
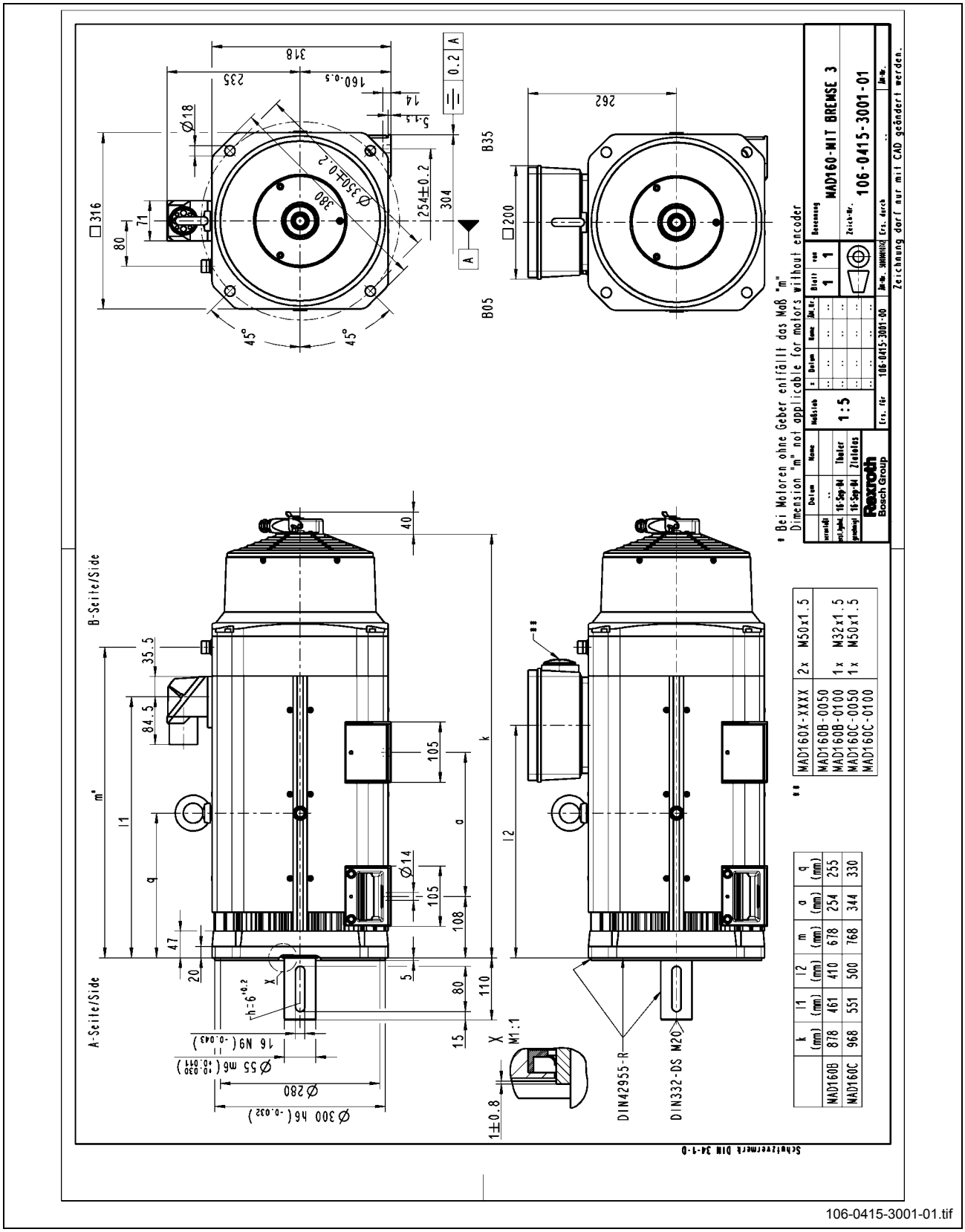


Fig. 5-6: Dimension sheet for MAD160, with brakes 1 and 5

5.7 Dimension Sheet for MAD160, with Brake 3

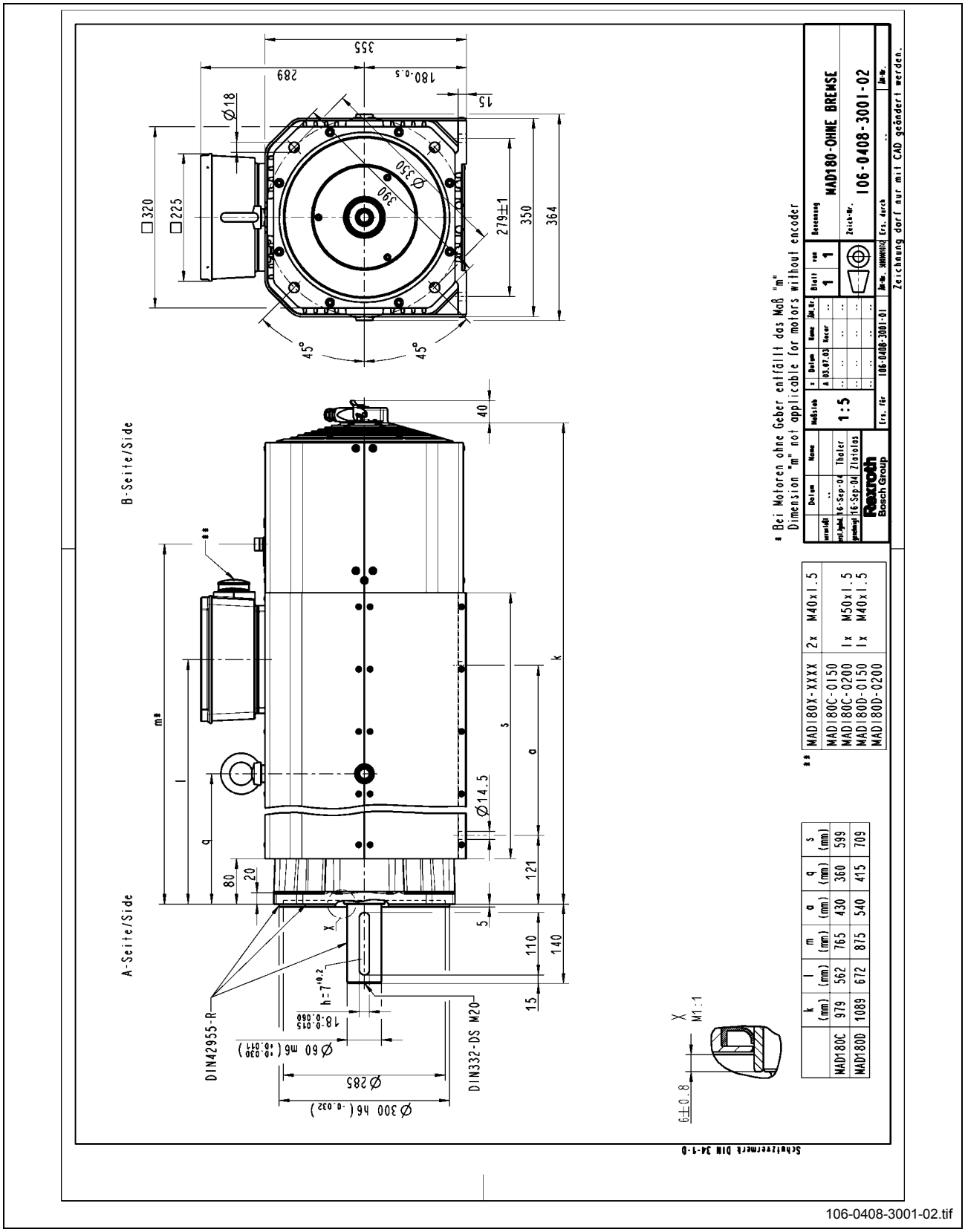


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)
MAD160B	878	461	410	678	254	255
MAD160C	968	551	500	768	344	330

MAD160X-XXXX	2x	M50x1.5
MAD160B-0050		
MAD160B-0100	1x	M32x1.5
MAD160C-0050	1x	M50x1.5
MAD160C-0100		

Fig. 5-7: Dimension sheet for MAD160, with brake 3

5.8 Dimension Sheet for MAD180, without Brake



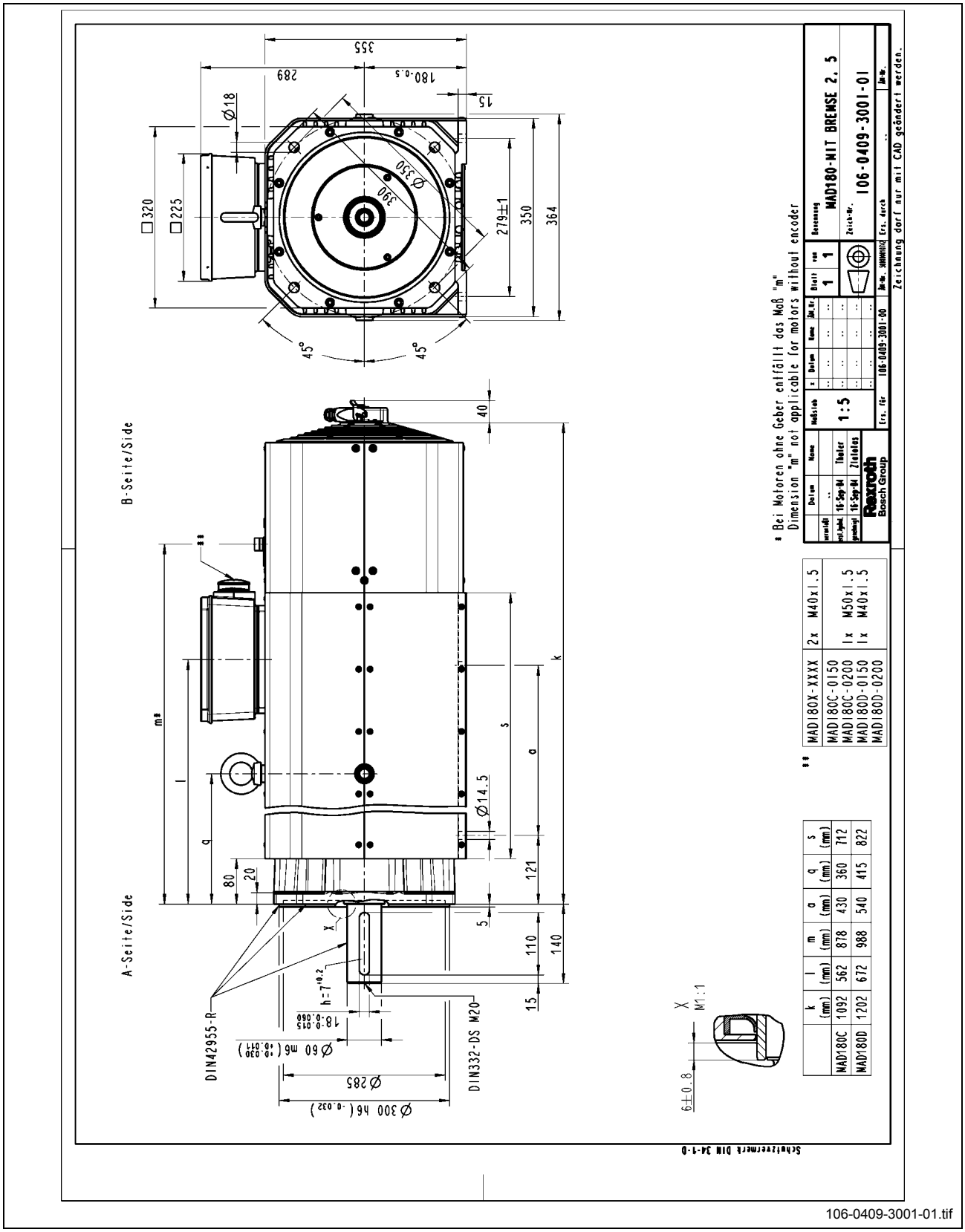
	k (mm)	l (mm)	m (mm)	a (mm)	q (mm)	s (mm)
MAD180C	979	562	765	430	360	599
MAD180D	1089	672	875	540	415	709

MAD180X-XXXX	2x	M40x1.5	
MAD180C-0150			
MAD180C-0200	1x	M50x1.5	
MAD180D-0150	1x	M40x1.5	
MAD180D-0200			

106-0408-3001-02.tif

Fig. 5-8: Dimension sheet for MAD180, without brake

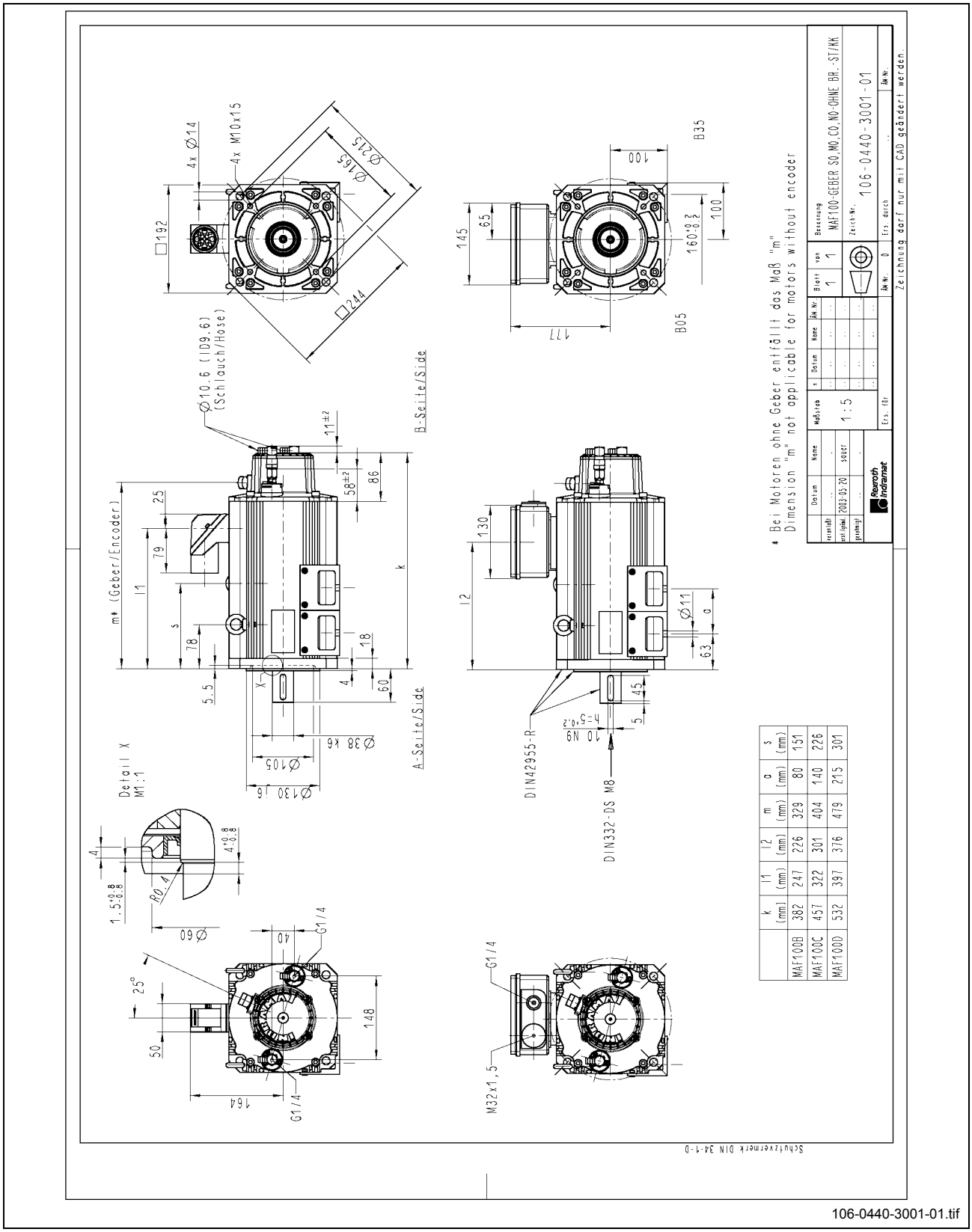
5.9 Dimension Sheet for MAD180, with Brakes 2 and 5



106-0409-3001-01.tif

Fig. 5-9: Dimension sheet for MAD180, with brakes 2 and 5

5.10 Dimension Sheet for MAF100, without Brake

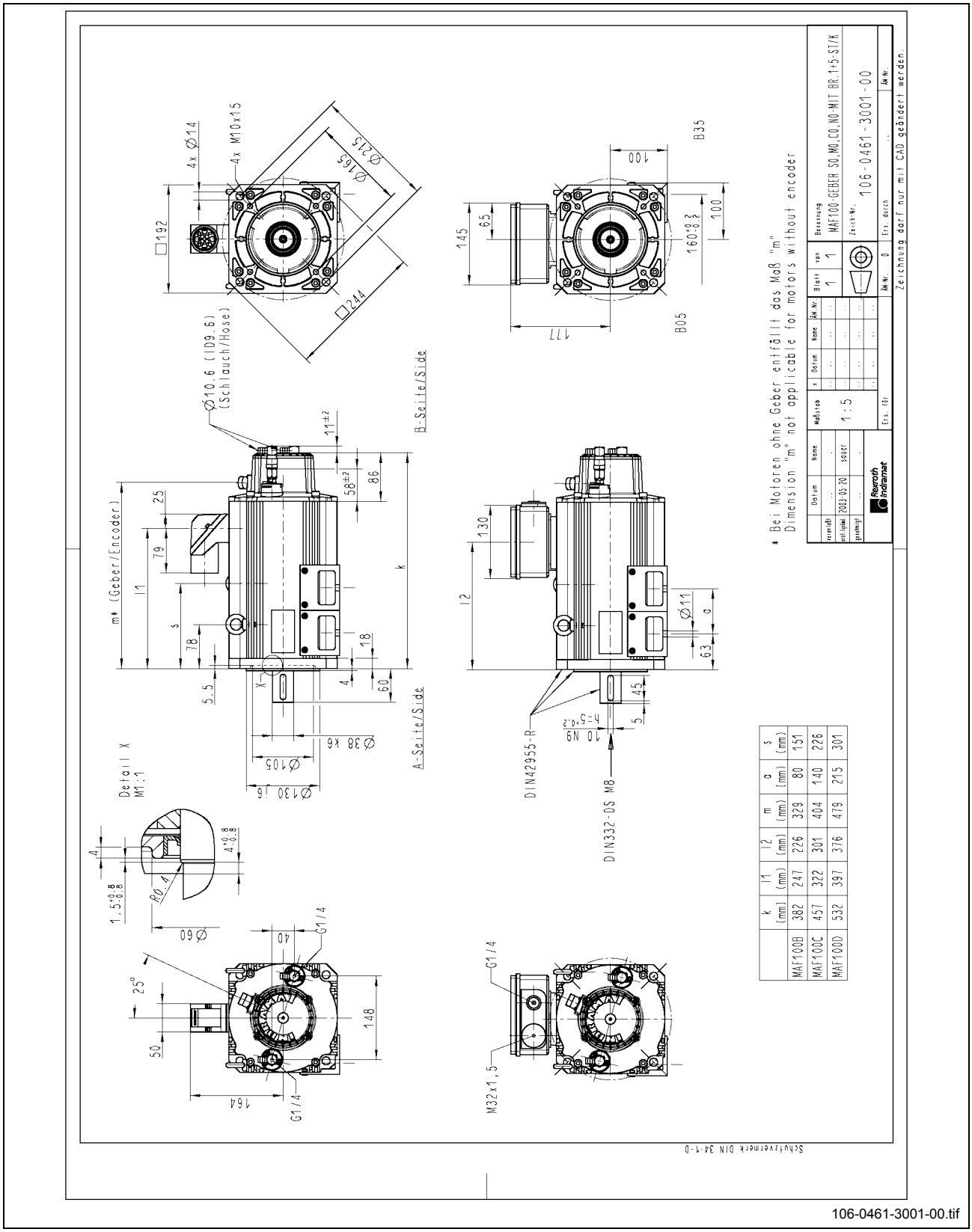


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAF100B	382	247	226	329	80	151
MAF100C	457	322	301	404	140	226
MAF100D	532	397	376	479	215	301

106-0440-3001-01.tif

Fig. 5-10: Dimension sheet for MAF100, without brake

5.11 Dimension Sheet for MAF100, with Brakes 1 and 5

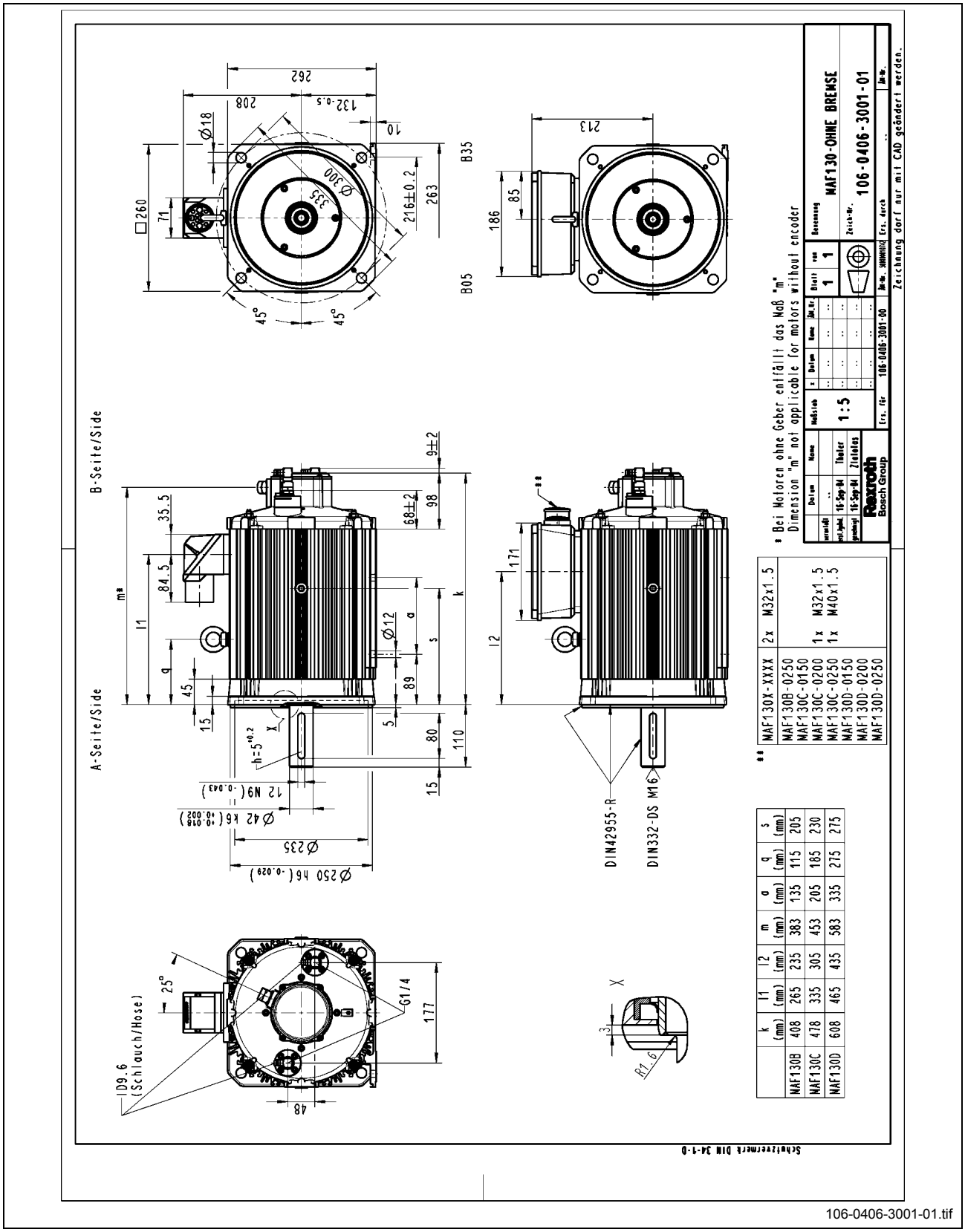


	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	s (mm)
MAF100B	382	247	226	329	80	151
MAF100C	457	322	301	404	140	226
MAF100D	532	397	376	479	215	301

106-0461-3001-00.tif

Fig. 5-11: Dimension sheet for MAF100, with brakes 1 and 5

5.12 Dimension Sheet for MAF130, without Brake



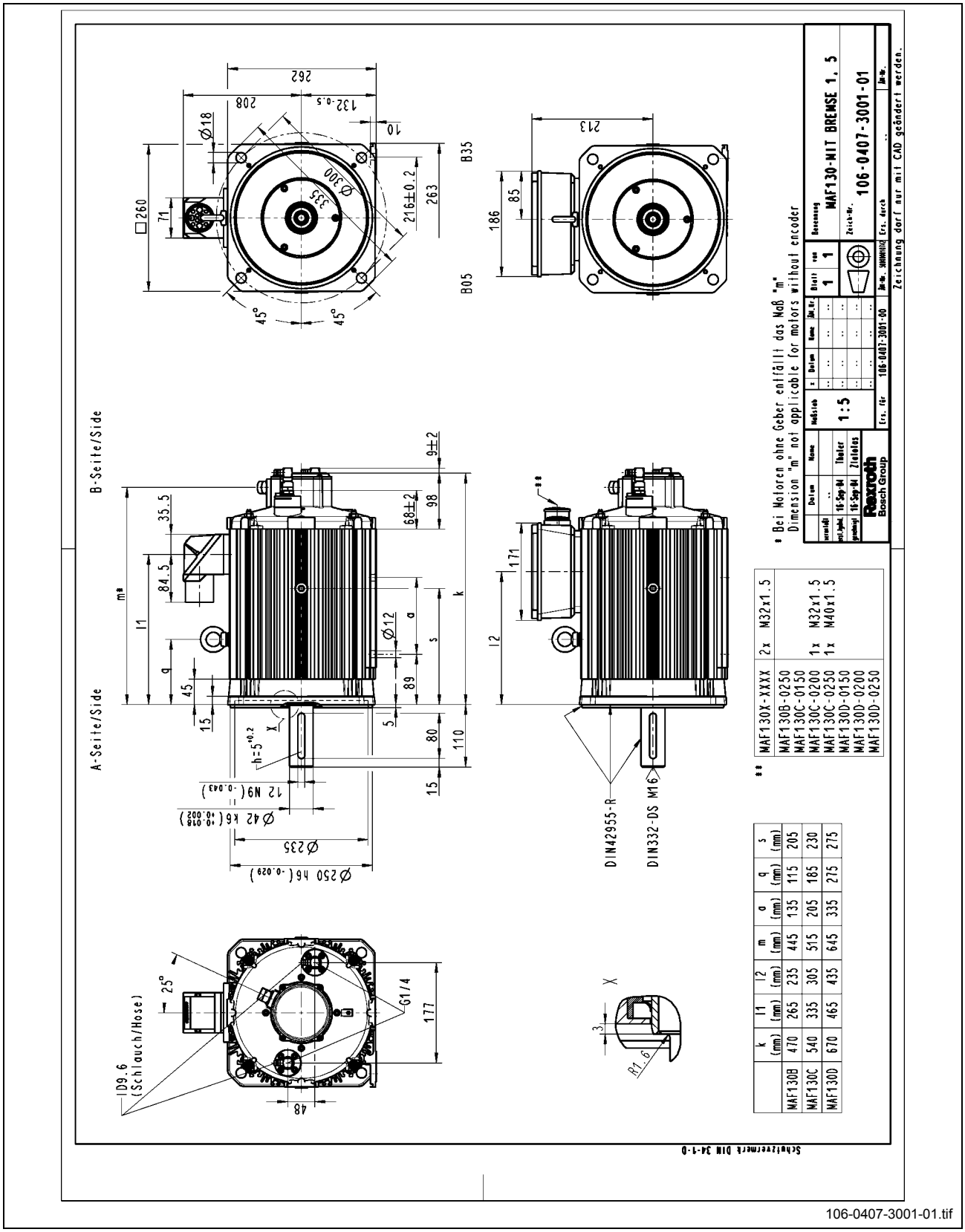
	k (mm)	l1 (mm)	l2 (mm)	m (mm)	a (mm)	q (mm)	s (mm)
NAF130B	408	265	235	383	135	115	205
NAF130C	478	335	305	453	205	185	230
NAF1300	608	465	435	583	335	275	275

MAF130X-XXXX	2x	M32x1.5	
MAF130B-0250			
MAF130C-0150			
MAF130C-0200	1x	M32x1.5	
MAF130C-0250	1x	M40x1.5	
MAF130D-0150			
MAF130D-0200			
MAF130D-0250			

106-0406-3001-01.tif

Fig. 5-12: Dimension sheet for MAF130, without brake

5.13 Dimension Sheet for MAF130, with Brakes 1 and 5



106-0407-3001-01.tif

Fig. 5-13: Dimension sheet for MAF130, with brakes 1 and 5

5.14 Dimension Sheet for MAF160, without Brake

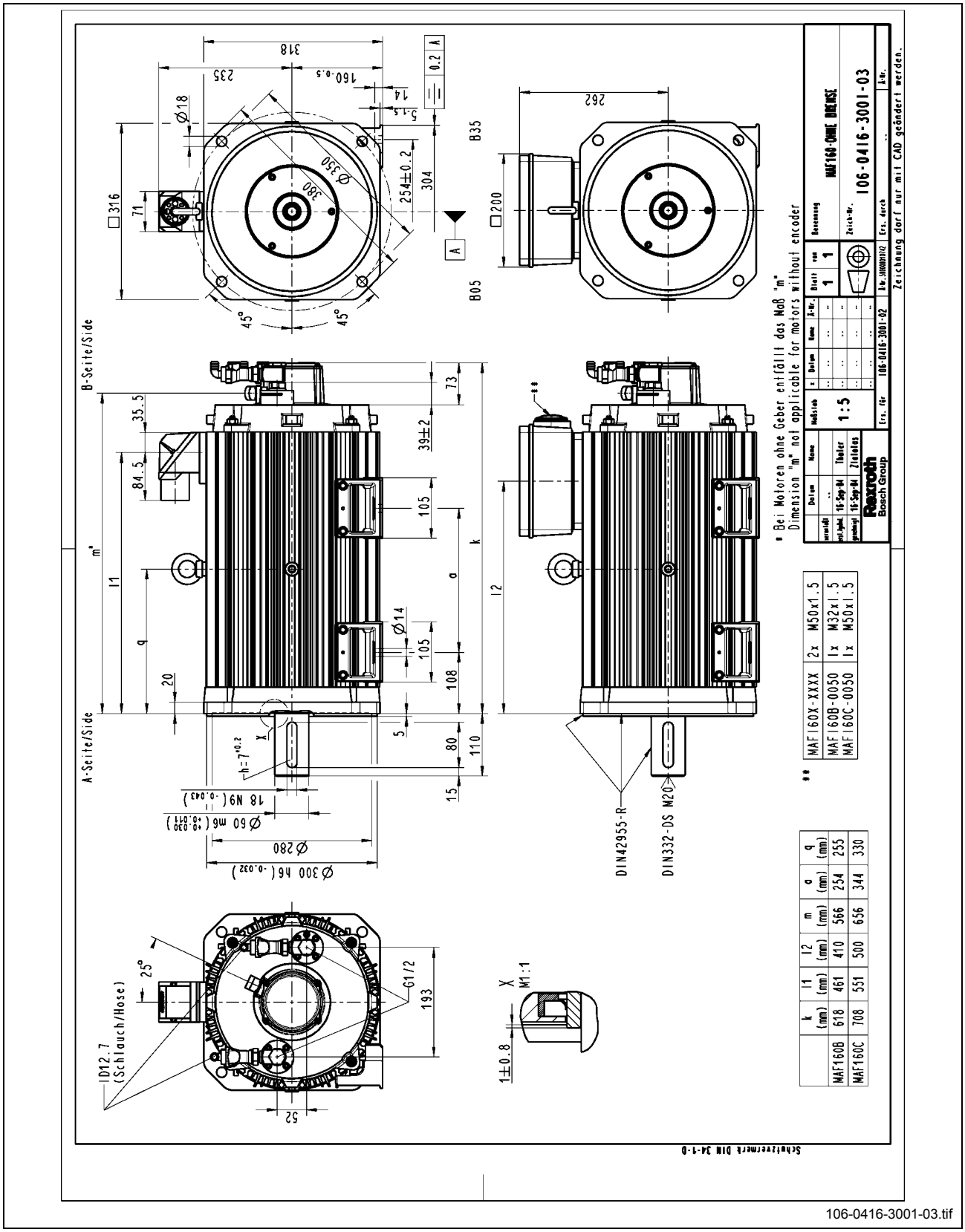
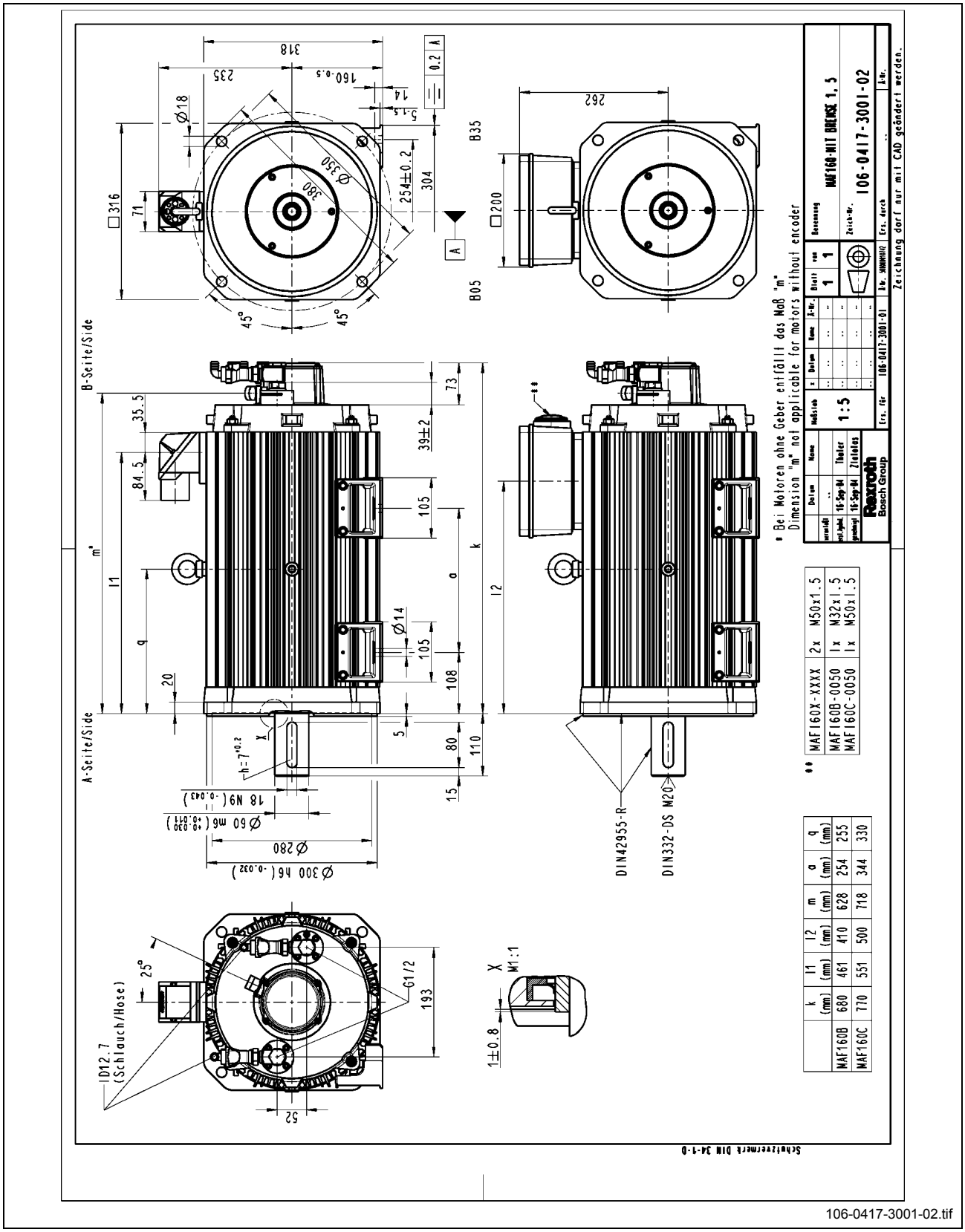


Fig. 5-14: Dimension sheet for MAF160, without brake

5.15 Dimension Sheet for MAF160, with Brakes 1 and 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

MAF160X-XXXX	2x	M50x1.5
MAF160B-0050	1x	M32x1.5
MAF160C-0050	1x	M50x1.5

106-0417-3001-02.tif

Fig. 5-15: Dimension sheet for MAF160, with brakes 1 and 5

5.16 Dimension Sheet for MAF160, with Brake 3

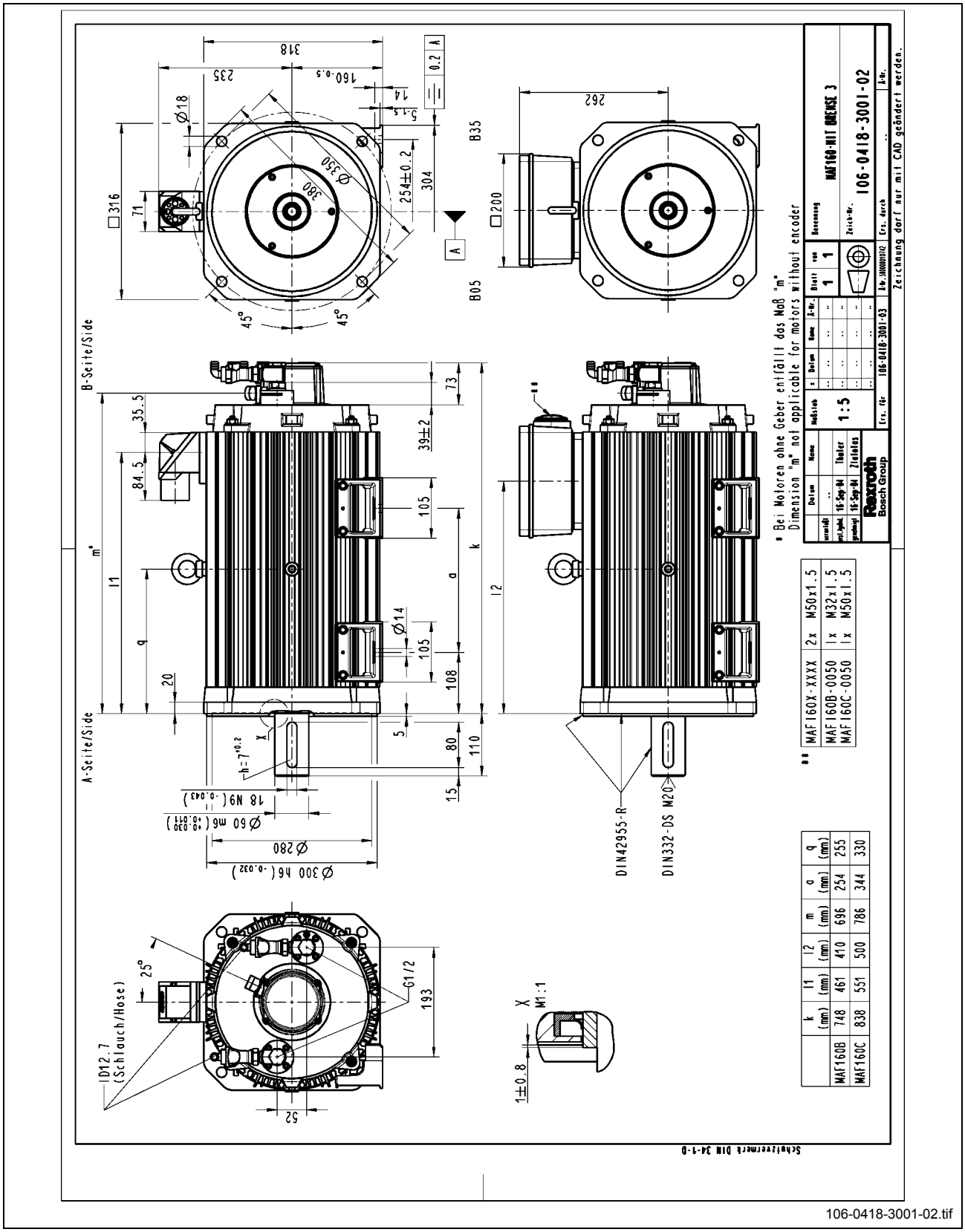


Fig. 5-16: Dimension sheet for MAF160, with brake 3

5.17 Dimension Sheet for MAF180, without Brake

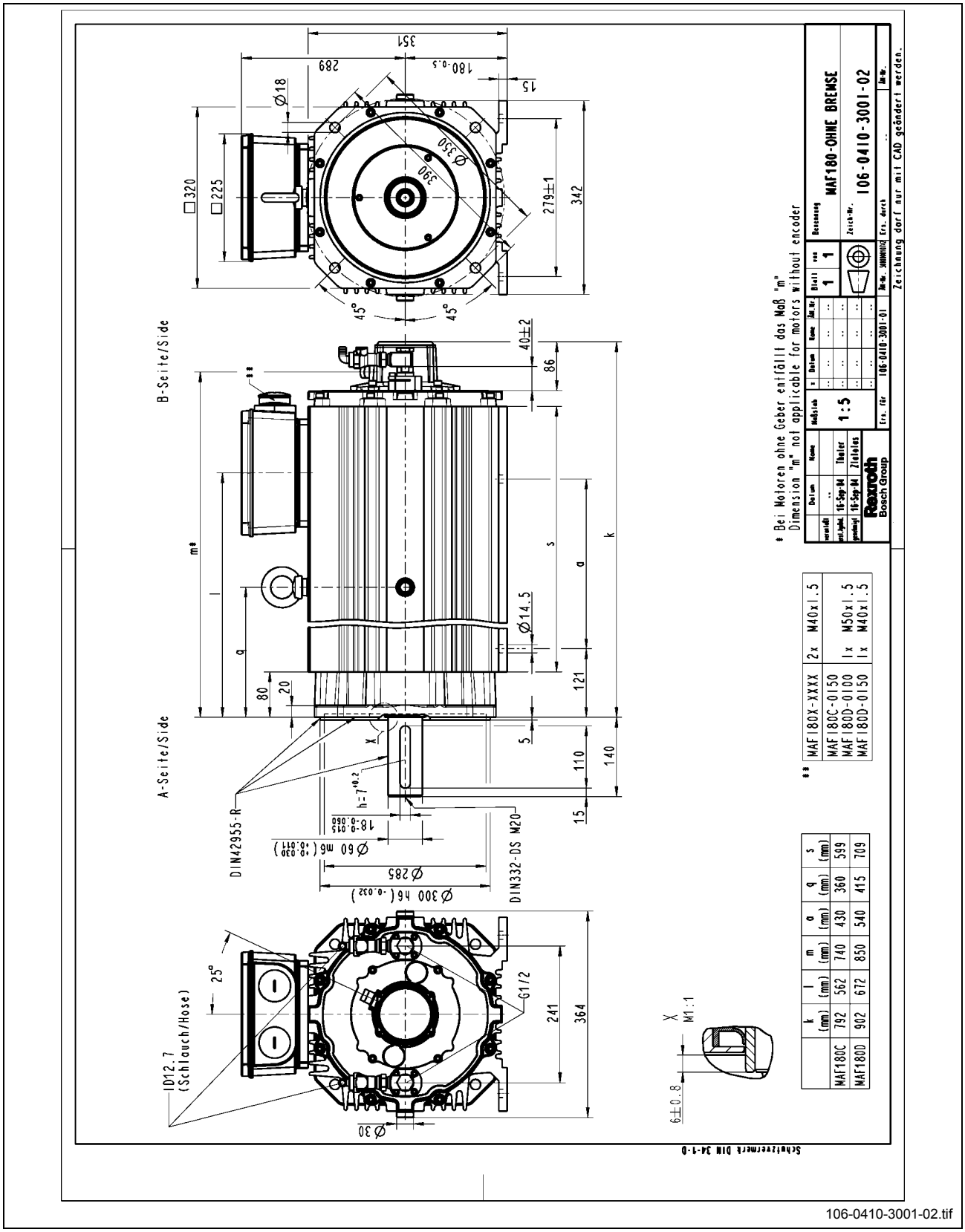
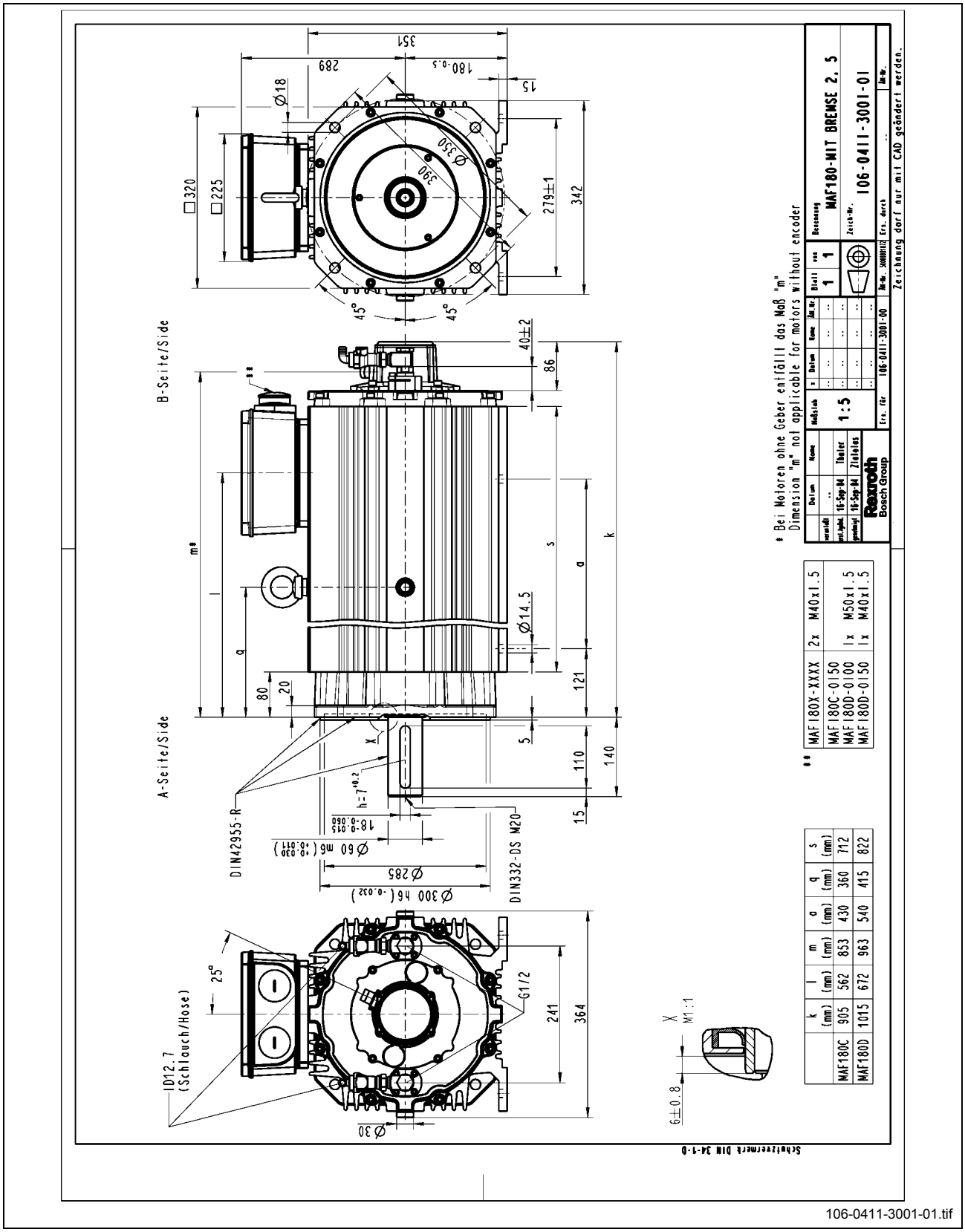


Fig. 5-17: Dimension sheet for MAF180, without brake

5.18 Dimension Sheet for MAF180, with Brakes 2 and 5



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

MAF180X-XXXX	2x	M40x1.5
MAF180C-0150	1x	M50x1.5
MAF180D-0100	1x	M50x1.5
MAF180D-0150	1x	M40x1.5

106-0411-3001-01.tif

Fig. 5-18: Dimension sheet for MAF180, with brakes 2 and 5

6 Type Codes

6.1 Introduction

IndraDyn A is the general product name for Bosch Rexroth's housed asynchronous motors.

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 description gives an overview of the individual positions of the type code and their meanings.

Note: When selecting a product, always consider the detailed specifications in Chapter 4 ”Technical Data” and Chapter 9 ”Application Notes”.

Definition

1. Product

Abbrev. Columns 1 2 3

MAD is the description of the blower cooled, housed asynchronous motors.

MAF is the description of liquid-cooled, housed asynchronous motors.

2. Motor Frame Size

Abbrev. Columns 4 5 6

The motor frame size is derived from the dimensions of the output flange 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 **D**.

4. Winding Code

Abbrev. Columns 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: Winding ID 0200 stands for a rated speed of 2000 rpm.

5. Type of Cooling

Abbrev. Columns 14 15

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

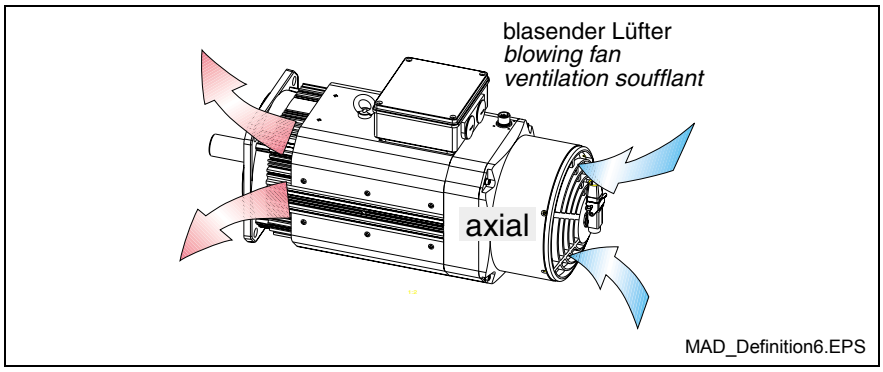


Fig. 6-1: MAD, blowing fan

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

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

6. Motor Encoder

Abbrev. Columns 17 18

IndraDyn A motors can be supplied with integrated encoders.

Option	Type	Periods	Signal 1)	Interface
C0	Incremental encoder	2048	1 V_{pp}	-
M0	Multiturn absolute encoder	512	1 V_{pp}	I²C
M2	Multiturn absolute encoder	2048	1 V_{pp}	EnDat2.1
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_{pp}	I²C
S2	Singleturn absolute encoder	2048	1 V_{pp}	EnDat2.1
1) All encoder signals are sinusoidal.				

Fig. 6-2: IndraDyn A motor encoders

7. Electrical Connection

Abbrev. Column 20

Electrical connection is made through a flanged socket-outlet or a terminal box.

For more detailed information, see 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			
	smooth shaft	with keyway	
		whole-key balanced	half-key balanced
Without shaft seal	**H**	**Q**	**L**
With shaft seal	**G**	**P**	**K**

Fig. 6-3: Output shaft options

Motors ordered with a keyway are always supplied with a key .

Centering holes with a "DS" thread according to DIN 332, Sheet 2 are located on all motor output shafts. Details are contained in the respective motor dimension sheets.

See the sections regarding the shaft seal and the output shaft in Chapter 9, ”Application Notes”.

9. Holding Brake

Abbrev. Column 22

MAD100-180 and MAF100-160 can be supplied with integrated holding brakes with different holding torques. Depending on the application, an "**electrically-clamping**" or "**electrically-releasing**" holding brake can be selected.

Note: The motor holding brake is not suitable for protection of personnel or as a service brake! Heed the notes regarding holding brakes in Chapter 9, "Application Notes" and Chapter 12.1, "Commissioning ".

10. Frame Shape

Abbrev. Columns 24 25

IndraDyn A motors are supplied in the frame shape **05** (flange mounting) or frame shape **35** (flange and foot installation). The permitted conditions of installation are explained in Chapter 9, "Application Notes".

11. Bearings

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 in order to bear greater radial forces. With reinforced bearing, there is an additional cylindrical-roller bearing at the drive side next to the deep-groove ball bearing.

High-speed bearings (option “**H**“) consists of a deep-groove ball bearing and permits higher speeds at a reduced axial and radial load-bearing capacity.

The bearing for the coupling attachment (option “**R**“) consists of a deep-groove ball bearing. This type of bearing has a special bearing seat to absorb rotary radial forces that may occur in motor operation with a coupling.

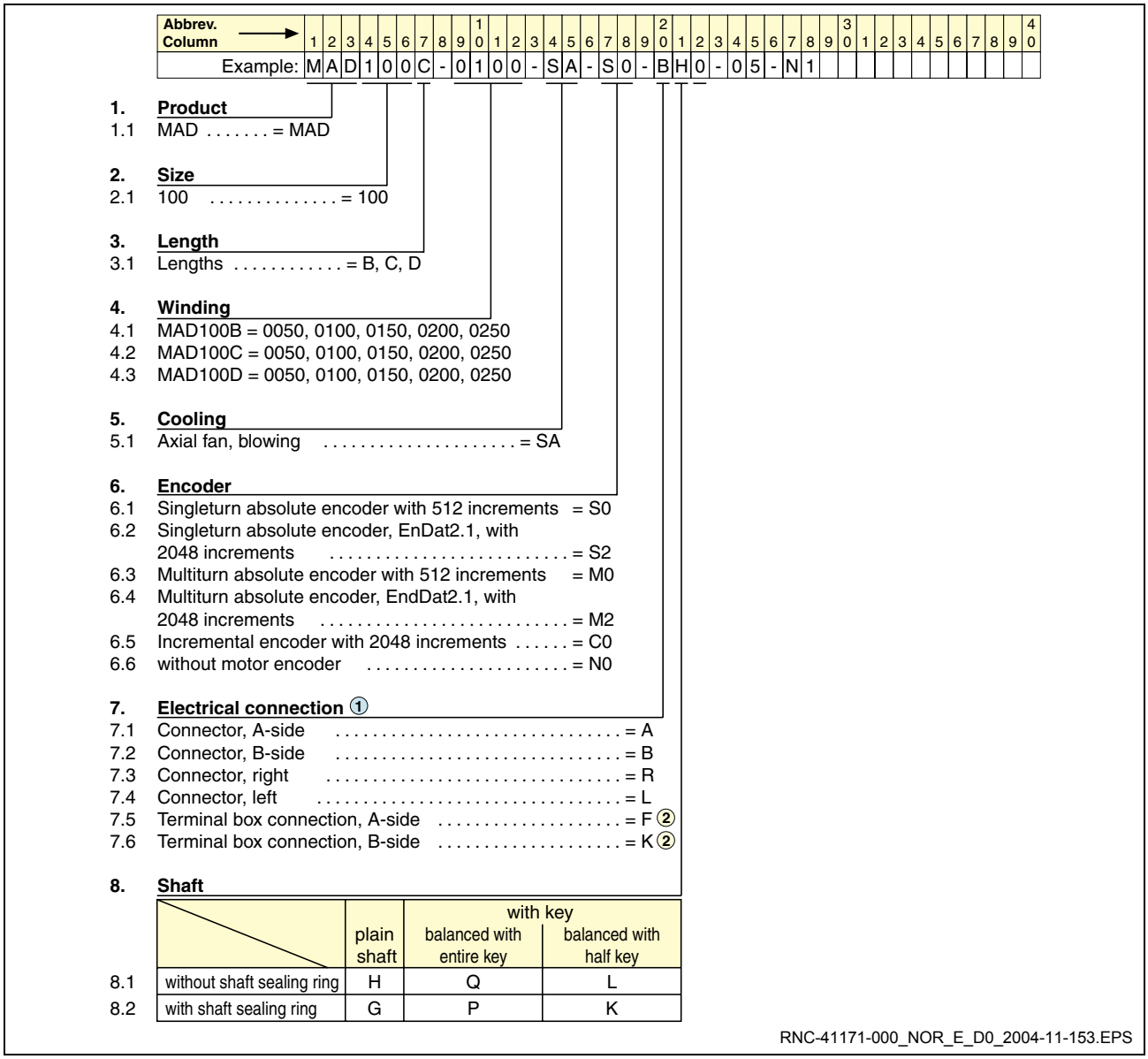
Heed the notes regarding holding brakes in Chapter 4, ”Technical Data ….” and Chapter 9, "Application Notes".

12. Vibration Severity Class

Abbrev. Column 28

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

6.2 Type Code for MAD100



		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

Fig. 6-4: Type code for 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													

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

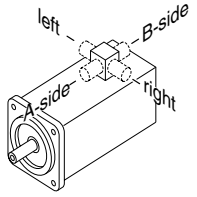
10. Mounting style
10.1 Flange mounting . . . . . = 05
10.2 Flange and foot mounting . . . . . = 35

11. Bearings
11.1 Standard . . . . . = N
11.2 High Speed . . . . . = H③
11.3 for clutch mounting . . . . . = R

12. Vibration severity grade
12.1 R . . . . . = 1
12.2 S . . . . . = 2
12.3 S1 . . . . . = 3④

Note:
① Looking from front onto driven shaft (see picture 1)
② Electrical connection "F" and "K" at mounting style "35" is only available on top
③ Bearings "H" s only available with length "B" and "C", shaft "H" and holding brake "0"
④ Vibration severity grade "S1" is only available with length "B" and "C"

Position of power connection = top



Picture 1

RNC-41171-000_NOR_E_D0_2004-11-154.EPS

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

6.3 Type Code for MAD130

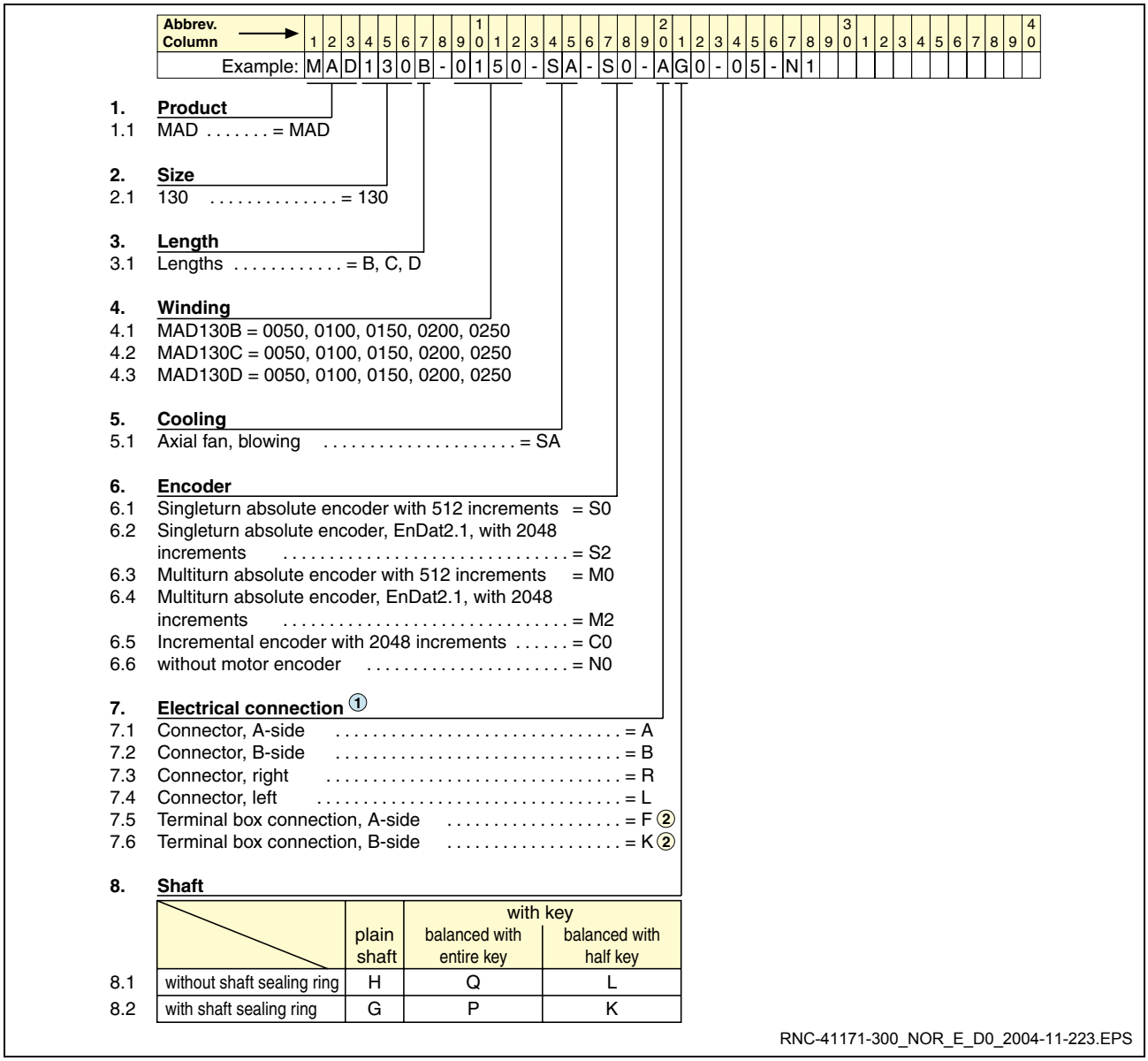


Fig. 6-6: Type code for MAD130 (1/2)

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													

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 . . . . . = H③
11.3 for clutch mounting . . . . . = R
11.4 reinforced bearings . . . . . = V

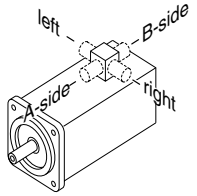
12. Vibration severity grade

12.1 R . . . . . = 1
12.2 S . . . . . = 2
12.3 S1 . . . . . = 3④

Note:

① Looking from front onto driven shaft (see picture 1)
② Electrical connection "F" and "K" at mounting style "35" is only available on top
④ Bearings "H" is only avalable with length "B" and "C", shaft "H" and holding brake "0"
③ Vibration severity grade "3" is only available with length "B" and "C" and bearings "N", "H" and "R"

Position of power connection = top



Picture 1

RNC-41171-300_NOR_E_D0_2004-11-224.EPS

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

6.4 Type Code for MAD160

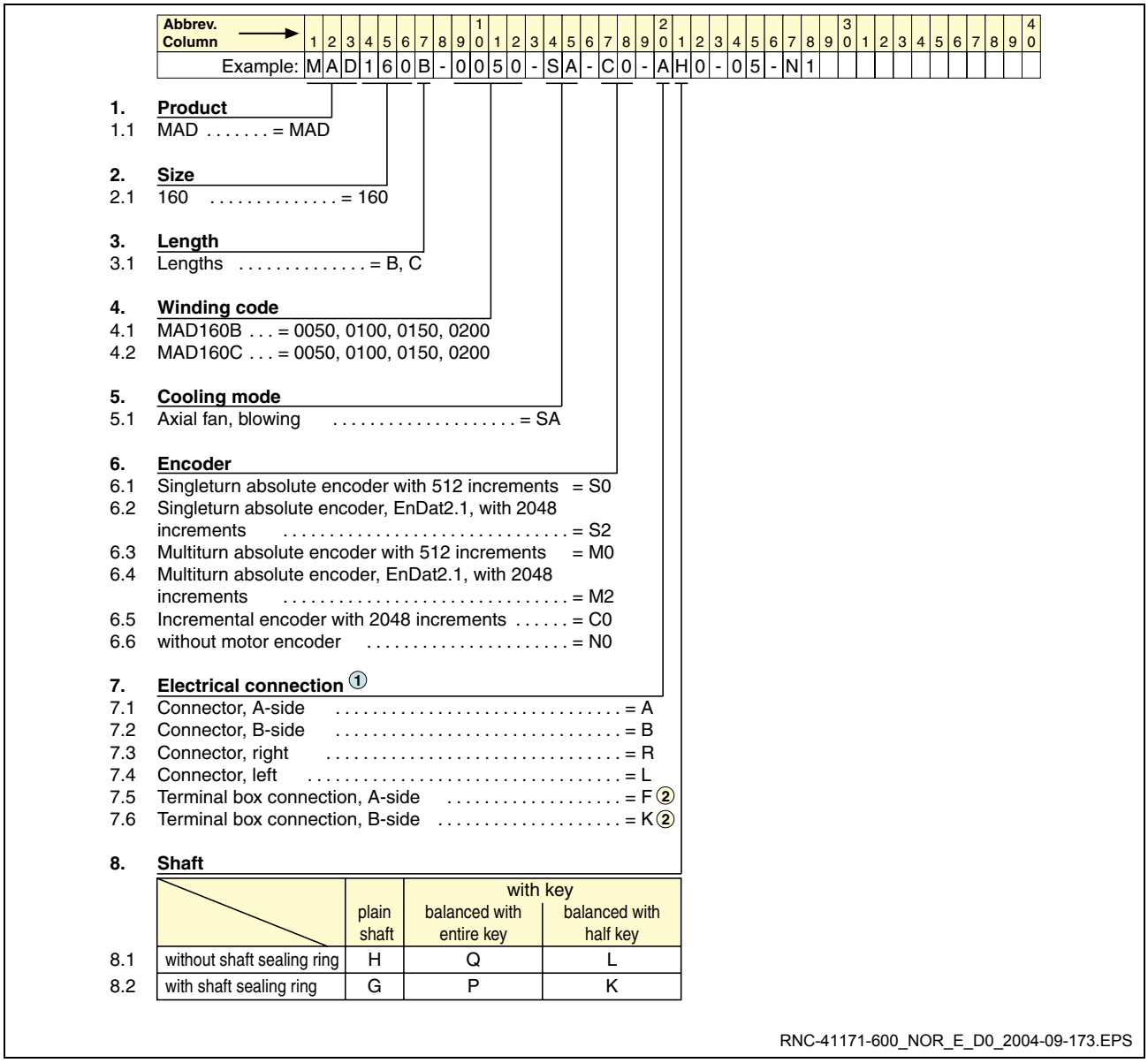


Fig. 6-8: Type code for MAD160 (1/2)

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													

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	reinforced bearings	= V
11.3	for clutch mounting	= R

12. Vibration severity grade

12.1	R	= 1
12.2	S	= 2
12.3	S1	= 3 ③

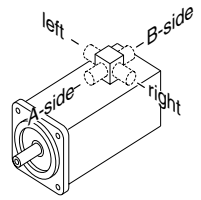
Note:

① Looking from front onto driven shaft (see picture 1)

② Electrical connection "F" and "K" at mounting style "35" is only available on top

③ Vibration severity grade "S1" is only available with bearings "N"

Position of power connection = top



Picture 1

RNC-41171-600_NOR_E_D0_2004-09-174.EPS

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

6.5 Type Code for MAD180

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													

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

2. Size
2.1 180 . . . . . = 180

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

4. Winding
4.1 MAD180C . . . = 0050, 0100, 0150, 0200
4.2 MAD180D . . . = 0050, 0100, 0150, 0200

5. Cooling
5.1 Axial blower, 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
6.5 Incremental encoder with 2048 increments . . . . . = C0
6.6 without motor encoder . . . . . = N0

7. Electrical connection ①②
7.1 Terminal box connection, A-side . . . . . = F
7.2 Terminal box connection, B-side . . . . . = K

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

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Fig. 6-10: Type code for 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													

10. Mounting style

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

11. Bearings

11.1 Standard . . . . . = N

11.2 reinforced bearings . . . . . = V

11.3 for clutch mounting . . . . . = R

12. Vibration severity grade

12.1 R . . . . . = 1

12.2 S . . . . . = 2

12.3 S1 . . . . . = 3 ③

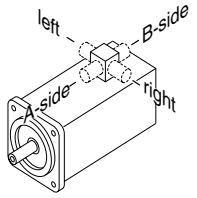
Note:

① Looking from front onto driven shaft (see picture 1)

② Electrical connection "F" and "K" at mounting style "35" is only available on top

③ Vibration severity grade "S1" is not available with bearings "V"

Position of power connection = top



Picture 1

RNC-41171-800_NOR_E_D0_2004-09-154.EPS

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

6.6 Type Code for MAF100

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													

1. Product
1.1 MAF . . . . . = MAF

2. Size
2.1 100 . . . . . = 100

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

4. Winding
4.1 MAF100B = 0050, 0100, 0150, 0200, 0250
4.2 MAF100C = 0050, 0100, 0150, 0200, 0250
4.3 MAF100D = 0050, 0100, 0150, 0200, 0250

5. Cooling
5.1 Liquid cooling with connection thread 1/4" = FQ
5.2 Liquid cooling with rapid action coupling 1/4" = FR

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 with, EnDat2.1, 2048 increments . . . . . = M2
6.5 Incremental encoder with 2048 increments . . . . . = C0
6.6 without motor encoder . . . . . = N0

7. Electrical connection ①
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 ②
7.6 Terminal box connection, B-side . . . . . = K ②

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

RNC-41181-000_NOR_E_D0_2004-11-153.EPS

Fig. 6-12: Type code for 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													

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 . . . . . = H③
11.3 for clutch mounting . . . . . = R

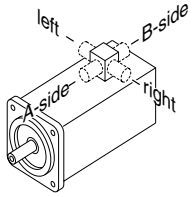
12. Vibration severity grade

12.1 R . . . . . = 1
12.2 S . . . . . = 2
12.3 S1 . . . . . = 3④

Note:

① Looking from front onto driven shaft (see picture 1)
② Electrical connection "F" and "K" at mounting style "35" is only available on top
③ Bearings "H" s only available with length "B" and "C", shaft "H" and holding brake "0"
④ Vibration severity grade "3" is only available with bearings "N"

Position of power connection = top



Picture 1

RNC-41181-000_NOR_E_D0_2004-11-154.EPS

Fig. 6-13: Type code for MAF100 (2/2)

6.7 Type Code for MAF130

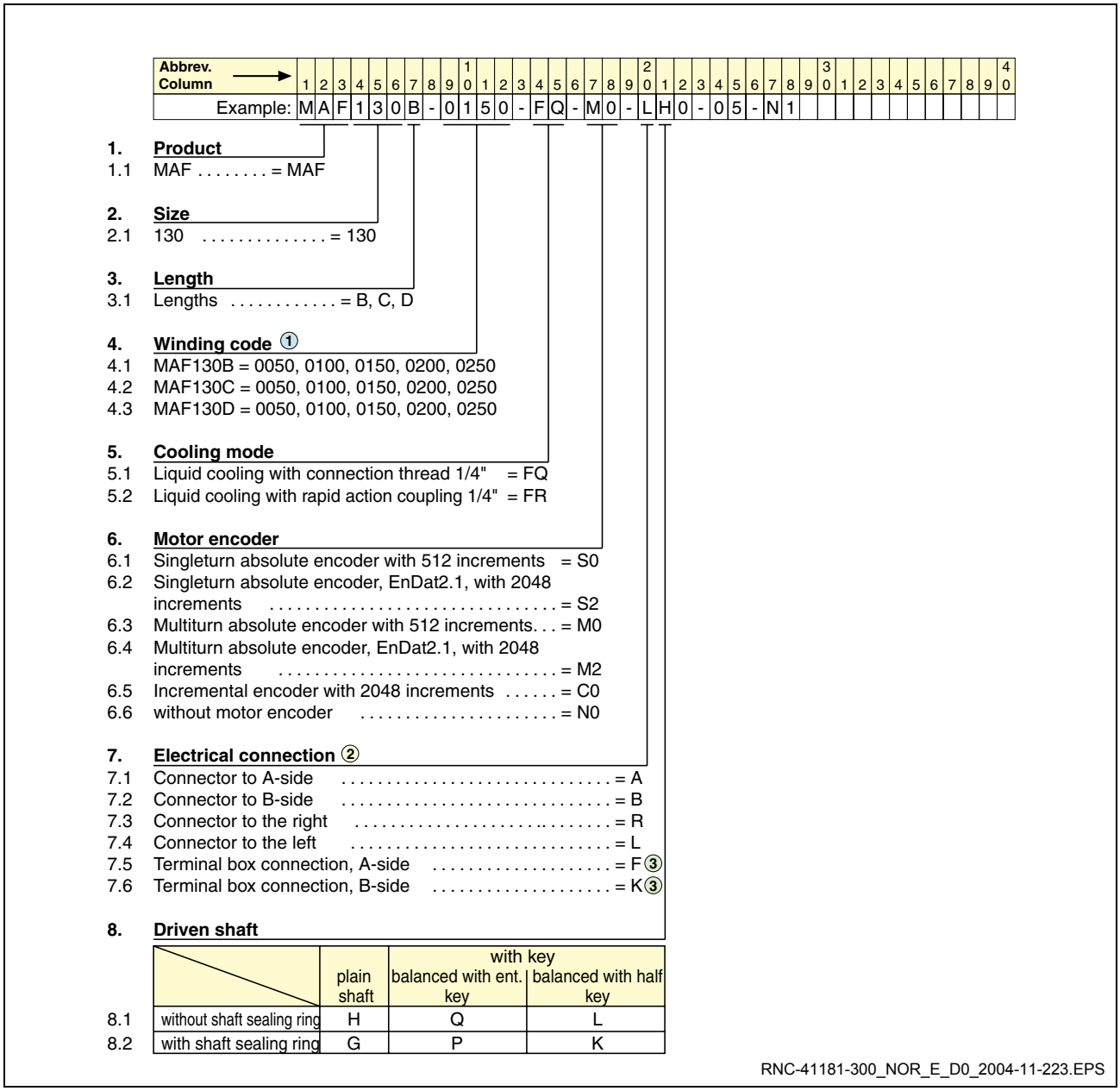


Abb. 6-14: Type code for MAF130 (1/2)

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													

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 . . . . . = H④
11.3 for clutch mounting . . . . . = R
11.4 reinforced bearings . . . . . = V

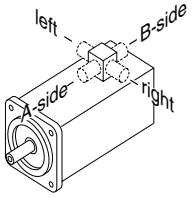
12. Vibration severity grade

12.1 R . . . . . = 1
12.2 S . . . . . = 2
12.3 S1 . . . . . = 3⑤

Note:

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

Position of power connection = top



Picture 1

RNC-41181-300_NOR_E_D0_2004-11-224.EPS

Fig. 6-15: Type code for MAF130 (2/2)

6.8 Type Code for MAF160

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													

1. Product
1.1 MAF . . . . . = MAF

2. Size
2.1 160 . . . . . = 160

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

4. Winding codes ①
4.1 MAF160B . . . = 0050, 0100, 0150, 0200
4.2 MAF160C . . . = 0050, 0100, 0150, 0200

5. Cooling mode
5.1 Liquid cooling with connection thread 1/2" = FQ
5.2 Liquid cooling with rapid action coupling 1/2" = FR

6. Motor 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
6.5 Incremental encoder with 2.048 increments . . . . . = C0
6.6 without motor encoder . . . . . = N0

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

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

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Fig. 6-16: Type code for 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													

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 for clutch mounting . . . . . = R
11.3 reinforced bearings . . . . . = V

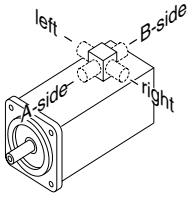
12. Vibration severity grade

12.1 R . . . . . = 1
12.2 S . . . . . = 2
12.3 S1 . . . . . = 3④

Note:

① Winding codes "MAF160B-0200", "MAF160C-0150" and "MAF160C-0200" are only available with electrical connection "F" and "K"
② Looking from front onto driven shaft (see picture 1)
③ Electrical connection "F" and "K" at mounting style "35" is only available at the top
④ Vibration severity grade "3" is only available with bearings "N"

Position of power connection = top



Picture 1

RNC-41181-600_NOR_E_D0_2004-09-154.EPS

Fig. 6-17: Type code for MAF160 (2/2)

6.9 Type Code for MAF180

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													

1. Product
1.1 MAF . . . . . = MAF

2. Size
2.1 180 . . . . . = 180

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

4. Winding code
4.1 MAF180C . . . = 0050, 0100, 0150, 0200
4.2 MAF180D . . . = 0050, 0100, 0150, 0200

5. Cooling mode
5.1 Liquid cooling with connection thread 1/2" = FQ
5.2 Liquid cooling with rapid action coupling 1/2" = FR

6. Motor 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
6.5 incremental encoder with 2048 increments . . . . . = C0
6.6 without motor encoder . . . . . = N0

7. Electrical connection ①②
7.1 Terminal box connector, A-side . . . . . = F
7.2 Terminal box connector, B-side . . . . . = K

8. Output shaft

	plain shaft	with key: balanced with entire key	with key: balanced with half key
8.1 without shaft seal. ring	H	Q	L
8.2 with shaft seal. 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

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Abb. 6-18: Type code for MAF180 (1/2)

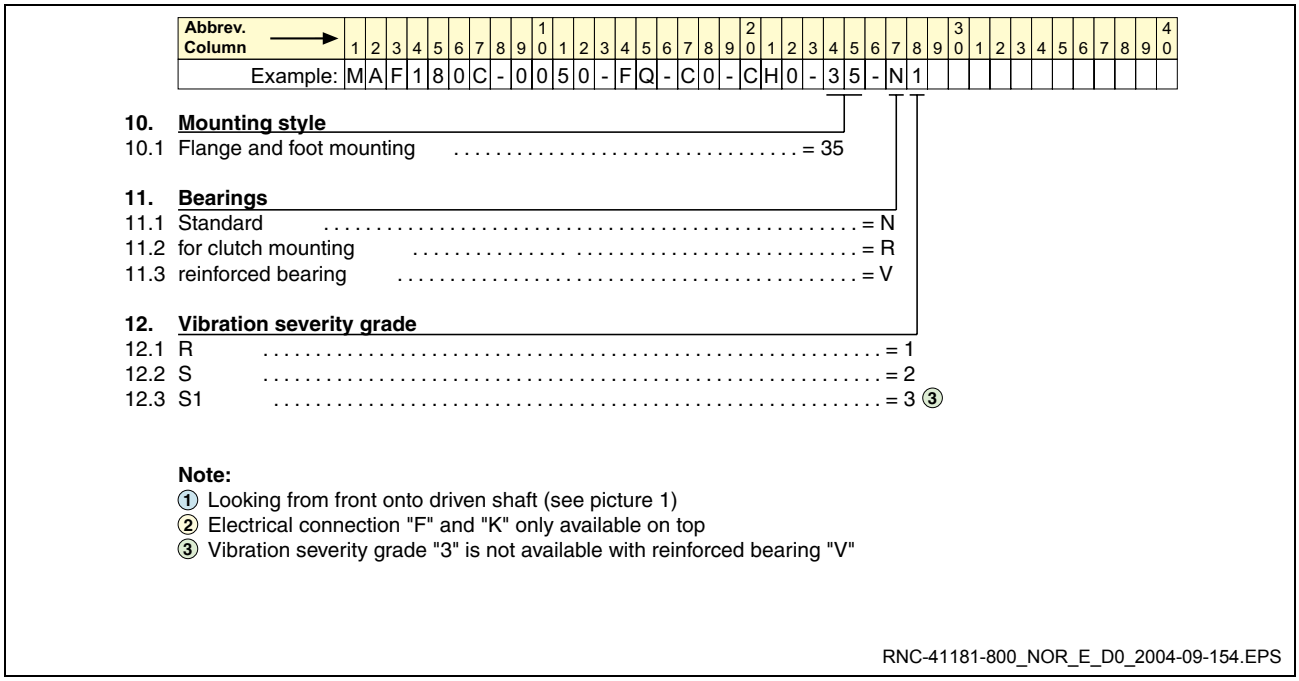


Fig. 6-19: Type code for MAF180 (2/2)

7 Accessories

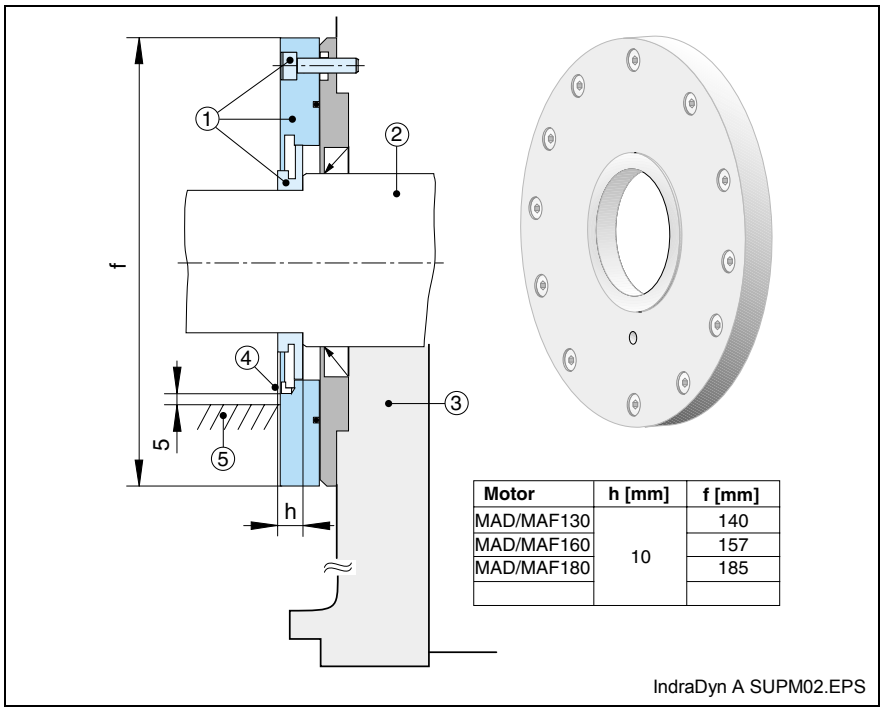
7.1 Labyrinth Seal

To protect the motor output shaft against spraying liquids, IndraDyn A motors that are already equipped with the "shaft seal" option can be retrofitted with a labyrinth seal (accessory SUP-M02-2AD...).

Labyrinth seal for	Type	MNR
MAD/MAF130	SUP-M02-2AD132	R911273268
MAD160	SUP-M02-2AD160	R911272843
MAF160	SUP-M02-ADF164	R911299702
MAD/MAF180	SUP-M02-2AD180	R911273209

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 (scope of delivery)
(2): Motor shaft
(3): Motor flange
(4): Drain hole
(5): Max. permitted level of a fluid
(h): Thickness of the labyrinth seal

Fig. 7-2: Labyrinth seal the IndraDyn A motors

Note:

- Pay attention to the assembly instructions for accessory SUP-M02-xxx... (in the scope of delivery).
- The labyrinth seal is only effective on horizontally-installed motors and above speeds of approx. 200 rpm. It may only

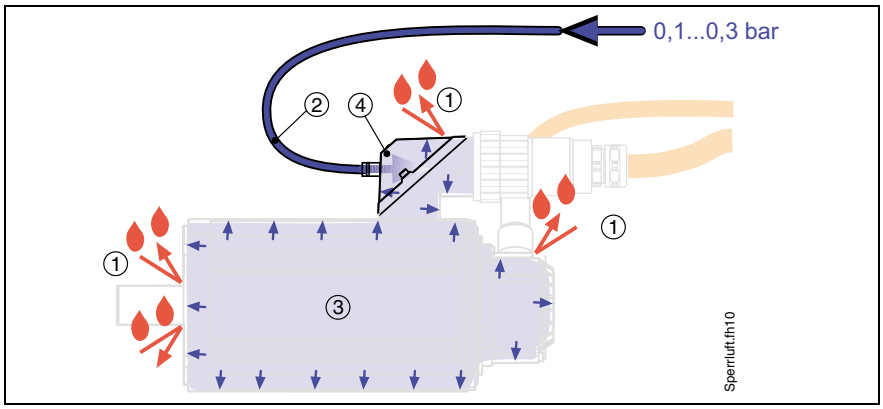
be installed in motors that have a factory-installed shaft seal.

- 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 Air-pressure Connector Kit

The standard international protection type (IP65) may not be sufficient during operation under adverse conditions. High demands may be made on the tightness of motor seals when the motors are used in areas where oily lubricating coolants are used. For this field of application, we recommend using sealing air for our motors.

A defined excess pressure in the motor interior induced by the air-pressure connector kit reliably prevents the penetration of, for example, seeping oil and coolant lubricants.



(1): Splashing water, coolant lubricant
(2): Compressed-air line (plastic pipe, type PA 4 x 0.75, or equivalent)
(3): Excess pressure inside the motor
(4): Air-pressure Connector Kit Accessory

Fig. 7-3: Motor with air-pressure connector kit

Air-pressure connector kits are available as an accessory for IndraDyn A motors with frame sizes of 100, 130 and 160, as long the motor has a flange socket for its power connection. They are attached by simply replacing the motor flange socket cover.

Ordering Name of Accessory Sets

Motor frame 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: Air-pressure Connector Kit Accessory

Note: Pay attention to the documentation “Sealing Air Accessory for Synchronous Servomotors”, MNR R911283689, as well as the assembly instructions for the accessory set (in the scope of delivery).

7.3 Gearboxes

In certain conditions, two-speed and planetary gearboxes can be attached to IndraDyn A motors.

Type	Gearbox type	Requirement at the motor	Supplier
GTS	Planetary gearbox [1]	Smooth motor drive shaft	**Bosch Rexroth**
GTM	Planetary gearbox [1]	Smooth motor drive shaft	**ZF** Maschinenbetriebe GmbH Postfach 2549 88015 Friedrichshafen Tel. +49-(0)7541-77-0
58...	Worm gear[2])	Smooth motor drive shaft	**ATLANTA** Zahnrad- und Werkzeugfabrik Seidenspinner GmbH & Co. Karl-Benz-Str. 16 74321 Bietigheim-Bissingen Tel. +49-(0)7142-7001-0
1) Gearboxes must be ordered as a separate subitem of the motor. 2) Bosch Rexroth does not manufacture or supply these gearboxes. Clarify compatibility and technical details with the manufacturer.			

Fig. 7-5: IndraDyn A motors with gearbox

Note: Only low axial shaft loads are permitted for IndraDyn A motors (see Chapter 9.13 “Bearing and Shaft Loads”). Therefore, the IndraDyn A motors are **not** suitable, or only suitable to a limited degree, for machine elements that generate axial loading of the motors (e.g. helical driving pinions).

8 Connection Techniques

8.1 Notes

Power cables and connectors are not in the scope of delivery of the motor. They have to be ordered separately.

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

Decisive advantages of Bosch Rexroth ready-made cables are:

- Pre-wired without additional finishing necessary
- Laid out for use in applications with continuous bending
- Resistant against mineral oils, grease and biologic oils; silicon- and halogen-free; low adhesion
- Use of licensed cables according 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 manufactures may not fulfill these criteria.

Bosch Rexroth shall not be held responsible for malfunction or damages resulting from use of non-Bosch Rexroth cables.

 You can find additional information ...

- on selecting power and encoder cables for **IndraDyn A** from the following descriptions in this chapter.

- on selecting power and encoder cables for **IndraDyn A** in the Documentation “Rexroth Connection Cables”, MNR R911280894.

- for assembling **cables and plugs**, as well as technical data, in the documentation "Rexroth Connection Techniques, Assembling and Tools...", MNR R911280895.

8.2 Power Connection

The connection of power to IndraDyn A motors is made at the top of the motors and can be established performed via a **flange socket or a terminal box**.

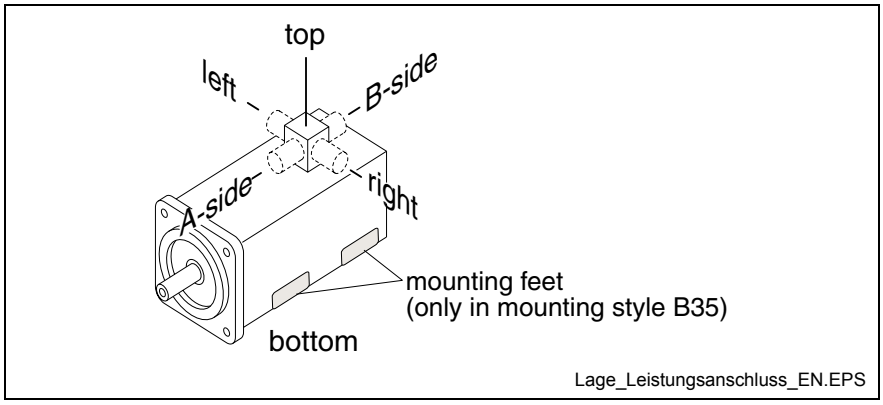


Fig. 8-1: Position of the power connection

Note:

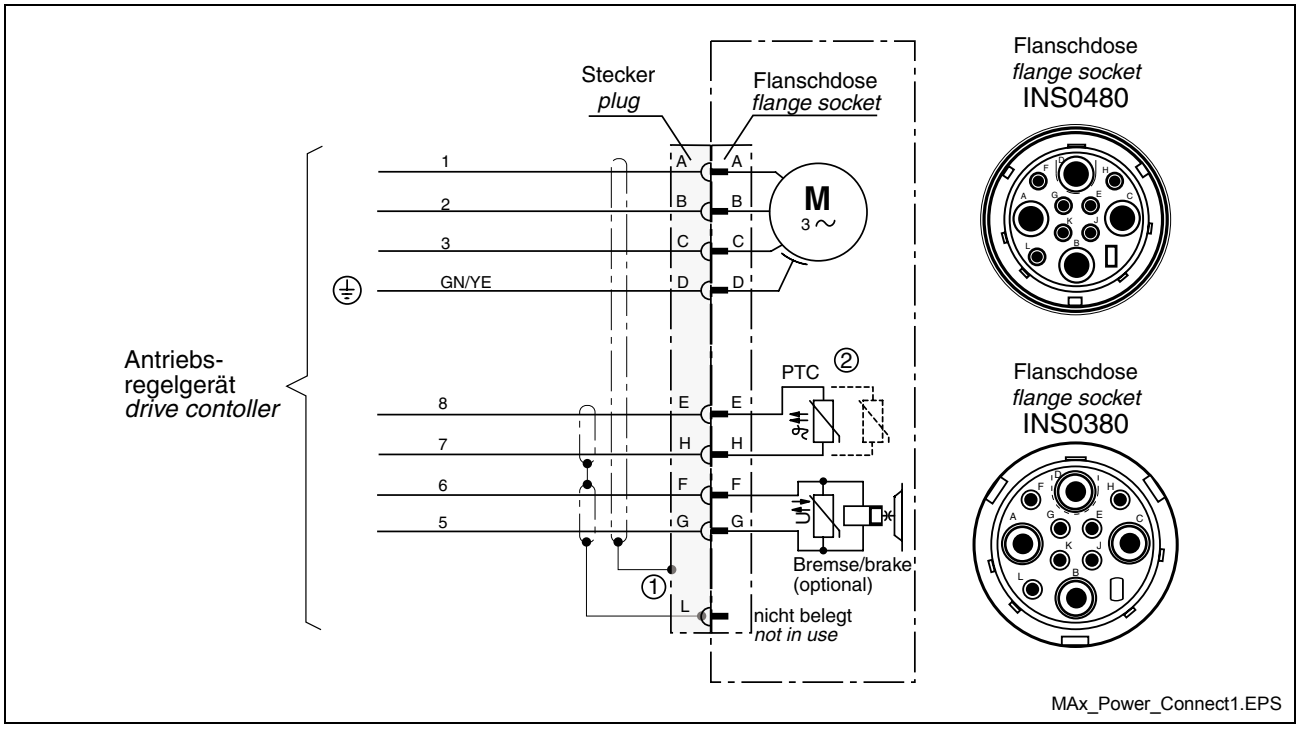
- When choosing the connection option “flange socket”, please note that the power cable must be equipped with a plug with a bayonet connection**.**
- When choosing the connection option “terminal box”, please note that the power cable must be terminated with ferrules on conductors U, V and W, and the PE (ground) conductor must be equipped with a ring terminal.
- The design of the power cable also depends on the drive device used. Please observe the documentation of the drive device.

Overview

Motor frame size MAD/MAF	Flange socket	Terminal box			
		U-V-W	Max. cross section of power cable	∅PE	Connection thread
100	INS480	Ferrules	10mm²	M6	see motor dimension sheet
130	INS380	Ferrules	25mm²	M8	see motor dimension sheet
160	INS380	Ferrules	35mm²	M8	see motor dimension sheet
180	not available	Ring terminal	50mm²	M12	see motor dimension sheet

Fig. 8-2: Overview power connection

8.3 Power Connection via Flange Socket



(1): The shield connection made in the plug via the cable grip.
(2): Only one PTC sensor is wired. The leads for the spare sensor are found within the plug housing.

Fig. 8-3: Layout of power connection in flange socket

Flange Socket

The power connectors of the IndraDyn A motors are equipped with flange sockets with bayonet connections.

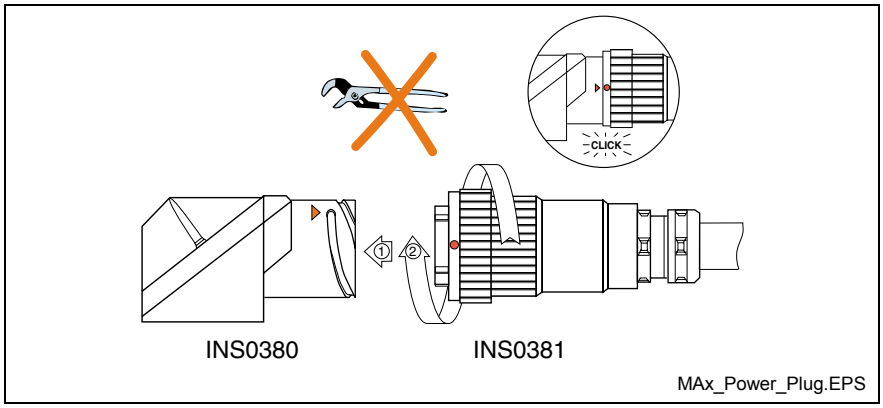
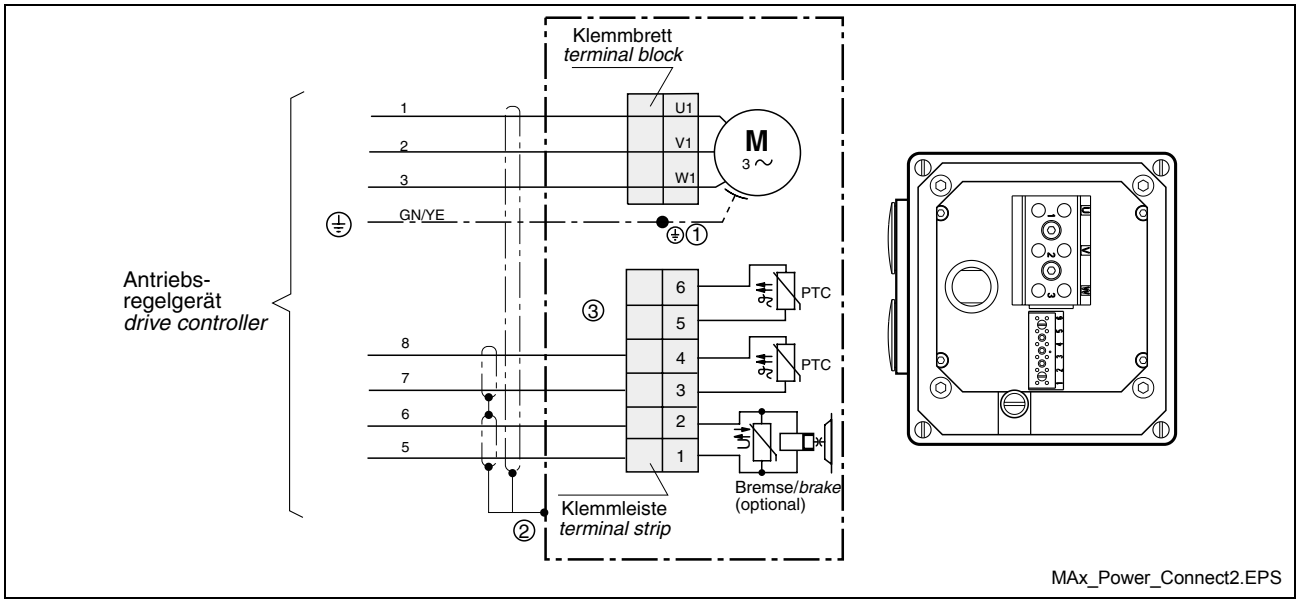


Fig. 8-4: Power connector

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

8.4 Power Connection via Terminal Box

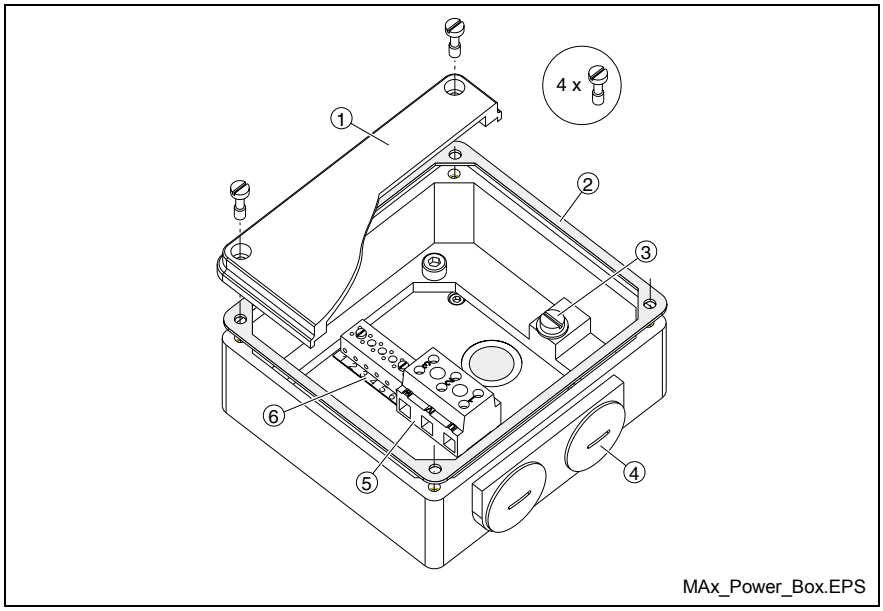


(1): Electrically-conducting connection to the motor housing
(2): The shield connection must be properly made in the cable via the cable grip after the cable grip is threaded into the terminal box
(3): Only one PTC sensor is monitored. Connect the spare sensor only if necessary, e.g. because of failure of the first sensor.

Fig. 8-5: Layout of power connection in terminal box

Terminal box

IndraDyn A motors designed for drive combinations with higher DC bus voltages - up to 750V_{DC} – are equipped with **a terminal strip or terminal block** in the terminal box for the connection of cables with ferrules.



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

Fig. 8-6: Terminal box

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

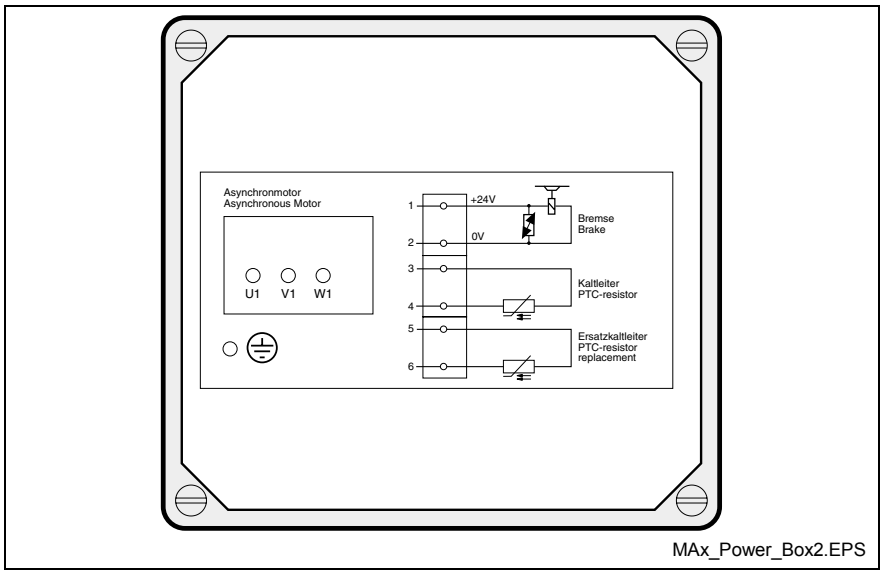


Fig. 8-7: Terminal box connection diagram

Note:

- The brake connections are assigned only if the motor was manufactured with the "brake" option.
- Only one contact pair of PTC resistor connectors 3-4 or 5-6 is assigned to the motor cable at one time.
- Do not remove or damage the gasket witch is glued to the cover.
- Observe the size of the screwed cable connection and connection thread for cable inlet into the terminal box.
- The connections of the internal winding interconnection in the terminal box must not be removed.

8.5 Connection Designations on the Drive Device

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

REXROTH Drive Controller	Clamp designations		
	Power	Temperature sensor	Holding brake
	(Terminal block X5)	(Terminal block 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. 8-8: Clamp designation on the Rexroth drive controller

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 accomplished on motors equippment with a terminal box (see Fig. 8-6).

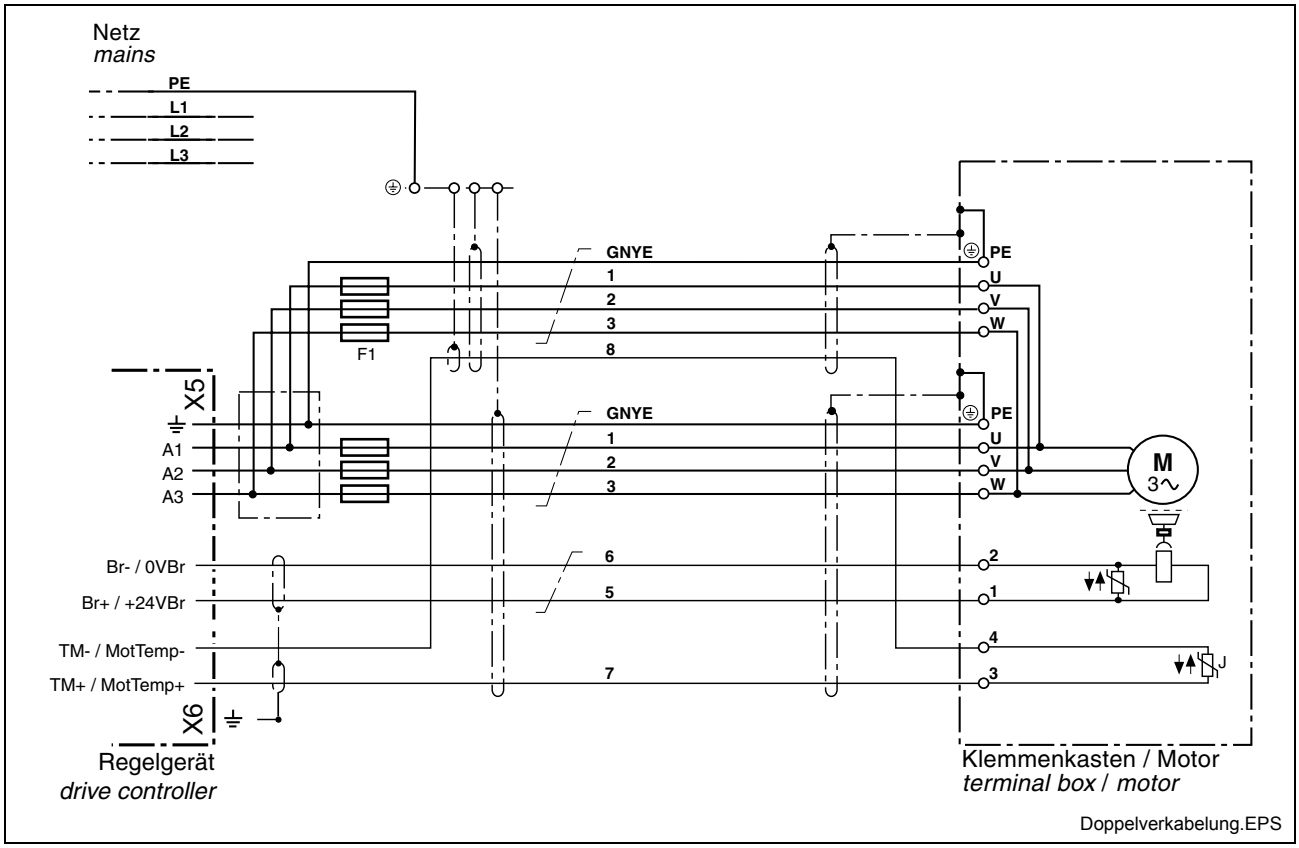


Fig. 8-9: Connecting diagram using double cabling diagram

Note:

- Conductors not shown in the switching diagram are not required and must not be connected.
- The fuses F1 (NH...), to protect the conductors in case of overload at cable break, are dimensioned according to the current rating based on the cross-sections of the individual conductor.
- The fuses should be installed in the electrical 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 electrical cabinet with the largest possible surface area.
- Cable pairs must be properly connected to the terminal strips or to the terminal studs of the drive controllers; they must also fulfill safety regulations.

Therefore, observe the following documentation:

- “Electromagnetic compatibility (EMC)...” MNR R911259740
- documentation of the motor used
- documentation of the drive device used
- documentation “Rexroth Connection Cables”, MNR R911282688.

8.7 Encoder Connection

The connection of the encoder to IndraDyn A motors is made via a 10-pole, 12-pole or 17-pole flange socket at the motor housing. See the following chart for the connector assignment:

PIN	Encoder option							
	C0			M0 / S0			S2, M2	
1	GN BK		A+	BU BK		A-	BN	+US
2	YE BK		A-	VI		SCL	WH	GND
3	RD		R+	YE		F Sample	GN	A+
4			free	GY		SD in	YE	A-
5			free	YE BK		B+	PK	B+
6			free	GN BK		B-	GY	B-
7	WH GN		0V	PK		SD out	BU	data+
8			free	RD BK		A+	VI	data-
9			free			free	BK	clk+
10	BN GN		+V	WH GN		0V	RD	clk-
11	BU BK		B+			free	not applicable	
12	RD BK		B-	BN GN		+V		
13	BK		R-	not applicable				
14			free					
15	WH		0V Sense					
16	BU		+5V Sense					
17			free					

Fig. 8-10: Overview of encoder connection layouts

Connection of Encoder Option C0

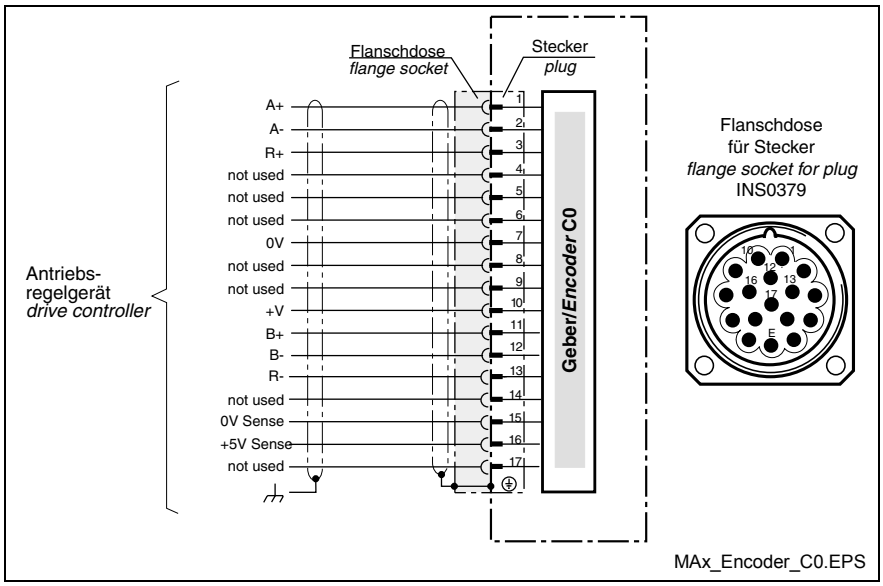


Fig. 8-11: Connection of Encoder Option C0

Connection of Encoder option M0 / S0

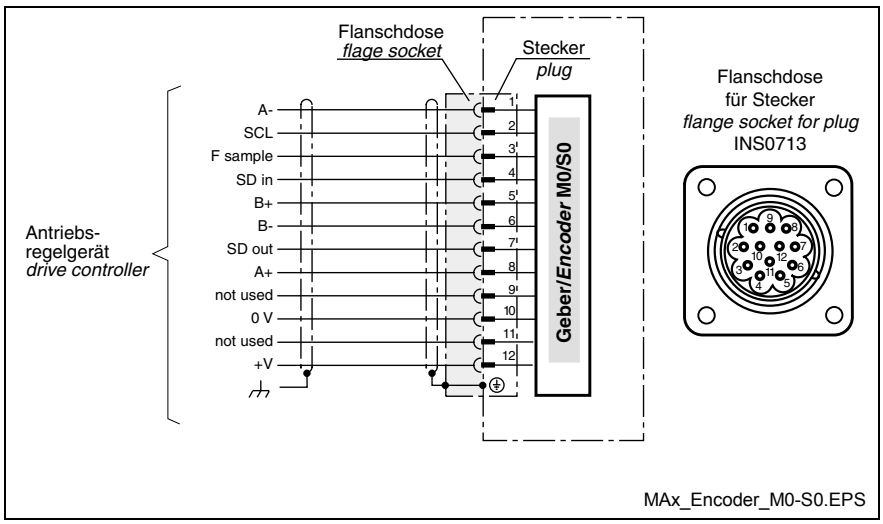


Fig. 8-12: Connection of Encoder option M0 / S0

Connection of Encoder Option M2 / S2

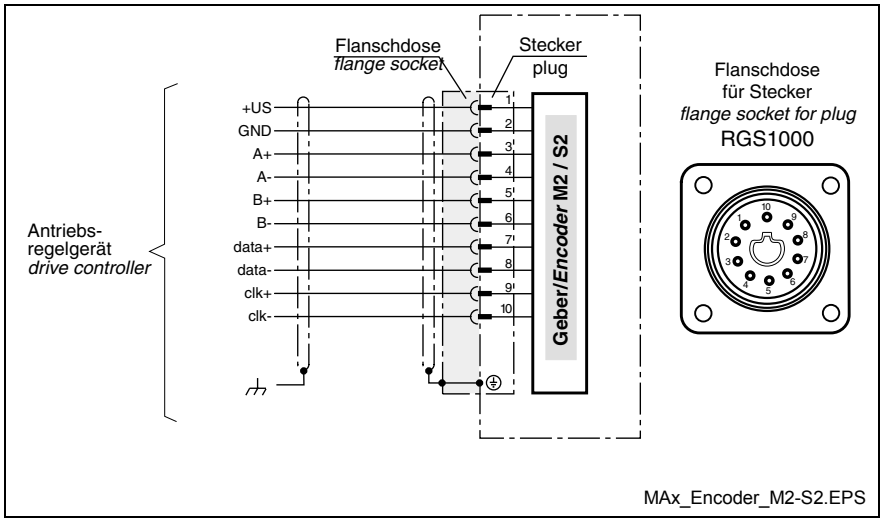


Fig. 8-13: Connection of Encoder Option M2 / S2

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

The motor encoder`s flange socket and the cable plug from the drive controller are mirror images of one another. They are connected without tools, i.e. by hand.

Heed the mechanical codings of the flange sockets.

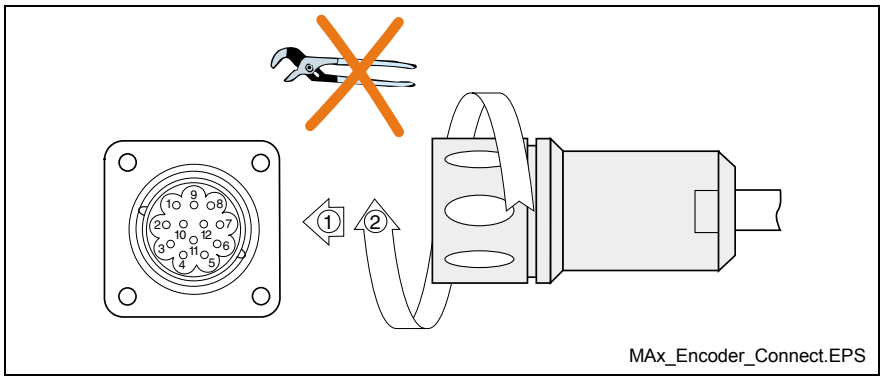


Fig. 8-14: Example of the encoder connection

1. Insert the plug into the flange socket paying attention to the coding.
2. Manually tighten the union nut.

8.8 Temperature Sensors

IndraDyn A motors are equipped with two PTC temperature sensors, type KTY84-130, which are permanently mounted in the motor windings. For additional information on temperature sensors, refer to Chapter 9.9 “Motor Temperature Overview”.

Note:

- For the connection layouts, refer to Figs. 8-3 and 8-5 at the beginning of this chapter.
- Notice the correct polarity when using the sensor for external temperature measurement (see Fig. 9-16).
- The signal lines to the PTC sensors are routed to the controller via the motor power cable.
- Only one sensor at a time is connected to and evaluated by the drive controller. 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 layout, refer to Figs. 8-3 and 8-5 at the beginning of this chapter.
- Control voltage is +24 V_{DC} (+/-10%)
- Take note of the functional differences of an electrically-clamping vs. an electrically-releasing brake (see Chapter 9.10 “Motor Holding Brake”).

8.10 Motor Cooling

Blower Connection

The motor blower is connected to the power supply system via a cable and motor-protecting switch, and it functions independent of the drive device.

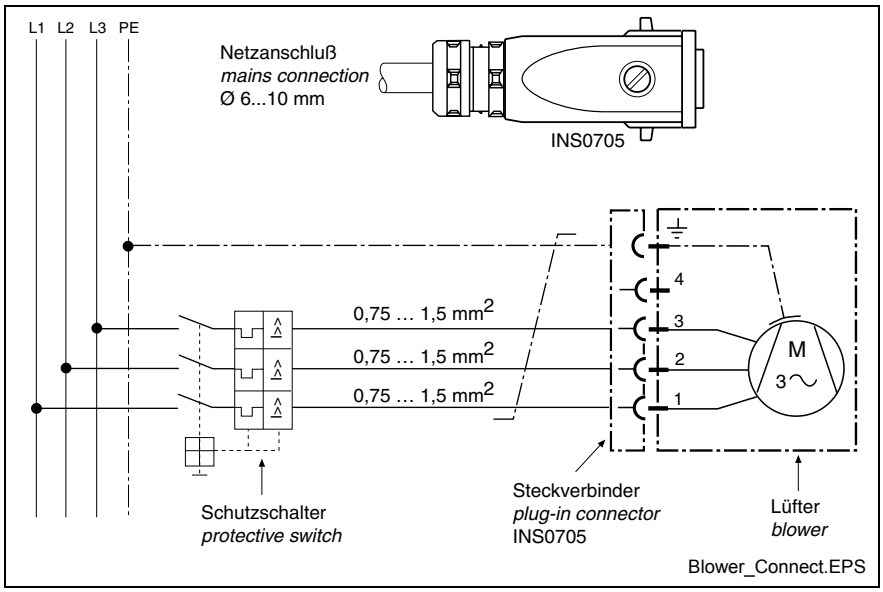


Fig. 8-15: Blower connection diagram

Note:

- To establish the connection, the blower plug must be opened and closed.
- The electric connection may only be established by skilled personnel. Please observe the safety notes.
- The seal of the plug housing may not be compromis.
- The machine manufacturer selects the motor protecting switch and the electrical protection. Please observe the regulations in the country of installation.

Connection of Liquid Cooling

For liquid-cooled motors, different connections are possible.

Motor MAF ...	Connection via		Note
	Thread	snap-on coupling [Ø d_i hose]	
100	G1/4"	9.6 mm	Selection of connection acc. to type code
130			
160	G1/2"	12.7 mm	
180			

Fig. 8-16: Overview of the cooling connections

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

The customer's equipment is threaded directly into the motor. The motor`s threads are plugged with factory-attached protective caps.

In the following illustrations, the assignment of inlet (IN) and outlet (OUT) is made for reasons of standardization; it does not affect the performance data of the motor. Existing installations with other assignment can be retained.

Operating Pressure

A maximum coolant supply pressure of **3 bar** applies to all MAF motors. This is to be read directly at the coolant connection of the motor.

Please note that additional threads or branches connections in the cooling circuit can have a negative influence on the flow and supply pressure of the coolant.

Snap-On Couplings

Another option for the coolant connection is a snap-on coupling which can also be released at full pressure, as they have integrated leak protection.

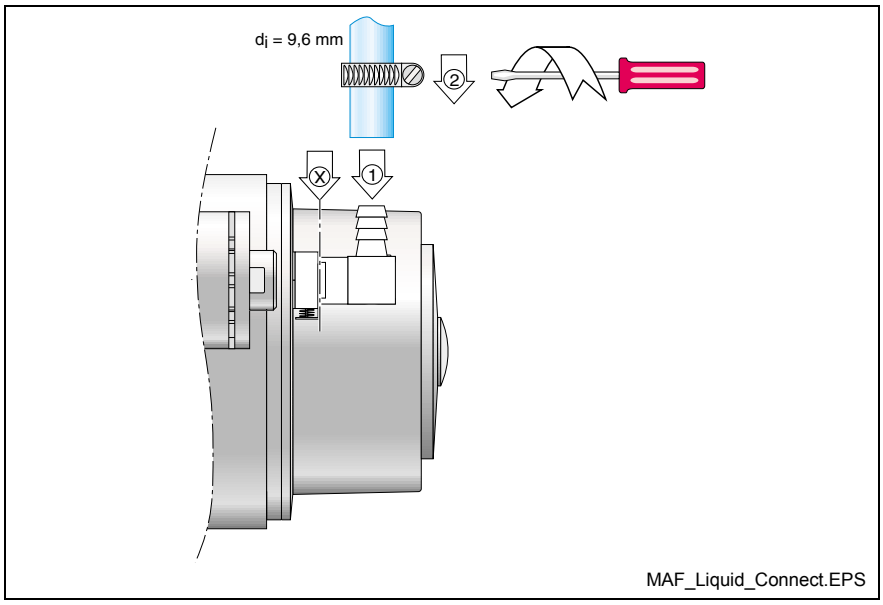


Fig. 8-17: Example of coolant connection of a MAF motor

Proceed as follows:

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

⇒ Screw down the end of the hose over the connection using the hose clamp (2).

⇒ For service purposes, the factory-attached screwed connection can be released at point “X”. Press the lock in and withdraw the elbow in the axial direction. It is not necessary to open the hose connection.

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

9 Application Notes

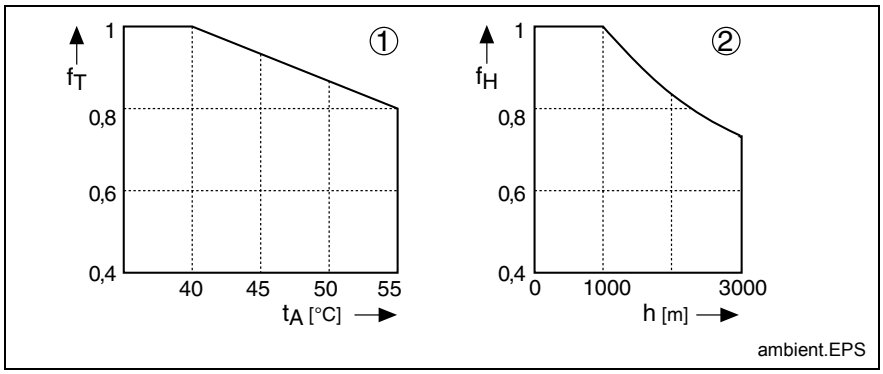
9.1 Operating Conditions

Setup Elevation and Ambient Temperature

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

- ambient temperatures of 0º C to +40º C,
- elevation between 0 and 1000 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 factor vs. ambient temperature
(2): Utilization factor vs. elevation
f_T: Utilization factor based on temperature
t_A: Ambient temperature in degrees Celsius
f_H: Utilization factor based on altitude
h: Setup elevation in meters

Fig. 9-1: Utilization factors

If **either** the ambient temperature **or** the setup elevation 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 setup elevation 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 Humidity

Environmental conditions are differentiated by class 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 supply parameters 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.

The following table provides an excerpt of this class:

Environmental factor	Unit	Class 3K4
Min. air temperature	°C	+5 [1])
Max. air temperature	°C	+40
Min. rel. humidity	%	5
Max. rel. humidity	%	95
Min. absolute humidity	g/m³	1
Max. absolute 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

Vibrations occur in stationary use and, depending on their intensity, have different effects on the robustness of the motors.

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

Based on DIN EN 60721-3-3 and DIN EN 60068-2-6, the following values are permissible for Rexroth 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 when used with M2/S2 encoders)

Fig. 9-3: Maximum values for vibrations

Shock

The shock load of the motors is indicated by providing the maximum permitted acceleration in non-stationary use, e.g. during transport.

Prevent damage to the motor by avoiding shocks which exceed the provided limits.

Based on DIN EN 60721-3-3 (1995), the following values apply for IndraDyn A motors:

	Maximum permissible shock load (duration 11ms)	
Motor frame size	axial	radial
100 180	10 m/s²	150 m/s²

Fig. 9-4: Maximum values for shock load

Note: Please also observe the specifications in Chapter 10.4 “Transportation and Storage”.

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

9.4 Compatibility with Foreign Material

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

However, as it is impossible to follow the continual development of all material which may come into contact with our drives and controllers, e.g. lubricants for machine tools, we cannot, in general, exclude any reaction with the materials used in our systems.

For this reason, you will have to carry out a test of compatibility between new coolants, lubricants, detergents, etc. and our housing/our housing materials.

9.5 Degree of Protection

The degree of protection acc. to IEC 60529 applies for IndraDyn A motors. In all installation positions of the motor, it must be ensured that the motors are not subjected to ambient conditions that exceed the valid degree of protection.

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

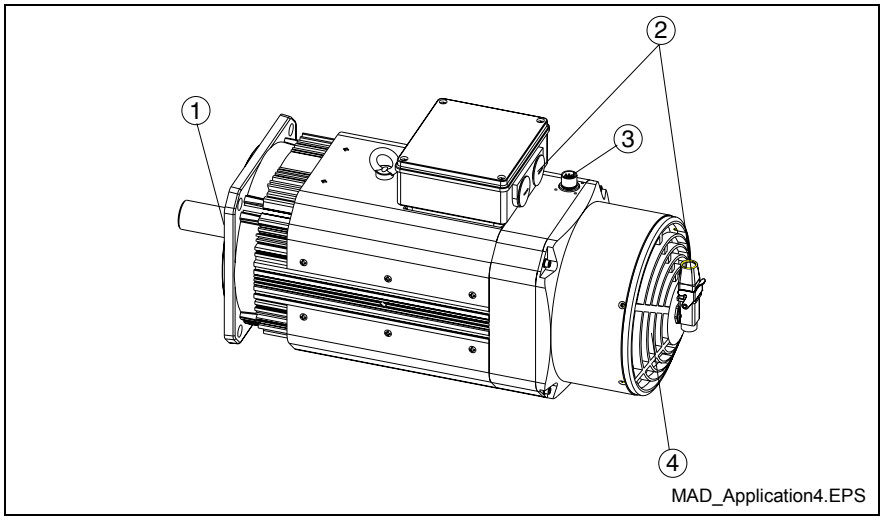


Fig. 9-5: Protection classes

Motor area	Degree of protection	Note
(1) Output shaft without shaft seal	IP 54	IP40 in vertical installation (see Fig. 9-10)
(1) Output shaft with shaft seal	IP 65	Option
(1) Output shaft with labyrinth seal	IP 65	Accessory; seal effective starting at 200 rpm.
(2) Power and feedback connections	IP 65	Terminal box or plug
(3) Motor encoder connection	IP 65	
(4) Motor blower	IP 65	Blower motor IP 65 Blower screen IP 24

Fig. 9-6: Motor protection class ranges

In every installation position be sure that the motors are not subjected to ambient conditions whitch exceed the 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 Design and Installation Position

IndraDyn A motors can be delivered in designs B05 and B35. Please refer to the table below for the conditions of installation permissible according to EN 60034-7.

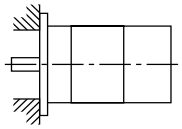
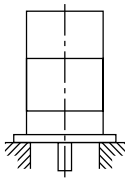
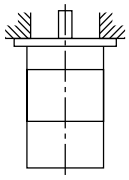
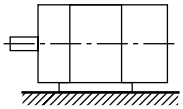
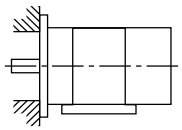
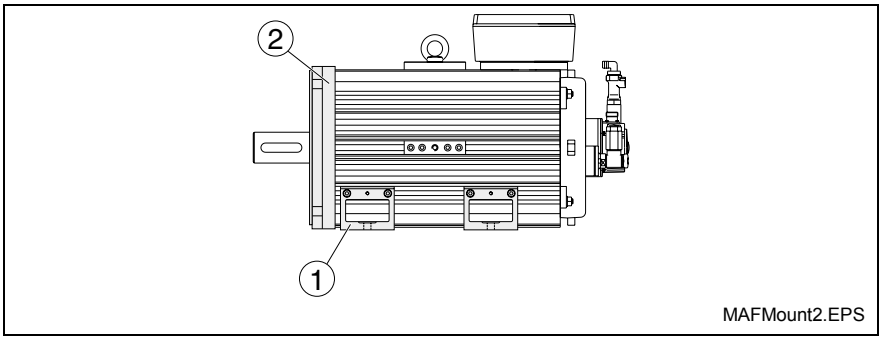
Motor design	Permissible conditions of installation		
	Description	Sketch	Setup
B05	IM B5		Flange mounting on the drive end of the flange
	IM V1		Flange mounting on the drive end of the flange; drive side pointing down
	IM V3		Flange mounting on the drive end of the flange; drive side pointing up
B35	IM B3		Base (foot) mounting, feet at the bottom
	IM B5		Flange mounting on the drive end of the flange

Fig. 9-7: Installation positions

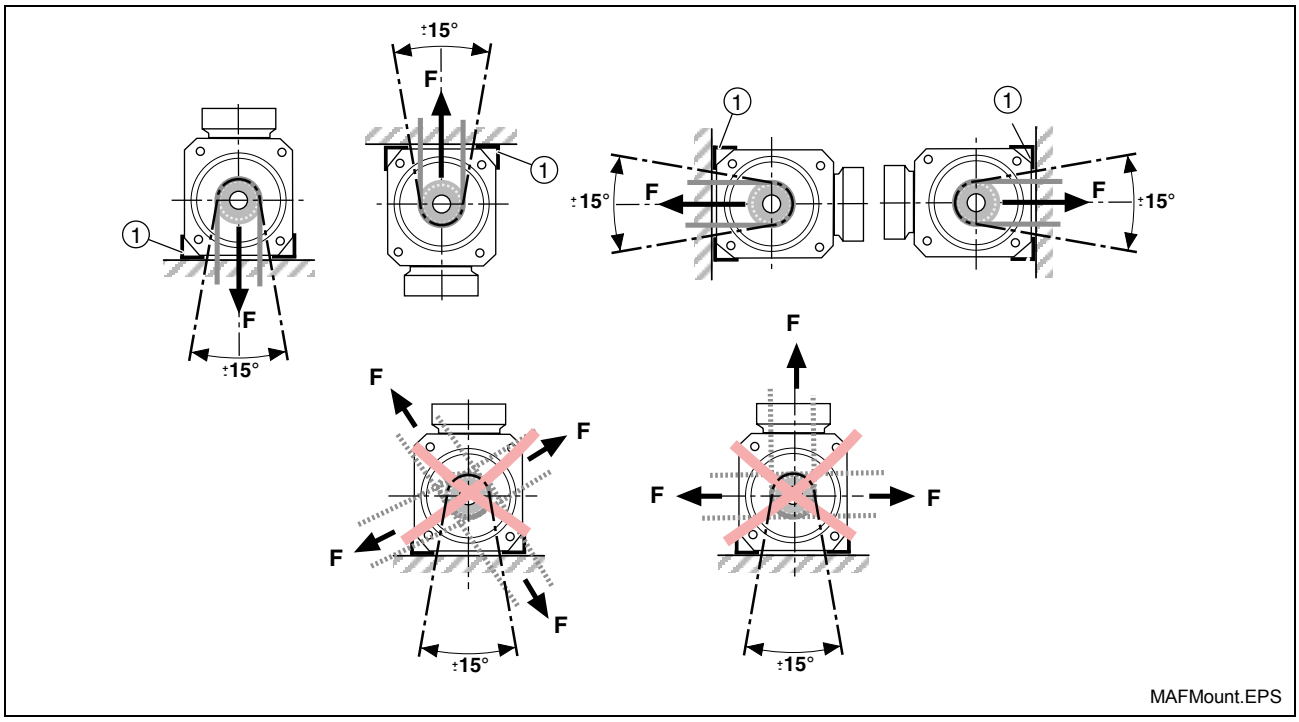
IndraDyn A motors with a B35 design can be mounted by using the foot-assembly or the flange-assembly method.



(1): Mounting feet
(2): Flange for flange assembly

Fig. 9-8: Methods of mounting the IndraDyn A

In the case of foot mounting, the forces of the load may only act in the vertical direction perpendicular to and towards the plain of feet (± 15°). The transfer of forces with other effective force directions is not permitted.



(1): Mounting feet

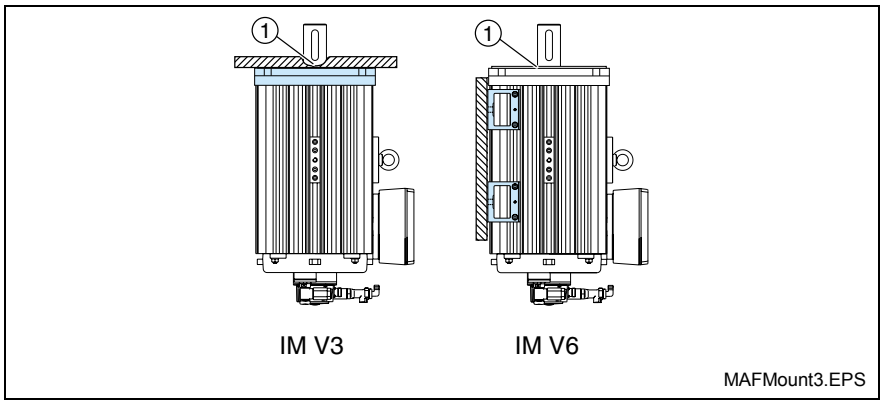
Fig. 9-9: Acceptable foot-mounting layouts

Notes:

- Forces transferred from a gearbox must not act on the feet of the motor; they must be supported by the gearbox itself.
- An improper installation situation results in forces that can quickly lead to motor damage.
- Consider the alternative "flange mounting".

Vertical Assembly

In the case of vertical installation positions as shown in the figure below, dirt and fluids can more easily enter the motor interior and cause malfunctions or break downs.



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

Fig. 9-10: Motor installed vertically

Notes:

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

⇒ Already take the installation position and the protection class of the motors into account when planning the system.

9.7 Housing Paint

The paint use of the motor housing consists of a black (RAL9005) 2K-Epoxydharz coating based on Epoxyd-Polyamid-Resin in water.

Chemically resistant against	Limited resistant against	Impermanent against
attenuated acids/brines Water, sea-water, sewage common machine oils	organic solvents hydraulic oil	concentrated acids/brines

Fig. 9-11: Varnish-resistance

The housing may be repainted, but the coat thickness may be no more than 40 µm. Check the adhesion and resistance of the new paint before painting.

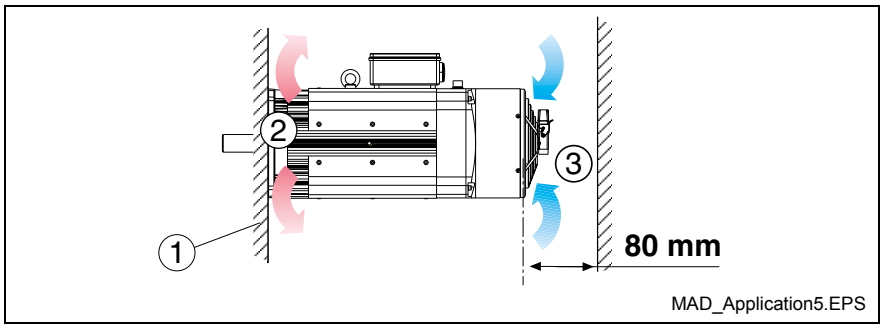
9.8 Motor Cooling

Blower

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

An axial blower is used for cooling purposes. The blower is only available with the ”blowing” option. Observe the information in the type code.

A minimum distance between the blower screen and the machine must be maintained to ensure that the required air volume can flow through the blower and out of the front of the motor. See Chapter 4, "Technical Data". The distance (2) is determined by the motor construction.



(1): Machine housing
(2): Blower Exhaust
(3): Blower In-take

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 blower variants is "blowing".

Contamination will reduce the performance of the blowers and can lead to thermal overload of the motors.

When the machine is installed in an unclean environment, regularly cleaning the blower and motor radiator fins will increase the lifetime of your motor.

When designing the machine, take into account accessibility to the motors and blowers for maintenance purposes.

Coolants

MAF motors must always be operated with an external cooling system.

The energy losses of the motor, P(v), are dissipated through the cooling system. Accordingly, MAF motors may only be operated if proper coolant flow is ensured. The cooling system has to be rated by the machine manufacturer in such a way that all requirements regarding flow, pressure, purity, temperature gradient etc. are maintained at all times.

CAUTION

Impairment or loss of motor, machine or cooling system!

⇒ Consider absolutely the motor data and the explanations and conceptions of the cooling systems in the documentation ”Liquid cooling, dimensioning, selection”, MNR R911265836.

⇒ Consider the manufacturer instructions at construction and operation of cooling systems.

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

All details and technical data refer to water as a coolant. When using other coolants, these data are no longer valid and must be recalculated.

Cooling using tap water is not recommended. Hard 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 additive which is suitable for mixed-installations with the materials acc. to Fig. 9-13.

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

⇒ Use a recirculating system with a fine filter ≤ 100 µm.

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

Aqueous Solution

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

Emulsion with Corrosion Protection

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

If the corrosion protection oil must not only provide corrosion protection also provide lubrication of the cooling pump, then the oil content of 5% by volume is necessary.

⇒ Note the regulations 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 frost protection	Deutsche Total GmbH, Düsseldorf
Aral coolant frost protection A	ARAL AG, Bochum
BP antifrost X 2270 A	Deutsche BP AG, Hamburg
emulsifiable mineral oil concentrate	
Shell Donax CC (WGK: 3)	Shell, Hamburg

Fig. 9-13: 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 in the responsibility of the machine manufacturer. See also Chapter 9.4 ”Compatibility”.

Materials used in the Cooling System

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

Motor, housing	Threaded connections	Snap-on coupling
Cu, CuZn39Pb2	Chromium-plated Brass	Chromium-plated Brass

Fig. 9-14: MAF material

In dimensioning and operating the cooling system, the machine manufacturer has to consider and prevent all chemical or electro-chemical interactions while ensuring against corrosion or decomposition of motor parts.

Inlet Temperature of Coolant

IndraDyn A motors have been designed acc. to DIN EN 60034-1 for operation with coolant temperature of +10...+40°C. This temperature range must be observed at all times. With higher coolant temperatures, the reduction of the available torque is increased. Because of high temperature gradients, lower coolant temperatures can lead to destruction of the motor.

Note: Install systems in the cooling circuit to monitor flow, pressure, and temperature.

Setting the Inlet Temperature

Setting the inlet temperature of the coolant must be carried out observing the specified temperature range and taking into account the existing ambient temperature.

The lower threshold of the recommended coolant inlet temperature may be limited depending on the existing ambient temperature. To avoid condensation, the lowest allowable coolant temperature may be max. 5°C below the existing ambient temperature.

Example 1:

Permissible range of coolant inlet temperature: +10... +40°C

Ambient temperature +20°C

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

Example 2:

Permissible range of coolant inlet temperature: +10... +40°C

Ambient temperature +30°C

Coolant inlet temperature to be set: +25... +40°C

9.9 Motor Temperature Overview

In their standard configuration, stators of IndraDyn L motors are equipped with built-in motor protection temperature sensors.

These have nearly a linear characteristic curve (see Fig. 9-16).

Temperature Measurement of Sensors

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

Fig. 9-15: Temperature measurement sensor

Note: To avoid damage, observe the correct polarity when using the sensor for external temperature measurement .

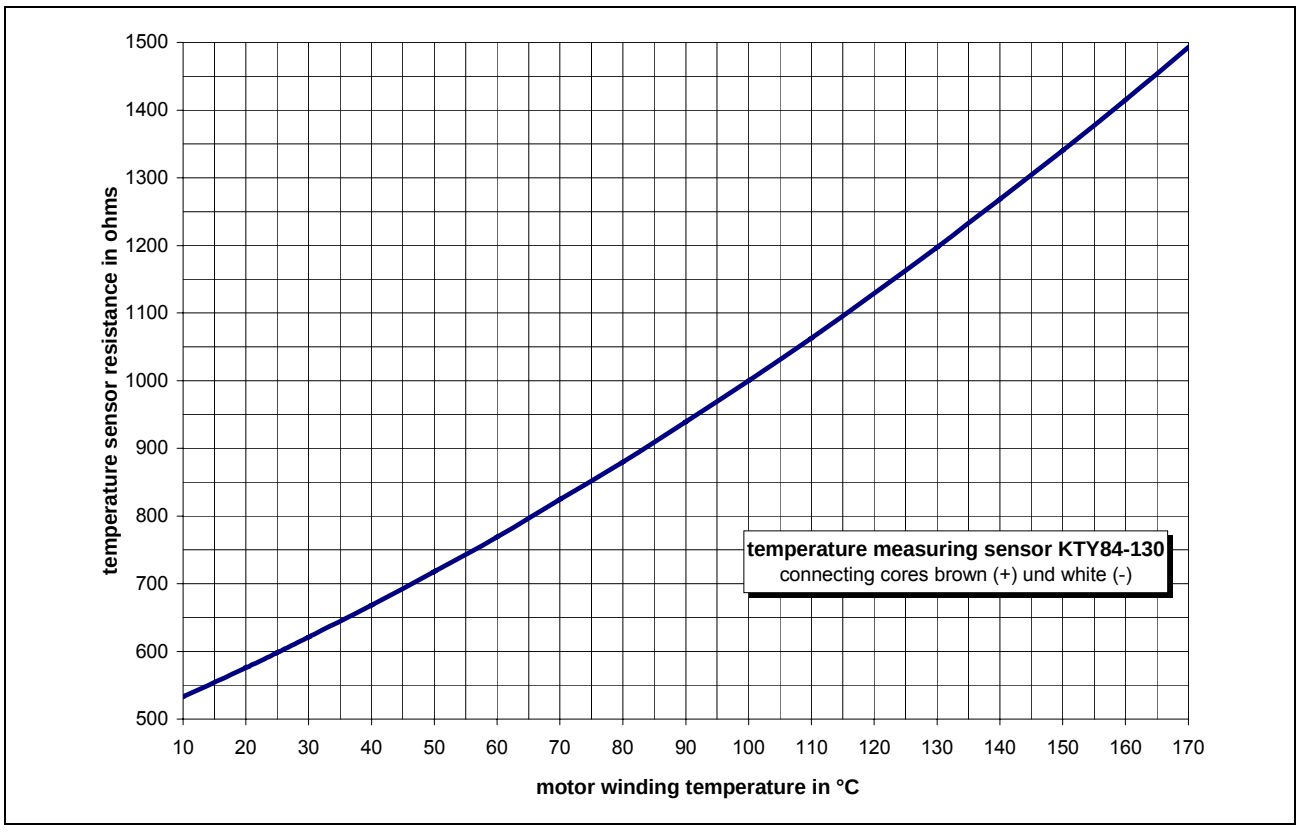


Fig. 9-16: Characteristic sensor temperature measurement KTY84-130 (PTC)

9.10 Motor 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 axes when the machine is in a de-energized state.

CAUTION

Hazardous movements! Persons endangered by falling or descending axes!

⇒ Observe supplementary DIN and guidelines. For European countries:

- DIN EN 954 / 03.97 on security-related parts of controllers.
- Instruction sheet for vertical axis

Editor:
Süddeutsche Metall-Berufsgenossenschaft
Fachausschuss Eisen und Metall II
Wilhelm-Theodor-Römheld-Str. 15
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 destinations must be observed!

⇒ The serially delivered motor holding brake does not suffice to ensure personal protection!

⇒ Ensure personal protection 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

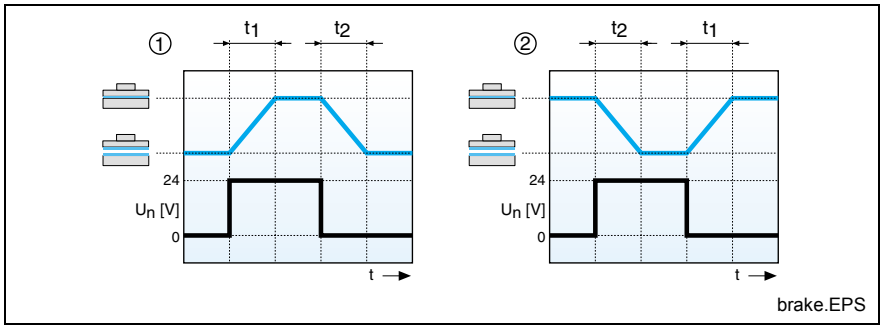
The brake's control mechanism must ensure this function in normal operation. Under the worst-case load condition of the power supply, a voltage of 24 V_{DC} +/- 10% must be provided the motor brake. To identify a failure in time during operation, the power supply for the brakes must be monitored by an 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-clamped or electrically-released. Due to functional differences, different brakes should be used for main-spindle and for servo-axes. Observe the safety requirements during the system design.



(1): Electrically-clamped brake
(2): Electrically-released brake
t_1: Clamp delay
t_2: Releasing time

Fig. 9-17: Holding brake diagram

Main Spindle Applications

Electrically-clamped Holding Brake

An **electrically-clamped** 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, i.e. after the controller has signaled the motor is at standstill.

An **electrically-released** holding brake should not be used on main spindles. Unintentional clamping of the holding brake at high motor speeds 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-released Holding Brake

An **electrically-released** holding brake is used to hold the axes at a standstill and when the “controller enable (rF)” signal is off. When the power supply voltage is lost or the rF-enable signal is LOW, the **electrically-released** brake will automatically close (engage).

⇒ Do not use the holding brake as an service brake for moving axes.

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.

Dimensioning of Holding Brakes (Application)

The physical conditions of holding brakes require consideration of two states. In addition to normal operation, fault conditions must also be considered. The effective braking torques are physically different.

Normal Operation

In **normal operation**, i.e. using the holding brake for clamping of an axis at standstill, the brake’s static-torque (M4) rating in the data sheets applies - directly as static holding torque (M4) - static friction (friction coefficient μ_H).

Fault Condition (EMERGENCY STOP)

In **fault conditions (i.e., EMERGENCY STOP)**, i.e. when the holding brake is used to stop a moving axis, the ”dynamic braking torque”, or sliding friction applies - friction coefficient μ_G.

The dynamic braking torque is reduced in comparison to the indicated static holding torque M4. Therefore, note the following description of dynamic dimensioning.

Dynamic Dimensioning

The load torque must be smaller 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 route, the additional mass moment of inertia of the whole system must be taken into account.

Further Important Aspects for Dimensioning:

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 generation on the friction surface, the brake holding torque can be reduced. Additionally, over voltages and temperatures can weaken the permanent magnets and the brake.

Dimensioning Recommendation

Bringing these factors together, the following recommendations can be given for dimensioning 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 chosen holding brake.

Note: Holding-torque reduction and premature deterioration occur when braking moving axes!

Do not use the holding brake to stop a moving axis! 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 the brake`s holding capacity can be expected after approximately 20,000 revolutions of a clamped/closed brake.

Observe the instructions on commissioning holding brakes as described in Chapter 12, ”Startup, Operation, and Maintenance”.

9.11 Motor Encoder

Options

"**S0**": Single-turn incremental encoder with I²C interface. 1Vpp sine/cosine signals with 512 lines per revolution and absolute period assignment within one shaft rotation.

"S2" Single-turn incremental encoder with EnDat2.1 interface. $1V_{pp}$ sine/cosine signals with 2048 lines per revolution and absolute period assignment within one shaft rotation. The encoder is equipped with a data memory that already contains all relevant motor data required for putting the motor into operation.

"**M0**": Multi-turn incremental encoder with I²C interface. $1V_{pp}$ sine/cosine signals with 512 lines per revolution and absolute period assignment within 4096 shaft rotations. The shaft position is stored if the power fails.

"**M2**": Multi-turn incremental encoder with EnDat2.1 interface. $1V_{pp}$ sine/cosine signals with 2048 lines per revolution and absolute period assignment within 4096 shaft rotations. The shaft position is stored if the power fails. The encoder is equipped with a data memory that already contains all relevant motor data required for putting the motor into operation.

"**C0**": Incremental encoder, sine/cosine signal-1Vpp with 2048 lines per revolution.

"**N0**": The motor is supplied without a factory-installed encoder unit. The rear of the motor is protected 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:

	ECO03	DIAX04	IndraDrive					
Encoder option	DKC 16...400	HDD, HDS	ADVANCED	BASIC OPEN LOOP	BASIC SERCOS	BASIC PROFIBUS	BASIC ANALOG	BASIC UNIVERSAL
C0	+	+	+	-	-	-	-	+
M0	+	+	+	-	-	-	-	+
M2	-	-	+	+	+	+	+	+
S0	+	+	+	-	-	-	-	+
S2	-	-	+	+	+	+	+	+
+ compatible - incompatible								

Fig. 9-18: Encoder compatibility

Accuracy/Repeatability

There are two types of accuracy for rotary encoders: "absolute accuracy" and "relative accuracy".

Absolute Accuracy

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 1Vpp with 2048 lines/rev	± 0.0056° (± 20")
M0	Multi-turn incremental encoder with I²C interface. Incremental encoder, sinus/cosine signal 1Vpp with 512 lines/rev	± 0.0167° (± 60")
M2	Multi-turn incremental encoder with EnDat2.1 interface. Incremental encoder sinus/cosine signal 1Vpp with 2048 lines/rev	± 0.0056° (± 20")
S0	Single-turn incremental encoder with I²C interface. Incremental encoder sinus/cosine signal 1Vpp with 512 lines/rev	± 0.0167° (± 60")
S2	Single-turn incremental encoder with EnDat2.1 interface. Incremental encoder sinus/cosine signal 1Vpp with 2048 lines/rev	± 0.0056° (± 20")

Fig. 9-19: Absolute accuracy of encoder

Relative Accuracy "Repeatability"

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 internal and external interpolation - and digitization electronics.

For IndraDyn A 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 1Vpp with 2048 strokes	± 0.01'
M0	Multi-turn incremental encoder with I²C interface. Incremental encoder, sinus/cosine signal 1Vpp with 512 lines/rev	± 0.005'
M2	Multi-turn incremental encoder with EnDat2.1 interface. Incremental encoder sinus/cosine signal 1Vpp with 2048 lines/rev	± 0.005'
S0	Single-turn incremental encoder with I²C interface. Incremental encoder sinus/cosine signal 1Vpp with 512 lines/rev	± 0.001'
S2	Single-turn incremental encoder with EnDat2.1 interface. Incremental encoder sinus/cosine signal 1Vpp with 2048 lines/rev	± 0.001'

Fig. 9-20: Relative encoder precision

Continuous development of the hardware and firmware for drive controllers may result in variances from the above values. Therefore,

always observe the information in the most-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 of the Encoder

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 additional details, refer to the dimension sheet of the motor and to Chapter 8 "Connection Technique".

Detailed information on the encoder connection to the controller, and on the setting of its parameters can be found in the documentation of the drive controllers.

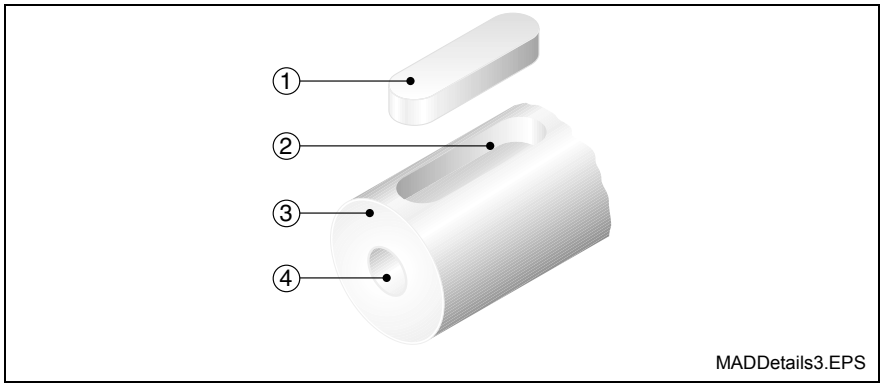
9.12 Output Shaft

Plain Shaft

The recommended standard model for all IndraDyn A motors provides a friction-type, zero-backlash, shaft-hub connection with a high degree of quietness. Use clamping sets, thrust sleeves or clamping elements to couple the machine elements to be driven by the motor.

Output Shaft with Key

An optional keyed output shaft, according to DIN 6885, Sheet 1, edition 08-1968, permits form-fitting transmission of torque for non-reversing with low requirements on the shaft-hub connection.



(1): Key (2): Keyway
(3): Motor drive shaft (4): Center hole

Fig. 9-21: Output shaft with key

The machine elements to be driven must additionally be secured in the axial direction via the centering hole in the front of the shaft.

Note: Avoid strong reversing operations. Deformations to the keyway can lead to breakage of the shaft.

Balancing with a Half Key

The motor is balanced with 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 Full Key

The motor is balanced using the included key. Hence, the machine element to be driven must be balanced without a key. The keyway 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 key or motor drive shafts.

Output Shaft with Seal

If the IndraDyn A motor is ordered with the optional radial shaft seal according to DIN 3760 – Design A, they can be mounted to transmissions with oil bath or circulating-oil lubrication, applied dusty environments, or operated in moist rooms.

Note: In case of open, oil-lubricated gearboxes, excessive mist or speeds above 4000min^{-1}, we recommend an additional labyrinth sealing which can be ordered and retrofitted as an accessory (refer to Chapter 7 “Accessories”).

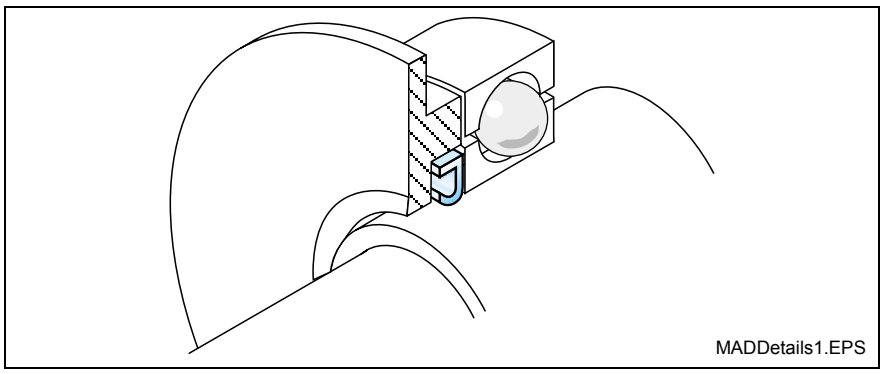


Fig. 9-22: Shaft seal

Deterioration

Radial shaft seals are friction seals. Hence, they are subject to deterioration and generate frictional heat.

Deterioration of the friction seal can be reduced only if lubrication is sufficient and if the point of contact is clean. Here, the lubricant also acts as a coolant, supporting the discharge of frictional heat from the contact area. The lifetime of the lip seal on the radial shaft seal depends on how clean it is, on the lubrication and on the motor speed.

Note: Prevent the surface area near the seal from becoming dry and dirty. Always ensure sufficient cleanliness and lubrication.

Resistance to Oil and Chemicals

The materials used for the shaft seal 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:

Motor MAD/MAF ...	Sealing material	Abbreviation
100...160	Polytetrafluorethylene	PTFE
180	Viton	FKM

Fig. 9-23: IndraDyn A shaft seal

The complex interactions between the seal, the shaft and the fluid to be sealed, as well as the particular operating conditions (frictional heat, soiling, etc.), do not allow for an exact calculation of the lifetime of the shaft seal.

With a circumferential speed of 5 m/s and in favorable conditions (e.g. sufficient cleanliness and lubrication), a lifetime of between 5,000 and 10,000 h can nevertheless be achieved.

Vertical Mounting Positions IM V3/IM V6

The international protection rating on the flange side of motors with an optional shaft seal is IP 65. Hence, impermeability is only ensured against splashing fluids. Liquid levels present on the motor-output side require a higher degree of protection. In the case of vertical installations, also heed the notes in Chapter 9.6 "Vertical Installation".

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

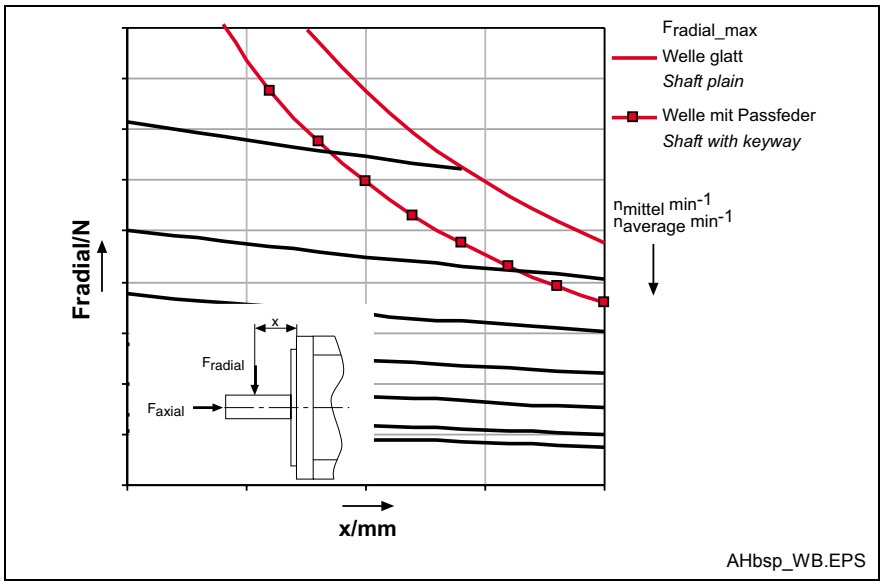


Fig. 9-24: Example of a shaft load diagram

Maximum Permissible Radial Force F_{radial_max}

The maximum permissible radial force F_{radial_max} depends on the following factors:

- Shaft-breaking stress
- Point of force application, x (see Fig. 9-24)
- Shaft design (smooth; with keyway)

Permissible Radial Force F_{radial}

The permitted radial force F_{radial} depends on the following factors:

- Arithmetic mean speed (n_{mean})
- Point of force application x (see Fig. 9-24)
- Bearing Lifetime

Permissible Axial Force F_{axial}

Only low axial shaft loads are permitted on IndraDyn A motors.

MAD/MAF	100	130	160	180
permissible axial load [N]	30	50		

Fig. 9-25: Axial load

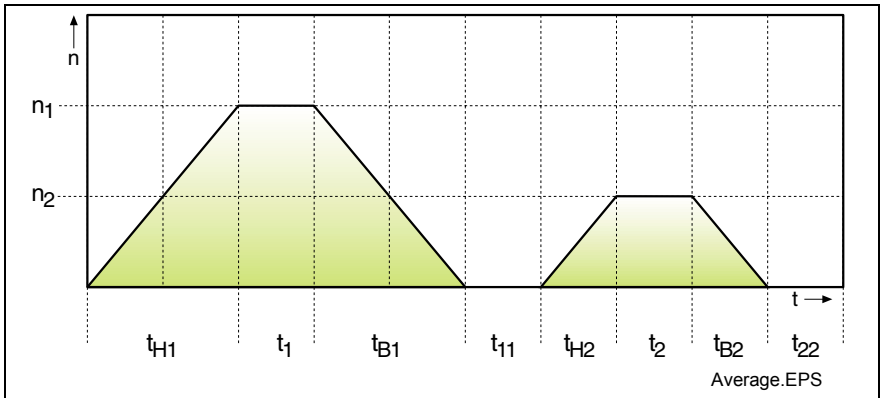
The permitted axial load applies for all installation positions. Therefore, the motors are **not** suitable for machine elements that generate axial loading of the motors (e.g. helical driving pinions).

Note: Avoid impermissible axial loads or jolting of the motor drive shaft.

Mean Speed

The acceleration and deceleration times can be ignored in the calculation if the time during which the drive is operated at a constant speed is

significantly greater than the acceleration and deceleration times. In the exact calculation of the mean speed according to the following example, the acceleration and deceleration times are taken into account.



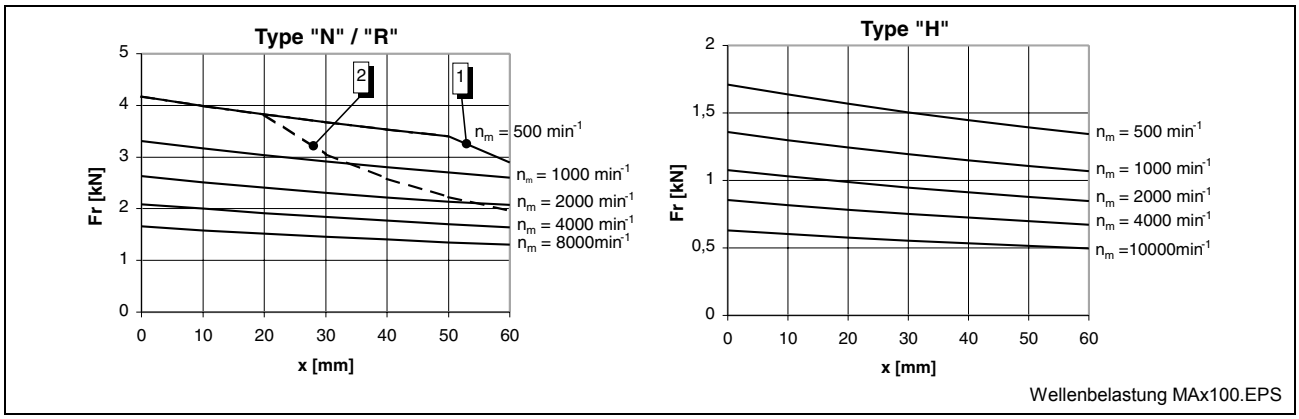
$$n_{1m} = \frac{\frac{n_1}{2} \cdot t_{H1} + n_1 \cdot t_1 + \frac{n_1}{2} \cdot t_{B1}}{t_{H1} + t_1 + t_{B1} + t_{11}}$$

n_{1m}:	mean speed in section 1	n_{2m}:	mean speed in section 2
n_1:	processing speed	n_2:	processing speed
t_{H1}:	acceleration time	t_{H2}:	acceleration time
t_1:	processing time	t_2:	processing time
t_{B1}:	deceleration time	t_{B2}:	deceleration time
t_{11}:	standstill time	t_{22}:	standstill time

Fig. 9-26: Mean speed

A complete operating cycle can consist of several sections with different speeds. In this case, the average is to be generated from all the sections.

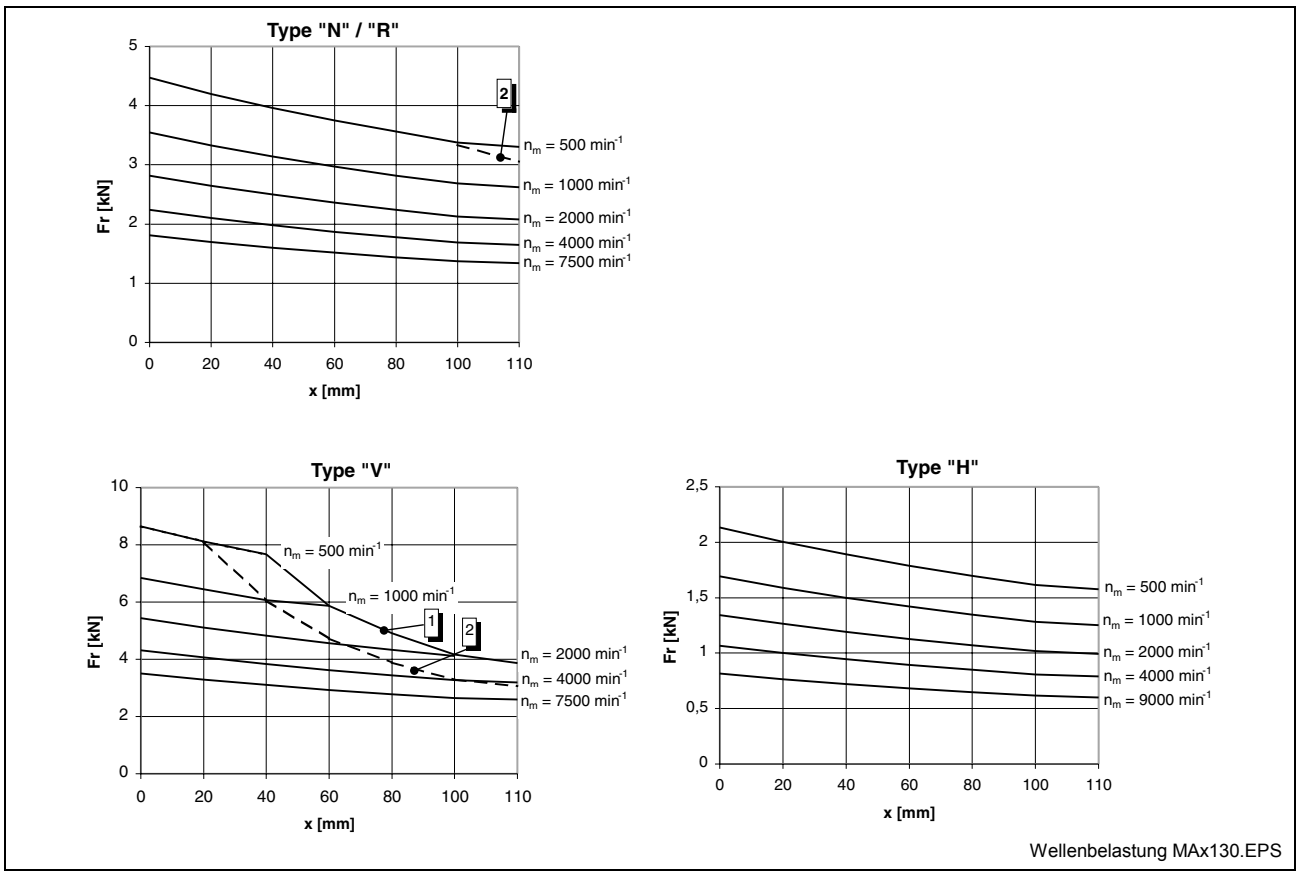
Shaft Load, Size 100



"N":	Standard bearings
“R“:	Bearing for coupling attachment
”H”:	High-speed bearing
(1):	Load limit for drive shaft without keyway
(2):	Load limit for drive shaft with keyway
n_m:	Mean speed

Fig. 9-27: Shaft load, Motor-frame size 100 (L_h=30,000 operating hours)

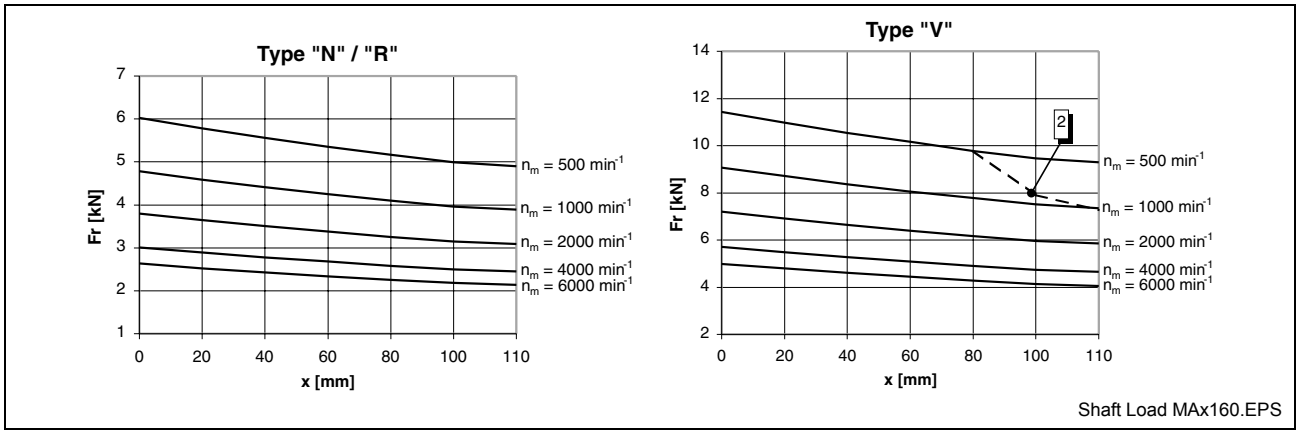
Shaft Load, Size 130



"N": Standard bearings
“R“: Bearing for coupling attachment
“V“: Reinforced bearing
”H”: High-speed bearing
(1): Load limit for drive shaft without keyway
(2): Load limit for drive shaft with keyway
n_m: Mean speed

Fig. 9-28: Shaft load, Motor-frame size 130 (L_h=30,000 operating hours)

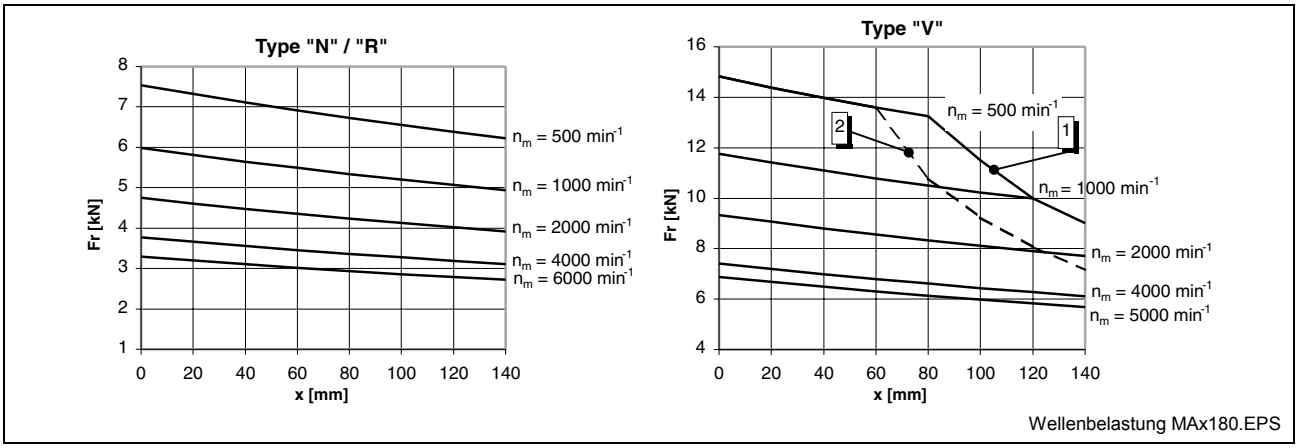
Shaft Load, Size 160



"N": Standard bearings
“R“: Bearing for coupling attachment
“V“: Reinforced bearing
(1): Load limit for drive shaft without keyway
(2): Load limit for drive shaft with keyway
n_m: Mean speed

Fig. 9-29: Shaft load, Motor-frame size 160 (L_h=30,000 operating hours)

Shaft load, size 180



"N": Standard bearings
"V": Reinforced bearing
(1): Load limit for drive shaft without keyway
(2): Load limit for drive shaft with keyway
n_m: Mean speed

Fig. 9-30: Shaft load, Motor-frame size 180 (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
- gear pinions

it is imperative that the following notes are observed.

Overdetermined Bearing

Generally, overdetermined 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 motor bearing and perhaps also to a distinctly reduced lifetime of the bearing or to a progressive bending fracture or fatigue fracture of the motor shaft.

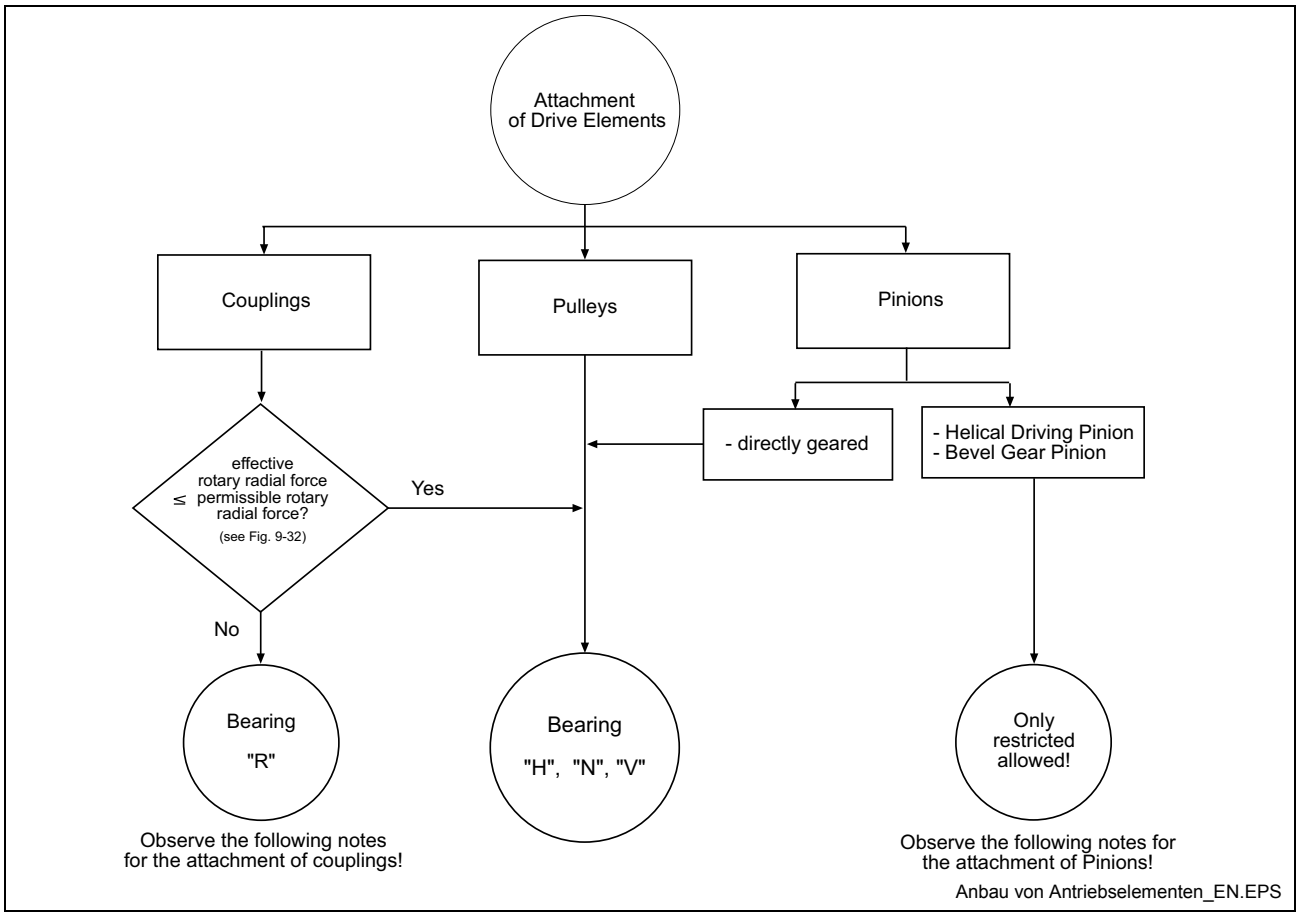


Fig. 9-31: Attachment of Drive Elements

Note: If redundant attachment cannot be avoided, it is absolutely necessary to consult with Bosch Rexroth.

Couplings

Couplings are attached for the torque transmission of two separate shaft ends, whereby normally the shaft offset, angular misalignment or axial distances must be balanced. When attaching couplings that are too stiff, a circumferential (= continuously changing the angular position) radial load can thereby be generated to the drive end. This circumferential radial load may result in an impermissibly high load to the seating of the bearing and thereby to a significantly reduced lifetime of the bearing.

Note: Rexroth offers the „R“ bearing type for attaching couplings to IndraDyn A motors.

By using the “R“ bearing, high circumferential radial forces can be absorbed. Furthermore, couplings with a high rate of radial rigidity can be used.

Motor frame size MAD/MAF….	Permissible circumferential radial forces	
	with “R“ bearing:	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

Fig. 9-32: Permissible circumferential radial forces

Note: By using the “R“ bearing, a limited maximum speed is available.

Details on the maximum speed are contained in Chapter 4, “Technical Data“ for the respective motor.

Coupling Recommendations

When used with R-type bearings, Rexroth recommends axial-balancing couplings such as, e.g.

- Spring washer couplings with two spring packages (double cardanic)
- Metal bellows couplings

These types of coupling are backlash-free and have a high level of torsional rigidity with a low radial spring rigidity.

Note: If the recommended types of coupling cannot be used then you **must** contact Bosch Rexroth.

Recommended manufacturers for the above-mentioned couplings are, e.g.

- A. Friedrich Flender GmbH
  Alfred Flender Strasse 77
  D-46395 Bocholt
  Tel.: +49 (0) 2871 920
  Fax +49 (0) 2871 922 596
  Internet: www.flender.com
- JAKOB GmbH&CoKG
  Daimler Ring 42
  D22 Bocholt
  Tel.: +49 (0) 6022 2208 0
  Fax +49 (0) 6022 2208
  Internet: jakobantriebstechnik.de
- R+W Antriebselemente GmbH
  Alfred Flender Strasse 0
  D22 Bocholt
  Tel.: +49 (0) 9372 9864
  Fax +49 (0) 9372 9864
  Internet: www.rw-kupplungen.de

Helical Driving Pinion

Owing to thermal effects, the end of the output shaft may shift up to 0.6mm in relation to the motor housing. If helical or spiral-bevel driving pinions are directly attached to the output shaft are used, this change in position will lead to

- a skewing of the bearing of the driven axis.

Note: The direct attachment of helical driving pinions is not allowed in general. If helical driving pinions have to be used then only drive elements with their own bearings may be used that are connected to the motor shaft via axial-balancing couplings!

Bevel Gear Pinion

Owing to thermal effects, the end of the output shaft may shift by 0.6 mm in relation to the motor housing. If bevel gear pinions are directly mounted to the output shaft, this change in position will lead to

- a thermally dependent component of the axial force if the driving pinions are axially fixed on the machine side. This could allow the maximum permissible axial force to be exceeded or for the backlash within the mesh to increase to an impermissible degree.

For this reason, bevel gear pinions may not be attached directly to the motor shaft. If bevel gear pinions have to be used then only drive elements with their own bearings may be used and these must be connected to the motor shaft via axial-balancing couplings!

Note: The direct attachment of bevel gear pinions to the motor shaft is not allowed.

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 Lifetime 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 loads from the corresponding chapter 9.13 "Shaft load" are never exceeded.
- The motor is operated within the permitted operating conditions and within the permitted ambient temperature range of 0° C to +40° C.
- The „mean speed“ over the entire processing cycle conforms to the following characteristics for the grease lifetime, whereby the following applies:

$$n_m < n_{m(t_f\,30000\,h)}$$

n_m: mean speed
$n_{m(tf)}$: mean speed for which a grease lifetime of 30,000 h can be expected.

Fig. 9-33: Mean speed

Differing loads can have the following influences:

- Premature malfunction of the bearing due to increased deterioration or mechanical damage.
- Reduction of the grease lifetime, leading to premature bearing loss.

⇒ Avoid exceeding the load limits.

Mechanical Lifetime with Increased Radial Force

In other cases, the bearing lifetime is reduced as follows:

$$L_{10h} = \left(\frac{F_{radial}}{F_{radial\_ist}} \right)^3 \cdot 3000$$

L_{10h}: (Bearing lifetime according to ISO 281, ed. 12/1990)
F_{radial}: Permissible radial force in N (Newton)
F_{radial_ist}: Actual radial force in N (Newton)

Fig. 9-34: Calculation of the bearing lifetime L_{10h} if the permissible radial force F_{radial} is exceeded

Note: Under no circumstances may the actually acting radial force F_{radial_ist} be higher than the maximum permissible radial force F_{radial_max}.

9.16 Grease Service Life

The grease service life (t_f) is the time from the start until the failure of the bearing as a result of a failure of the lubrication.

Please observe that unfavorable operating and environmental conditions result in a reduction of the grease service life. When determining the expected grease service life (t_{fq}), certain reducing factors for unfavorable operating and environmental conditions must therefore always be taken into consideration for each individual application. The following table indicates the reduction factor, based on the FAG Kugelfischer AG Publication No. WL 81 115/4 DA.

Reduction Factor

Description	Description	Influence	Factor	Note
Influence of dust and moisture on the functional surfaces of the bearing	f_1	moderate	0.9....0.7	Rexroth offers the „radial shaft seal“ option for this environment. By the use of this option $f_1 = 1$
		severe	0.7....0.4	
		very severe	0.4....0.1	
Influence of load due to shock, vibration and oscillations	f_2	moderate	0.9....0.7	e.g. in machine tools and printing machines
		severe	0.7....0.4	e.g. in conveying equipment (gantries)
		very severe	0.4....0.1	e.g. in punches and pressers
Influence of high temperatures	f_3	moderate (to 75°C)	0.9....0.6	The bearing temperature depends on the load on the motor. Through the use of a special high-temperature grease the following load results in the following factor: - load 0...70% $f_3 = 1$ - load 71...100% $f_3 = 0.99...0.7$
		severe (75...85°C)	0.6....0.3	
		very severe (85..0.120°C)	0.3....0.1	
Influence of a high load	f_4	P/C=0.1...0.15	1.0....0.7	With a corresponding load to the shaft/bearing acc. to the respective shaft load diagram, the following results for 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 currents through the bearing	f_5	low currents	0.7....0.5	In proper operation, there is no effective air current in the motor $f_5 = 1$
		high currents	0.5....0.1	
In case of a centrifugal effect or vertical installation, depending on the type of seal	f_6	vertical	0.7....0.5	When the motor is installed horizontally $f_6 = 1$

Fig. 9-35: Factors that reduce the grease service life

Calculation

$$t_{fq} = t_f \cdot f_1 \cdot f_2 \cdot f_3 \cdot f_4 \cdot f_5 \cdot f_6$$

Fig. 9-36: Calculation of the grease service life to be due

Note: Ensure that the permissible loads in Chapter 9.13 “Bearing and Shaft Loads”, are not exceeded.

If the duration of use of the motor is limited by a short grease lifetime, the duration of use can be increased by using the standard bearing in place of the reinforced bearing in exceptional cases. The grease lifetime therefore increases, however, the increased loading of the standard bearing reduces the available mechanical lifetime to below 30,000 operating hours.

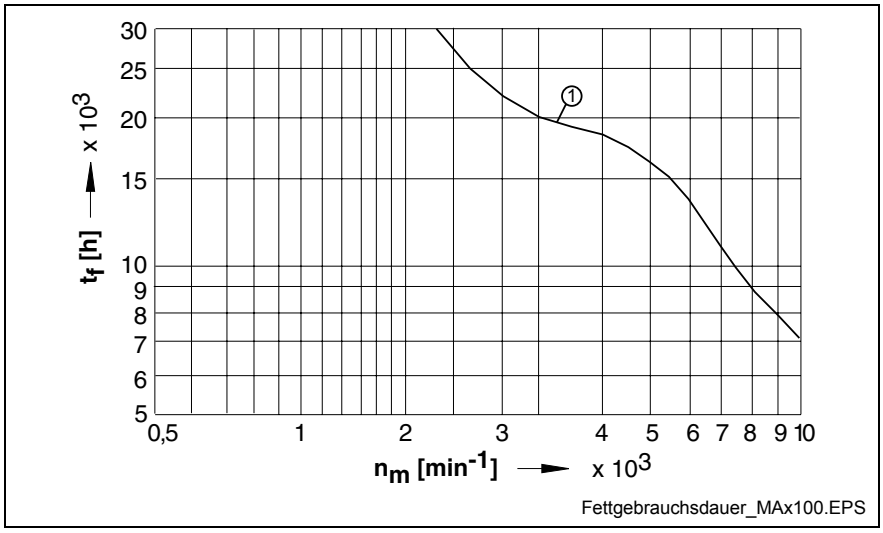
⇒ This requires subsequent calculation of the bearing lifetime by Rexroth. In this case, contact one of our branch offices and explain your application with all relevant application data (load cycle, axial and radial loads, speeds, etc.).

The calculation and dimensioning of the bearing is based on standard DIN ISO 281.

The available grease lifetime of the deep-groove ball bearing and the cylindrical roller bearing in IndraDyn A motors is shown in the following diagrams.

The diagram contains the various characteristic curves, depending on the type of bearing, i.e. standard, high-speed or reinforced bearings, as well as the bearing for the attachment of a coupling.

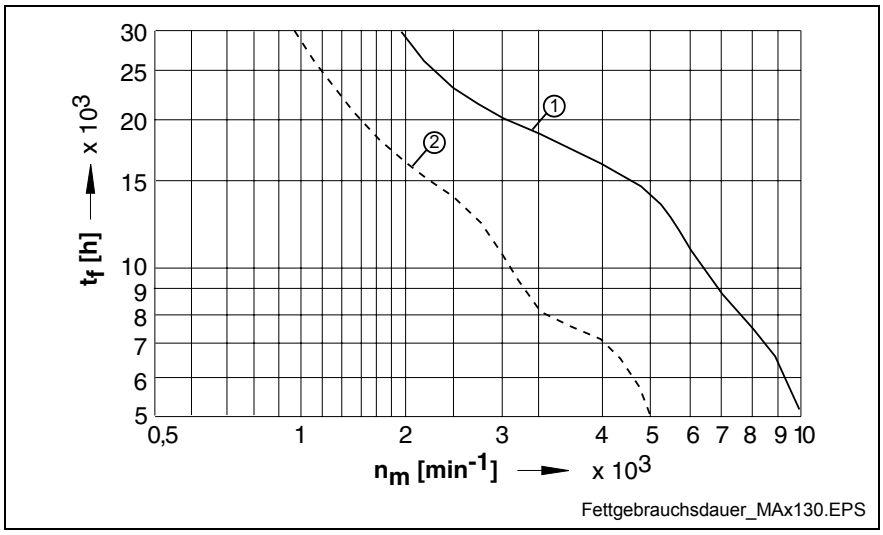
Grease Lifetime, Motor-frame size 100



t_f: Grease lifetime (without reduction factor)
(1): Standard bearing, high-speed bearing and bearing for coupling attachment
n_m: mean speed (for the calculation, refer to Fig. 9-26)

Fig. 9-37: Grease lifetime, size 100

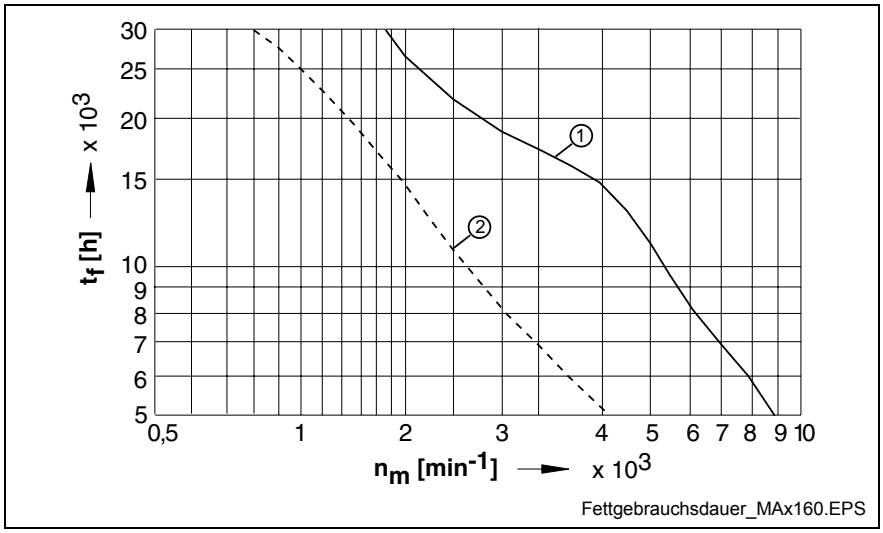
Grease Lifetime, Motor-frame size 130



t_f: Grease lifetime (without reduction factor)
n_m: mean speed (for the calculation, refer to Fig. 9-26)
(1): Standard bearing, high-speed bearing and bearing for coupling attachment
(2): Reinforced bearing

Fig. 9-38: Grease lifetime, size 130

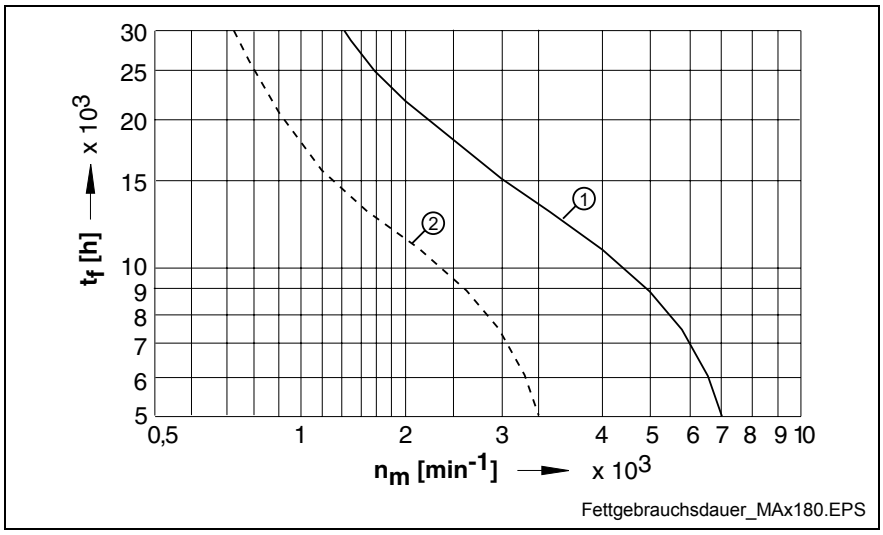
Grease Lifetime, Motor-frame size 160



t_f: Grease lifetime (without reduction factor)
n_m: mean speed (for the calculation, refer to Fig. 9-26)
(1): Standard bearing and bearing for coupling attachment
(2): Reinforced bearing

Fig. 9-39: Grease lifetime, size 160

Grease Lifetime, Motor-frame size 180



t_f: Grease lifetime (without reduction factor)
n_m: mean speed (for the calculation, refer to Fig. 9-26)
(1): Standard bearing and bearing for coupling attachment
(2): Reinforced bearing

Fig. 9-40: Grease lifetime, size 180

9.17 Types of Bearing

The following types of bearing can be delivered depending on the motor frame sizes of the IndraDyn A motors:

- 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 model
- Bearing for coupling attachment “**R**“ = deep-groove ball bearing + special bearing seat

Standard Bearings

Universal bearing (type code “N”), suitable for taking up low to medium radial and axial forces.

Advantages:

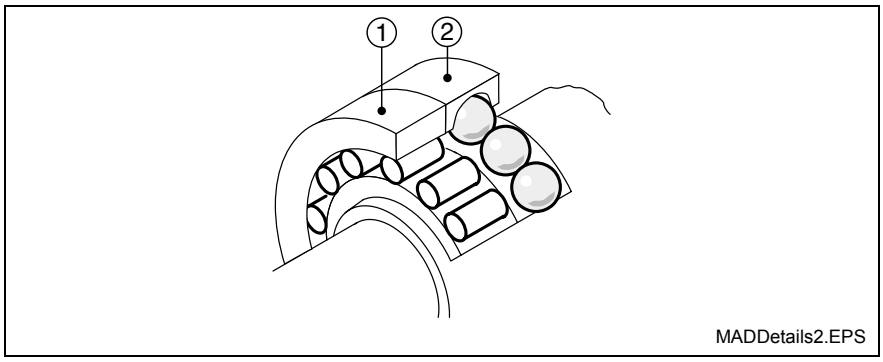
1. Easily available and high lifetime
2. Suitable for high speeds
3. Quiet running

Disadvantage:

Deep-groove ball bearings are suitable only for low to medium radial and axial loads.

Reinforced Bearings

The reinforced bearing (type code "V") is equipped with an additional cylindrical roller bearing on the drive side.



(1): Cylindrical roller bearing
(2): Deep-groove ball bearing
Fig. 9-41: IndraDyn A reinforced bearing

Advantage:

The reinforced bearing can take up larger radial forces.

Disadvantages:

1. The grease lifetime is reduced to half of the standard value.
2. In certain motors, a reduction of the maximum permitted speed results.
3. Motors with a reinforced bearing may be operated only with a permanent radial load (see Fig. 9-42). Without this force, the bearings could be damaged by resulting sliding friction.

Motors with a reinforced bearing must be operated with the following minimum radial loads.

MAD/MAF	130	160	180
Minimum radial load [kN]	1	1.5	2

Fig. 9-42: radial load while using a reinforced bearing

Note: Select the "reinforced bearing" option only in exceptional cases.

High-speed Bearings

The high-speed bearing (type code "H") permits very high speeds due to a deep-groove ball bearing with an accordingly low-weight construction.

Advantage:

The high-speed bearing permits very high speeds.

Disadvantage:

High-speed bearings can take up only low radial loads.

Bearing for Coupling Attachment

The bearing option for the coupling attachment (type code “R“) allows the acceptance of higher circumferential radial forces, such as can result from motor operation in connection with a coupling.

Advantages:

1. Couplings with a high rate of radial rigidity can be used.
2. High level of resistance to circumferential radial forces that can occur during motor operation with a coupling.

Disadvantage:

A reduced maximum speed of the motor is available to it.

Tips for Selection

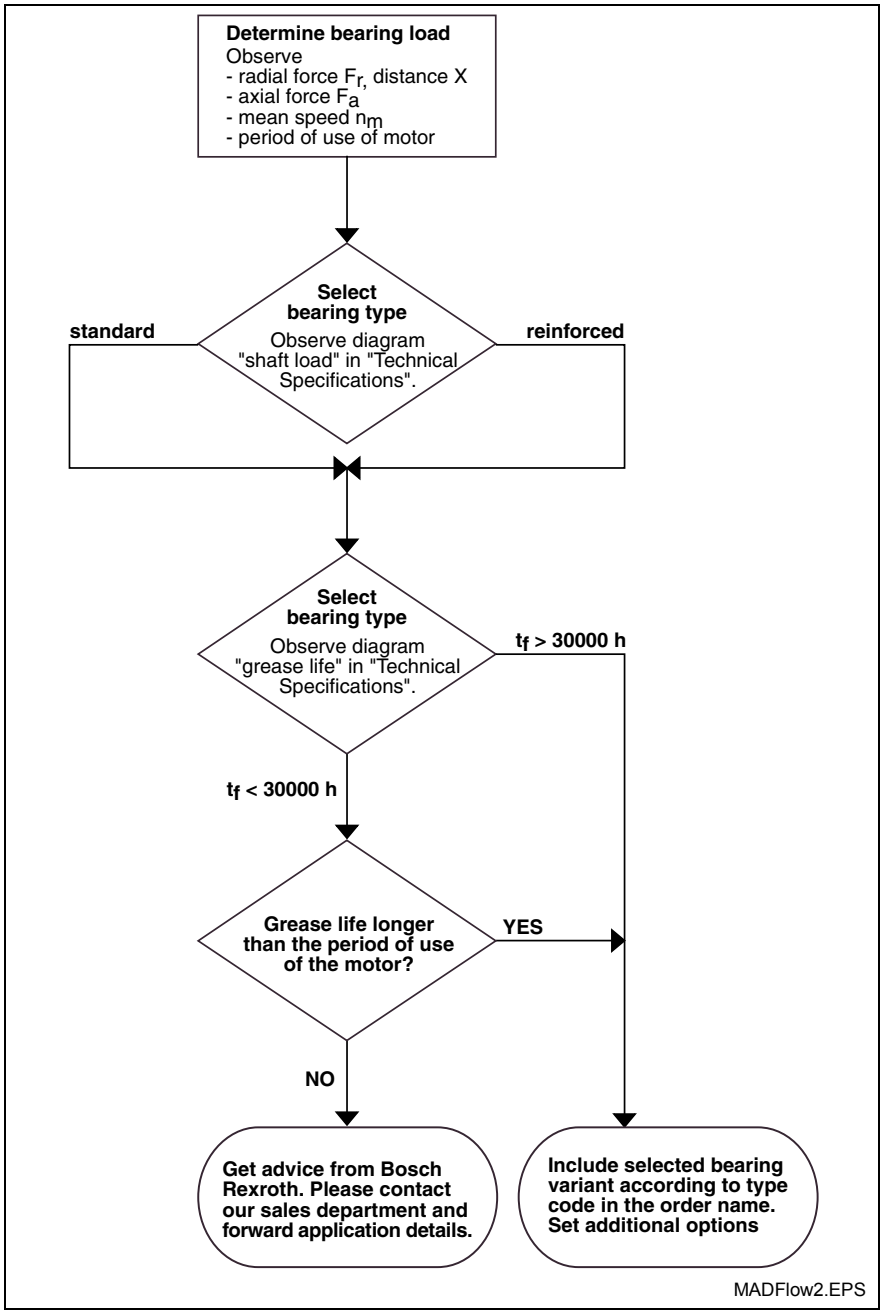


Fig. 9-43: Bearing selection process

9.18 Vibration Severity Class

IndraDyn A motors are dynamically balanced according to DIN ISO 2373.

Vibration severity Class R is standard for all IndraDyn A motors. Classes 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.

Vibration Class	Effective imbalances 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. 9-44: Effective imbalances

The vibrational behavior of attached or driven machine elements can cause repercussions on the IndraDyn A 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.

⇒ Take the vibration behavior of the motor and the machine elements into account when designing the system.

9.19 Acceptances and Authorizations

CE Symbol

Certificate of Conformity

Certificate of conformity certifying the structure of and compliance with the valid EN standards and EC guidelines are available for all IndraDyn A motors. If necessary, these certificate of conformity can be requested from the responsible sales office.

The CE symbol is applied to the motor type label of IndraDyn A motors.

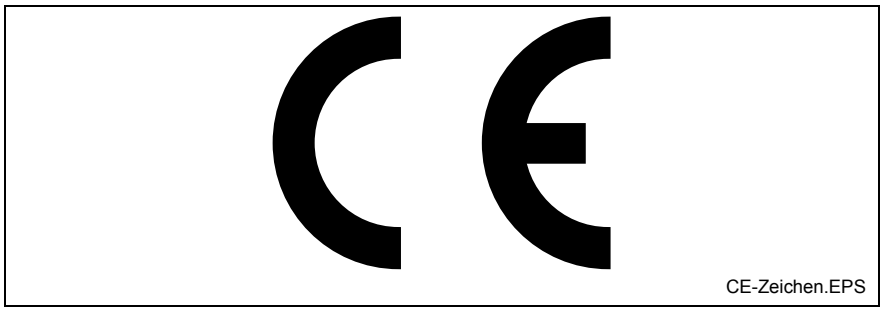


Fig. 9-45: CE mark

UR, cUR Listing

IndraDyn A motors have been presented to and authorized by the UL-authority „Underwriters Laboratories Inc.®“.

The corresponding designation of the motors is made on the motor name plate.

Fig. 9-46: cUR mark

10 Handling and Transportation

10.1 Delivery status

IndraDyn A motors are delivered in wooden crates or in cartons. Packing units on pallets are secured by metal band.

CAUTION

Injuries due to uncontrolled movement of the metal band when cutting!

⇒ Maintain a sufficient distance and carefully cut the metal band.

On delivery from the factory, the motor drive shaft and the connectors have protective sleeves. Remove the protective sleeves just before assembly.

Factory Test

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.
- Protective earth conductor connection according to EN 60204-1/1.92, Section 20.3.

Mechanical Test

- Concentricity and position tolerances of shaft end and mounting flange according to DIN 42955.
- Vibration measurement according to DIN 2373.

Inspection Tests by the Customer

Since all IndraDyn A motors undergo a standardized inspection procedure, high-voltage tests by the customer 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! Loss 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 deviation immediately.

10.3 Designation

The type designation of the complete product results from the selected options. 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.

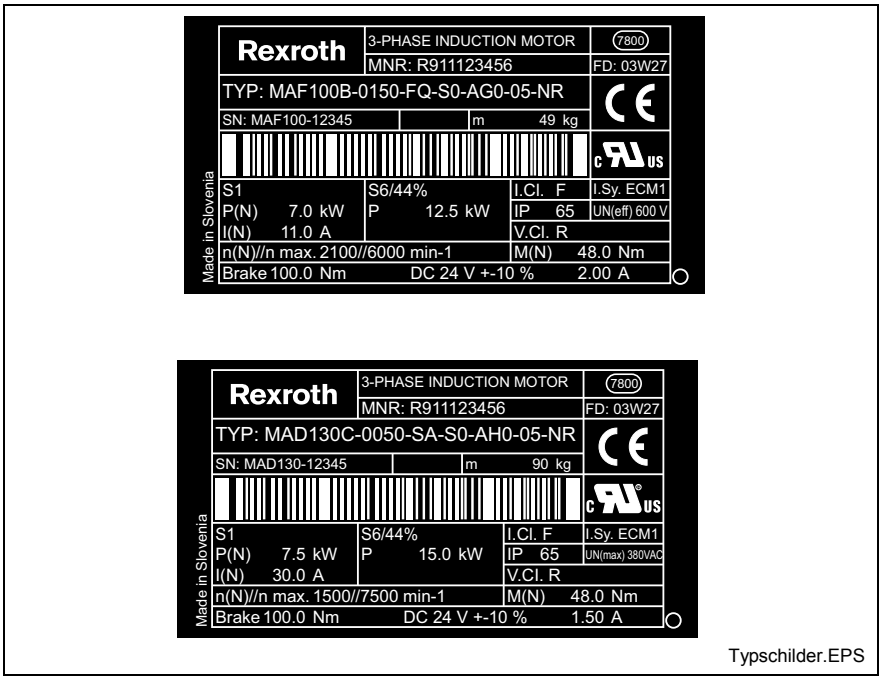


Fig. 10-1: IndraDyn A name plates

IndraDyn A motors are supplied with 2 name plates each.

Attach the second name plate to an easily-visible portion of the machine. Thus, you'll be able to read the motor data at any time without having to get into inaccessible places where the installed motor may be situated.

Before sending questions to Bosch Rexroth, always note the full type identification data and serial number of the affected products.

10.4 Transportation and Storage

CAUTION

Damage or injuries and loss warranty due to improper handling! Heavy!

⇒ Protect the products from dampness and corrosion

⇒ Avoid mechanical stressing, throwing, tipping or dropping of the products.

⇒ Use only suitable lifting equipment on the transport eyes of the motor.

⇒ Never lift the motor by the fan housing.

⇒ Use suitable protective equipment and protective clothing during transport.

Note:

- The permissible transport temperature range is –20°C to +80°C.
- The permissible storage temperature range is 0°C to +45°C.
- After storage of one to five years, the motor must warm up for one hour at 1,000 rpm before start-up.
- 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

Mechanical Ambient 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 – 200 Hz	200 -2000 Hz

Fig. 10-2: Mechanical environmental 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

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, protective equipment and protective clothing during transport.

⇒ Do not lift or move the motor by the fan unit.

⇒ Observe the safety notes found in previous chapters.

Carry out all working steps especially carefully. In this way, you minimize the risk of accidents and damages.

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

Mounting Holes

IndraDyn A motors are manufactured either for flange mounting (structural shape 05) or for foot mounting (structural shape 35). Details for the fastening holes can be found in the corresponding dimension sheet. For mounting, the following general assignment applies:

	B05 (flange assembly)			B35 (Foot assembly)		
	Hole	Bolt 1)		Hole	Bolt 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) Type and torques as recommendations for bolts of fastening class 8.8.
M_{GA} = Torque in Newton-meters.

Fig. 11-1: Mounting holes

Note: The threaded connections must be able to take up both the force due to the weight of the motor and the forces acting during operation.

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.
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.

Assembly

⇒ Assemble the motor.

Note:

⇒ Avoid clamping or jamming the piloting center on the motor side.

⇒ Avoid damage to the pilot hole on the system side.

⇒ Check the fit and accuracy of the connection before you proceed.

After proper mechanical assembly, make the electrical connections.

Electrical Connection

It is recommended that you use ready-made Rexroth connection cables. These cables provide a number of advantages, such as UL/CSA authorization, extreme load capability and resistance as well as a design suitable for EMC.

⇒ Perform the electrical connection of the IndraDyn A motors according to the instructions in the chapter 8 “Connection Techniques”.

Note:

- In the case of self-manufactured cables, pay attention that the design and installation are suitable for EMC.
- 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.

12 Operating IndraDyn A Motors

12.1 Commissioning

CAUTION

Material damage due to errors in activating 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.

⇒ It is not allowed to operate with damaged products!

⇒ 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 used products ready.
2. Log all measures taken in the commissioning log.
3. Check the products for damage.
4. Check all mechanical and electrical connections.
5. Activate the safety and monitoring equipment of the system.

Execution

When all prerequisites have been fulfilled, proceed as follows:

1. Activate the blower at the MAD or the external cooling system for supply of the MAF motors, and check for regular condition. Consider the notes of the manufacturer.
2. Carry out the commission of the drive-system according to the instructions of the respective documentation. You can find the respective information in the functional description of the drive-controller.
3. Log all measures taken in the start-up report.

Commissioning of drive controllers and the control systems 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, maintenance measures or to deactivate the motors, proceed as follows:

1. Observe the instructions of the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power and control voltage of the drive controller.
4. **Only for MAD:** Switch off the motor protection switch for the motor blower.
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 expire and then disconnect all electrical connections.
8. Before dismantling, secure the motor and blower unit against falling or movements before disconnecting the mechanical connections.
9. Log all measures taken in the start-up report.

12.3 Dismantling

DANGER

Fatal injury due to errors in activating motors and 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 feeder against falling or movements before disconnecting the mechanical connections.

1. Observe the instructions of the machine documentation.
2. Please heed the safety notes and carry out all steps as described in the anterior instructions in the chapter ”Deactivation”.
3. Before dismantling, secure the motor and feeder against falling or movements 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 done measures in the start-up report and 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 the availability with regular preventive-maintenance measures. Notice the information in the maintenance schedule of the machine manufacturer and the described service measures.

⇒ 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 function of the coolant system	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Only for MAD: Check the functioning of the motor blower and the air circulation.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Check the mechanical and electrical connections.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Check the machine for smooth running, vibrations and bearing noises.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Remove dust, chips and other dirt from the motor housing, cooling fins and the connections.	Depending on the degree of soiling, but after one operating year at the latest.

Fig. 12-1: Maintenance measures

MAD – Motor blower

It may become necessary to dismantle the blower unit for maintenance or troubleshooting.

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

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

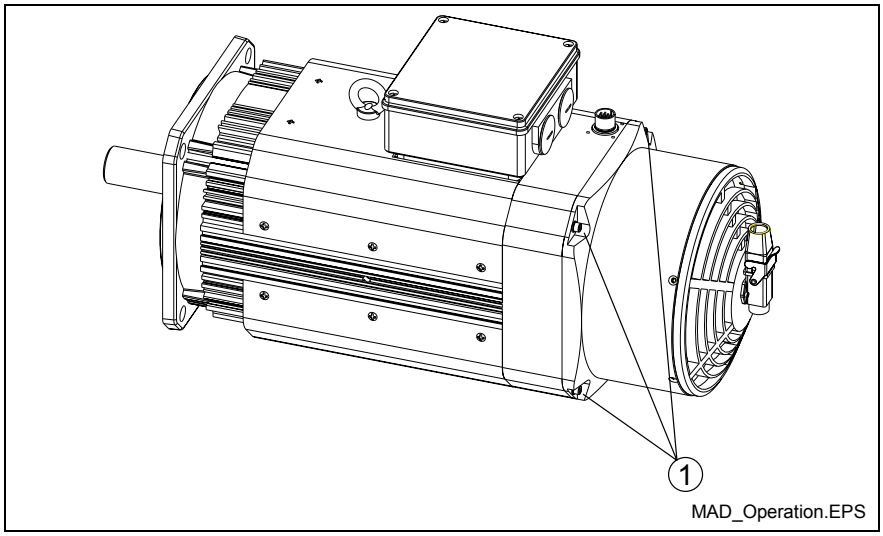
⇒ During dismantling, keep the strips, screws and nuts with which the blower units are fastened.

Parts of the blower unit housings consist of several elements that are screwed together. Remove only the indicated screws.

The fastening and basic housing of the blower unit are essentially identical for axial and radial blowers.

General procedure for maintaining the blower:

1. Switch off the system and disconnect the electrical blower connection.
2. Before loosening the fastening screws, make sure the blower unit does not drop; carefully remove the blower unit from the motor.
3. After completing cleaning or troubleshooting, reattach the blower unit. Secure the fastening screws with "LOCTITE 243 screw fastener" and reestablish the connections.
4. Check the functioning of the motor blower and the air circulation.
5. Log all maintenance measures in the machine maintenance plan.



(1): Mounting screws (also on rear)

Fig. 12-2: MAD blower

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 qualified personnel.

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

⇒ 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, and burn-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 burned-in as described in step 4.
4. Burn-in process:

Recommendation for brake burn-in	
Interval	1x
Burn-in speed and duration	100 rpm / 30s duration
Procedure	500ms, clocked
Ambient Temperature	–20 °C to +50 °C

Fig. 12-3: Recommended procedure for burn-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 steps 4 and 5 of the burn-in process.

If the specified holding torque is not attained after the second burn-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, a film of rust may develop on the brake friction surface.

To prevent the holding torque from dropping below the specified holding torque, we recommend the burn-in procedure described below:

Recommendation for grinding in	
Interval	Once in 48 h
burn-in speed and duration	100 rpm
Number of burn-in revolutions	1
Ambient Temperature	–20 °C to +50 °C

Fig. 12-4: Recommended procedure for burn-in motor holding brakes

Note: The option of automatically implementing the burn-in routine in the program run is described in the documentation of the particular drive controllers.

During normal operation, it is not necessary to burn-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 await the discharging time of the electric systems

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

⇒ Do not work on hot surfaces.

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

- Motor-cooling circuit, or blower function temperature curve
- Internal temperature sensor
- Motor encoder or encoder connection
- Mechanical damage of the motor
- Mechanical connection to machine

Encoder connection and temperature sensor are controlled by the drive-controller or control unit, and corresponding diagnoses are indicated. Observe the notes in the corresponding documentation.

Subsequently some troubles are shown exemplary with potential reasons. 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 restart after raised motor temperature!

⇒ Liquid cooled motors should not be reloaded immediately or with cold coolant after loss of the coolant system. Danger of damage!

⇒ Wait before you re-start until the motor temperature has dropped to 40°C.

Possible causes

1. Failure or malfunction in the blower or cooling system.
2. Original processing cycle has been changed.
3. Original motor parameters have been changed.
4. Motor bearings are worn or defective.

Countermeasures

1. With **MAD,** check blower function. Clean if necessary. In the case of failure, contact Bosch Rexroth Service. With **MAF,** check the cooling system. Clean or rinse the cooling circuit as needed. Contact the machine manufacturer upon failure of the coolant system.
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 dimensioning 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 failure (PTC).

Countermeasures

1. Check the wiring and connection of the temperature sensor according to the connection plan.
2. Check the diagnostics system on the device controller or the control.
3. Check the resistance value of the temperature sensor using a multimeter.
   - Set the measuring instrument to resistance measurement.
   - Switch off the system and await the discharging time. Separate the temperature sensor connection from the device controller and connect the wire pair with the measuring instrument (this includes the sensor cable in the test). Check the values according to the characteristic curve in Fig. 9-16

Motor or Rotary Table Generates 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 life time or grease life time elapsed.
3. Motor mount loose.
4. Drive system control loop 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 drive system (motor and encoder data). Observe the troubleshooting notes in the documentation for the drive controller.

Specified Position is not Attained

Status

The positioning command of the control is not precisely executed – or not at all. No malfunction display on the drive 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 connection plan and check state of cables for damage.
2. Check shielding; if necessary increase effective contact surfaces of shielding.
3. Correct the parameters. Observe the start-up report for original values.
4. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
5. Change of encoder necessary. Contact the machine manufacturer.

13 Service & Support

13.1 Helpdesk

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

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

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

13.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

After helpdesk hours, contact our service department directly at

+49 (0) 171 333 88 26

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

13.3 Internet

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

- Verkaufsniederlassungen
- Niederlassungen mit Kundendienst

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

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

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

- sales agencies
- offices providing service

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

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

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

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

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

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

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

13.5 Kundenbetreuungsstellen - Sales & Service Facilities

Deutschland – Germany

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from abroad: don't dial (0) after country code!

Vertriebsgebiet Mitte Germany Centre	SERVICE AUTOMATION	SERVICE AUTOMATION	SERVICE AUTOMATION
Rexroth Indramat GmbH Bgm.-Dr.-Nebel-Str. 2 / Postf. 1357 97816 Lohr am Main / 97803 Lohr **Kompetenz-Zentrum Europa** Tel.: +49 (0)9352 40-0 Fax: +49 (0)9352 40-4885	CALL ENTRY CENTER Helpdesk MO – FR von 07:00 - 18:00 Uhr from 7 am – 6 pm **Tel. +49 (0) 9352 40 50 60** **Fax +49 (0) 9352 40 49 41** service.svc@boschrexroth.de	HOTLINE 24 / 7 / 365 außerhalb der Helpdesk-Zeit out of helpdesk hours **Tel.: +49 (0)172 660 04 06** oder / or **Tel.: +49 (0)171 333 88 26**	**ERSATZTEILE / SPARES** verlängerte Ansprechzeit - extended office time - ♦ nur an Werktagen - only on working days - ♦ von 07:00 - 18:00 Uhr - from 7 am - 6 pm - **Tel. +49 (0) 9352 40 42 22**
Vertriebsgebiet Süd Germany South	Vertriebsgebiet West Germany West	Gebiet Südwest Germany South-West	
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Bosch Rexroth AG Walsroder Str. 93 30853 Langenhagen Tel.: +49 (0) 511 72 66 57-0 Service: +49 (0) 511 72 66 57-256 Fax: +49 (0) 511 72 66 57-93 Service: +49 (0) 511 72 66 57-783	Bosch Rexroth AG Regionalzentrum Mitte Waldecker Straße 13 64546 Mörfelden-Walldorf Tel.: +49 (0) 61 05 702-3 Fax: +49 (0) 61 05 702-444	Bosch Rexroth AG Beckerstraße 31 09120 Chemnitz Tel.: +49 (0)371 35 55-0 Fax: +49 (0)371 35 55-333	Bosch Rexroth AG Regionalzentrum Ost Walter-Köhn-Str. 4d 04356 Leipzig Tel.: +49 (0)341 25 61-0 Fax: +49 (0)341 25 61-111

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Austria - Österreich

Bosch Rexroth GmbH
Electric Drives & Controls
Stachegasse 13
1120 Wien

Tel.: +43 (0)1 985 25 40
Fax: +43 (0)1 985 25 40-93

Austria – Österreich

Bosch Rexroth GmbH
Electric Drives & Controls
Industriepark 18
4061 Pasching

Tel.: +43 (0)7221 605-0
Fax: +43 (0)7221 605-21

Belgium - Belgien

Bosch Rexroth NV/SA
Henri Genessestraat 1
1070 Bruxelles

Tel: +32 (0) 2 451 26 08
Fax: +32 (0) 2 451 27 90
info@boschrexroth.be
service@boschrexroth.be

Denmark - Dänemark

BEC A/S
Zinkvej 6
8900 Randers

Tel.: +45 (0)87 11 90 60
Fax: +45 (0)87 11 90 61

Great Britain – Großbritannien

Bosch Rexroth Ltd.
Electric Drives & Controls
Broadway Lane, South Cerney
Cirencester, Glos GL7 5UH

Tel.: +44 (0)1285 863000
Fax: +44 (0)1285 863030
sales@boschrexroth.co.uk
service@boschrexroth.co.uk

Finland - Finnland

Bosch Rexroth Oy
Electric Drives & Controls
Ansatie 6
017 40 Vantaa

Tel.: +358 (0)9 84 91-11
Fax: +358 (0)9 84 91-13 60

France - Frankreich

Bosch Rexroth SAS
Electric Drives & Controls
Avenue de la Trentaine
(BP. 74)
77503 Chelles Cedex

Tel.: +33 (0)164 72-63 22
Fax: +33 (0)164 72-63 20
Hotline: +33 (0)608 33 43 28

France - Frankreich

Bosch Rexroth SAS
Electric Drives & Controls
ZI de Thibaud, 20 bd. Thibaud
(BP. 1751)
31084 Toulouse

Tel.: +33 (0)5 61 43 61 87
Fax: +33 (0)5 61 43 94 12

France – Frankreich

Bosch Rexroth SAS
Electric Drives & Controls
91, Bd. Irène Joliot-Curie
69634 Vénissieux – Cedex

Tel.: +33 (0)4 78 78 53 65
Fax: +33 (0)4 78 78 53 62

Italy - Italien

Bosch Rexroth S.p.A.
Via G. Di Vittorio, 1
20063 Cernusco S/N.MI

Hotline: +39 02 92 365 563
Tel.: +39 02 92 365 1
Service: +39 02 92 365 300
Fax: +39 02 92 365 500
Service: +39 02 92 365 516

Italy - Italien

Bosch Rexroth S.p.A.
Via Paolo Veronesi, 250
10148 Torino

Tel.: +39 011 224 88 11
Fax: +39 011 224 88 30

Italy - Italien

Bosch Rexroth S.p.A.
Via Mascia, 1
80053 Castellamare di Stabia NA

Tel.: +39 081 8 71 57 00
Fax: +39 081 8 71 68 85

Italy - Italien

Bosch Rexroth S.p.A.
Via del Progresso, 16 (Zona Ind.)
35020 Padova

Tel.: +39 049 8 70 13 70
Fax: +39 049 8 70 13 77

Italy - Italien

Bosch Rexroth S.p.A.
Via Isonzo, 61
40033 Casalecchio di Reno (Bo)

Tel.: +39 051 29 86 430
Fax: +39 051 29 86 490

Netherlands - Niederlande/Holland

Bosch Rexroth Services B.V.
Technical Services
Kruisbroeksestraat 1
(P.O. Box 32)
5281 RV Boxtel

Tel.: +31 (0) 411 65 19 51
Fax: +31 (0) 411 67 78 14
Hotline: +31 (0) 411 65 19 51
services@boschrexroth.nl

Netherlands – Niederlande/Holland

Bosch Rexroth B.V.
Kruisbroeksestraat 1
(P.O. Box 32)
5281 RV Boxtel

Tel.: +31 (0) 411 65 16 40
Fax: +31 (0) 411 65 14 83
www.boschrexroth.nl

Norway - Norwegen

Bosch Rexroth AS
Electric Drives & Controls
Berghagan 1 or: Box 3007
1405 Ski-Langhus 1402 Ski

Tel.: +47 (0) 64 86 41 00

Fax: +47 (0) 64 86 90 62

Hotline: +47 (0)64 86 94 82
jul.ruud@rexroth.no

Spain - Spanien

Bosch Rexroth S.A.
Electric Drives & Controls
Centro Industrial Santiga
Obradors s/n
08130 Santa Perpetua de Mogoda
Barcelona

Tel.: +34 9 37 47 94 00
Fax: +34 9 37 47 94 01

Spain – Spanien

Goimendi S.A.
Electric Drives & Controls
Parque Empresarial Zuatzu
C/ Francisco Grandmontagne no.2
20018 San Sebastian

Tel.: +34 9 43 31 84 21
- service: +34 9 43 31 84 56
Fax: +34 9 43 31 84 27
- service: +34 9 43 31 84 60
sat.indramat@goimendi.es

Sweden - Schweden

Bosch Rexroth AB
Electric Drives & Controls
- Varuvägen 7
(Service: Konsumentvägen 4, Älfsjö)
125 81 Stockholm

Tel.: +46 (0)8 727 92 00
Fax: +46 (0)8 647 32 77

Sweden - Schweden

Bosch Rexroth AB
Electric Drives & Controls
Ekvändan 7
254 67 Helsingborg

Tel.: +46 (0) 42 38 88 -50
Fax: +46 (0) 42 38 88 -74

Switzerland East - Schweiz Ost

Bosch Rexroth Schweiz AG
Electric Drives & Controls
Hemrietstrasse 2
8863 Buttikon

Tel. +41 (0) 55 46 46 111
Fax +41 (0) 55 46 46 222

Switzerland West - Schweiz West

Bosch Rexroth Suisse SA
Av. Général Guisan 26
1800 Vevey 1

Tel.: +41 (0)21 632 84 20
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Australia - Australien AIMS - Australian Industrial Machinery Services Pty. Ltd. 28 Westside Drive Laverton North Vic 3026 Melbourne Tel.: +61 3 93 14 3321 Fax: +61 3 93 14 3329 **Hotlines: +61 3 93 14 3321** **+61 4 19 369 195** enquires@aimservices.com.au	Australia - Australien Bosch Rexroth Pty. Ltd. No. 7, Endeavour Way Braeside Victoria, 31 95 Melbourne Tel.: +61 3 95 80 39 33 Fax: +61 3 95 80 17 33 mel@rexroth.com.au	China Shanghai Bosch Rexroth Hydraulics & Automation Ltd. Waigaoqiao, Free Trade Zone No.122, Fu Te Dong Yi Road Shanghai 200131 - P.R.China Tel.: +86 21 58 66 30 30 Fax: +86 21 58 66 55 23 richard.yang_sh@boschrexroth.com.cn gf.zhu_sh@boschrexroth.com.cn	China Shanghai Bosch Rexroth Hydraulics & Automation Ltd. 4/f, Marine Tower No.1, Pudong Avenue Shanghai 200120 - P.R.China Tel: +86 21 68 86 15 88 Fax: +86 21 58 40 65 77
China Bosch Rexroth China Ltd. 15/F China World Trade Center 1, Jianguomenwai Avenue Beijing 100004, P.R.China Tel.: +86 10 65 05 03 80 Fax: +86 10 65 05 03 79	China Bosch Rexroth China Ltd. Guangzhou Repres. Office Room 1014-1016, Metro Plaza, Tian He District, 183 Tian He Bei Rd Guangzhou 510075, P.R.China Tel.: +86 20 8755-0030 +86 20 8755-0011 Fax: +86 20 8755-2387	China Bosch Rexroth (China) Ltd. A-5F., 123 Lian Shan Street Sha He Kou District Dalian 116 023, P.R.China Tel.: +86 411 46 78 930 Fax: +86 411 46 78 932	China Melchers GmbH BRC-SE, Tightening & Press-fit 13 Floor Est Ocean Centre No.588 Yanan Rd. East 65 Yanan Rd. West Shanghai 200001 Tel.: +86 21 6352 8848 Fax: +86 21 6351 3138
Hongkong Bosch Rexroth (China) Ltd. 6th Floor, Yeung Yiu Chung No.6 Ind Bldg. 19 Cheung Shun Street Cheung Sha Wan, Kowloon, Hongkong Tel.: +852 22 62 51 00 Fax: +852 27 41 33 44 alexis.siu@boschrexroth.com.hk	India - Indien Bosch Rexroth (India) Ltd. Electric Drives & Controls Plot. No.96, Phase III Peenya Industrial Area Bangalore – 560058 Tel.: +91 80 51 17 0-211...-218 Fax: +91 80 83 94 345 +91 80 83 97 374 mohanvelu.t@boschrexroth.co.in	India - Indien Bosch Rexroth (India) Ltd. Electric Drives & Controls Advance House, II Floor Ark Industrial Compound Narol Naka, Makwana Road Andheri (East), Mumbai - 400 059 Tel.: +91 22 28 56 32 90 +91 22 28 56 33 18 Fax: +91 22 28 56 32 93 singh.op@boschrexroth.co.in	India - Indien Bosch Rexroth (India) Ltd. S-10, Green Park Extension New Delhi – 110016 Tel.: +91 11 26 56 65 25 +91 11 26 56 65 27 Fax: +91 11 26 56 68 87 koul.rp@boschrexroth.co.in
Indonesia - Indonesien PT. Bosch Rexroth Building # 202, Cilandak Commercial Estate Jl. Cilandak KKO, Jakarta 12560 Tel.: +62 21 7891169 (5 lines) Fax: +62 21 7891170 - 71 rudy.karimun@boschrexroth.co.id	Japan Bosch Rexroth Automation Corp. Service Center Japan Yutakagaoka 1810, Meito-ku, NAGOYA 465-0035, Japan Tel.: +81 52 777 88 41 +81 52 777 88 53 +81 52 777 88 79 Fax: +81 52 777 89 01	Japan Bosch Rexroth Automation Corp. Electric Drives & Controls 2F, I.R. Building Nakamachidai 4-26-44, Tsuzuki-ku YOKOHAMA 224-0041, Japan Tel.: +81 45 942 72 10 Fax: +81 45 942 03 41	Korea Bosch Rexroth-Korea Ltd. Electric Drives and Controls Bongwoo Bldg. 7FL, 31-7, 1Ga Jangchoong-dong, Jung-gu Seoul, 100-391 Tel.: +82 234 061 813 Fax: +82 222 641 295
Korea Bosch Rexroth-Korea Ltd. 1515-14 Dadae-Dong, Saha-gu Electric Drives & Controls Pusan Metropolitan City, 604-050 Tel.: +82 51 26 00 741 Fax: +82 51 26 00 747 eunkyong.kim@boschrexroth.co.kr	Malaysia Bosch Rexroth Sdn.Bhd. 11, Jalan U8/82, Seksyen U8 40150 Shah Alam Selangor, Malaysia Tel.: +60 3 78 44 80 00 Fax: +60 3 78 45 48 00 hockhwa@hotmail.com rexroth1@tm.net.my	Singapore - Singapur Bosch Rexroth Pte Ltd 15D Tuas Road Singapore 638520 Tel.: +65 68 61 87 33 Fax: +65 68 61 18 25 sanjay.nemade@boschrexroth.com.sg	South Africa - Südafrika TECTRA Automation (Pty) Ltd. 71 Watt Street, Meadowdale Edenvale 1609 Tel.: +27 11 971 94 00 Fax: +27 11 971 94 40 **Hotline: +27 82 903 29 23** georgv@tectra.co.za
Taiwan Bosch Rexroth Co., Ltd. Taichung Industrial Area No.19, 38 Road Taichung, Taiwan 407, R.O.C. Tel : +886 - 4 -235 08 383 Fax: +886 - 4 -235 08 586 jim.lin@boschrexroth.com.tw david.lai@boschrexroth.com.tw	Taiwan Bosch Rexroth Co., Ltd. Tainan Branch No. 17, Alley 24, Lane 737 Chung Cheng N.Rd. Yungkang Tainan Hsien, Taiwan, R.O.C. Tel : +886 - 6 –253 6565 Fax: +886 - 6 –253 4754 charlie.chen@boschrexroth.com.tw	Thailand NC Advance Technology Co. Ltd. 59/76 Moo 9 Ramintra road 34 Tharang, Bangkhen, Bangkok 10230 Tel.: +66 2 943 70 62 +66 2 943 71 21 Fax: +66 2 509 23 62 Hotline +66 1 984 61 52 sonkawin@hotmail.com	

Nordamerika – North America

USA Headquarters - Hauptniederlassung Bosch Rexroth Corporation Electric Drives & Controls 5150 Prairie Stone Parkway Hoffman Estates, IL 60192-3707 Tel.: +1 847 6 45 36 00 Fax: +1 847 6 45 62 01 servicebrc@boschrexroth-us.com repairbrc@boschrexroth-us.com	USA Central Region - Mitte Bosch Rexroth Corporation Electric Drives & Controls Central Region Technical Center 1701 Harmon Road Auburn Hills, MI 48326 Tel.: +1 248 3 93 33 30 Fax: +1 248 3 93 29 06	USA Southeast Region - Südwest Bosch Rexroth Corporation Electric Drives & Controls Southeastern Technical Center 3625 Swiftwater Park Drive Suwanee, Georgia 30124 Tel.: +1 770 9 32 32 00 Fax: +1 770 9 32 19 03	**USA SERVICE-HOTLINE** - 7 days x 24hrs - **+1-800-REX-ROTH** **+1 800 739 7684**
USA East Region – Ost Bosch Rexroth Corporation Electric Drives & Controls Charlotte Regional Sales Office 14001 South Lakes Drive Charlotte, North Carolina 28273 Tel.: +1 704 5 83 97 62 +1 704 5 83 14 86	USA Northeast Region – Nordost Bosch Rexroth Corporation Electric Drives & Controls Northeastern Technical Center 99 Rainbow Road East Granby, Connecticut 06026 Tel.: +1 860 8 44 83 77 Fax: +1 860 8 44 85 95	USA West Region – West Bosch Rexroth Corporation 7901 Stoneridge Drive, Suite 220 Pleasant Hill, California 94588 Tel.: +1 925 227 10 84 Fax: +1 925 227 10 81	
Canada East - Kanada Ost Bosch Rexroth Canada Corporation Burlington Division 3426 Mainway Drive Burlington, Ontario Canada L7M 1A8 Tel.: +1 905 335 5511 Fax: +1 905 335 4184 **Hotline: +1 905 335 5511** michael.moro@boschrexroth.ca	Canada West - Kanada West Bosch Rexroth Canada Corporation 5345 Goring St. Burnaby, British Columbia Canada V7J 1R1 Tel. +1 604 205 5777 Fax +1 604 205 6944 **Hotline: +1 604 205 5777** david.gunby@boschrexroth.ca	Mexico Bosch Rexroth Mexico S.A. de C.V. Calle Neptuno 72 Unidad Ind. Vallejo 07700 Mexico, D.F. Tel.: +52 55 57 54 17 11 Fax: +52 55 57 54 50 73 mariofelipe.hernandez@boschrexroth.com.mx	Mexico Bosch Rexroth S.A. de C.V. Calle Argentina No 3913 Fracc. las Torres 64930 Monterrey, N.L. Tel.: +52 81 83 65 22 53 +52 81 83 65 89 11 +52 81 83 49 80 91 Fax: +52 81 83 65 52 80

Südamerika – South America

Argentina - Argentinien Bosch Rexroth S.A.I.C. "The Drive & Control Company" Rosario 2302 B1606DLD Carapachay Provincia de Buenos Aires Tel.: +54 11 4756 01 40 +54 11 4756 02 40 +54 11 4756 03 40 +54 11 4756 04 40 Fax: +54 11 4756 01 36 +54 11 4721 91 53 victor.jabif@boschrexroth.com.ar	Argentina - Argentinien NAKASE Servicio Tecnico CNC Calle 49, No. 5764/66 B1653AOX Villa Balester Provincia de Buenos Aires Tel.: +54 11 4768 36 43 Fax: +54 11 4768 24 13 **Hotline: +54 11 155 307 6781** nakase@usa.net nakase@nakase.com gerencia@nakase.com (Service)	Brazil - Brasilien Bosch Rexroth Ltda. Av. Tégula, 888 Ponte Alta, Atibaia SP CEP 12942-440 Tel.: +55 11 4414 56 92 +55 11 4414 56 84 Fax sales: +55 11 4414 57 07 Fax serv.: +55 11 4414 56 86 alexandre.wittwer@rexroth.com.br	Brazil - Brasilien Bosch Rexroth Ltda. R. Dr.Humberto Pinheiro Vieira, 100 Distrito Industrial [Caixa Postal 1273] 89220-390 Joinville - SC Tel./Fax: +55 47 473 58 33 Mobil: +55 47 9974 6645 prochnow@zaz.com.br
Columbia - Kolumbien Reflutec de Colombia Ltda. Calle 37 No. 22-31 Santafé de Bogotá, D.C. Colombia Tel.: +57 1 368 82 67 +57 1 368 02 59 Fax: +57 1 268 97 37 reflutec@etb.net.co			

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Rexroth
Bosch Group

Bosch Rexroth AG
Electric Drives and Controls
P.O. Box 13 57
97803 Lohr, Germany
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr, Germany
Phone +49 (0)93 52-40-50 60
Fax +49 (0)93 52-40-49 41
service.svc@boschrexroth.de
www.boschrexroth.com

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