Rexroth
Bosch Group

Rexroth MKD synchronous motors for potentially hazardous areas group II category 3

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Edition 02

Project Planning Manual

Title Rexroth MKD synchronous motors
for potentially hazardous areas
group II category 3

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Purpose of Documentation This documentation …

- explain the product qualties, possible applikations, technical data, operating conditions and limits.
- gives indications for the product choice, handling and operating.

Record of Revisions

Description	Release Date	Notes
DOK-MOTOR*-MKD*EXGIIK3-PR02-EN-P	03/03	1st edition
DOK-MOTOR*-MKD*EXGIIK3-PR02-EN-P	10/03	2nd edition

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

Inhaltsverzeichnis

1 Product Presentation

1.1 MKD Synchronous Motors for standard use in explosion-hazardous areas according to ATEX-instructions

The cost-efficient solution for use in explosion-hazardous areas of the general automation. MKD-motors according to ATEX-standards offer torques up to 18 Nm. The motors are serially fitted with resolver encoders. If requested, this motors can be delivered with a multiturn-resolver, holding brake or keyway.

Important note

This documentation describes only a selection of deliverable MKD-motors of Bosch Rexroth. The contents and descriptions of this documentation refer to motors which are produced especially for use in explosive areas according to the ATEX-standards.

Power gradation

MKD-motors according to ATEX-standard (Ex II3 GD EEx nA II T155°C) can be delivered with the following power gradation.

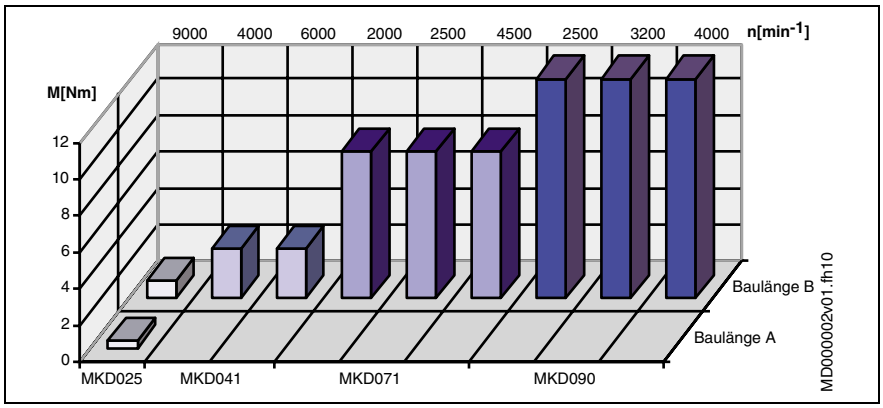

Fig. 1-1: MKD power gradation

1.2 About this Documentation

Structure of this Document Edition

The present documentation contains safety regulations, technical data, and operating instructions for MKD motors. The chapters can be subdivided in the following focal points with regard to their contents:

Chapter	Title	
1	Product Presentation	General information
2	Important Instructions on Use	**Safety**
3	Safety notes	
4	General for explosive hazardous-areas	**Product description (Planners and projectors)**
5	MKD Type Code	
6	General Notes on Technical Data	
7	MKD025	
8	MKD041	
9	MKD071	
10	MKD090	
11	Accessories	
12	Connection System	
13	Application Instructions	
14	Handling	**Practice (Operating and maintenance personnel)**
15	Assembly	
16	Startup, Operation, and Maintenance	
17	Appendix	
18	Service and Support	Additional information
19	Index	

Fig. 1-2: Document structure

Modifications as Compared with the Predecessor Version

The following list shows the modifications as compared with the predecessor version DOK-MOTOR*-MKD*EXGIIK3-PR01-EN-P.

Where?	What?
Chapter 4.2	**Modification:** Emergency Stop, Internal motor brake
Chapter 7.5	**New:** Dimensions MKD025A
Chapter 8	**New:** Technical Data, speed torque curve MKD041B-058
Chapter 9	**New:** Technical Data, speed torque curve MKD071B-024

Abb. 1-1: Modifications

Advanced documentation

Note: If the present documentation contains references to advanced documentations, the version of the latter is always represented in bold and underlined type (e.g. **06**). If documentations are ordered, their version may be a higher one!

Standards

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

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Outside Systems

Documentations 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.

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 appreciate your corresponding feedback.

Please send your remarks to:

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2 Important Instructions on Use

2.1 Intended Use

Introduction

In their design and manufacture, the products by Rexroth reflect the latest state of technology. Before they are delivered, they are checked for their operationally safe state.

The products may only be used as intended. If they are not used as intended, situations may arise resulting in injuries to property and persons.

Note: For damage caused by products not being used as intended, Bosch Rexroth, as manufacturers, do not give any warranty, assume any liability, or pay any damages. Any risks resulting from the products not being used as intended are the sole responsibility of the user.

Before using the products by Rexroth, the following requirements must be fulfilled so as to ensure that they are used as intended:

- Anybody handling one of our products in any manner must read and understand the appropriate safety instructions and the intended use.
- If they are hardware components, the products concerned must be left in their original state, i.e. it is not permitted to modify them structurally. Software products may not be decompiled; their source codes may not be altered.
- Damaged or defective products may not be installed or put into operation.
- It must be ensured that the products are installed, operated and serviced according to the regulations and environmental conditions specified in the documentation.

Fields of Use and Application

AC servo motors of the MKD series by Rexroth are intended to be used as servo and main drive motors. The following are typical fields of application:

- Machine tools
- Printing and paper-processing machines
- Packaging and food-processing machines
- Automation and handling

Unit types with different driving powers and different interfaces are available for an application-specific use of the motors.

Controlling and monitoring of the motors may require connection of additional sensors and actuators.

Note: The motors may only be used with the accessories specified in the documentation. Components which are not expressly named may neither be mounted nor connected. The same applies to cables and lines.

The motors may be operated only in the expressly specified component configurations and combinations and with the software and firmware specified in the appropriate functional description.

Any connected drive controller must be programmed before startup, in order to ensure that the motor executes the functions specific to the particular application.

The motors may only be operated under the assembly, mounting and installation conditions, in the position of use, and under the environmental conditions (temperature, degree of protection, humidity, EMC, and the like) specified in this documentation.

2.2 Non-Intended Use

Any use of the motors outside of the fields of application mentioned above or under operating conditions and technical data other than those specified in this documentation is considered to be “non-intended use”.

MKD motors may not be used if . . .

- environmental conditions at the installation location requires a higher explosion protection than indicated at the motor type plate.
- they are subjected to operating conditions which do not comply with the environmental conditions described above (e.g. operation under water, under extreme variations in temperature or extreme maximum temperatures is not permitted),
- the intended fields of application have not been expressly released for the motors by Rexroth. Please be absolutely sure to also observe the statements made in the general safety instructions.

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.
  For example, the following areas of use are not permitted: 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 sensitive to high frequency, 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 five (5) 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!

WARNING

Burning via hot surface with temperatures over 100°C

⇒ Do not touch the hot motor housing! Risk of burning

⇒ Touch the motor only after cooling! A cooling up to 140 minutes can be necessary! The stated thermical time constant in the technical data is a measure for the necessary cooling

⇒ Do not work on hot surfaces.

⇒ Use safety gloves.

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 General for explosive hazardous-areas

4.1 Explosive hazardous-areas and categories according to EU directive 94/9/EG appendix I

Equipment Group II Category 1

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection. Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dust mixtures are present continuously, for long periods or frequently. Equipment in this category must ensure the requisite level of protection, even in the event of rare incidents relating to equipment, and is characterized by means of protection such that:

- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection; or
- the requisite level of protection is assured in the event of two faults occurring independently of each other.

Note: Motors of equipment group II, category 1 for the use in hazardous areas Rexroth does not offer.

Equipment Group II Category 2

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment in this category is intendend for use in areas which has to be calculated that an explosive atmosphere of dust/air mixture can occur **occasionally**. The means of protection relating to equipment in this category ensure the requisite level of protection, even in the event of frequently occurring disturbances or equipment faults which normally have to be taken into account.

Note: The MKE-motors of Rexroth are equipment according to equipment group II, category 2 for use in hazardous areas.

Equipment Group II Category 3

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment in this category is intended for use in areas in which explosive atmospheres caused by dust/air mixtures are unlikely to occur or, if they do occur, are likely to do so **only infrequently and for a short period only.** Equipment in this category ensures the requisite level of protection during normal operation.

Note: The MKD-motors type “S” of Rexroth are equipment according to equipment group II, category 3 for use in hazardous areas.

4.2 Application condition for motors with classification Ex II3 GD EEx nA II T155°C

DANGER

Danger of life or damage to property, explosion risk by inappropriate use! To avoid danger by ignitable gas or explosive dust/air mixture in the near of the motors, note the following:

⇒ Only the components and accessories described in this documentation are allowed to be used for this motors.

⇒ The application conditions described in this documentation have to be observed at any case when projecting and operating of the motors within the machine or equipment.

Range of application

Equipment category I

The motors are not allowed to be used in underground mines and their surface mining.

Equipment category II

Gas (G) and dust (D)

The here described motors (components for equipment category II, category 3) are only allowed to be used in one area (ATEX-directive 94/9EG, Appendix II, cap. 1.5.1),

- in which in normal operation no explosive atmosphere occures, as this is avoided by ventilation and survey.
- in which in an event of fault explosive atmosphere can occur occasionally and this could be eliminated and intercepted by the user immediately after appearence. Thus the explosive atmosphere appears seldom and during a short period.

Therefore, the machine and the components have to be designed by the user in this way that no inflammable gas or dust in the area of the motor, during normal operation, can occur.

An event of fault by ignitable gas or dust must be identified immediately and the error has to be fixed. Further operation after occurence is not allowed.

The failure of occurence of ignitable gas or dust/air mixtures should not accumulate. If it accumulates, measures to reduce the probability of occurence have to be made by return. (ATEX-directive 94/9/EG, appendix II, Cap. 1.2.3)

Dust (D)

When using the here described motors (components for equipment group II, category 3) in an area with dust and dust/air mixture the erection appointments in the EN 50281-1-2, 1998 for

- normal operation and
- event of failure

have to be observed.

The installation or extension of this motors has to be projected in this way that dust, deposit on the motors, can not inflame and the hazardous protection is not be affected.

Dust deposit has to be avoided, because of the motor cooling on the motor housing. Is dust deposit unavoidable, the requirements of EN 50281-1-2 are to be observed. The layer thickness of dust deposit is to be narrowed because of danger of heat accumulation

The smoldering temperature of the dust must exceed the max. motor temperature clearly. (ATEX-directive 94/9/EG, appendix II, Cap. 1.2.3 and Cap. 2.3.2.3)

Environmental temperature

If the environmental temperature is outside of the usual, the area of the machine or equipment has to be marked by the user (see section 10.3, EN 50281-1-1).

Temperatures

The ignition temperature of the ignitable gas, the smoldering temperature of the explosive dust or the ignition temperature of the ignitable air/dust mixture has to be far above of the maximum motor temperature (155°C). (Further information see ATEX-directive 94/9/EG, appendix II, Cap. 2.3.1.2, Cap. 2.3.2.2)

The maximum operating temperature is at 40°C environmental temperature:

- 155°C within the motor
- outside of the motor housing: 115 °C.

Connection condition

The motors are only allowed to operate with the Rexroth Drives DIAX04, ECODRIVE, DURADRIVE and INDRADRIVE. Controllers of other manufacturers are not permitted.

The plug-in terminals in the terminal box have to be bolt together securely.

Do not disconnect or connect connectors in explosive areas!

Grounding

RPM-regulated drive-systems include unavoidable heat losses over the earth. For this reason, the motors have to be grounded over the motor cable and over a separate ground wire with min. 4 mm² cross-section, as specified in the connecting diagram. The fixed location of the ground terminals has to be checked before put into service.

If connection of the ground wire in the motor cable and the second separate ground wire are not connected on the motor housing or by corrosion and other failures are interrupted during the life-time, the leakance current is floating as leakage current over the conductive housing parts. This has to be prevented with the above-mentioned measures. (ATEX-directive 94/9/EG, appendix II, Cap. 1.2.3 and Cap. .1.3.3, 1.4)

Risk of corrosion

Corrosion by agressive substances (like specified coolants, lubricants, cutting oil or salt mist) on the motor housing must be prevented.

Emergency cutout

Stored energy in the intermediate circuit has to be degraded or isolated as soon as possible via pressing the emergency stop, that in the case of failure the risk of an effect into the danger zone is reduced. (ATEX-directive 94/9/EG, appendix II, Cap. 1.6.2)

The following possibilities consist to press the emergency stop, e.g.

- Reduce the energy via an intermediate short circuit.
- Isolate the energy before passing the hazardous area via energy-clearing of the cables and motors within the hazardous area.

Other Environmental Influences

In view of danger via outside influences note the following:

- Operation only inside the specified environmental conditions,
- Do not exceed the maximum vibration and impact load.
- Corrosion by humidity, agressive substances and contamination on the connection of the ground wire has to be excluded.

Internal motor brake (if existing)

Use the brake inside the motor in **normal operation** only in standstill and for performing the drive-internal brake check. Hereby only poor temperatures of T < 100 °C are coming up and there is no spark, as no critical grinding occurs.

Drive of the brake

The brake's control mechanism must ensure this function in normal operation. Under the worst installation condition of the power supply of the brake and under the worst load condition of the supplier with a voltage of 24 V_{DC} +/- 10% must be supplied to the motor. Does a voltage divergence occur via a failure during operation, this failure has to be identified and corrected immediately. Identification of the failure can be made, e.g. via an inviligator for undervoltage.

Malfunction

Only in malfunctions, which can occur through failure within the equipment, it is allowed to press the brake during an engine speed of the motor to avoid, for example, dangerous sinking of the axis. Hereby sparks and increased temperatures in the brake can occur within the motor. After coming-up of this failure, it must be removed by the user.

Function test

Before commissioning and in operation in periodic intervals (e.g. every 8 hours) the brake is to be tested on its functions with an appropriate braking test. By applying a defined amount of motor torque, the brake is tested for slippage. Some drive devices have the possibility to carry out an integrated braking test via the command brake control. Further information can be found in the respective firmware operation manual for the drive device.

Battery

Maintenance

If a change of the battery within the motor becomes necessary, open the motor only outside of the explosive area and change then the battery.

- Do not disconnect or connect connectors in the explosive area under load!

Acceptance test

Before putting the machine into service an acceptance test with an acceptance protocol is necessary, in which the here given notes and application condition are confirmed. After repair and disambly at overhouling of security relevant motor parts, the parts check of the motor according to EN 50021 must be done again, if the explosive-protection features were changed at repair or disambly. (see section 26 in EN 50014)

4.3 Selection of the components

Motor cable

Cables of Rexroth

The listed Rexroth-Cables below were checked on conformity with the ATEX-devices and relevant DIN and EN standards. They fulfill all requirements.

Only the following cables are allowed to use:

Motor type	Power cable not ready-made	Power cable ready-made	Encoder cable not ready-made	Encoder ready-made
MKD025_-___-___-US	INK0653	IKG4006, IKG4008, IKG4009, IKG4017, IKG4077, IKG4099	INK0448	IKS4042, IKS4065, IKS4374, IKS4376
MKD025_-___-___-KS MKD041_-___-___-_S MKD071_-___-___-_S MKD090_-___-___-_S	INK0653	IKG4013, IKG4016, IKG4018, IKG4020, IKG4100	INK0448	IKS4103, IKS4043, IKS4151, IKS4153

Fig. 4-1: Rexroth-cables

Note: For different cable types please contact Rexroth.

Cables of other manufacturers

If cables of other manufacturers are used, they must have the following features to ensure the leakage.

- Compliance of the criteria for protection class IP65 according to EN 60034-5 in connected condition.
- Strain-relief according to section 26.14 of EN 50021 in connected condition,
- The cables must be specified for minimum 80°C (according to EN 50021).

For using the MKD-ATEX motors in explosive areas, cables with a temperature resistance of min. 80°C (176°F) have to be used.

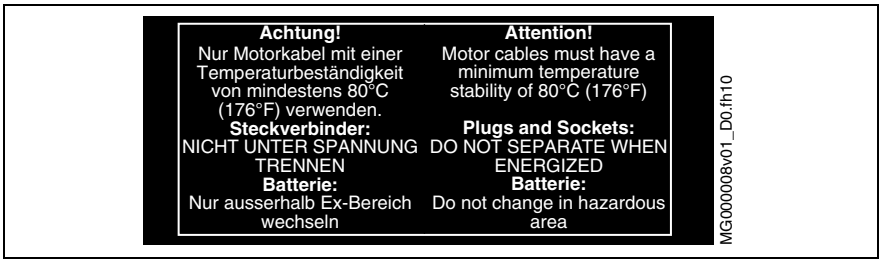


Fig. 4-2: Decal information “Cable-temperature resistance”

Note: The features of the cables required in the norm have to be checked by the user and have to be proved.

Cables from other manufacturers are allowed to have the following external diameter only:

Motor type	External diameter			
	Power cables		Encoder cable	
	min	max	min	max
MKD025_-___-___-US MKD025_-___-___-KS MKD041_-___-___-_S MKD071_-___-___-_S MKD090_-___-___-_S	11,5	12,7	8,2	9,1

Fig. 4-3: Cables from other manufacturers

Connection:

The motors are only allowed to operate with the Rexroth Drives DIAX04, ECODRIVE, DURADRIVE and INDRADRIVE. Controllers of other manufacturers are not permitted.

The motors have to be grounded over the motor cable and over a separate grounding wire with min 4 mm² cross-section as specified in the connecting diagram.

Blower unit

Mounting and operation of an external standard blower unit is **not** allowed! Should an external ventilation be needed anyway, the ventilation must be licensed for the present protection zone.

4.4 Remaining risk

The remaining risks listed below have to be observed by the user when constructing the equipment.

Because of the here mentioned remaining risks, the motors are NOT allowed for use in areas in which explosive atmosphere or explosive materials

- do permanentely occur or over a longer period or
- **by frequently device errors or usually expected failure can occur (EU-Device ATEX 94/9/EG (Appendix I), EN 50014 (1997)).**

Under the following terms state of risks can arise:

Brake

Sparks or high temperatures with the consequence of explosion risk can occur under the following device errors when using a brake:

- In the environmental area an explosive atmosphere occurs,
- Explosive materials penetrade during a residence time into the motor, e.g. because of aged sealings,
- The brake operates incorrect, so that higher temperatures than allowed, occure within the motor.

Overstress

At operation of the motor with overload, even due to failures in the mechanical or electrical equipment of the machine, high temperature with the consequence of explosion risk can occur with the following device error:

- In the environmental area an explosive atmosphere occurs,
- Explosive gas penetrades during a residence time into the motor, e.g. because of aged sealings,
- The motor is overloaded on the shaft or according to the specifications of the project instruction unsufficient cooled,
- The temperature control by software function brakes down due to a failure within the electric drive, so that higher temperature occur on and in the motor housing.

Explosive dust atmosphere

At operation in explosive dust atmosphere explosion risks can occur due to incorrect use.

- During the residence time a thick dust film accumulates on the motor. Hereby a sufficient cooling of the motor could be no more guaranteed.
- The dust film has an unsufficient heat conductivity,
- Due to the insulating dust film, the motor is loaded in such a way, that he becomes heated over the allowed temperature.
- The temperature control by software function brakes down due to a failure within the electric drive, so that higher temperature occur on and in the motor housing.

Variable-speed drive systems cause unavoidable leakage current. As long as the connector of the ground connector on the motor cable and the second separate ground connector are not connected as specified or interrupted by corrosion and other failures during life time, the leakage current flows over conductive parts of the housing. From this follows, risk

of sparking on passing and of occurrence of explosive materials. The outcome of this is explosion risk. This has to be prevented with the above-mentioned measures. (ATEX-directive 94/9/EG, appendix II, Cap. 1.2.3 and Cap. .1.3.3, 1.4)

Material aging

The residence and reaction time of explosive materials depends on the use. It depends also on aging of the sealings, on the mechanical extension of the motor, on the features of the explosive gas or dust/air mixture and over the occuring middle temperature during operation time, as a result of load cycles.

Temperature control

A failure of the temperature control in the drive system can occur due to a failure during the life time and cannot be identified, if the motor runs within the common temperature range and load cycle.

Battery change

Risk at battery change:

- When changing the battery, it has to be reckon with sparking.
- THE HOUSING HAS TO BE OPENED ONLY OUTSIDE OF AN EXPLOSIVE AREA. THEN THE BATTERY CAN BE CHANGED!

Leakage

Leakage of the motor housing, incl. connector or terminal box:

- The housing is because of the possibility of suction of external gas by the unavoidable temperature change during operation and the aging of the shaft sealing not leak-proof against infiltration of explosive gas. Interpretation and testing of the leakage have to be according to the protection category IP 65 (EN 50021, section 10.2). The maximum temperature on parts outside of the motor can reach in normal operation a maximum environmental temperature of 155 °C.

4.5 Marking

The motors are marked as follows:

CE:	CE mark
Ex:	Ex-mark
II:	means type II, which is suitable for all Ex-areas except hazardous mines.
3:	means category 3, i.e. units suitable for hazardous areas by gas or dust, which occures rarely and temporary.
G:	gas
D:	dust
EEx:	EEx means: European norm for Ex-protection was used.
n:	Type of protection n means that requirements of EN 50021 for rarely and temporary occurance of an explosive athmosphere are fulfilled.
A:	means non-sparking equipment
T 155 °C :	means the max surface temperature inside and outside of the housing, where explosive gas or dust can occur.

Fig. 4-4: MKD ATEX motor marks

5 MKD Type Code

Each order about a product by Rexroth must be based on the type code. All available motor versions are uniquely described by their type code. The following figure describes the individual characters of the type code (abbrev. column) and their meaning.

Note: **When selecting a product, always consider the detailed specifications and instructions in the chapters entitled "Technical Data" and "Application Instructions".**

- The sections below are numbered according to the numbering of the individual type codes (see chapter "Technical Data").
- Before ordering, please check the availability of the separate options with your Bosch Rexroth Service.

1. Product Group

Abbrev. column 1 2 3

MKD Three-digit Rexroth-specific designation of a servo motor series.

2. Motor Frame Size

Abbrev. column 4 5 6

The motor frame size defines essential mechanical motor dimensions. The following table assigns essential motor dimensions to the motor frame sizes.

Motor frame size	Description / details	
	Flange size in mm	Centering diameter in mm
025	54	40
041	82	50
071	115	95
090	140	110

Fig. 5-1: MKD motor frame sizes

3. Motor Frame Length

Abbrev. column 7

Within the scope of a motor frame size, the motor frame length defines the various continuous torques at standstill. The continuous torques at standstill of the MKD motors are listed in the table below. The values specified are applicable to the "natural convection" mode and a housing overtemperature of 60K.

Motor frame length	Motor frame size				
	025	041	071	090	
A	0.4 Nm	1.3 Nm	3.5 Nm	--	
B	0.9 Nm	2.7 Nm	8.0 Nm	12.0 Nm	

Fig. 5-2: MKD motor frame lengths

4. Winding Code

Abbrev. column 9 10 11

In connection with the motor frame size and motor frame length, the winding codes define the electric motor output data for all Bosch Rexroth motors.

The type code specifies all possible winding codes, which are available for a motor frame size / length.

Example

Motor frame size / length	Available winding codes
MKD090B	024, 035, 058

Fig. 5-3: Winding code example

In chapters 6 to 10, the technical data and the speed-torque curves are specified for all motors.

5. Motor encoder (encoder system)

Abbrev. column 13

MKD motors are equipped with an integrated encoder system (motor encoder). To control the motor speed and/or to position the motor, the drive controller requires information on the current motor position.

To achieve this, the integrated encoder system (motor encoder) makes the appropriate signals available to the drive controller.

The following options are available:

Option	Encoder type	Type of position detection
N	resolver (RSF)	Relative
P	Resolver (RSF with integrated multiturn absolute encoder	Absolute (more than 4096 revolutions)

Fig. 5-4: MKD motor encoder

6. Output Shaft

Abbrev. column 14

To connect the machine elements to be driven to the motor shafts, the following options are available for MKD motors.

Option	Design	Detail
G	Plain shaft	With end-sided centering hole with “DS” thread according to DIN 332, Part 2, Edition 05.83
P	Shaft with keyway [1)]	
1) Keyway according to DIN 6885, Sheet 1, ed. 08.68. For details, refer to the motor rating sheet!		

Fig. 5-5: MKD output shafts

Note: MKD motors are balanced with the **complete** featherkey. The pertinent featherkey is not included in the scope of delivery.

7. Holding Brake

Abbrev. column 15

Optional. Required for clamping the servo axis when the machine is in the de-energized state.

Option	Holding Brakes	
0	Without holding brake	
1, 2	With holding brake	Please refer to the motor type codes for the holding torques.

Fig. 5-6: MKD holding brakes

The holding brake is operated according to the “electrically releasing” principle. In the de-energized state, a magnetic force acts upon the brake armature disk. This causes the brake to close and to hold the axis.

By applying 24 VDC (± 10%), the permanent magnetic field is compensated by the electrically generated magnetic field: the brake opens.

Note: Please also observe the installation and safety instructions on the motor holding brakes in the chapter entitled “Application Instructions”.

8. Output Direction of Power Connector

Abbrev. column 17

The possible cable output directions for Rexroth motors are defined as follows. The following is applicable (view on the output shaft):

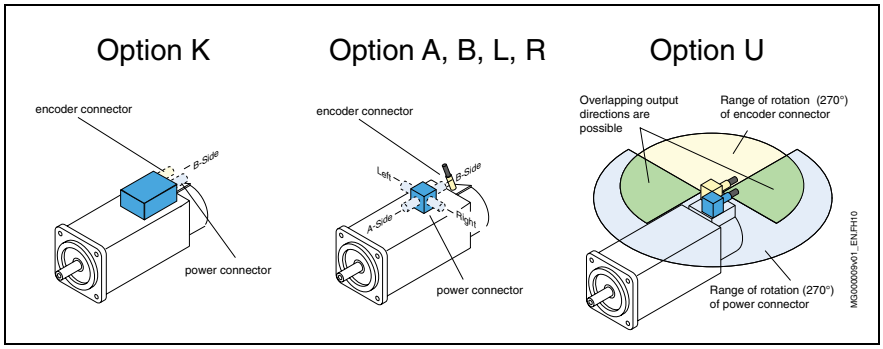


Fig. 5-7: Definition of cable output directions

Option	Output direction	Available for the motors below
K	connection box	MKD025 MKD041 MKD071 MKD090
U	Power and feedback connectors turnable within a range of 270°	MKD025

Fig. 5-8: MKD cable output directions

State upon delivery

MKD motors are delivered according to the option specified in the order.

Note: The cable output direction can be changed during assembly (see Chapter 18).

9. Housing Type

Abbrev. column 18

N = standard performance

S = Ex-performance according to unit group II, category 3, G and D as per DIN EN 50021.

10. Reference to Standards

The item “reference to standards” indicates standards referred to in the type code (e.g. DIN, EN, ISO, etc.) or also applicable factory standards (INN . . .). The version listed is always that valid at the time of type code issuing.

Remark

Please refer to this item for additionally required information concerning the handling of the type code. This includes, e.g, descriptions on footnotes, notes on availability, or exclusion clauses.

6 General Notes on Technical Data

6.1 60K and 100K Parameters

The speed-torque curves and the technical data are specified for two different motor overtemperatures.

These are:

- 60K 60K housing overtemperature
- 100K winding overtemperature

Note: When selecting the technical data, observe the temperatures specified! The appropriate parameters are identified by **100K** or **60K.**

Structure and measurement of the 60-K characteristic curve

The motor data and characteristic curves are determined using MKD motors under the following conditions:

- Environmental temperature approx. 45 °C
- Insulated structure (aluminum flange)
- Permissible housing overtemperature ΔT = 60 K
- If motors with the optional holding brake are concerned, the data are always specified for motors **with** holding brake.
- Motors with radial shaft sealing ring

Structure and measurement of the 100-K characteristic curve

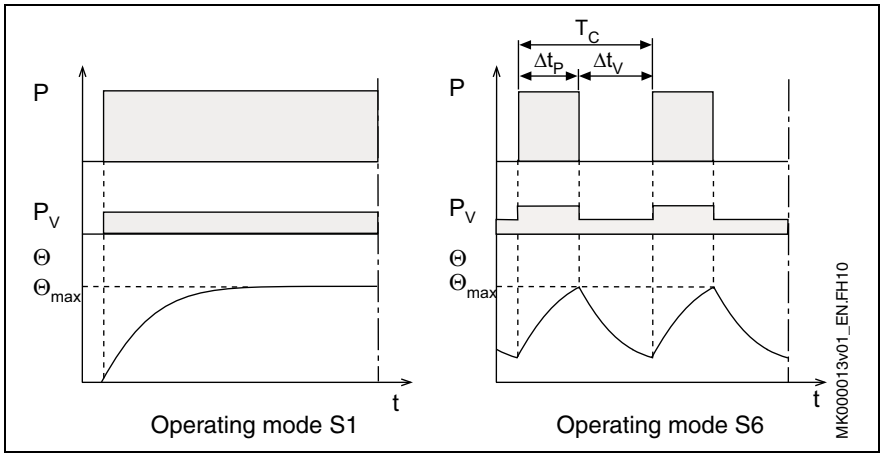
The motor data and characteristic curves are determined using MKD motors under the following conditions:

- Environmental temperature approx. 40°C
- Structure **not** insulated (attachment to steel flange, LxWxH 450x30x350 in size; LxWxH 120x40x100 in case of the MKD041)
- Permissible winding overtemperature ΔT =100 K
- If motors with the optional holding brake are concerned, the data are always specified for motors **with** holding brake.
- Motors with radial shaft sealing ring

Note: The machine accuracy can be negatively affected by an increased linear expansion during 100K operation. We recommend to use 60K data when projecting systems.

6.2 Operating Modes

Bosch Rexroth motors are documented according to the test criteria and measuring methods of EN 60034-1. The characteristic curves specified correspond to the operating modes S1 or S6.



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

Fig. 6-1: 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 with the following formula:

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

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

Fig. 6-2: Cyclic duration factor

The values specified in the documentation have been determined on the basis of the following parameters:

Cycle duration: 15 min (MKD041, -071, -090, -112)
10 min (MKD025)

Cyclic duration factor (ED): 25%

Note: If applicable, conditions deviating therefrom are marked accordingly.

6.3 Definition of Parameters

Electric parameters

Characteristic motor speed n_K
With a DC link voltage of 540 V_{DC} and at the characteristic speed, the continuous torque that can be output is approx. ½ continuous torque at standstill.

Continuous torque at standstill M_{dN}
The continuous torque that can be output at the motor output shaft at a speed of n = 0.

Continuous current at standstill I_{dN}
Phase current (crest value) of the motor required for the continuous torque at standstill M_{dN} at a speed of n = 0.

Peak current I_{max}
Maximum, briefly permissible phase current (crest value) of the motor without adverse affect on the permanent magnet circuit of the motor.

Torque constant at 20 °C K_M
Ratio of the increase in torque to the motor phase current (crest value) at a motor temperature of 20 °C. Unit: (Nm/A). Applicable up to approx. i = 2x I_{dN} .

Voltage constant at 20 °C $K_{E(eff)}$
Root-mean-square value of the induced motor voltage at a motor temperature of 20 °C and 1000 revolutions per minute. Unit: (V/1000 min^{-1}).

Winding resistance at 20 °C R_{12}
Winding resistance measured between two phases in ohms (Ω).

Winding inductivity L_{12}
Inductivity measured between two phases in (mH).

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

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

Rated torque M_N
Continuous torque that can be output at the rated speed in operating mode S1.

Rated current $I_{N(eff)}$
Phase current of the motor at the rated speed and load with rated torque, specified as root-mean-square value.

Rated output P_N
Power consumption of the motor at the rated speed and load with rated torque, specified in kilowatts (kW).

Rated voltage $U_{N(eff)}$
Root-mean-square value of the voltage to be applied to the motor, with the motor loaded with the rated torque and the rated speed. Unit (V).

Rated frequency f_N
Frequency of the rated voltage at rated speed (Hz).

Mechanical parameters

Maximum speed n_{max}

Maximum permissible speed of the motor. Limiting factors can have mechanical (centrifugal forces, bearing stress) or electrical (DC link voltage) causes.

Theoretical maximum torque M_{max}

Maximum torque that can be output for approx. 400 ms at a peak current of I_{max} (guaranteed value which, owing to production tolerances, may be higher by 20%). The achievable maximum torque depends on the drive controller used. Only the maximum torques M_{max} specified in the selection lists for the motor-controller combination are binding.

Moment of inertia of the rotor $J_{M)}$

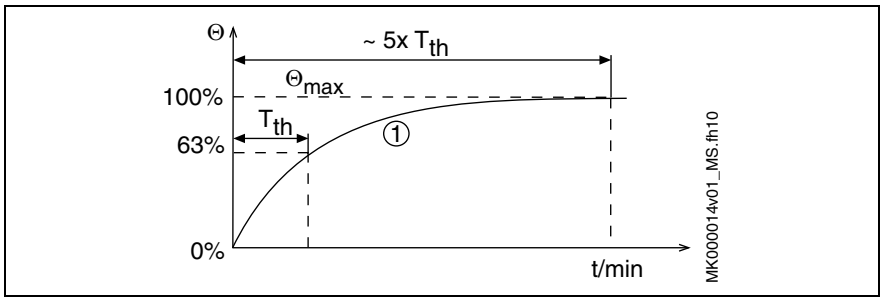
Moment of inertia of the rotor without the optional holding brake. Unit (kgm^2).

Mass m_M

Motor mass without the optional holding brake and optional motor fan, specified in kg.

Thermal time constant T_{th}

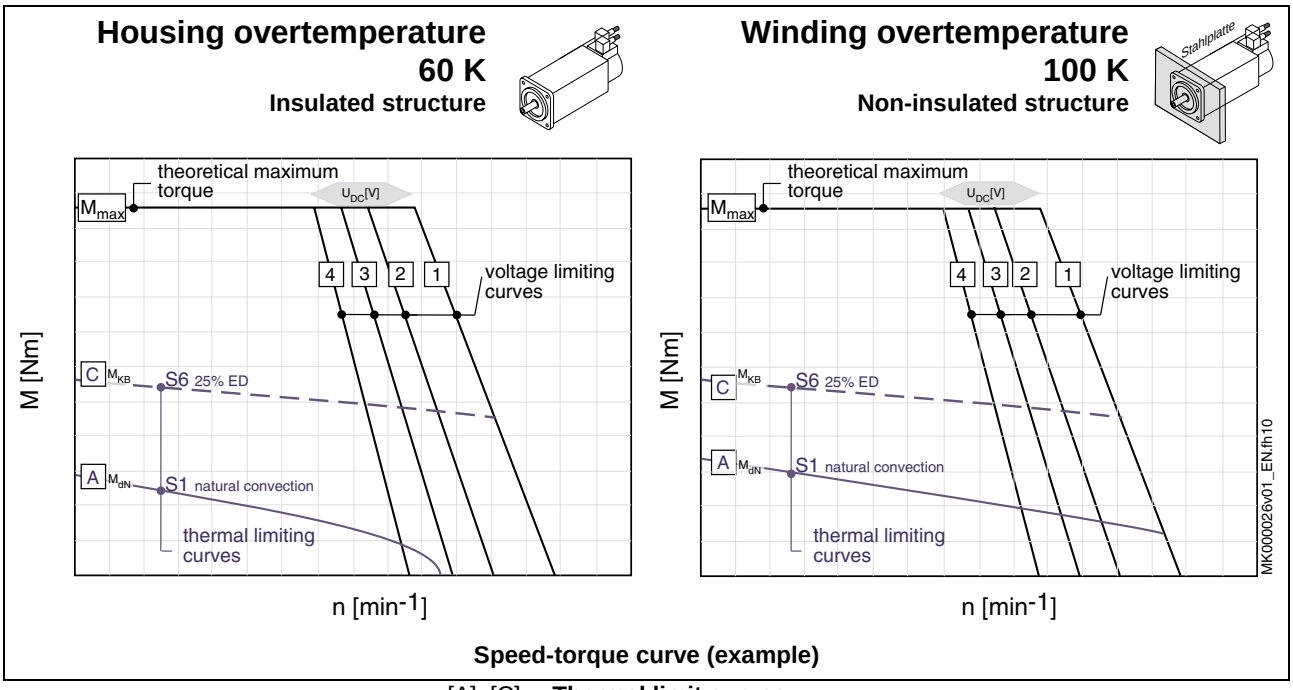
Time of the temperature rise to 63% of the final temperature of the motor housing with the motor loaded with the permissible S1 continuous torque. The thermal time constant is destined for the size of the motors and the used method of cooling.



(1): Time constant of motor housing-temperature
Θ_{max}: Highest temperature (motor housing)
T_{th}: Thermal time constant

Fig. 6-3: Thermal time constant

6.4 Sample Curve



Speed-torque curve (example)

[A], [C]: **Thermal limit curves**

[A]: **M_{dN}** S1 continuous operation curve of the motor (according to EN 60034-1; 1998), natural convection

[C]: **M_{KB}** S6 intermittent operation curve with a motor ON time of 25% (according to EN 60034-1; 1998). The maximum cycle duration is 15 min.

[**M_{max}**]: Corresponds to the theorectically possible maximum torque of the motor. The value can be limited by the drive controller.

[1]-[4]: **Characteristic voltage limit curves.** When a speed at the safe commutation limit is reached, the voltage limit curve limits the available maximum torque M_{max}. The maximum motor speed is determined by the DC link voltage used. There are separate characteristic curves for the various drive controllers in connection with the power supply unit and the supply voltage used.

[1]: HDS to HVR

[2]: HDS to HVE **or** DKCxx.3 with a power connection of 3 x AC 480 V

[3]: HDS to HVE **or** DKCxx.3 with a power connection of 3 x AC 440 V

[4]: HDS to HVE **or** DKCxx.3 with a power connection of 3 x AC 400 V

Fig. 6-4: Sample curves

7 MKD025

7.1 Technical Data

Description	Symbol	Unit	MKD025A-144		
Type of cooling Motor overtemperature			Natural 60K	Natural 100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	9000		
Continuous torque at standstill	M_{dN}	Nm	0.4	0.45	
Continuous current at standstill	I_{dN}	A	2.2	2.5	
Peak current	I_{max}	A	10.0		
Torque constant at 20 °C [1]	K_m	Nm/A	0.2		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	18.2		
Winding resistance at 20 °C	R_{12}	Ω	7.3		
Winding inductivity	L_{12}	mH	8.1		
Number of pole pairs	p		3		
Rated data [2]					
Rated speed	n_N	min^{-1}	5000	5000	
Rated torque	M_N	Nm	0.18	0.39	
Rated current	I_N	A	0.7	1.5	
Rated output	P_N	kW	0.12	0.27	
Rated voltage	U_N	V	97	104	
Rated frequency	f_N	Hz	250	250	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	0.2 (0.3) [8] x 10^{-4}		
Theoretical maximum torque	M_{max}	Nm	1.8		
Minimum strand cross-section [4]	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	15	15	
Maximum speed	n_{max}	min^{-1}	9000		
Motor mass [3] [5]	m	kg	1.5		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.
[8] Value in brackets applicable for motors with an encoder “K”.

Fig. 7-1: Technical Data MKD025A

Description	Symbol	Unit	MKD025B-144		
Type of cooling Motor overtemperature			Natural 60K	Natural 100K	Surface 60 K/100 K
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	9000		
Continuous torque at standstill [3]	M_{dN}	Nm	0.9 (0.8)	1.0 (0.9)	
Continuous current at standstill [3]	I_{dN}	A	5.1(4.5)	5.7 (5.1)	
Peak current	I_{max}	A	23.0		
Torque constant at 20 °C [1]	K_m	Nm/A	0.2		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	18.,2		
Winding resistance at 20 °C	R_{12}	Ω	2.7		
Winding inductivity	L_{12}	mH	3.7		
Number of pole pairs	p		3		
Rated data [2]					
Rated speed	n_N	min^{-1}	5000	5000	
Rated torque [3]	M_N	Nm	0.31 (0.28)	0.59 (0.53)	
Rated current [3]	I_N	A	1.2 (1.1)	2.4 (2.1)	
Rated output [3]	P_N	kW	0.2 (0.18)	0.4 (0.36)	
Rated voltage [3]	U_N	V	94.7 (94.3)	98.4 (97.5)	
Rated frequency	f_N	Hz	250	250	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	0.3×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	4		
Minimum strand cross-section [4]	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	15	15	
Maximum speed	n_{max}	min^{-1}	9000		
Motor mass [3] [5]	m	kg	2.0 (2.3)		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Value in brackets applicable for motors with a holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 7-2: Technical Data MKD025B

Holding Brake

Description	Symbol	Unit	Holding brake data
Holding torque	M_4	Nm	1.0
Rated voltage (+/- 10%)	U_N	V	24
Rated current	I_N	A	0.4
Moment of inertia	J_B	kgm²	0.08
Connection time	t_1	ms	3
Disconnection time	t_2	ms	4
Mass brake	m_B	kg	0.25

Fig. 7-3: Technical data of MKD025 holding brake (optional)

7.2 Type Code – Order designation

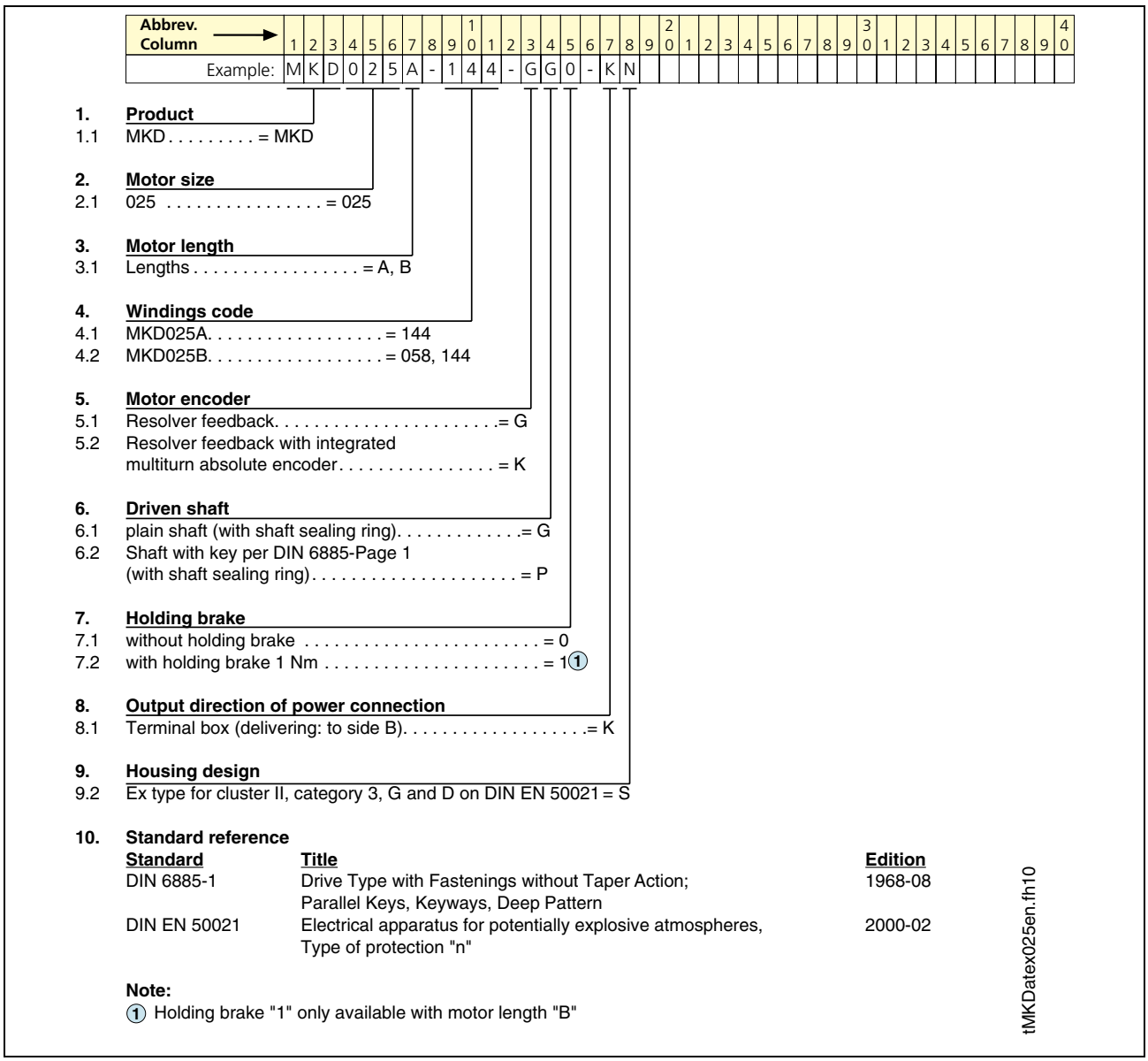
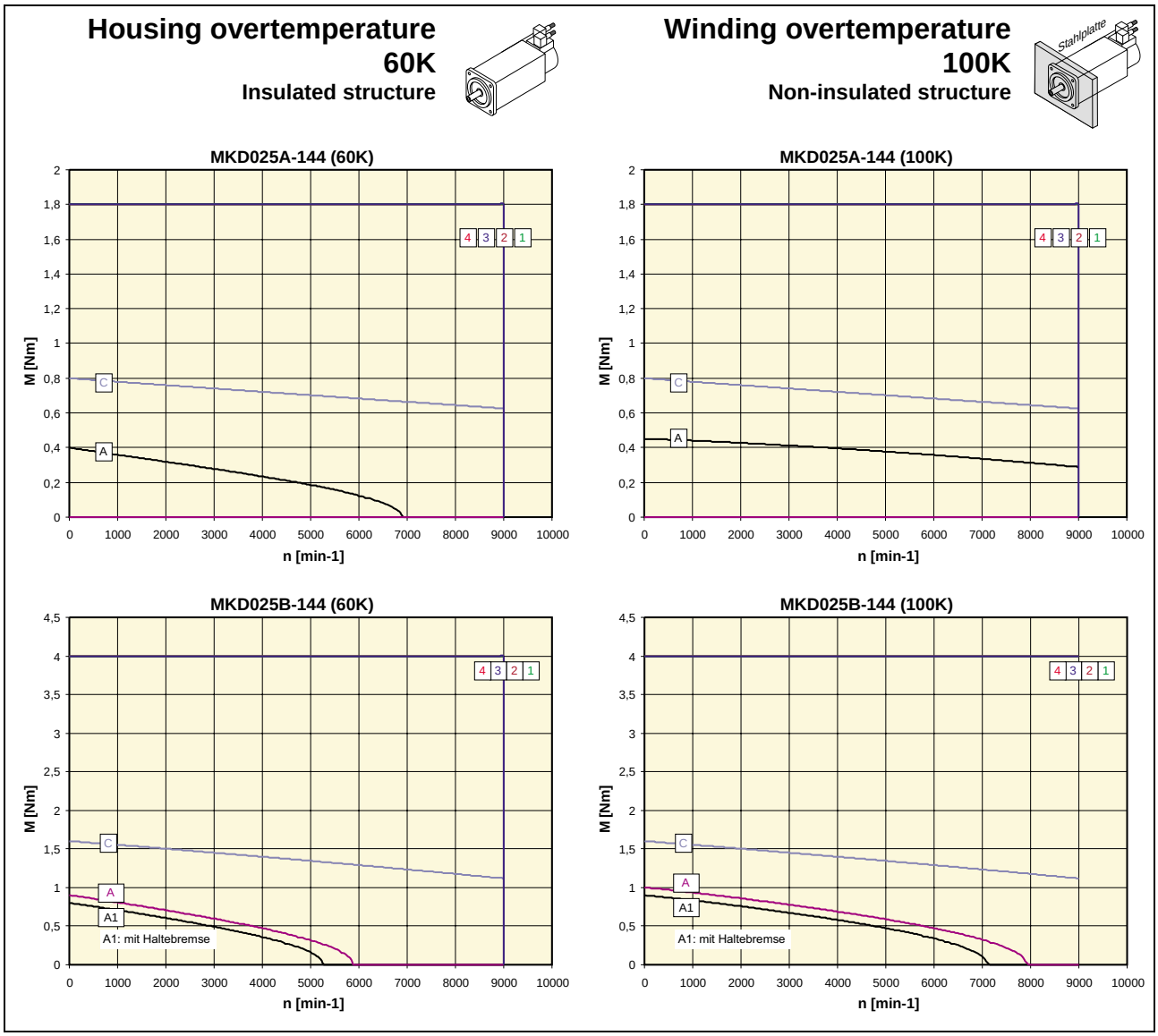


Fig. 7-4: MKD025 type code

7.3 Speed-Torque Curves



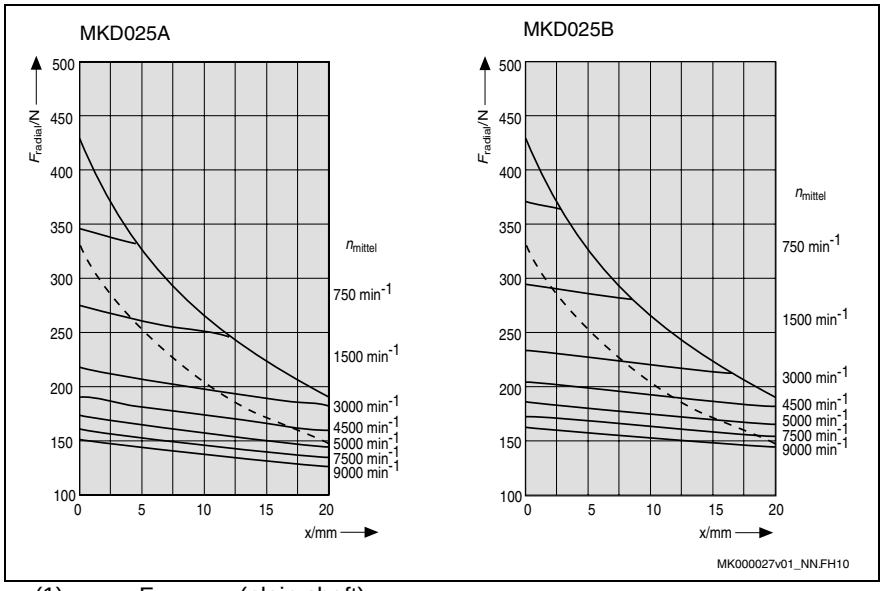
[A]: M_{dN} Natural conv. (S1 continuous operation)
[A1]: M_{dN} Natural conv. (S1 continuous process), motor with holding brake
[C]: M_{KB} (S6 intermittent operation, 25% ED)
[1]: HDS to HVR
[2]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 480 V
[3]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 440 V
[4]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 400 V

Fig. 7-5: Characteristic curves

7.4 Shaft Load

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

For explanations refer to Chapter 16.



(1): F_{radial_max} (plain shaft)
(2): F_{radial_max} (shaft with keyway)

Fig. 7-6: MKD025: Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

Permissible axial force F_{axial}

$$F_{axial} = x \cdot F_{radial}$$

x: 0.59 for MKD025A
0.55 for MKD025B
F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 7-7: MKD025: permissible axial force F_{axial}

7.5 Dimensional Details

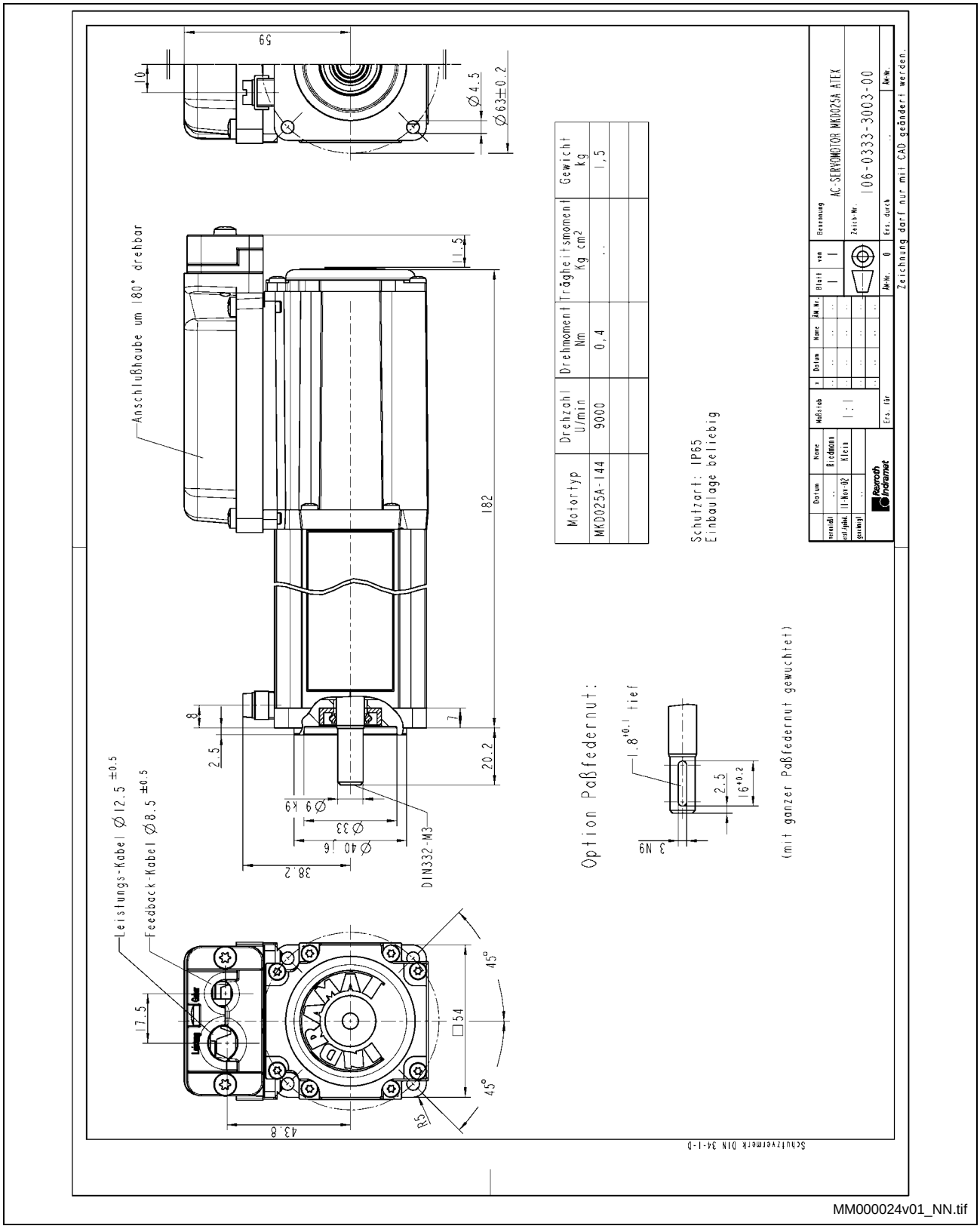


Abb. 7-1: dimensions MKD025A (terminal box)

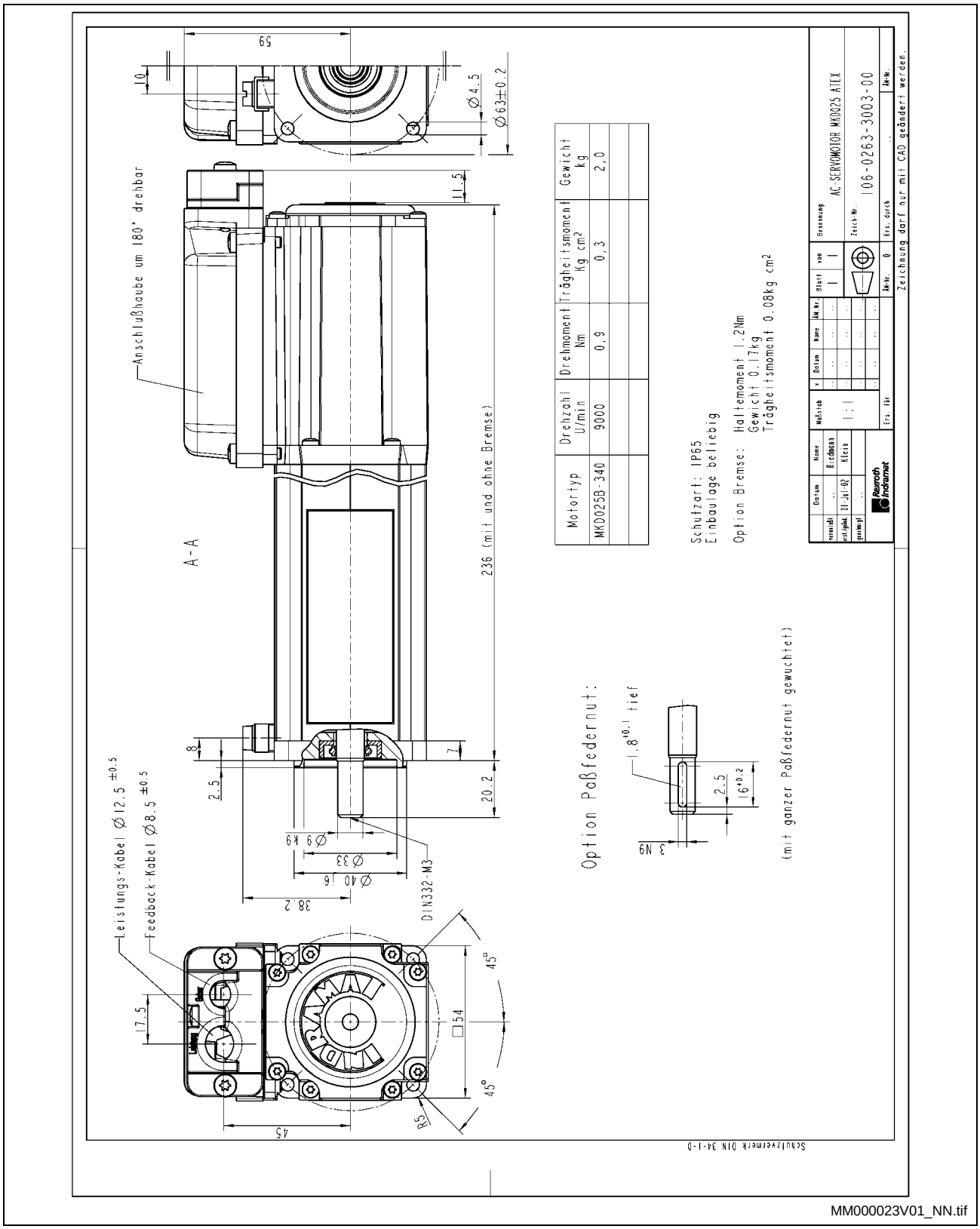


Abb. 7-2: dimensions MKD025B (terminal box)

Shaft end

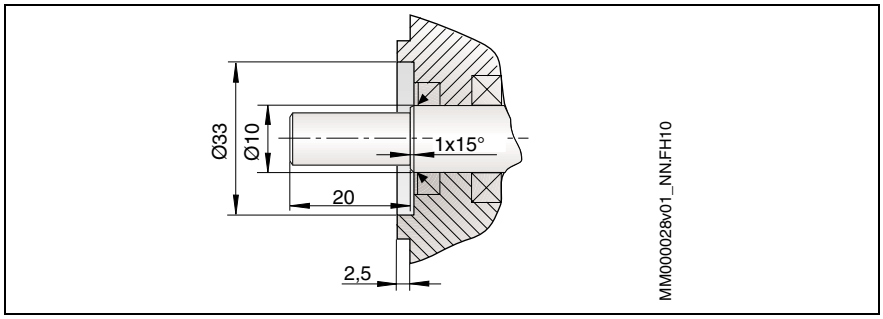


Fig. 7-8: Shaft end MKD025

- Shaft end cylindrical according to DIN 748, Part 3, ed. 07.75. IEC 60072 (1971).
- DS M3 centering hole according to DIN 332, Part 2, ed. 05.83, max. tightening torque for screw 0.7 Nm.
- Vibration severity grade N according to DIN VDE 0530, Part 14, ed. 02.93.

Motor design

- Motor design B5 according to EN 60034-7 / 1996-06 for all installation positions.

Flange

- Flange according to DIN 42948, ed. 11.65.
- Positional accuracy with regard to true running, axial running and coaxiality to the shaft according to DIN 42955 Tolerance Class N, ed. 12.81

Output shaft

- Plain shaft (preferred type)

or

- Shaft with keyway according to DIN 6885, Sheet 1, ed. 08.68.

Note: Caution! Balanced with **complete** featherkey!

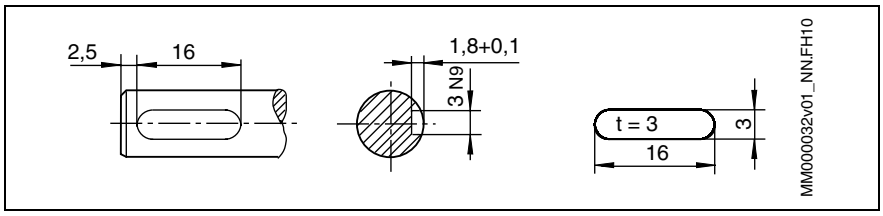


Fig. 7-9: Output shaft with keyway MKD025

Note: Pertinent featherkey: DIN 6885-A 3x3x16, does not belong to the scope of delivery of the motor.

Options

For options refer to the chapter entitled “Type Code – Order designation”.

Notes

8 MKD041

8.1 Technical Data

Description	Symbol	Unit	MKD041B-058		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}			
Continuous torque at standstill	M_{dN}	Nm	2.7	2.9	
Continuous current at standstill	I_{dN}	A	3.4	3.8	
Peak current	I_{max}	A	15.3		
Torque constant at 20 °C [1]	K_m	Nm/A	0.87		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	75.8		
Winding resistance at 20 °C	R12	Ω	6.8		
Winding inductivity	L12	mH	19.0		
Number of pole pairs	p		3		
Rated data [2]					
Rated speed	n_N	min^{-1}	5000	5000	
Rated torque	M_N	Nm	1.5	1.71	
Rated current	I_N	A	1.34	1.58	
Rated output	P_N	kW	0.9	1.1	
Rated voltage	U_N	V	390	392	
Rated frequency	f_N	Hz	250	250	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm²	1.7×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	11.3		
Minimum strand cross-section [4]	S	mm^2	1.0	1.0	
time constant	T_{th}	min	30	30	
Maximum speed	n_{max}	min^{-1}	7500		
Motor mass [3] [5]	m	kg	4.4		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			without		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 8-1: Technical data of MKD041B-058

Description	Symbol	Unit	MHD041B-144		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	6000		
Continuous torque at standstill	M_{dN}	Nm	2.7	2.9	
Continuous current at standstill	I_{dN}	A	7.5	8.2	
Peak current	I_{max}	A	34.0		
Torque constant at 20 °C [1])	K_m	Nm/A	0.4		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	36.3		
Winding resistance at 20 °C	R12	Ω	1.8		
Winding inductivity	L12	mH	5		
Number of pole pairs	p		3		
Rated data [2])					
Rated speed	n_N	min^{-1}	3000	4500	
Rated torque	M_N	Nm	1.4	1.5	
Rated current	I_N	A	2.8	3	
Rated output	P_N	kW	0.52	0.88	
Rated voltage	U_N	V	115	170	
Rated frequency	f_N	Hz	150	225	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	1.7×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	11.3		
Minimum strand cross-section [4])	S	mm^2	1	1	
time constant	T_{th}	min	30	30	
Maximum speed	n_{max}	min^{-1}	7500		
Motor mass [3]) [5])	m	kg	4.4		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6])	T_{um}	°C	0 to 40		
Maximum setup height [6])	h	m	1000 above MSL		
Degree of protection [7])			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1]) K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2]) Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3]) Without holding brake.
[4]) Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5]) Without fan unit.
[6]) If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7]) Provided the power and encoder cables are mounted properly.

Fig. 8-2: Technical data of MKD041B-144

Holding Brake

Description	Symbol	Unit	Holding brake data
Holding torque	M_4	Nm	2.2
Rated voltage (+/- 10%)	U_N	V	24
Rated current	I_N	A	0.34
Moment of inertia	J_B	kgm²	0.00001
Connection time	t_1	ms	14
Disconnection time	t_2	ms	28
Mass brake	m_B	kg	0.23

Fig. 8-3: Technical data of MKD041 holding brake (optional)

8.2 Type Code – Order designation

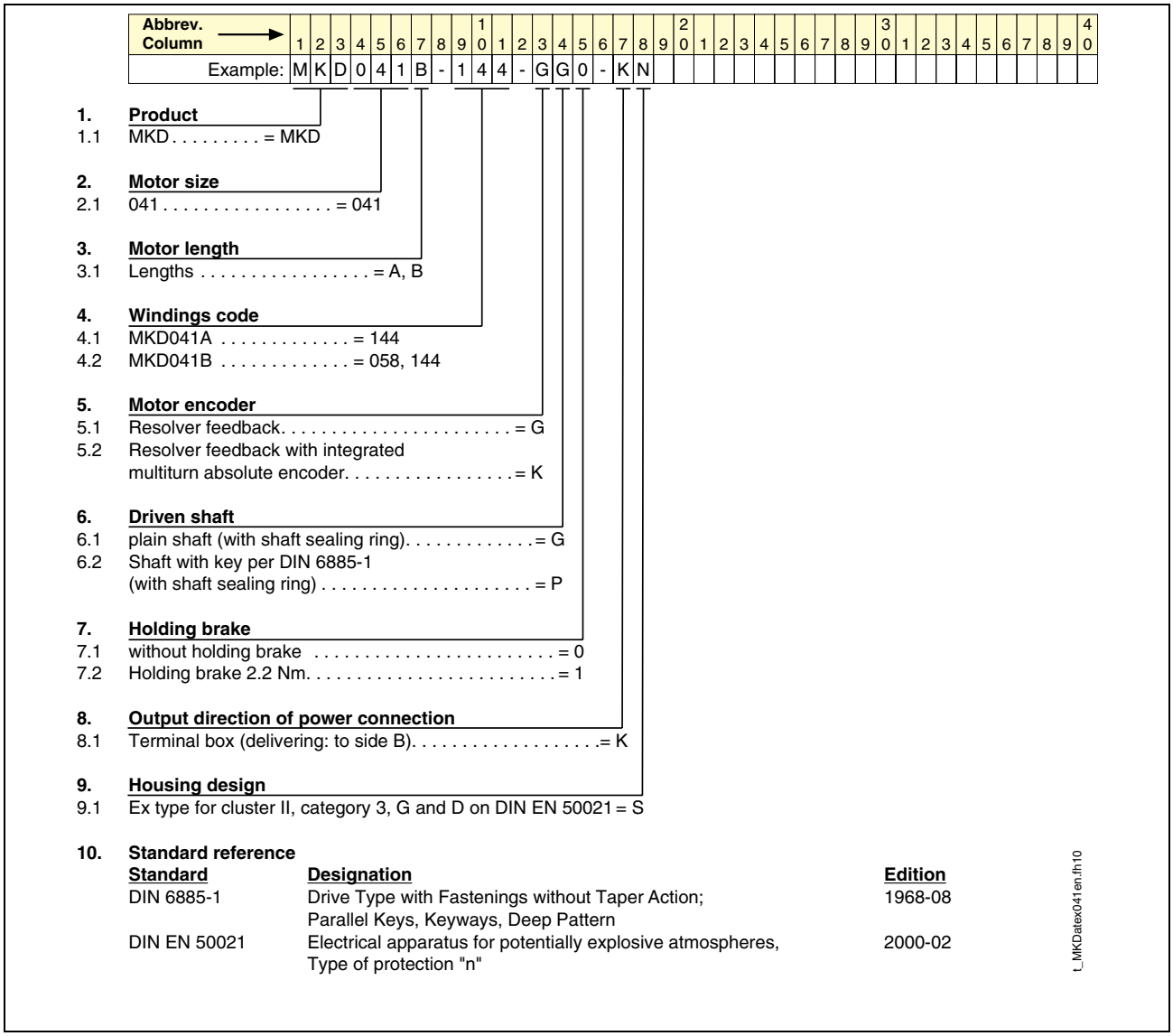
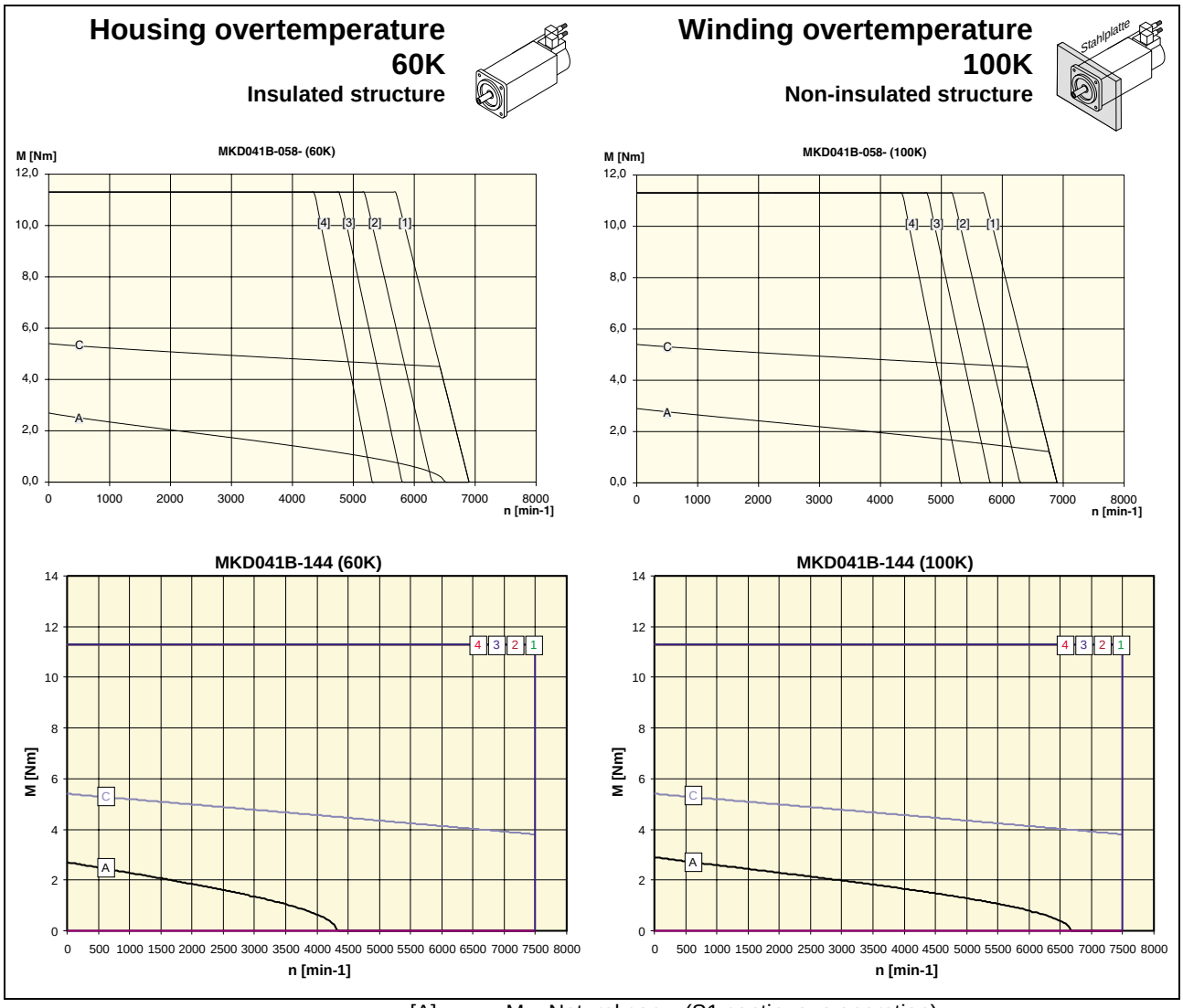


Fig. 8-4: MKD041 type code

8.3 Speed-Torque Curves



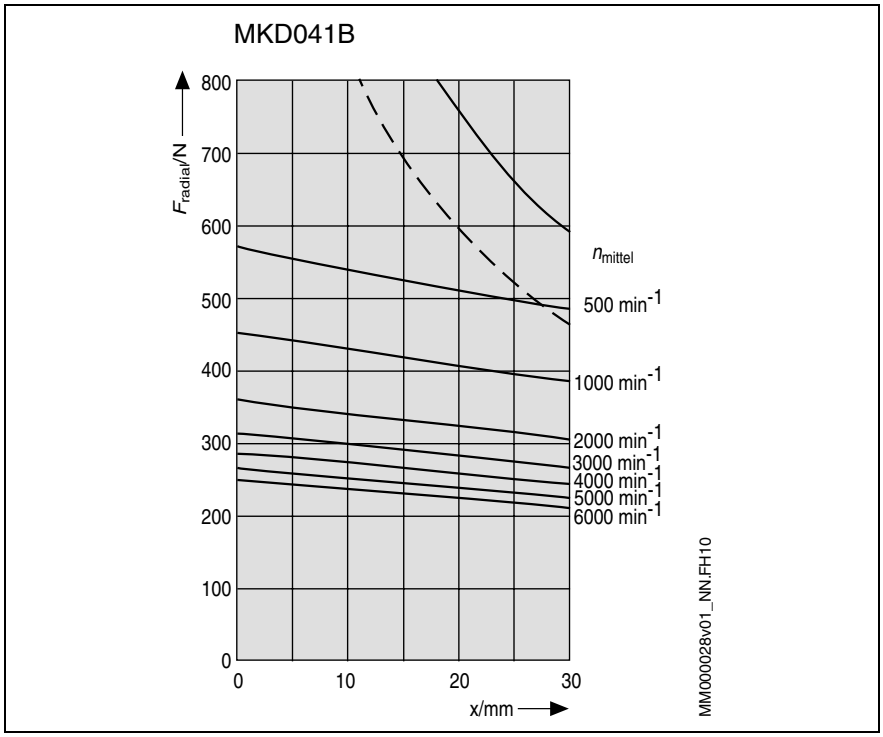
[A]: M_{dN} Natural conv. (S1 continuous operation)
[C]: M_{KB} (S6 intermittent operation, 25% ED)
[1]: HDS to HVR
[2]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 480 V
[3]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 440 V
[4]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 400 V

Fig. 8-5: Characteristic curves

8.4 Shaft Load

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

For explanations refer to Chapter 16.



(1): F_{radial_max} (plain shaft)
(2): F_{radial_max} (shaft with keyway)

Fig. 8-6: MKD041: Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

Permissible axial force F_{axial}

$$F_{axial} = x \cdot F_{radial}$$

x: 0.45 for MKD041B
F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 8-7: MKD041: permissible axial force F_{axial}

8.5 Dimensional Details

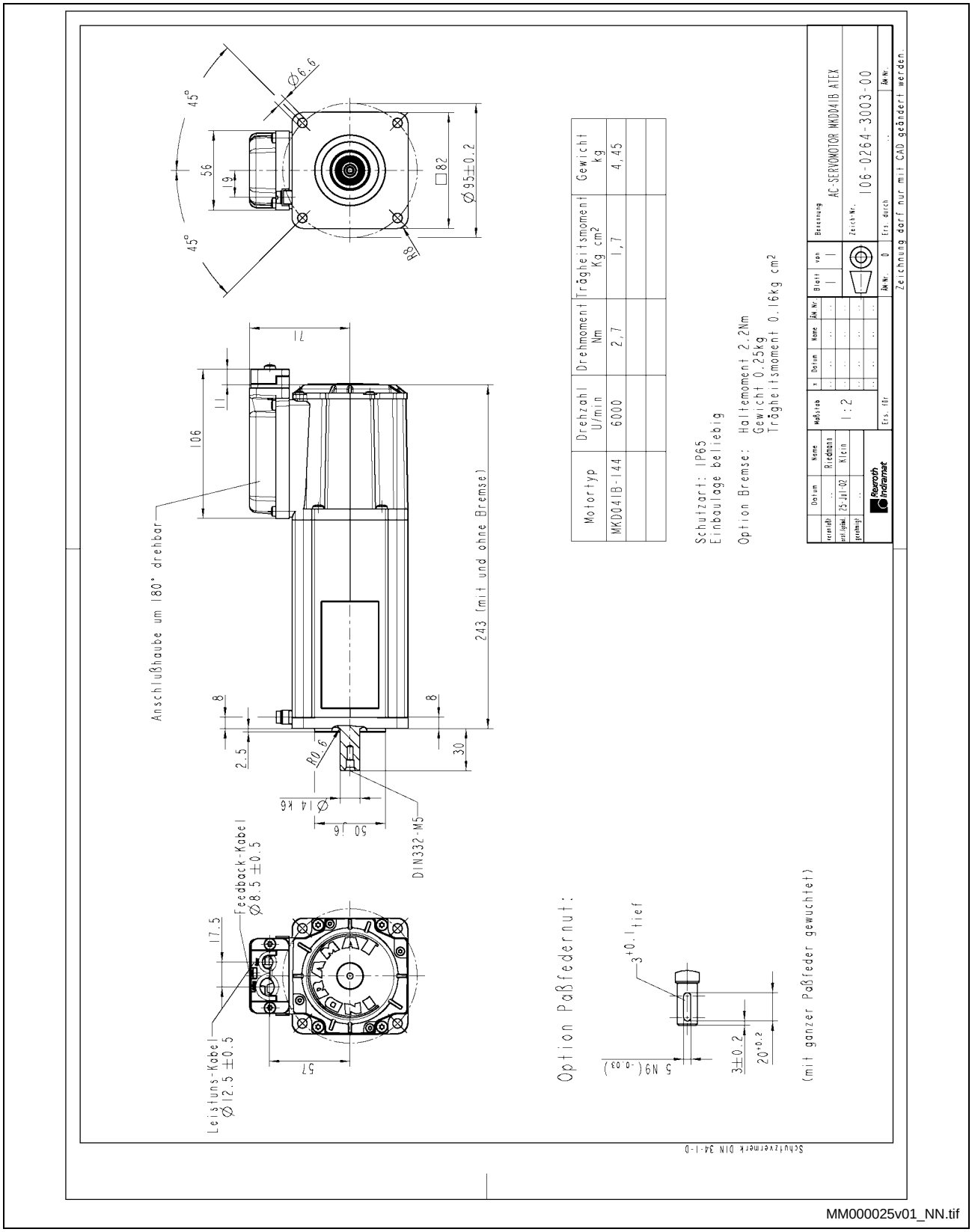


Abb. 8-1: Dimensional details of MKD041

Shaft end

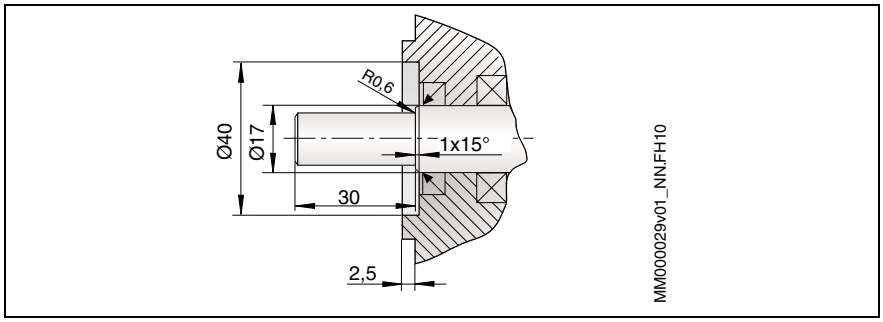


Fig. 8-8: Shaft end MKD041

- Shaft end cylindrical according to DIN 748, Part 3, ed. 07.75. IEC 60072 (1971).
- DS M5 centering hole according to DIN 332, Part 2, ed. 05.83, max. tightening torque for screw 3.0 Nm.
- Vibration severity grade N according to DIN VDE 0530, Part 14, ed. 02.93.

Motor design

- Motor design B5 according to EN 60034-7 / 1993 for all installation positions.

Flange

- Flange according to DIN 42948, ed. 11.65.
- Positional accuracy with regard to true running, axial running and coaxiality to the shaft according to DIN 42955 Tolerance Class N, ed. 12.81

Output shaft

- Plain shaft (preferred type)

or

- Shaft with keyway according to DIN 6885, Sheet 1, ed. 08.68.

Note: Caution! Balanced with **complete** featherkey!

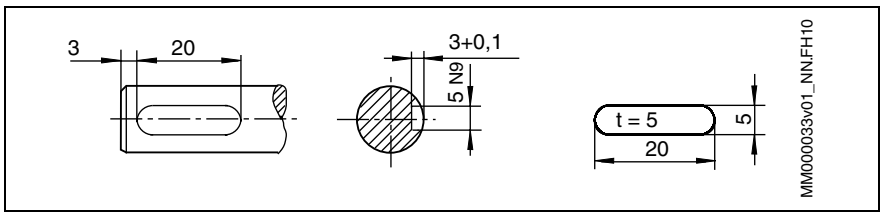


Fig. 8-9: Output shaft with keyway MKD041

Note: Pertinent featherkey: DIN 6885-A 5x5x20, does not belong to the scope of delivery of the motor.

Options For options refer to the chapter entitled “Type Code – Order Designation”.

9 MKD071

9.1 Technical Data

Description	Symbol	Unit	MKD071B-024		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}			
Continuous torque at standstill	M_{dN}	Nm	8.0	9.0	
Continuous current at standstill	I_{dN}	A	4.4	5.1	
Peak current	I_{max}	A	19.8		
Torque constant at 20 °C [1]	K_m	Nm/A	2.01		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	174.9		
Winding resistance at 20 °C	R12	Ω	8.4		
Winding inductivity	L12	mH	34.4		
Number of pole pairs	p		4		
Rated data [2]					
Rated speed	n_N	min^{-1}	2000	2000	
Rated torque	M_N	Nm	5.8	6.8	
Rated current	I_N	A	2.2	2.7	
Rated output	P_N	kW	1.4	1.8	
Rated voltage	U_N	V	372	377	
Rated frequency	f_N	Hz	100	100	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	8.7×10^{-4}		
Theor. Maximum torque	M_{max}	Nm			
Minimum strand cross-section [4]	S	mm^2	1.0	1.0	
Therm. Time constant	T_{th}	min	45	45	
Maximum speed	n_{max}	min^{-1}			
Motor mass [3] [5]	m	kg	8.8		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 9-1: Technical data of MKD071B-024

Description	Symbol	Unit	MKD071B-035		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	2500		
Continuous torque at standstill	M_{dN}	Nm	8.0	9.0	
Continuous current at standstill	I_{dN}	A	6.3	7.4	
Peak current	I_{max}	A	28.3		
Torque constant at 20 °C [1]	K_m	Nm/A	1.38		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	125		
Winding resistance at 20 °C	R12	Ω	4.57		
Winding inductivity	L12	mH	23		
Number of pole pairs	p		4		
Rated data [2]					
Rated speed	n_N	min^{-1}	2500	2500	
Rated torque	M_N	Nm	5.2	7.5	
Rated current	I_N	A	2.9	4.4	
Rated output	P_N	kW	1.6	2.5	
Rated voltage	U_N	V	333	349	
Rated frequency	f_N	Hz	167	167	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	8.7×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	32		
Minimum strand cross-section [4]	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	45	45	
Maximum speed	n_{max}	min^{-1}	6000		
Motor mass [3] [5]	m	kg	8.8		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 9-2: Technical data of MKD071B-035

Description	Symbol	Unit	MHD071B-061		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	4500		
Continuous torque at standstill	M_{dN}	Nm	8.0	9.0	
Continuous current at standstill	I_{dN}	A	11.2	13.2	
Peak current	I_{max}	A	50.4		
Torque constant at 20 °C [1]	K_m	Nm/A	0.77		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	70		
Winding resistance at 20 °C	R12	Ω	1.45		
Winding inductivity	L12	mH	7.2		
Number of pole pairs	p		4		
Rated data [2]					
Rated speed	n_N	min^{-1}	4000	5000	
Rated torque	M_N	Nm	1.7	5.3	
Rated current	I_N	A	1.7	5.5	
Rated output	P_N	kW	0.8	3.4	
Rated voltage	U_N	V	283	368	
Rated frequency	f_N	Hz	267	333	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	8.7×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	32		
Minimum strand cross-section [4]	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	45	45	
Maximum speed	n_{max}	min^{-1}	6000		
Motor mass [3] [5]	m	kg	8.8		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 9-3: Technical data of MKD071B-061

Holding Brake

Description	Symbol	Unit	Holding brake 1	Holding brake 3
Holding torque	M_4	Nm	5.0	10
Rated voltage (+/- 10%)	U_N	V	24	24
Rated current	I_N	A	0.56	0.65
Moment of inertia	J_B	kgm²	0.72	1.07
Connection time	t_1	ms	20	26
Disconnection time	t_2	ms	38	43
Mass brake	m_B	kg	0.62	0.7

Fig. 9-4: Technical data of MKD071 holding brake (optional)

9.2 Type Code – Order Designation

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	K	D	0	7	1	B	-	0	6	1	-	G	G	0	-	K	N																						

1. Product
1.1 MKD . . . . . = MKD

2. Motor size
2.1 071 . . . . . = 071

3. Motor length
3.1 Length. . . . . = B

4. Windings code
4.1 MKD071B. . . . . = 024, 035, 061

5. Motor encoder
5.1 Resolver feedback. . . . . = G
5.2 Resolver feedback with integrated multiturn absolute encoder. . . . . = K

6. Driven shaft
6.1 plain shaft (with shaft sealing ring). . . . . = G
6.2 Shaft with key per DIN 6885-1 (with shaft sealing ring) . . . . . = P

7. Holding brake
7.1 without holding brake . . . . . = 0
7.2 Holding brake 5 Nm . . . . . = 1
7.3 Holding brake 10 Nm . . . . . = 3

8. Output direction of power connection ①
8.1 Junction box (delivering: to side B). . . . . .= K

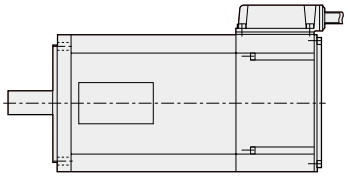
9. Housing design
9.1 standard . . . . . = N
9.2 Ex type for cluster II, category 3, G and D on DIN EN 50021 = S

10. Standard reference

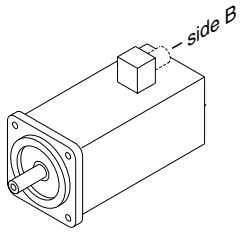
Standard	Title	Edition
DIN 6885-1	Drive Type with Fastenings without Taper Action; Parallel Keys, Keyways, Deep Pattern	1968-08
DIN EN 50021	Electrical apparatus for potentially explosive atmospheres, Type of protection "n"	2000-02

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

Illustration example: MKD071



Position of power connection = top

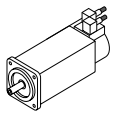


Picture 1

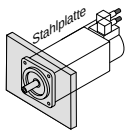
Fig. 9-5: MKD071 type code

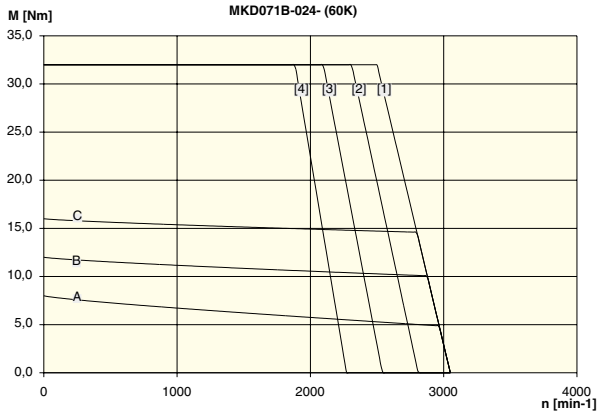
9.3 Speed-Torque Curves

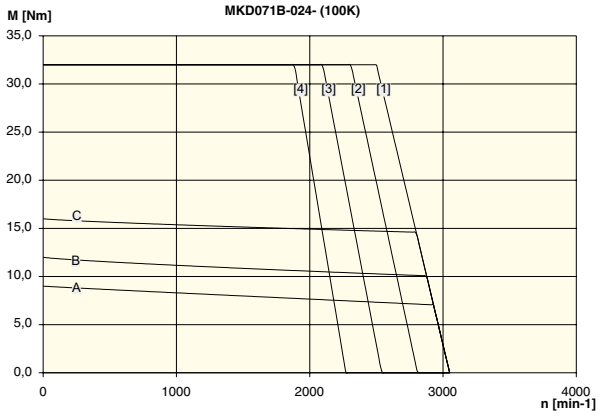
Housing overtemperature 60K
Insulated structure

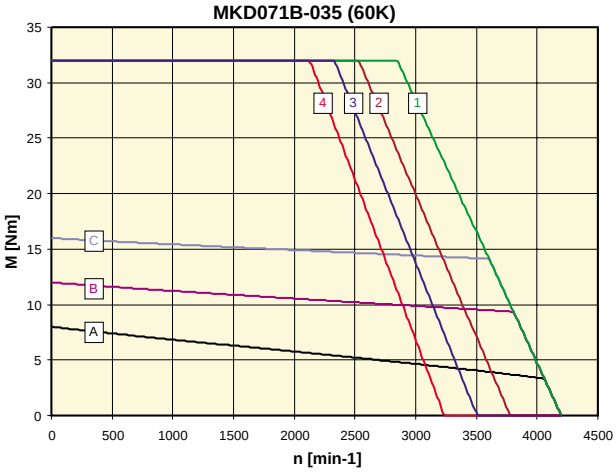


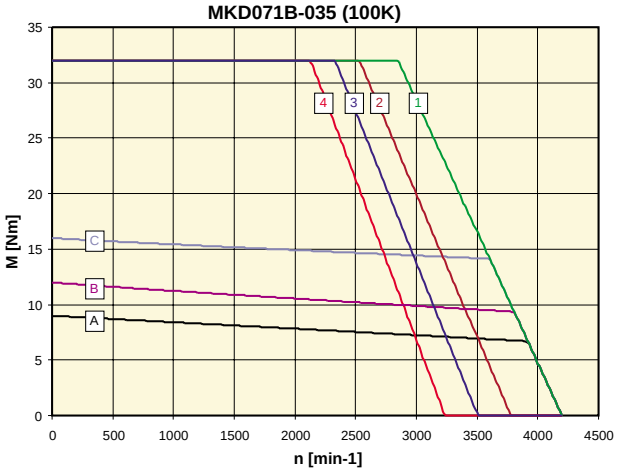
Winding overtemperature 100K
Non-insulated structure

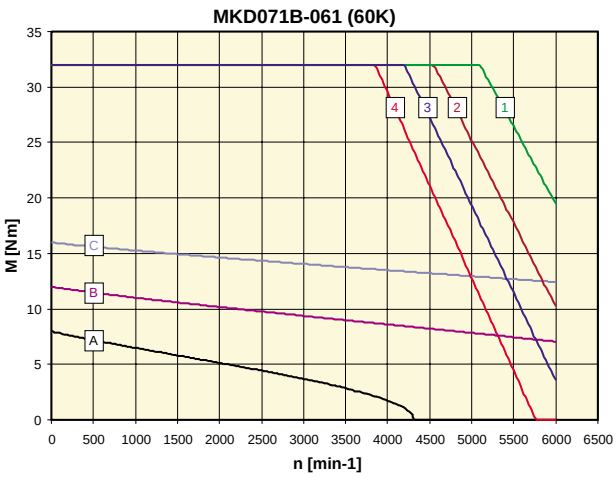


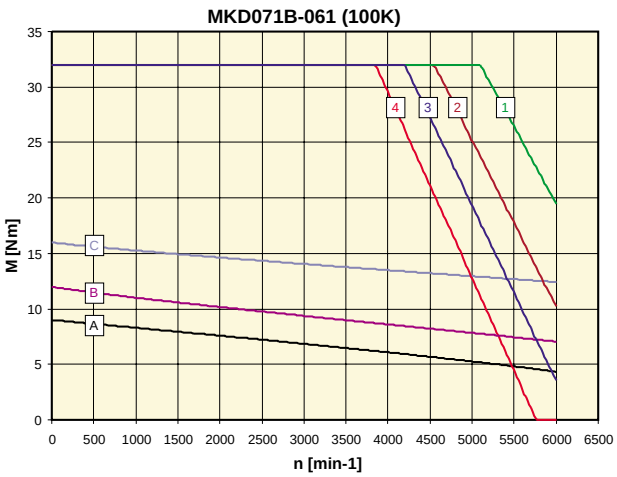












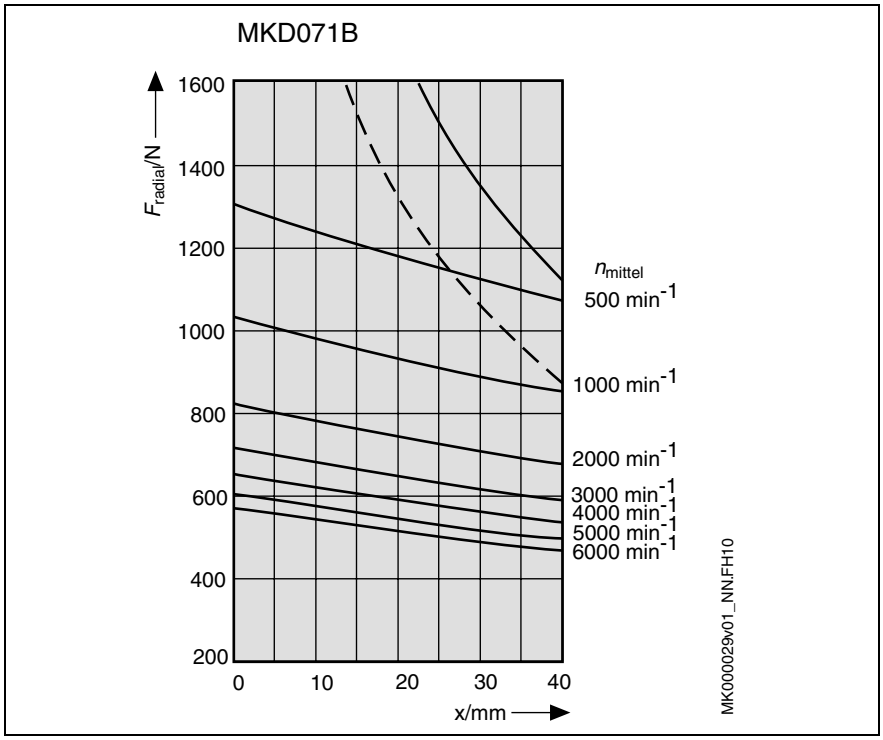
[A]: M_{dN} Natural conv. (S1 continuous operation)
[B]: M_{dn} Surface cooling (S1 continuous operation); curve theoretical, Bosch Rexroth deliveres no fans for the explosive-hazardous areas.
[C]: M_{KB} (S6 intermittent operation, 25% ED)
[1]: HDS to HVR
[2]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 480 V
[3]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 440 V
[4]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 400 V

Fig. 9-6: Characteristic curves

9.4 Shaft Load

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

For explanations refer to Chapter 16.7



(1): F_{radial_max} (plain shaft)
(2): F_{radial_max} (shaft with keyway)

Fig. 9-7: Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial} for MKD071

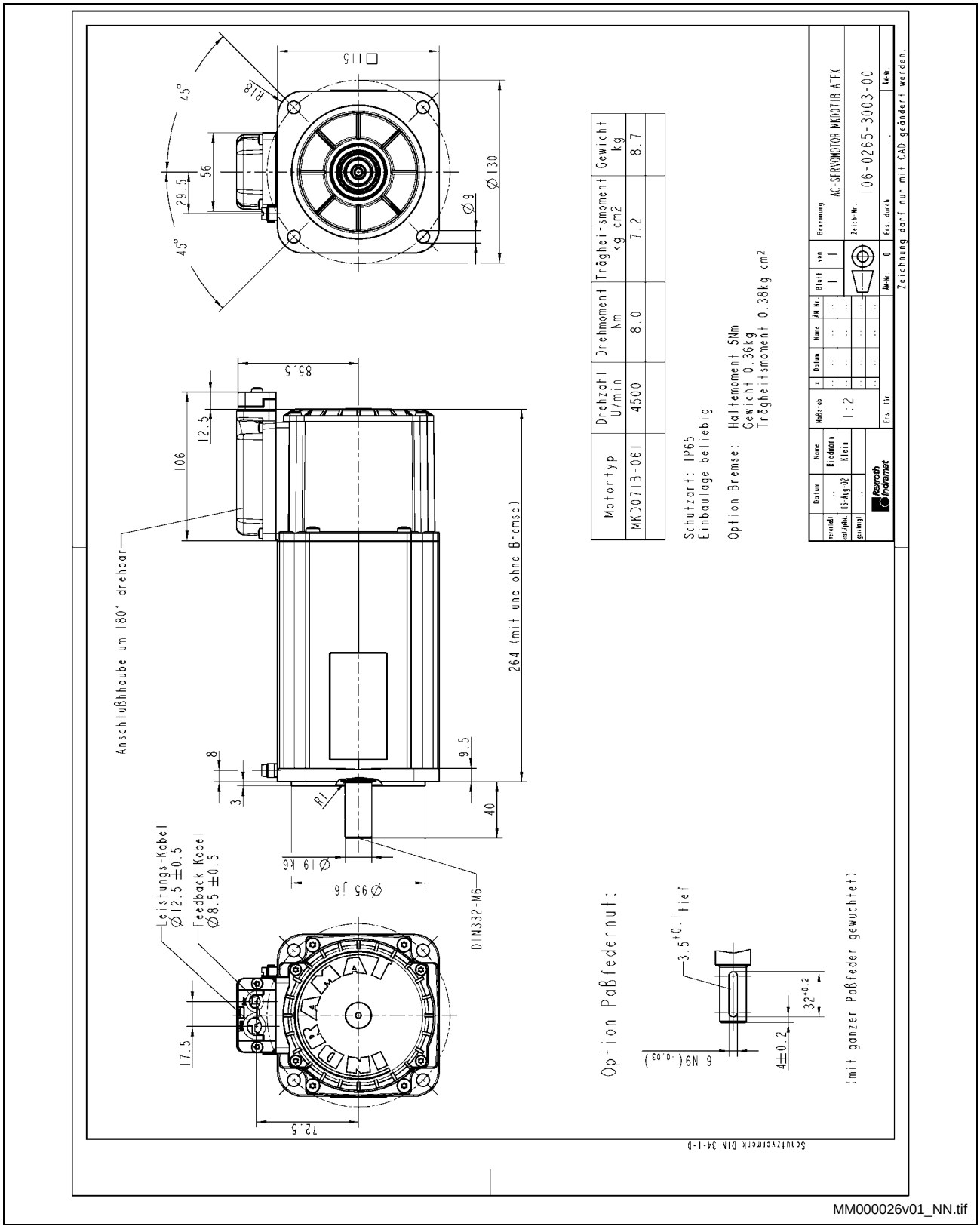
Permissible axial force F_{axial}

$$F_{axial} = x \cdot F_{radial}$$

x: 0.55 for MKD071B
F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 9-8: MKD071: permissible axial force F_{axial}

9.5 Dimensional Details



MM000026v01_NN.tif

Fig. 9-1: Dimensional details of MKD071

Shaft end

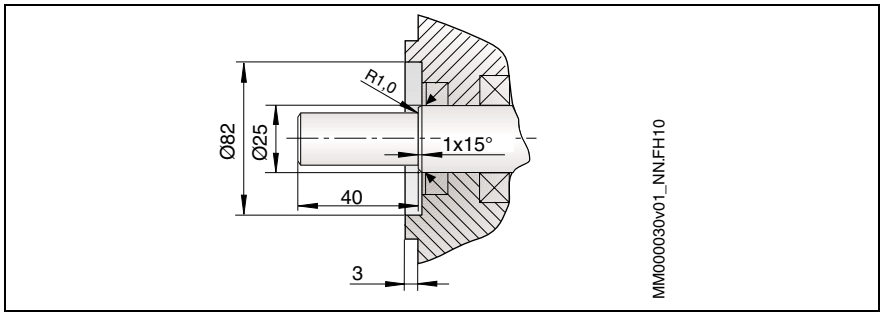


Fig. 9-9: Shaft end MKD071

- Shaft end cylindrical according to DIN 748, Part 3, ed. 07.75. IEC 60072 (1971).
- DS M6 centering hole according to DIN 332, Part 2, ed. 05.83, max. tightening torque for screw 5.0 Nm.
- Vibration severity grade N according to DIN VDE 0530, Part 14, ed. 02.93.

Motor design

- Motor design B5 according to EN 60034-7 / 1993 for all installation positions.

Flange

- Flange according to DIN 42948, ed. 11.65.
- Positional accuracy with regard to true running, axial running and coaxiality to the shaft according to DIN 42955 Tolerance Class N, ed. 12.81

Output shaft

- Plain shaft (preferred type)

or

- Shaft with keyway according to DIN 6885, Sheet 1, ed. 08.68.

Note: Caution! Balanced with **complete** featherkey!

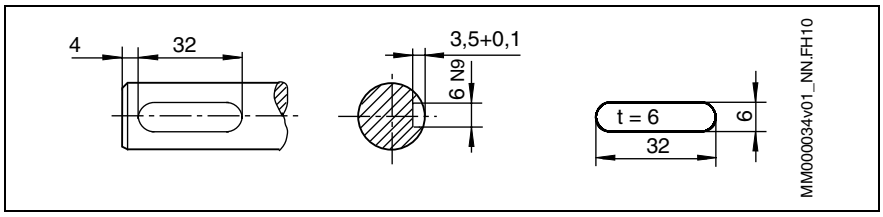


Fig. 9-10: Output shaft with keyway MKD071

Note: Pertinent featherkey: DIN 6885-A 6x6x32, does not belong to the scope of delivery of the motor.

Options For options refer to the chapter entitled “Type Code – Order Designation”.

10 MKD090

10.1 Technical Data

Description	Symbol	Unit	MKD090B-035		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	2500		
Continuous torque at standstill	M_{dN}	Nm	12.0	13.5	
Continuous current at standstill	I_{dN}	A	11.0	12.5	
Peak current	I_{max}	A	49.5		
Torque constant at 20 °C [1]	K_m	Nm/A	1.22		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	111		
Winding resistance at 20 °C	R12	Ω	1.88		
Winding inductivity	L12	mH	15.5		
Number of pole pairs	p		4		
Rated data [2]					
Rated speed	n_N	min^{-1}	3000	3000	
Rated torque	M_N	Nm	7.2	10.2	
Rated current	I_N	A	4.7	6.7	
Rated output	P_N	kW	2.8	4	
Rated voltage	U_N	V	354	369	
Rated frequency	f_N	Hz	200	200	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	43.0×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	43.5		
Minimum strand cross-section[4])	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	60	60	
Maximum speed	n_{max}	min^{-1}	5000		
Motor mass [3] [5]	m	kg	14.0		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1]) K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2]) Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3]) Without holding brake.
[4]) Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5]) Without fan unit.
[6]) If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7]) Provided the power and encoder cables are mounted properly.

Fig. 10-1: Technical data of MKD090B-035

Description	Symbol	Unit	MKD090B-047		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	3200		
Continuous torque at standstill	M_{dN}	Nm	12.0	13.5	
Continuous current at standstill	I_{dN}	A	13.3	14.4	
Peak current	I_{max}	A	59.4		
Torque constant at 20 °C [1]	K_m	Nm/A	1.05		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	91		
Winding resistance at 20 °C	R12	Ω	1.2		
Winding inductivity	L12	mH	10.1		
Number of pole pairs	p		4		
Rated data [2]					
Rated speed	n_N	min^{-1}	3500	3500	
Rated torque	M_N	Nm	6.2	9.9	
Rated current	I_N	A	4.8	8.4	
Rated output	P_N	kW	2.7	4.8	
Rated voltage	U_N	V	332	351	
Rated frequency	f_N	Hz	233	233	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	43.0×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	43.5		
Minimum strand cross-section [4]	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	60	60	
Maximum speed	n_{max}	min^{-1}	5000		
Motor mass [3] [5]	m	kg	14.0		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 10-2: Technical data of MKD090B-047

Description	Symbol	Unit	MKD090B-058		
Type of cooling			Natural	Natural	
Motor overtemperature			60K	100K	
Electric parameters					
Characteristic motor speed	n_K	min^{-1}	4000		
Continuous torque at standstill	M_{dN}	Nm	12.0	12.0	
Continuous current at standstill	I_{dN}	A	17.2	17.2	
Peak current	I_{max}	A	79.0		
Torque constant at 20 °C [1]	K_m	Nm/A	0.81		
Voltage constant at 20 °C	$K_{E(eff)}$	$V/1000min^{-1}$	70		
Winding resistance at 20 °C	R12	Ω	0.74		
Winding inductivity	L12	mH	5.8		
Number of pole pairs	p		4		
Rated data [2]					
Rated speed	n_N	min^{-1}	4000	4000	
Rated torque	M_N	Nm	4.2	8.9	
Rated current	I_N	A	4.3	9.2	
Rated output	P_N	kW	2.1	4.6	
Rated voltage	U_N	V	286	300	
Rated frequency	f_N	Hz	267	267	
Mechanical parameters					
Moment of inertia of the rotor	J_M	kgm^2	43.0×10^{-4}		
Theor. Maximum torque	M_{max}	Nm	43.5		
Minimum strand cross-section [4]	S	mm^2	1	1	
Therm. Time constant	T_{th}	min	60	60	
Maximum speed	n_{max}	min^{-1}	5000		
Motor mass [3] [5]	m	kg	14.0		
Perm. stor. a. transport temperature	T_L	°C	-20 to +80		
Permissible ambient temperature [6]	T_{um}	°C	0 to 40		
Maximum setup height [6]	h	m	1000 above MSL		
Degree of protection [7]			IP65		
Insulation class (according to DIN VDE 0530 Part 1)			F		
Housing varnish			Prime coat black in a/w RAL 9005		

[1] K_m is to be used for calculations with crest values (I_{dN}, I_{max}). For calculations with root-mean-square values (rated data), the torque constant K_m must be multiplied by a factor of $\sqrt{2}$.
[2] Values determined according to EN 60034-1. Current and voltage specified as root-mean-square values.
[3] Without holding brake.
[4] Applicable to Bosch Rexroth cables. Rated according to VDE0298-4 (1992) and installation type B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C.
[5] Without fan unit.
[6] If the limits specified are exceeded, the performance data must be reduced if necessary. For reduction factors, refer to the chapter entitled “Environmental Conditions”.
[7] Provided the power and encoder cables are mounted properly.

Fig. 10-3: Technical data of MKD090B-058

Holding Brake

Description	Symbol	Unit	Holding brake data
Holding torque	M_4	Nm	11.0
Rated voltage (+/- 10%)	U_N	V	24
Rated current	I_N	A	0.71
Moment of inertia	J_B	kgm²	3.6
Connection time	t_1	ms	13
Disconnection time	t_2	ms	30
Mass brake	m_B	kg	1.1

Fig. 10-4: Technical data of MKD090 holding brake (optional)

10.2 Type Code – Order Designation

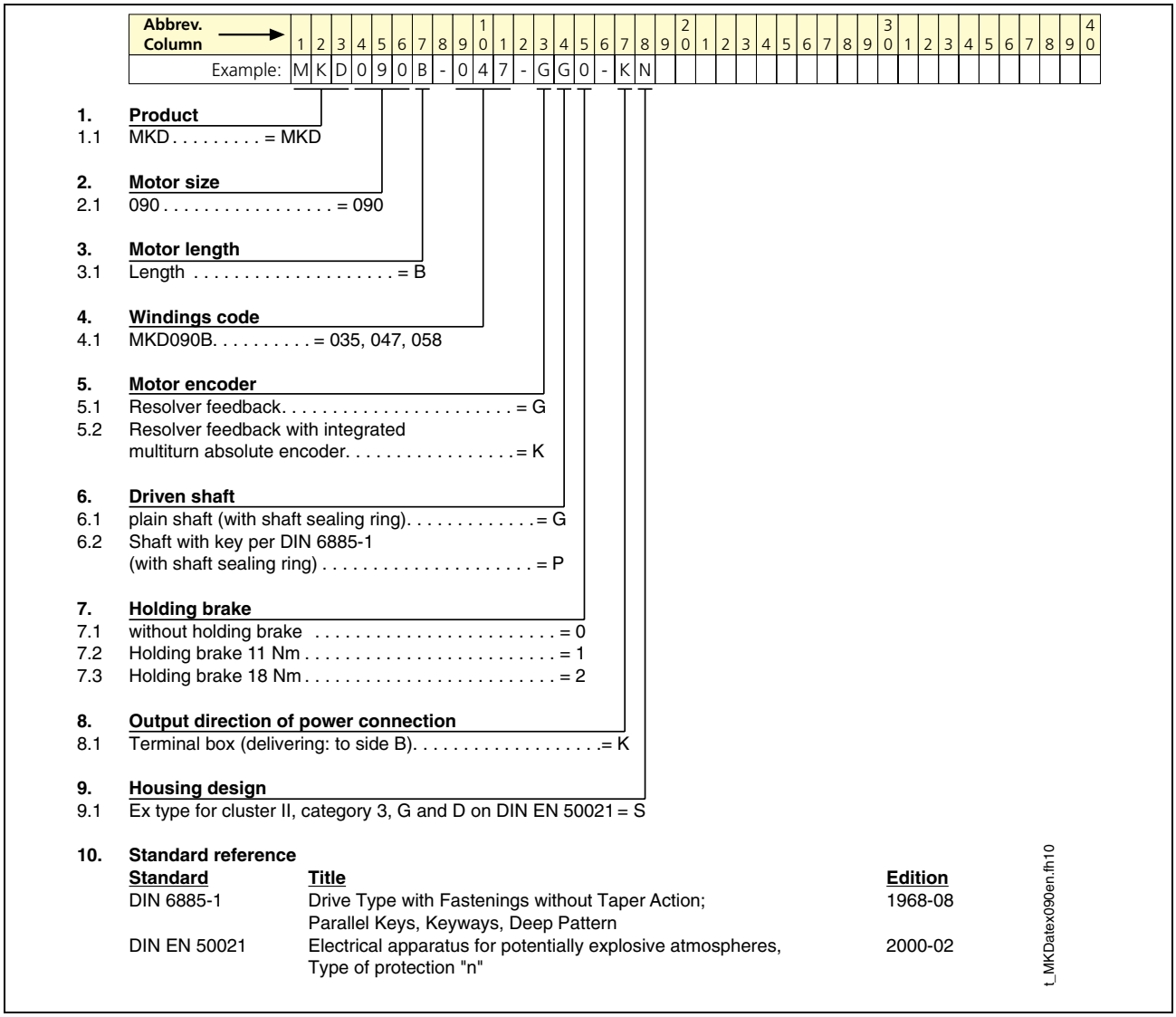
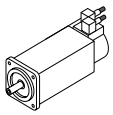


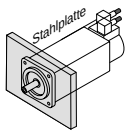
Fig. 10-5: MKD090 type code

10.3 Speed-Torque Curves

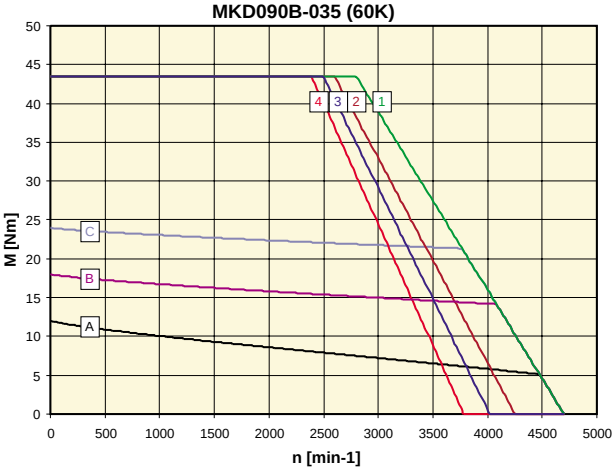
Housing overtemperature
60K
Insulated structure



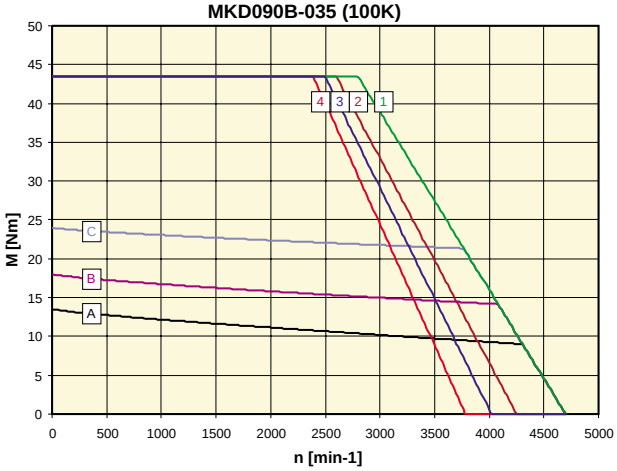
Winding overtemperature
100K
Non-insulated structure



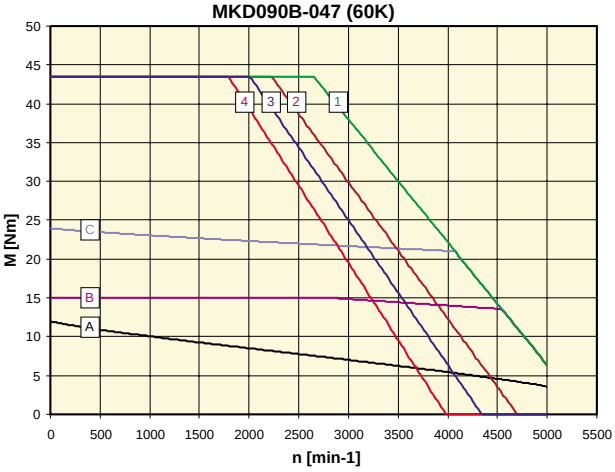
MKD090B-035 (60K)



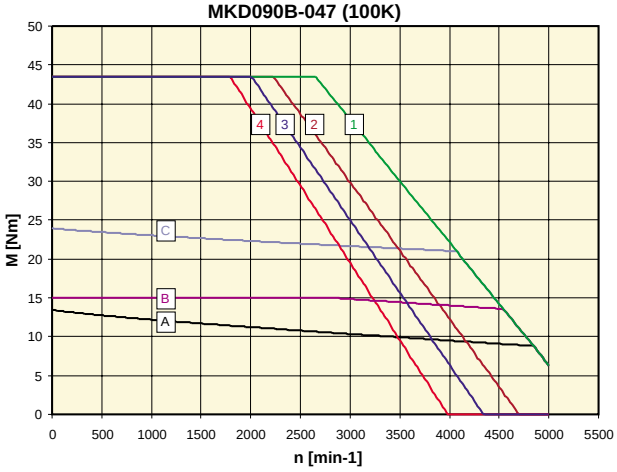
MKD090B-035 (100K)



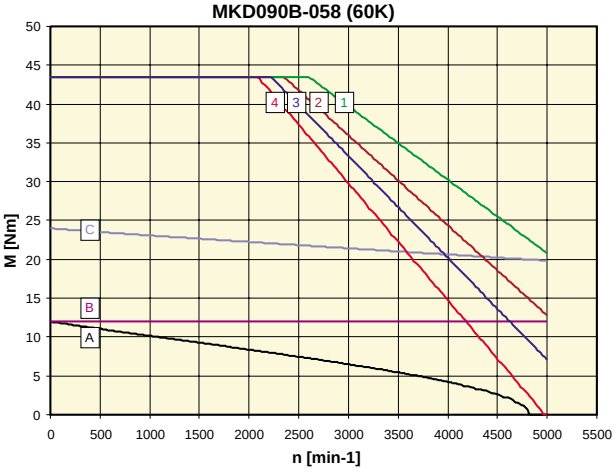
MKD090B-047 (60K)



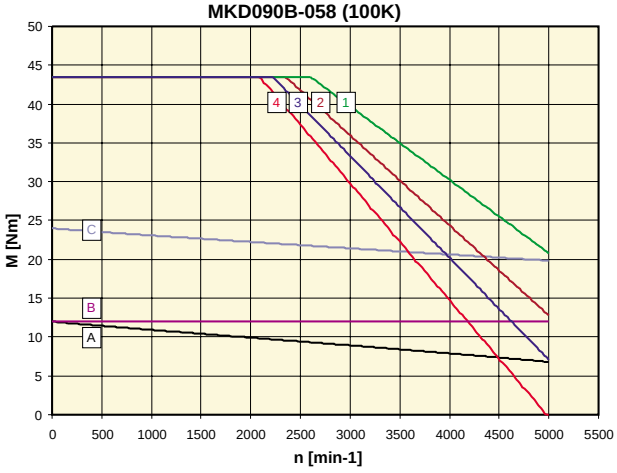
MKD090B-047 (100K)



MKD090B-058 (60K)



MKD090B-058 (100K)



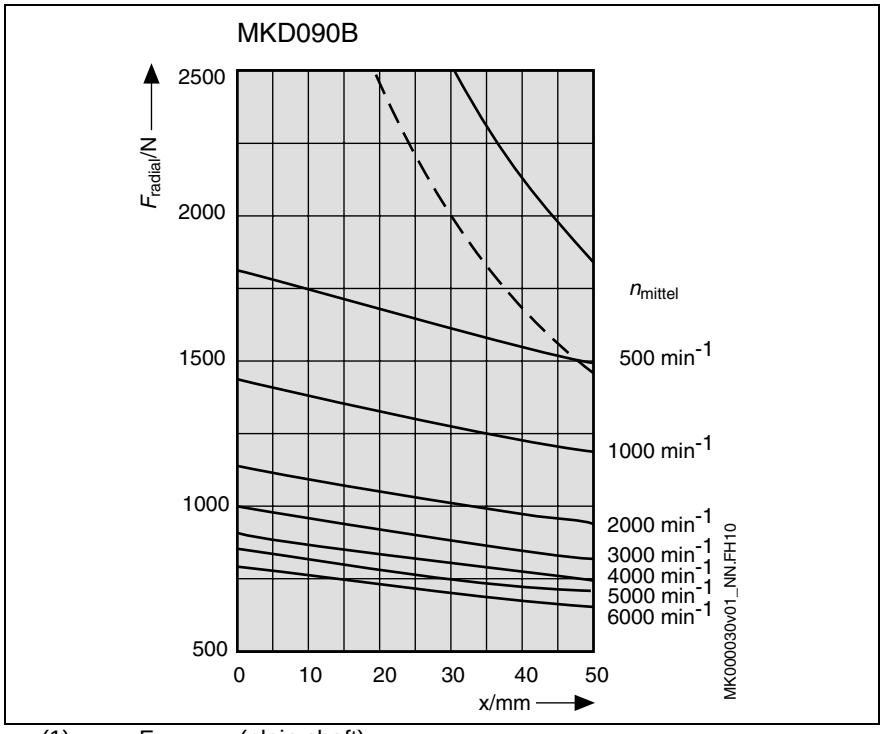
[A]: M_{dN} Natural conv. (S1 continuous operation)
[B]: M_{dn} Surface cooling (S1 continuous operation); curve theoretical, Bosch Rexroth deliveres no fans for the explosive-hazardous areas.
[C]: M_{KB} (S6 intermittent operation, 25% ED)
[1]: HDS to HVR
[2]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 480 V
[3]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 440 V
[4]: HDS to HVE or DKCxx.3 with a power connection of 3 x AC 400 V

Fig. 10-6: Characteristic curves

10.4 Shaft Load

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

For explanations refer to Chapter 16.7



(1): F_{radial_max} (plain shaft)
(2): F_{radial_max} (shaft with keyway)

Fig. 10-7: MKD090: Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

Permissible axial force F_{axial}

$$F_{axial} = x \cdot F_{radial}$$

x: 0.34 for MKD090B
F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 10-8: MKD090: permissible axial force F_{axial}

10.5 Dimensional Details

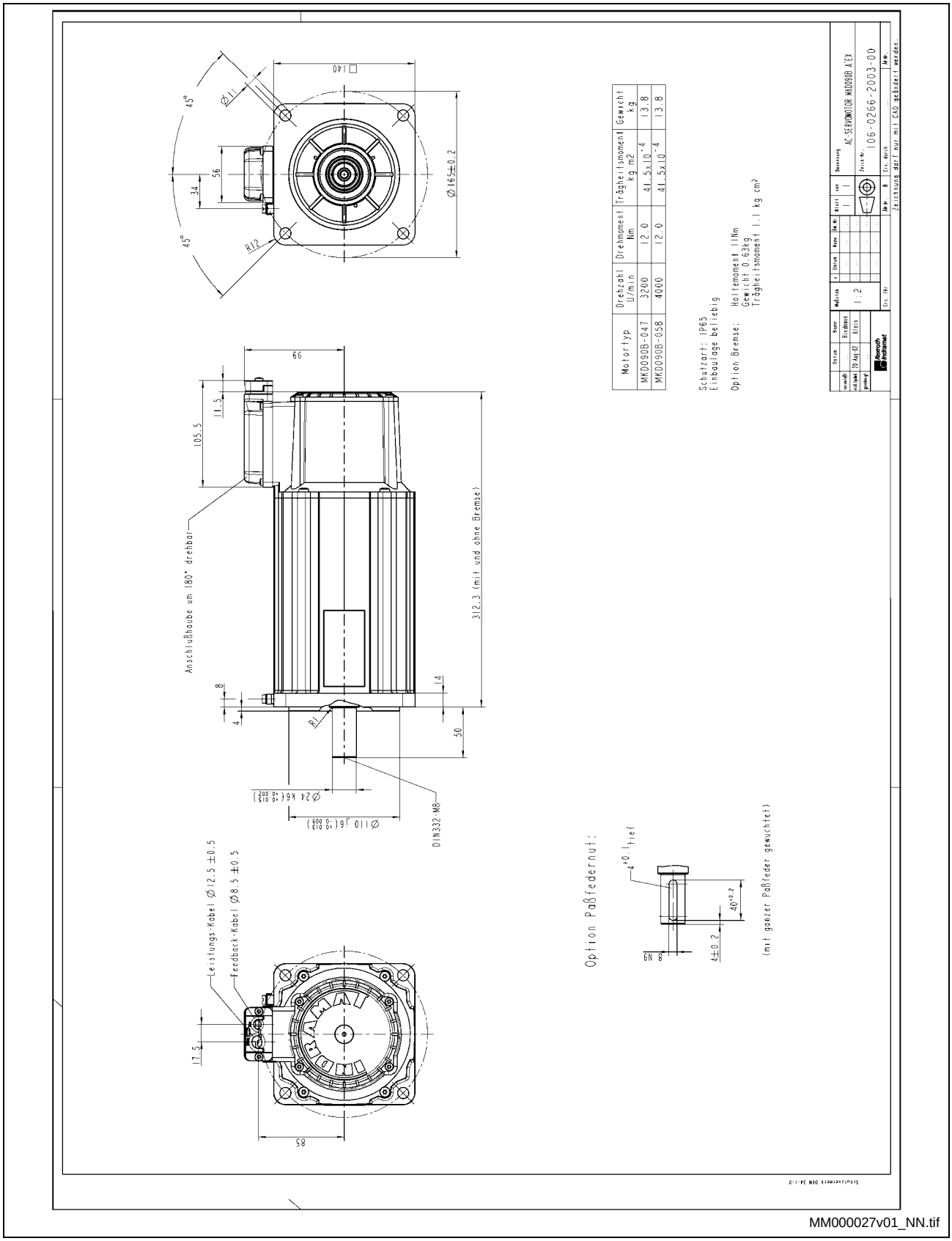


Abb. 10-1: MKD090 specifications

Shaft end

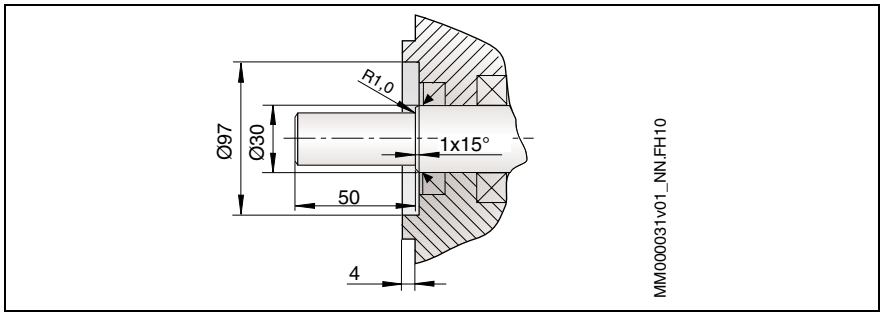


Fig. 10-9: Shaft end MKD090

- Shaft end cylindrical according to DIN 748, Part 3, ed. 07.75. IEC 60072 (1971).
- DS M6 centering hole according to DIN 332, Part 2, ed. 05.83, max. tightening torque for screw 12.0 Nm.
- Vibration severity grade N according to DIN VDE 0530, Part 14, ed. 02.93.

Motor design

- Motor design B5 according to EN 60034-7 / 1993 for all installation positions.

Flange

- Flange according to DIN 42948, ed. 11.65.
- Positional accuracy with regard to true running, axial running and coaxiality to the shaft according to DIN 42955 Tolerance Class N, ed. 12.81

Output shaft

- Plain shaft (preferred type)

or

- Shaft with keyway according to DIN 6885, Sheet 1, ed. 08.68.

Note: Caution! Balanced with **complete** featherkey!

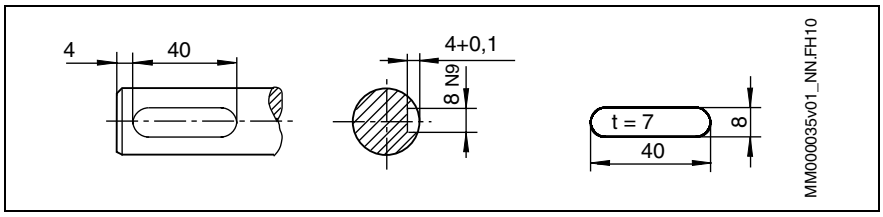


Fig. 10-10: Output shaft with keyway MKD090

Note: Pertinent featherkey: DIN 6885-A 8x7x40 does not belong to the scope of delivery of the motor.

Options For options refer to the chapter entitled “Type Code – Order Designation”.

11 Accessories

11.1 Gearbox

GTS, GTP, GTM Planetary Gearings

Planetary gearings for the

- GTS and
- GTP
- GTM (new)

are deliverable and suitable for mounting on MKD motors.

The planetary gearings are characterized by the following features:

High operational reliability

- Low-maintenance operation owing to lifetime lubrication
- Use under adverse environmental conditions is possible (owing to the completely closed design in IP 65 degree of protection)

High performance data

- Low-play gear teeth with minimum reverse play owing to ground gear pairs
- High torsional strength owing to load distribution to three planetary wheels
- High efficiency owing to planetary wheel principle
- High dynamics owing to low masses of inertia
- Low weight owing to compact design

Easy attachment to machine

- Direct overhung mounting of pinions and belt pulleys, owing to the bearing being designed for high permissible radial loads
- Flange design permitting attachment according to design B5 (DIN 42959, Part 1, ed. 08.77) with hole in the flange

The output shaft can be mounted in two different ways:

- friction-locked shaft-hub connection by means of a plain shaft, or
- friction-locked shaft-hub connection by means of an output shaft with keyway.

Note:

- Refer to the documentation DOK-GEAR**-GTS********-PR**06**-EN-P for a detailed description of the GTS planetary gearings.
- Refer to the documentation DOK-GEAR**-GTP********-PRJ**1**-EN-P for a detailed description of the GTP planetary gearings.

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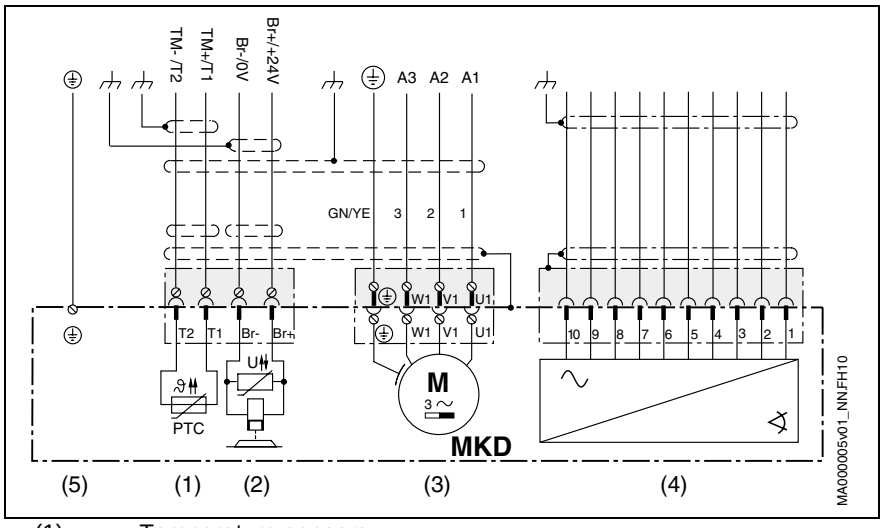
12 Connection System

12.1 Overview of Connections

The electric connections of Rexroth drives are standardized. The MKD motors are provided with

- a power connector, incl. connection for temperature sensor and holding brake,
- an encoder connection (feedback connector).

Both connections depend of the motor type, wether as connection box or as a separate plug-in connector. MKD motors according to ATEX-standard are only deliverable with a terminal box.



(1): Temperature sensors
Temperature sensors (PTC) are fixed-mounted in the motor windings. The measurement data evaluation is occured over the drive controller.

(2): Holding brake
The optional holding brake can be triggered over an external control (SPS) or with an appropriate drive controller.

(3): Power connection
a terminal box is standard. For type 025 connectors can also be delivered alternatively.

(4): Encoder connection
Standard version as connector box, on motor type 112 as plug-in connector. For motor type 025 connectors can also be delivered alternatively.

(5): **potential equalization line**

Fig. 12-1: MKD Connection diagram: overview

Grounded earth conduction

The grounded earth conduction connector of the MKD motors is provided via the grounded earth conduction within the motor power cable.

An additional connector of a grounded earth conduction or a potential equalization line is according to EN 50021: 2000 for Motors type “S” specified. MKD motors type “S” become grounded via an additional connector (grounded earth conductor clamp on the motor flange).

12.2 Motors with connector box

Note: Here is only the direct connection between motor and drive controller described. The connection diagrams are also guilty for all other connections (e.g. with intermediate connection). There is no change with coordinating the motor and drive controller connections.

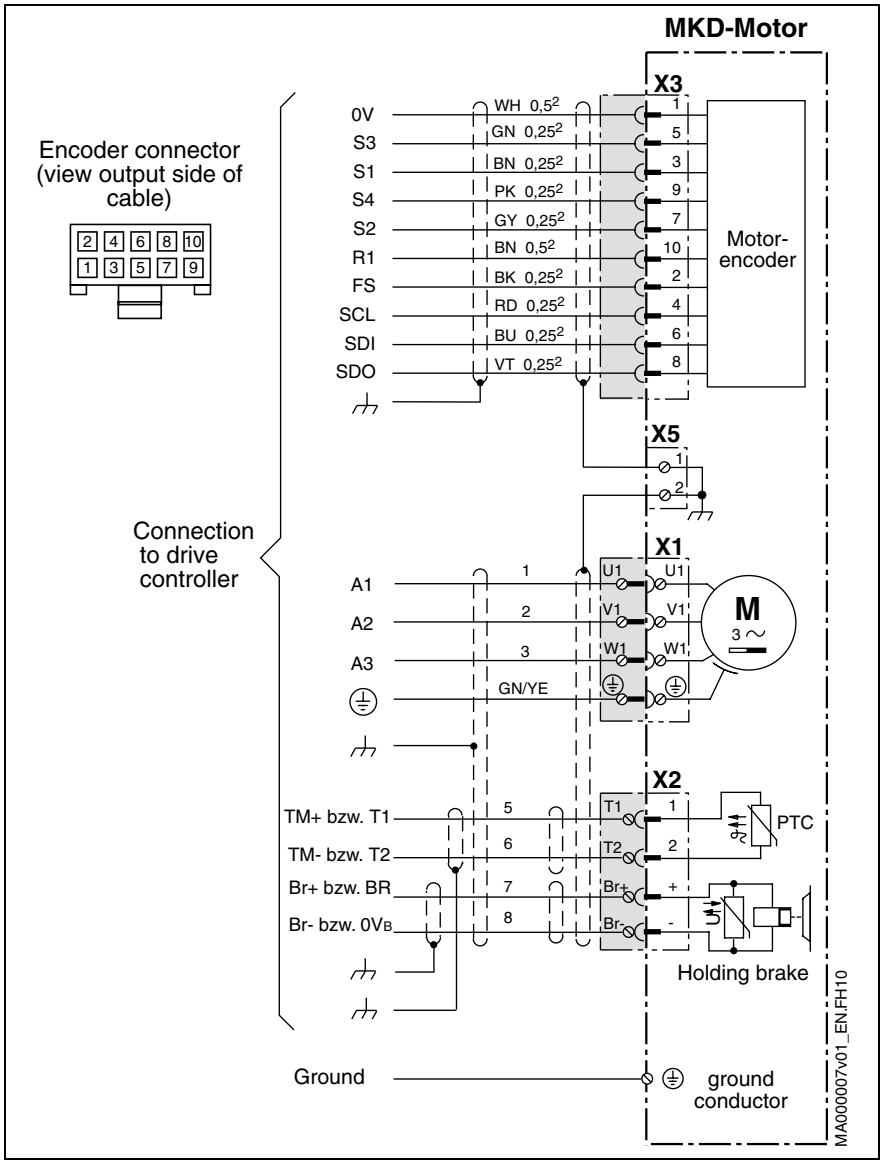


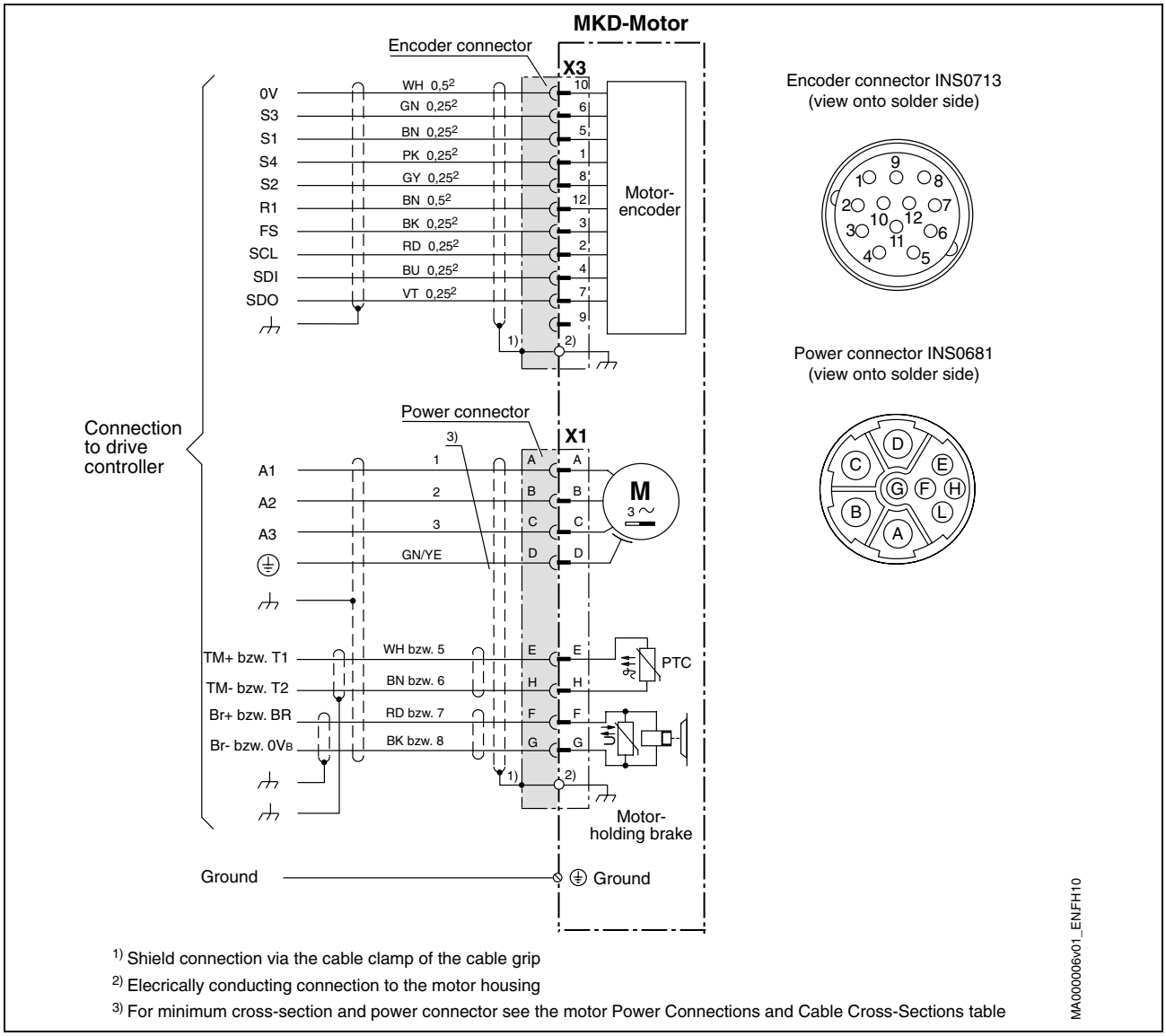
Fig. 12-2: Connection diagram: “Motor with connector box” MKD-motor with connector box.

Cables are not included in the scope of delivery of the motors and must be ordered as separate items.

Note: The external grounding is to be connected at any rate!

12.3 Motors with connector receptacle

Note: Here is only described the direct connection between motor and drive controller. The connection diagrams are also guilty for all other connections (e.g. with intermediate connection). There is no change with coordinating the motor and drive controller connections.



1) Shield connection via the cable clamp of the cable grip
2) Elecrically conducting connection to the motor housing
3) For minimum cross-section and power connector see the motor Power Connections and Cable Cross-Sections table

Fig. 12-3: Connection diagram motors with connector receptacle MKD-motor with connector receptacle

Plugs and cables are not included in the scope of delivery of the motors and must be ordered as separate items.

Note: The external grounding is to be connected at any rate!

Deliverable motors with flange socket

Motor		Connection/flange socket	Appropriate plug
MKD	Winding		
MKD025A	144	INS0680	INS0681
MKD025B	144		

Fig. 12-4: MKD with connector receptacle

Power connector flange socket

Flange socket	INS0680	Description
Power supply contacts	A,B,C	U1, V1, W1
PE contact	D	⏚
Temp contact sensor	E,H	T1, T2
Brake contact	F,G	Br+, Br–
Unused contacts	L	

Fig. 12-5: Pin assignment of flange socket for the MKD power connector

Encoder connection flange sockets

Please refer to the overview of connectors for the assignment of the encoder signals and the pin assignment of the flange socket.

Flange socket	INS0613	Description
Contacts	1, 2, 3, 4, 5, 6, 7, 8, 10	See overview of connectors
Unused contacts	9, 11	

Fig. 12-6: Pin assignment of flange socket for the MKD encoder connection

12.4 Connection Cable

Dimensioning of power cable

The specified and calculated cross sectional area of the cables in this Rexroth documentation base on RMS current and the assumption for “rotating motors”. Base for this calculation are the specified stillstand-constant current in the technical data. They are specified as peak values.

The relevant electric currents are in association as follows:

“rotating motor”

$$I_{(Cable)} = \frac{I_{dN(Motor)}}{\sqrt{2}}$$

$I_{(cable)}$ relevant electric current to dimensioning for the cable

$I_{dN(Motor)}$ Stillstand-constant current motor (peak values)

Fig. 12-7: RMS – and peak values (“rotating motor”)

The dimensioning after RMS current at a “rotating motor” is generally sufficient.

“motor at standstill”

$$I_{(Cable)} = I_{dN(Motor)}$$

$I_{(cable)}$ relevant electric current to dimensioning for the cable

$I_{dN(Motor)}$ Stillstand-constant current motor (peak values)

Fig. 12-8: RMS – and peak values (“motor at stillstand”)

In some cases, applications, working over a longer period, require a continuous torque at standstill when speed = 0 min^{-1} for the motors (standard value see Fig. 12-9 is recommended to manage the cable-dimensioning as specified peak values in the technical data (“standstill motor”).

Motor type		period
MKD	025	10 min
MKD	041, 071, 090	15 min

Fig. 12-9: Working over a longer period

Note: The specified, recommended minimum cross sections have to be checked by the machine/system manufacturer for the machine/system-specific conditions and, if necessary, corrected.

Selection of connection cable

Bosch Rexroth delivers ready-made power and encoder cable sets. The following documentation contains:

- an overview of the cable types available.
- technical data of the various cables,
- general installation regulations for Bosch Rexroth cables.

Ordering name DOK-CONNEC-CABLE*STAND-AU**xx**-EN-P

Material number: 00280894

This documentation includes an overview to select motor power cables.

13 Application Instructions

13.1 Operating Conditions

Setup Height and Ambient Temperature

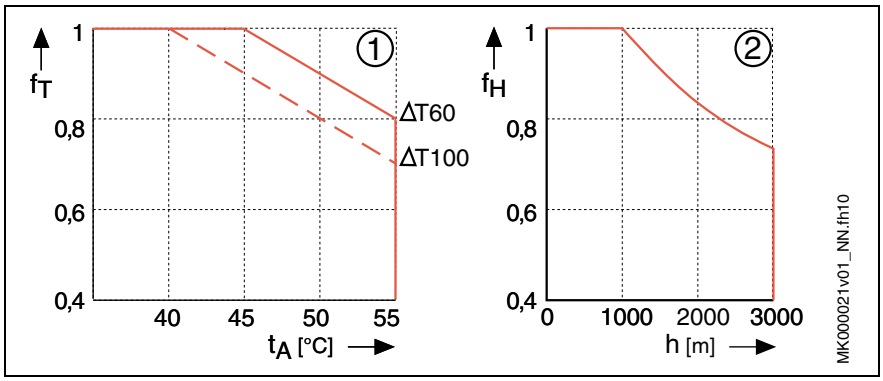
Nominal data

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

- Ambient Temperature of 0 ºC up to +45 ºC
- Setup Height 0 m up to 1000 m above MSL.

Exceeding the nominal data
Derating curves

If you intend to use motors above these ranges, you must take the “utilization factors” into consideration. This reduces the performance data.



(1): Utilization depending on the ambient temperature
(2): Utilization depending on the setup height
f_T: Temperature utilization factor
t_A: Ambient temperature in degrees Celsius
ΔT60 / ΔT100: Mode of operation
f_H: Height utilization factor
h: Setup height in meters

Fig. 13-1: MKD derating (utilization factors)

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

1. Multiply the torque data specified in the selection data by the utilization factor.
2. Ensure that the reduced torque data are not exceeded by your application.

If **both** the ambient temperature **and** the setup height are exceeding 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 torque data specified in the selection data.
3. Ensure that the reduced torque data are not exceeded by your application.

Vibration and Shock Loads

MKD motors can carry loads, such as are typically occurring in case of presses, punches, or press inlets, only if they are attached in a shock-absorbed or shock-decoupled way. The construction of such attachments must be checked in isolated cases.

According to IEC 721-3-3 ed. 1987 and EN 60721-3-3 ed. 06/1994, MKD motors, if used stationary and weather-resistant, may be operated under the following conditions:

- Longitudinal motor axis: according to Class 3M1
- Transverse motor axis: according to class 3M4

⇒ Ensure that the limits specified in Fig. 13-2 and Fig. 13-3 for storage, transport, and operation of the MKD motors are not exceeded.

Influencing quantity	Unit	Maximum value in longitudinal axis	Maximum value in transverse axis
Amplitude of the excursion at 2 to 9 Hz	mm	0,3	3,0
Amplitude of the acceleration at 9 to 200 Hz	m/s²	1	10

Fig. 13-2: Limits for sinusoidal vibrations

Influencing quantity	Unit	Maximum value in longitudinal axis	Maximum value in transverse axis
Total shock-response spectrum (according to IEC721-1, :1990; Table 1, Section 6)		Type L	type I
Peak acceleration	m/s²	40	100
Duration	ms	22	11

Fig. 13-3: Limits for shock load

13.2 Degree of protection

The type of protection is defined by the identification symbol IP (International Protection) and two characteristic numerals specifying the degree of protection.

The **first characteristic numeral** defines the degree of protection against contact and penetration of foreign particles. The **second characteristic numeral** defines the degree of protection against water.

First characteristic numeral	Degree of protection
6	Protection against penetration of dust (dust-proof); complete shock protection
Second characteristic numeral	**Degree of protection**
5	Protection against a water jet from a nozzle directed against the housing from all directions (jet water)

Fig. 13-4: IP degrees of protection

Tests regarding the second characteristic numeral must be performed using fresh water. If cleaning is effected using high pressure and/or solvents, coolants, or penetrating oils, it might be necessary to select a higher degree of protection.

The design of the MKD motors complies with the following degrees of protection according to DIN VDE 0470, Part 1, ed. 11/1992 (EN 60 529):

Motor ranges	Degree of protection	Remark
Motor housing, output shaft, power and feedback connectors (if mounted properly only)	IP 65	Standard design

Fig. 13-5: Ranges of IP degrees of protection for the motors

13.3 Design and Installation Positions

MKD motors are available in design B05. Please refer to the table below for the types of installation permissible according to EN 60034-7:1993.

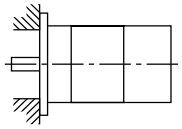
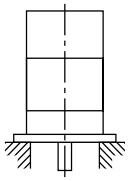
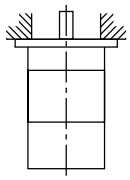
Motor design	Permissible types of installation		
	Description	Sketch	Setup
B05	IM B5		Flange attached on the drive side of the flange
	IM V1		Flange attached on the drive side of the flange; drive side pointing down
	IM V3		Flange attached on the drive side of the flange; drive side pointing up

Fig. 13-6: Mounting position

DANGER

Penetration of fluids! If motors are attached according to IM V3, fluid present at the output shaft over a prolonged time may enter into and cause damage to the motors.

⇒For that reason, ensure that fluid cannot be present at the output shaft.

Prime Coat and Housing Varnish

State upon delivery: Prime coat black in a/w RAL 9005

Resistance: Against weather, coloring, chalking, diluted acids and diluted lyes

It is not permitted to provide the housing with additional varnish (coat thickness no more than 40 µm).

Holding brake (Option)

Use the brake in normal operation only in standstill and for performing the drive-internal brake check. The holding brake is required for holding the axis when the machine is in de-energized state.

DANGER

Hazardous movements! Persons endangered by falling or descending axes!

⇒ Observe supplementary DIN and recommendations. For European countries:

- DIN EN 954 / 03.97 on security specified units of controllers.
- instruction sheet for vertical axes

Editor:

Süddeutsche Metall-Berufsgenossenschaft

Fachausschuss Eisen und Metall II

Wilhelm-Theodor-Römheld-Str. 15

55130 Mainz

USA: See National Electric Code (NEC), national association of the manufacturers of electric systems (NEMA) as well as local building regulations.

The following is generally valid: The national terms have to be observed!

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

⇒ Ensure personal protection by overriding failsafe measures.

⇒ Cordon off the hazardous area by means of a safety fence or a safety screen.

⇒ Additionally secure vertical axes to prevent them from falling or descending after having switched off the motor, for instance as follows:

– lock the vertical axis mechanically,

– provide an external braking / collecting / clamping device, or

– ensure proper weight compensation of the axis.

- miscellaneous convenient measures

Brake control

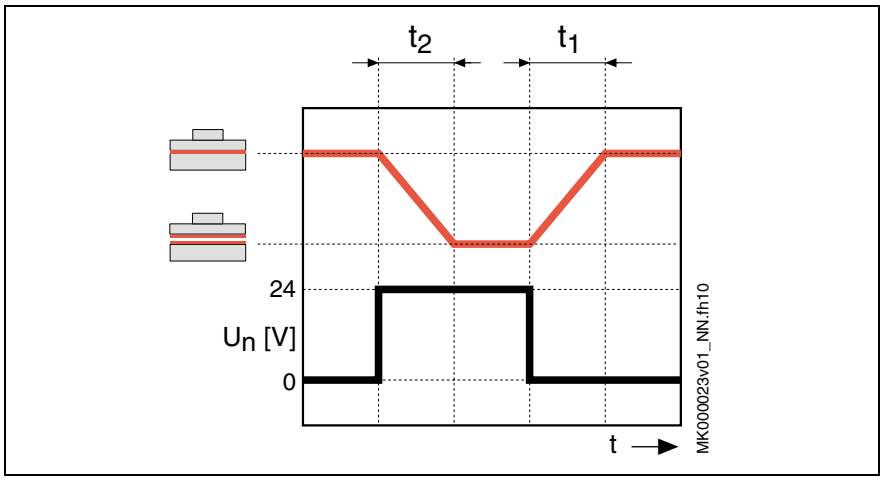
The brake`s control mechanism has to ensure this function in normal operation. Under the worst load condition of the power supply with a voltage of 24 V_{DC} +/- 10% must be supplied to the motor. To identify a failure during operation on time, the power supply for the brakes must be monitored by an undervoltage detection system.

Functional test

Before start-up 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 tested for slippage. Additional information and specifications of this function may be found in the ECODRIVE firmware functional descriptions.

Selection of holding brakes

Brakes are either electrically-clamping or electrically-released. Due to functional differences for main spindle and servo-axes different brakes should be used. Observe the safety requirements at plant design.



t_1: Clamping delay
t_2: Release delay

Fig. 13-7: Holding brake diagram

Servo application

Electrically-released holding brake

The electrical-released holding brake is used to hold the axis at standstill and when the signal “controller enable” is off. Upon loss of supply voltage and stopping the controller enabling, the electrically-released brake will automatically close.

⇒ Do not use the holding brake as an operational 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 occure.

The electrically-actuated holding brake is inappropriate for servo applications, as clamping in a de-energized clamping state is not possible.

Sizing of holding brakes (application)

The physical facts of holding brakes require consideration of both normal operation and fault condition. Beyond the normal operation also the incident must be viewed. The effective braking torques are physically different.

Normal operation

In normal operation, using the holding brake for clamping of an axis standstill, the brake`s static torque (M4) rating in the data sheets applies directly as static friction (M4) – stiction (friction coefficient μ_H).

Fault conditions (i.e., EMERGENCY STOP)

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

The dynamic braking torque is reduced in comparison to the indicated static holding torque M4. Note the following description of dynamic sizing.

Dynamic sizing

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 should be decelerated in a determined time or in a determinated way, the additional moment of inertia of the whole system must be taken into account.

Further important aspects for sizing:

The holding brake is not a safety brake (ref. DIN EN 954 / 03.97,vertical axis data sheet SMBG). As a result of uncontrollable influencing factors such as rust film on the brake surface, the brake holding torque can be reduced. Additionally, over-voltage and excessive temperature can weaken the permanent magnets and the brake.

Sizing recommendation

Bringing this factors together, the following recommendations can be given for sizing of the holding brakes on the axes.

The necessary holding torque required for the application does not have to exceed maximum 60% of the static holding torque (M4) of the used holding brake.

Note: Holding torque reduction and premature wear 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 down to the value of the available dynamic braking torque. Complete deterioration of brake holding capability can be expected after approximately 20,000 revolutions of the brake when clamped.

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

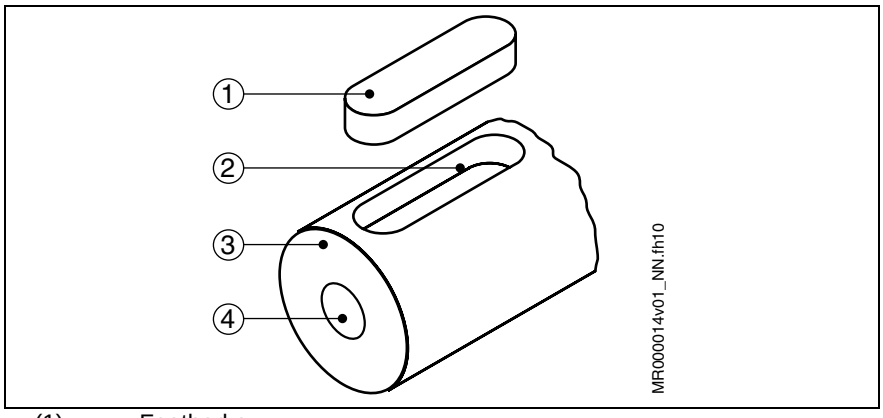
13.4 Output Shaft and Motor Bearing

Flush wave

The standard design recommended for MKD motors provides a friction-locked shaft-hub connection without play and excellent running smoothness. Use clamping sets, clamping sleeves or clamping elements to couple the machine elements to be driven.

Output shaft with fitting key

The optional featherkey according to DIN 6885, Sheet 1, version 08-1968, permits keyed transmission of torques with constant direction, with low requirements for the shaft-hub connection.



(1): Featherkey
(2): Keyway
(3): Motor shaft
(4): Centering hole

Fig. 13-8: MKD output shaft with featherkey

The machine elements to be driven must be additionally secured in axial direction via the centering hole on the end face.

CAUTION

Shaft damage! In case of intense reversing operation, the seat of the featherkey may deflect. Increasing deformations in this area can then lead to a break of the shaft!

⇒Preferrably, plain output shafts should be used.

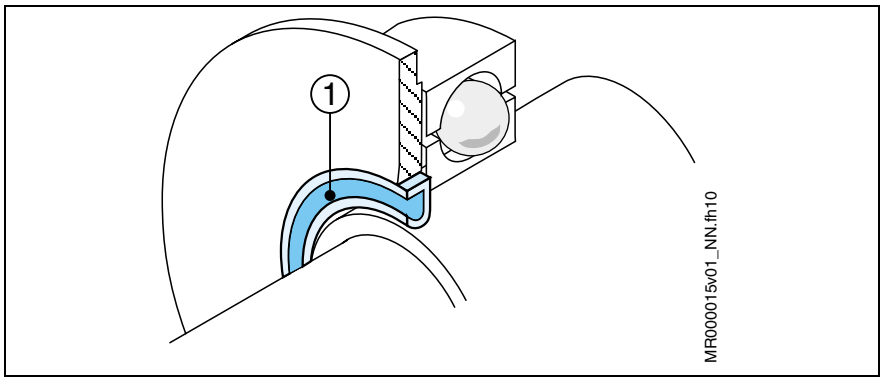
Balancing with the complete featherkey

MKD motors are balanced with the **complete** featherkey. Hence, the machine element to be driven must be balanced without featherkey.

Modifications to the featherkeys may only be made by the user himself and on his own responsibility. Bosch Rexroth does not give any warranty for modified featherkeys or motor shafts.

Output Shaft With Shaft Sealing Ring

MKD motors are designed with radial shaft sealing rings according to DIN 3760 – design A.



(1) Radial shaft sealing ring

Fig. 13-9: MKD radial shaft sealing ring

Wear and tear

Radial shaft sealing rings are rubbing seals. Hence, they are subject to wear and tear and generate frictional heat.

Wear and tear of the rubbing seal can be reduced only if lubrication is adequate and the sealing point is clean. Here, the lubricant also acts as coolant, supporting the discharge of the frictional heat from the sealing point.

⇒ Prevent the sealing point from becoming dry and dirty. Always ensure adequate cleanliness.

Note: Under normal environmental conditions the shaft seal is greased for lifetime. Under unfavourable environmental conditions (e.g. grinding dust, scops) maintanance could be necessary.

Resistance

The materials used for the radial shaft sealing rings are highly resistant to oils and chemicals. The performance test for the particular operating conditions lies, however, with the machine manufacturer's responsibility.

At the moment of printing of the present document, the following material assignment is applicable:

Motor	Sealing material	Short name
MKD	Fluorocaoutchouc	FPM (Viton)

Fig. 13-10: MKD shaft sealing ring

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

Vertical installation positions IM V3

The degree of protection on the flange side of motors with shaft sealing ring is IP 65. Hence, tightness is ensured only in case of splashing fluids. Fluid levels present on side A require a higher degree of protection. If the motor is installed in vertical position (shaft pointing up), the instructions in the section "Design and Installation Positions" in this chapter must, in addition, be observed.

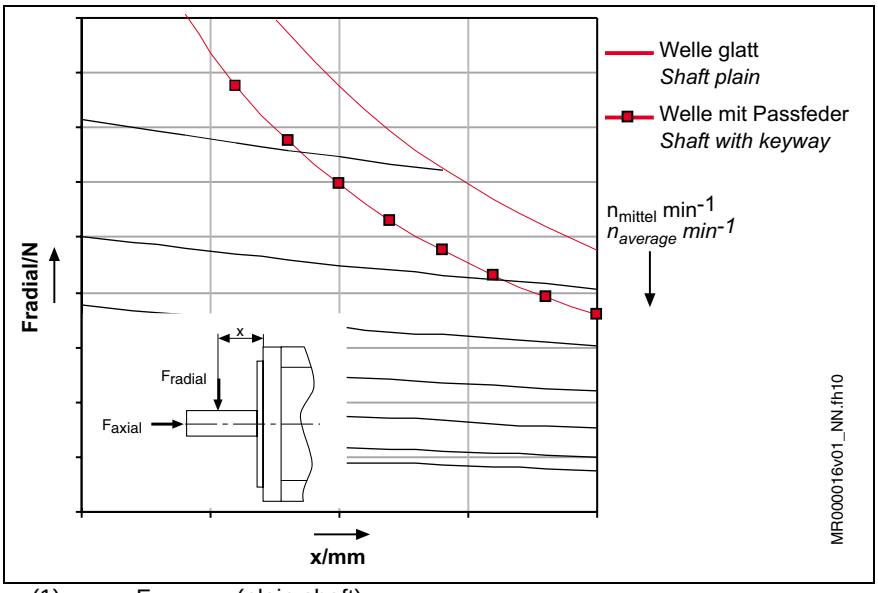
Note on construction

Bosch Rexroth recommend that any direct contact of the output shaft and the radial shaft sealing ring with the processing medium (coolant, material corrosion), caused by the type of machine or system construction, should be avoided.

Bearings and Shaft Load

During operation, both radial and axial forces act upon the motor shaft and the motor bearings. The construction of the machine and the attachment of driving elements on the shaft side must be adjusted to one another to ensure that the load limits specified are not exceeded.

Radial load, axial load



(1): F_{radial_max} (plain shaft)
(2): F_{radial_max} (shaft with keyway)

Fig. 13-11: Example of a shaft load diagram

Maximum permissible radial force F_{radial_max}

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

- Shaft break load
- Point of force application x (see Fig. 13-11)
- Shaft design (plain; with keyway)

Permissible radial force F_{radial}

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

- arithmetical middle of speed ($n_{middlel}$)
- Point of force application x (see Fig. 13-11)
- Bearing service life

Permissible axial force F_{axial}

The maximum permissible axial force F_{axial} is proportional to the radial force. Please refer to the section entitled “Shaft load” in the technical data for the proportionality factor.

Note: Owing to thermal effects, the flange-sided end of the output shaft may shift by 0.6 mm in relation to the motor housing. If skew bevel driving pinions or bevel gear pinions directly attached to the output shaft are used, this change in position will lead to

- a shift in the position of the axis, if the driving pinions are not defined axially on the machine side,
- to a thermally dependent component of the axial force, if the driving pinions are defined axially on the machine side. This causes the risk of exceeding the maximum permissible axial force or of the play within the gearing increasing to an impermissible degree.

  In such cases, you should, therefore, preferrably use drive elements with their own bearings, which are connected to the motor shaft via axially compensating couplings.

Bearing service life

If the MKD motors are operated within the limits specified for radial and axial loads, the nominal service life of the bearings is as follows:

Nominal bearing service life

L_{10h} = 30.000 operating hours

(calculated according to ISO 281, ed. 12/1990)

In other cases, the bearing service life is reduced as follows:

$$L_{10h} = \left(\frac{F_{radial}}{F_{radial\_is}} \right)^3 \cdot 30000$$

L_{10h}: (Bearing service life according to ISO 281, ed. 12/1990)
F_{radial}: Determined permissible radial force in N (Newton)
F_{radial_ist}: Actually acting radial force in N (Newton)

Fig. 13-12: Calculation of the bearing service life L_{10h} if the permissible radial force F_{radial} is exceeded

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

Attachment of drive elements

For all attachments of drive elements to the drive shaft, as e.g.

- transmissions
- couplings
- pinions

it is imperative that the following notes are observed.

Redundant bearing

Generally, redundant bearing is to be avoided by all means when connecting drive elements. The tolerances inevitably present in such cases will lead to additional forces acting on the bearing of the motor shaft and, should the occasion arise, to a distinctly reduced service life of the bearing.

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

couplings

The machine construction and the drive elements used must be carefully adapted to the motor type so that the loading limits of the shaft and the bearing are not exceeded.

Note: When connecting extremely stiff couplings, the radial force which constantly changes the angular position may cause an impermissibly high load on shaft and bearing.

Bevel gear pinions or skew bevel drive pinions

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

- a shift in the position of the axis, if the driving pinions are not defined axially on the machine side,
- to a thermally dependent component of the axial force, if the driving pinions are defined axially on the machine side. This causes the risk of exceeding the maximum permissible axial force or of the play within the gearing increasing to an impermissible degree.

Note: In such cases, you should therefore, preferably use drive elements with their own bearings, which are connected to the motor shaft via axially compensating couplings.

13.5 Motor Encoder

To control the motor speed and/or to position the motor, the drive controller requires information on the current motor position.

To achieve this, the integrated encoder system (motor feedback) makes the appropriate signals available to the drive controller. The drive controllers are capable of transmitting the positional value thus determined to a superordinate CNC or SPS.

Encoder data memory "motor feedback encoder data memory"

The encoder electronics is equipped with a data memory where the motor type name, the control loop parameters and the motor parameters are filed.

These data are read by the digital intelligent drive controllers by Bosch Rexroth. This ensures

- quick and easy startup,
- adjustment between the motor and the drive controller without the risk of damage to the motor.

Following encoder variants are available for MKD motors:

Option [1)]	Encoder type	Measurement method	System precicion	Postion input type	Position resolution at the motor
G	Digital resolver encoder	inductive	±8 angular minutes	Relative	MKD025 MKD041 3 x 2^{13} = 24 576 MKD071 MKD090 4 x 2^{13} = 32 768 Information / environment
K	Digital servo encoder (HSF with integrated multiturn absolute encoder	inductive	±8 angular minutes	Absolute (more than 4096 revolutions)	

Fig. 13-13: MKD motor encoder

Digital resolver feedback

Provided for relative indirect position detection. Replaces separate incremental encoders at the motor.

Note: Characteristics of the resolver feedback After a voltage failure or after the first POWER ON, the axis must always be moved to its home position at first, before the processing can begin.

⇒ Consider when placing the home position circuit breaker and during the reference that the resolver during a mechanical motor rotation generates several index signals.

- at MKD025, -041: 3 index signals per rotation
- at MKD071, -090: 4 index signals per rotation

⇒ Avoid too high gear ratio or to slight feed-constant.

Digital servo feedback (RSF with integrated multiturn absolute encoder

Provided for absolute indirect position detection within 4096 motor revolutions. Replaces separate absolute value encoders at the motor.

Note: The absolute axis position at this encoder variety is still exist because of the battery back-up also after power shut down. The nominally durability of the batterie is about 10 years.

13.6 Acceptances, Approvals

CE mark

Declaration of conformity

Declarations of conformity certifying the structure of and the compliance with the applicable EN standards and EC guidelines are available for all MKD motors. If necessary, these declarations of conformity can be demanded from the pertinent sales office.

The CE mark is applied to the motor type label of the MKD motors.

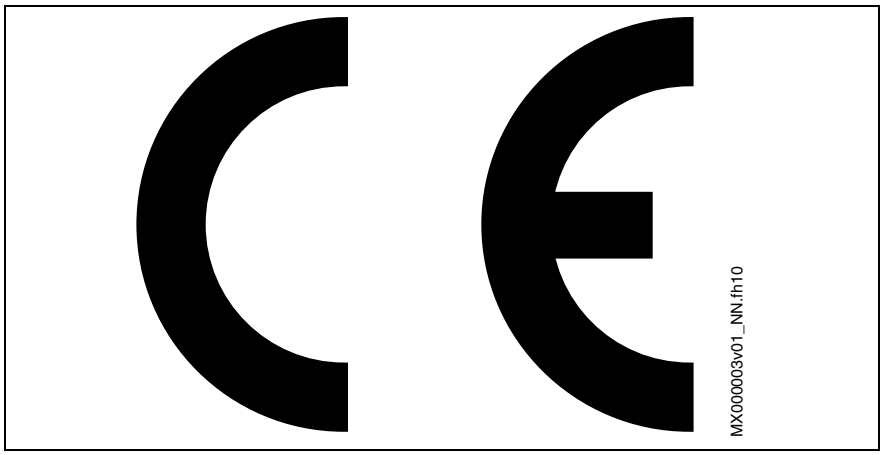


Fig. 13-14: CE mark

Ex-mark

Additional mark of MKE motors. It is confirmed with the following Ex-mark that Rexroth motors type MKD are according to the guilty EG-instructions and could be used in the specified areas.

CE:	CE mark
Ex:	Ex-mark
II:	means type II, which is suitable for all Ex-areas except hazardous mines. II:
3:	means category 3, i.e. units suitable for hazardous areas by gas or dust, which occures rarely and temporary.
G:	gas
D:	dust
EEx:	EEx means: European norm for Ex-protection was used.
n:	Type of protection n means that requirements of EN 50021 for rarely and temporary occurance of an explosive athmosphere are fulfilled.
A:	means non-sparking equipment
T 155:	means the max surface temperature inside and outside of the housing, where explosive gas or dust can occur.

Fig. 13-15: MKD ATEX motor marks

14 Handling

14.1 Identifying the Goods

Delivery note

A single copy of the delivery note is enclosed to each delivery. The delivery note lists all components with their order designation. If the contents are distributed among several parcels (transport containers), then this is noted on the delivery note or it can be seen from the freight bill.

Bar code label

Each motor package is provided with a bar code label providing the following data:

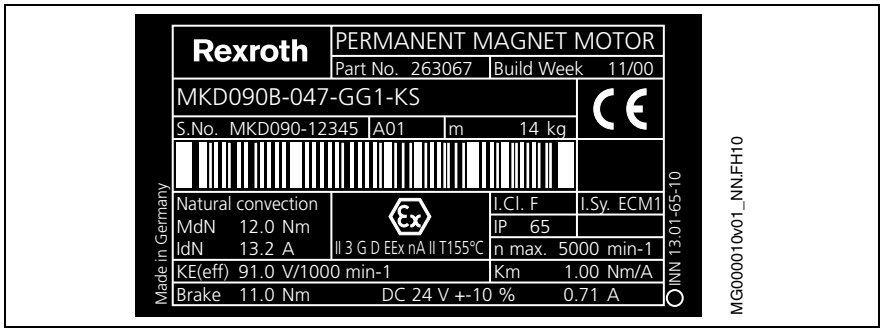
- Type name of the motor
- Customer
- Delivery note number
- Consignment
- Forwarding agent ordered

The bar code label is provided for identification of the contents during processing of the order.

14.2 Type Labels

Motor

The motor delivered, includes a type label. The type label is attached to the motor housing. In addition, a second type label is adhered onto the original type label on the motor housing, using double-sided adhesive tape. The latter type label can be put well visible on the machine, if the original type label on the motor be concealed by parts of the machine.



(1): CE mark
(2): Ex mark

Fig. 14-1: MKD type label (example)

The type label is provided for

- identification of the motor,
- procurement of spare parts in case of a failure,
- service information.

Note: The type name of the motor is also filed in the encoder data memory.

Non-assembled cables
Raw cable type

The name of the raw cable type is printed on the cable sheath. When ordering raw cables, the desired length in meters must be specified in addition to the raw cable type.

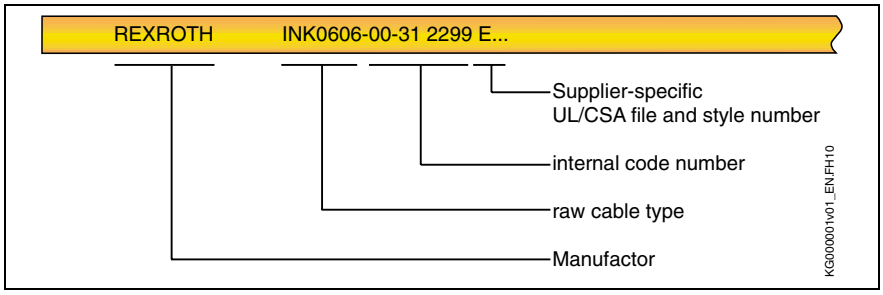


Fig. 14-2: Raw cable name

14.3 Instructions on the Packing

Instructions on storage, transport and handling of the parcels are printed on the packing. It is absolutely necessary that these instructions are observed.

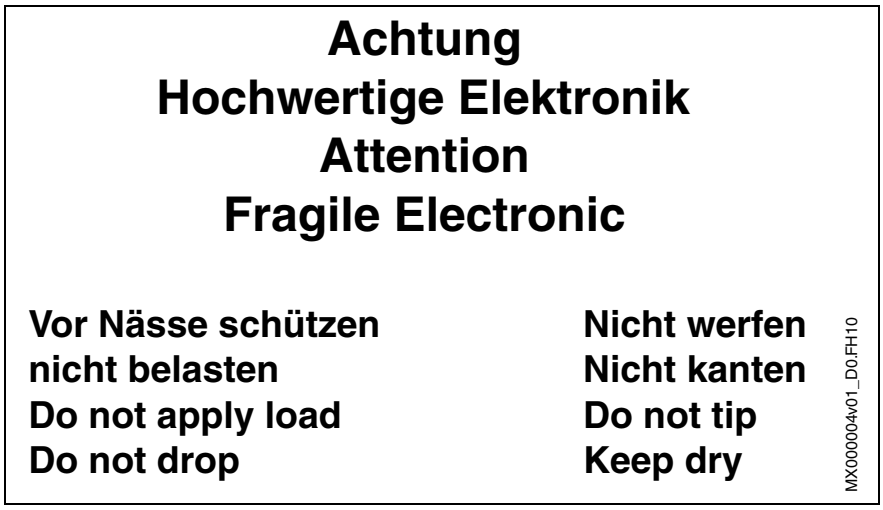


Fig. 14-3: Instructions on storage, transport and handling on the packing

14.4 Storage

WARNING

Damage to motor and loss of warranty possible! Any improper storage may cause damage to the motor. In addition, any warranty claim will expire.

⇒ For that reason, please observe the following instructions.

The following conditions must be kept during storage:

- Permissible range of temperature: -20° C up to +80 °C.
- Store motors at dry places which are free from dust and vibrations.
- Store motors horizontally.
- Do not remove the plastic protective sleeve on the drive shaft. It protects the shaft from moisture and mechanical damage.

14.5 Transport and Handling

VORSICHT

Damage to motor and loss of waranty possible! Improper transport and handling may cause damage to the motor. In addition, any warranty claim will expire.

⇒ For that reason, please observe the following instructions.

The following conditions must be kept during transport and handling:

- Use the appropriate means for transport. Take the weight of the components into consideration (weights are specified in the chapters pertaining to the various motors, in the sections on technical data and/or on the type label of the motor).
- Provide for shock absorption, if strong vibrations may occur during transport. Note 13-2:
- Transport only in horizontal position.
- Use cranes with lifting sling belts to lift the motors.
- Avoid damage to the motor flange and the drive shaft.
- Avoid impacts on the drive shaft.
- Remove the plastic protective sleeve from the drive shaft only shortly before mounting the motors.

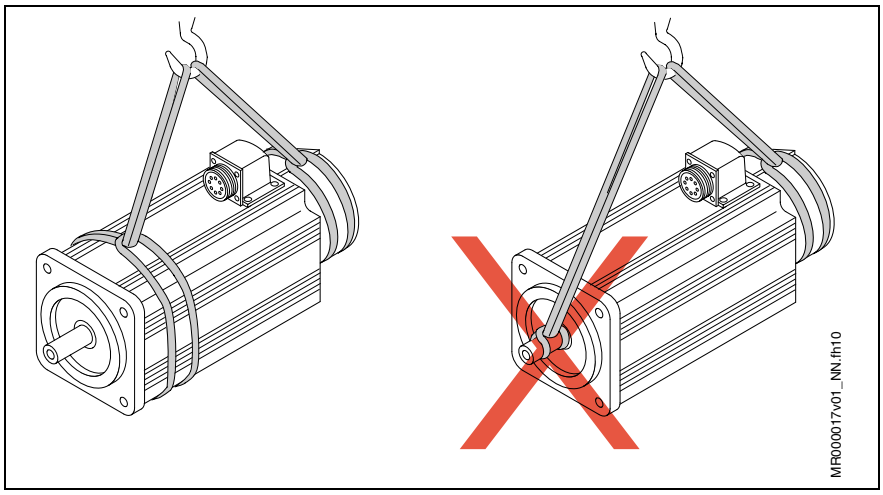


Fig. 14-4: Lifting and transporting the motors by means of lifting sling belts

15 Assembly

15.1 Skilled Technical Personnel

Any work on the system and on the drives or in their vicinity may only be carried out by appropriately trained technical personnel. The owner of the system must ensure that all persons carrying out

- installation work,
- maintenance measures, or
- operation activities

on the system are adequately familiar with the contents of this documentation as well as with all warnings and precautionary measures contained therein. Qualified technical personnel must have been trained and instructed and are authorized to activate and deactivate, ground and mark electric circuits and equipment according to the safety rules and regulations. Qualified technical personnel must possess the appropriate safety equipment and have to be trained in first aid.

15.2 Mounting the Motor

General for mounting

Observe all warnings and safety advices mentioned in Chapter 3. This minimizes the risk of accidents and damage to the system or the motor.

Do all handling advices carefully. This ensures correct mounting and dismounting of the components.

MKD motors comply with design B5 in accordance with DIN 42950, Part 1, ed. 08.77. Please refer to the dimensional sheets in Chapters 6 to 13 for all relevant dimensional details.

Before mounting:

1. Procure tools, auxiliary materials, measuring and test equipment.
2. Control all components if they are clean.
3. Proof all components if they are obviously damaged. Defective components may not be mounted.
4. Ensure that mounting can be done in a dry and clean environment.
5. Ensure that the holder for the motor flange is without burrs.

If the optional holding brake is used

6. Check whether the motor holding brake reaches the holding torque specified in the data sheet. Should the brake fail to reach the torque specified, first grind in the holding brake as described under the “Holding Brake” section in Chapter 13. Then proceed as follows:

Mounting the MKD motors:

Mount the motor. All measures and tolerances specified in the dimensional sheets must be kept.

To fix the flange, we recommend to use the screws and tightening torques listed in the table below.

Motor frame size	Recommended screw size	Tightening torque [Nm]	Minimum strength
MKD025	4x M4	3,1	8.8
MKD041	4 x M6	10,4	8.8
MKD071	4 x M8	25	8.8
MKD090	4 x M10	51	8.8

Fig. 15-1: Locking screws

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

15.3 Connecting the Motor

After having mounted the motor mechanically as specified, proceed to connecting the motor.

DANGER

Danger to life by electric voltage! Handling within the range of live parts is extremely dangerous. Therefore:

⇒ Any work required on the electric system may only be carried out by skilled electricians. It is absolutely necessary to use electric tools.

⇒ Before starting work, the system must be de-energized and the power switch be secured against unintentional or unauthorized re-energization.

⇒ Before starting work, the appropriate measuring equipment must be used to check whether parts of the system are still applied to residual voltage (e.g. caused by capacitors, etc.). If so, wait until these parts have discharged.

WARNING

Injuries to persons or property are possible! Interrupting or connecting live lines may cause unpredictable dangerous situations or lead to physical damage. Therefore:

⇒ Connect and disconnect plug connectors only when they are dry and de-energized.

⇒ During operation of the system, all plug connectors must be securely tightened.

WARNING

Risk of short-circuit caused by liquid coolant or lubricant! Short-circuits of live lines may cause unpredictable dangerous situations or lead to physical damage. Therefore:

⇒ Provide open mating sides of power plug connectors with safety caps when installing or replacing drive components, if you cannot exclude that they might be moistened with liquid coolant or lubricant.

The connection diagrams by Bosch Rexroth are exclusively intended for the preparation of system circuit diagrams!

⇒ Connect the motor as specified in the machine manufacturer's system circuit diagram! Refer to the connection diagram in Chapter 15 for support.

Motor with connection box

WARNING

Damages on connection box or at the cable are possible! Too high accelerating torques can damage the bolt-on fixing or can squeeze the cable. If bolt-on fixings are damaged, the protection IP65 cannot be ensured any longer.

⇒ In fact of this use no automatic screwdriver (e.g. electronical, pneumatic or hydraulic screwdriver).

Adjust the output direction

The connector box lid can be turned 180° when it is mounted. This means the output direction can be set to:

- side A or
- side B.

Note: The cable output direction is side B at the time of delivery.

The cable output direction can be selected when mounting power and encoder cable.

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Bosch Group

Connecting MKD- Motors

⇒ Demount the terminal box lid (1) by opening screws (7).
⇒ Demount parts (2) to (5) by opening screws (6). Remove protection paper (A).

Preparing power and encoder connections (on the motor)

Connect plugs X1, X2 and X3 as specified in the terminal diagram shown in Fig. 3.
⇒ Remove sheath, strip the insulation as specified in Fig. 2.

Power Connection

⇒ Over the individual braided screens (core 5/6 or 7/8) pull 5mm of the shrink sleeve, then cut the screens off flush with the sleeve and finally pull another 8 mm shrink sleeve over this.

Note: Use sufficient shrink sleeve sizes!

⇒ Twist whole screen and filler litz wire. Solder on 0,75 ^{2} litz wire length of 70 mm and secure the soldered spot with a shrink sleeve.
⇒ Enclose the end of the sheathing with a shrink sleeve (length 13mm); excess end over outside mantel of cable 5 mm.
⇒ Mount ferrules as per cross section to cores and connect plugs X1, X2 as well as ring terminals for shield conection (Fig.3).

Encoder connection

⇒ Shield connection as with the entire shield of power connection.
⇒ Insert crimp contacts for X3 into clap positioner (Fig.1).
⇒ Fold in clap positioner with tongs completely open, feed in litz wires from opposite side and crimp the contact.
⇒ Feed contact as per Fig. 5 (Note position of latch!) into plug X3.
⇒ Mount plug-in interlock to connector X3 (Fig. 6) then fit connector onto printet circuit board.

Fig. 1

Note:
Bosch Rexroth makes available manual crimping tongs to mount X3, see Fig. 1 (Mat. no.: 262 293).

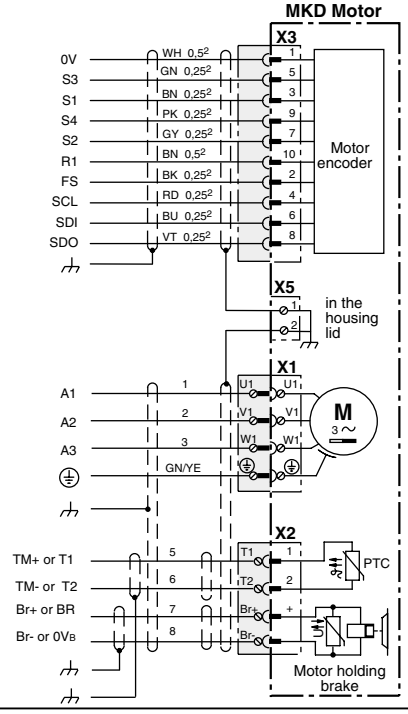


Fig. 3

Mounting ready-made cables

⇒ Mount support panel (5), gasket (4) and the pressure plate (3) around the cable.
⇒ Insert cable end through the opening of the terminal box (see Fig. 4) and slacken screws (6) of the cable leadthrough slightly.
⇒ Pull the cables back to the point where the shrink sleeve protrudes about16 mm into the inside of the terminal box (see Fig. 2).
⇒ Tighten screws (6) with 2.5 Nm.
⇒ Screw ground ring terminals (8) and (9) with 1.3 Nm firmly onto the terminal box lid (1).
⇒ Insert X1, X2 and encoder connector X3 into position on the motor PCB.
⇒ Tighten screws of X1 with 0.4 Nm.
⇒ Set terminal box back on with the desired cable output direction.
⇒ Make sure that no cable cores or the PCB have been pinched or damaged and then screw the terminal box firmly into place with 2.5 Nm.
⇒ Titghten strain relief screw (10) with 2,5 Nm.

Sheath/ insulation stripping	
exterior mantel power, encoder	90 mm
connecting litz wires for X1, X2	7 mm
connecting litz wires for X3	3 mm

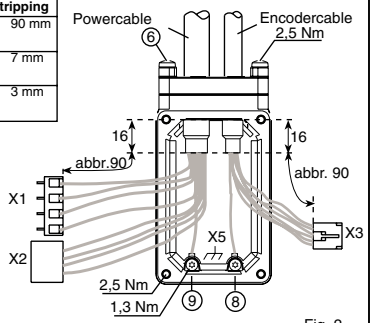


Fig. 2

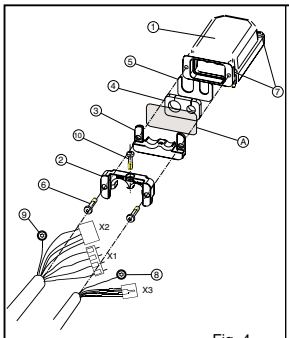
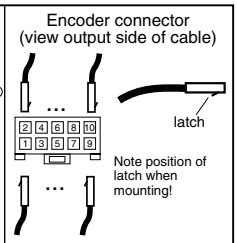


Fig. 4



Note
When removing: latch of contacts must be removed with appropriate tools!
Fig. 5

Plug-in interlock X3

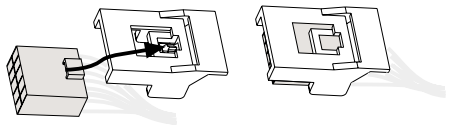

Mount plug-in interlock to connector X3 then fit connector onto PCB.
Fig. 6

Fig. 15-2: Assembly instructions for MKD motor with connector box

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Motors with plug-in connectors

Power connector

Power connectors for MKD025

When fitting the INS0681 power connector with thread, proceed as follows:

1. Put the power connector onto the thread of the connection housing in the correct position.
2. Tighten the union nut of the power connector manually. By leading the cable in further, the power connector can be steadily put to its final position.
3. Tighten the union nut as securely as you can manually.

Encoder connector

Encoder connector

When fitting the encoder connectors, proceed as follows:

1. Put the encoder connector onto the thread of the connection housing in the correct position.
2. Tighten the union nut of the power connector manually. By leading the cable in further, the encoder connector can be steadily put to its final position.
3. Tighten the union nut as securely as you can manually.

Adjust the output direction of power connector

Changing the output direction on MKD025

The output direction on MKD025 motors can be chosen when mounting the power connector. The flange sockets are designed such that they can be turned (angle of rotation of 270 degrees).

Adjustment of the desired connector output direction is described below.

Note: Do not use any tools (e.g. tongs or pliers or screwdrivers) to turn the motor flange socket. Mechanical damage to the flange socket when using tools cannot be excluded.

The motor flange socket can be turned easily if an appropriate plug has been connected. Owing to the leverage of the connected plug, the flange socket can be turned manually to the desired output direction.

Proceed as follows:

1. Connect the motor power cable to the flange socket.
2. Put the flange socket to the desired output direction by turning the connected plug.

   The desired output direction is set.

Note: Whenever the flange socket is turned, the holding torque in the set position is reduced. To ensure the required holding torque of the flange socket, the output direction should be changed no more than 5 times!

It is not necessary to “rebuild” the flange socket (i.e. dismounting and mounting the flange socket, relocated by 90 degrees). The following problems and risks can arise should the flange socket be “rebuilt”:

- The O-ring seal between the flange socket and the motor housing is not ensured any longer.
- The tightening torques prescribed are, perhaps, not kept.
- The TFL coating (screw locking element) of the locking screws will wear by unscrewing, thus becoming ineffective.

Note: No warranty!

- If the cable output direction is changed by **“rebuilding”** the flange socket, the warranty for the overall drive system given by Bosch Rexroth will expire. The cable output direction may only be changed by turning the flange socket.

Adjust the output direction of encoder connector

Changing the output direction on MKD025

The output direction on MKD025 motors can be chosen. The flange sockets are designed such that they can be turned (angle of rotation of 270 degrees).

Adjustment of the desired connector output direction is described below.

Note: Do not use any tools (e.g. tongs or pliers or screwdrivers) to turn the motor flange socket. Mechanical damage to the flange socket cannot be excluded.

The motor flange socket can be turned easily if an appropriate plug has been connected. Owing to the leverage of the connected plug, the flange socket can be turned manually to the desired output direction.

Proceed as follows:

1. Connect the encoder cable to the flange socket.
2. Put the flange socket to the desired output direction by turning the connected cable.

   The desired output direction is set.

Note: Whenever the flange socket is turned, the holding torque in the set position is reduced. To ensure the required holding torque of the flange socket, the output direction should be changed no more than 5 times!

It is not necessary to “rebuild” the flange socket (i.e. dismounting and mounting the flange socket, relocated by 90 degrees). The following problems and risks can arise should the flange socket be “rebuilt”:

- The O-ring seal between the flange socket and the motor housing is not ensured any longer.
- The tightening torques prescribed are, perhaps, not kept.
- The TFL coating (screw locking element) of the locking screws will wear by unscrewing, thus becoming ineffective.

Note: No warranty!

- If the cable output direction is changed by **“rebuilding”** the flange socket, the warranty for the overall drive system given by Bosch Rexroth will expire. The cable output direction may only be changed by turning the flange socket.

16 Startup, Operation, and Maintenance

16.1 Startup

The MKD motors may be put into operation only if they have been carefully and properly mounted and if the electric connection has been properly established.

Before startup

Before putting the MKD motors into operation, the following must be checked and/or ensured:

- It must be possible to turn the rotor manually with the holding brake opened; there may be no running noise (e.g. rubbing). If necessary, the holding brake must be opened by applying a DC voltage of 24 V ±10%.
- The motor must be mounted and aligned correctly. The motor flange must be coupled to the machine structure or the gear absolutely even.
- It must be ensured that all electric connections (motor and drive controller) have been established as specified and that the cable screw unions have been tightened.
- It must be ensured that the protective conductor and/or the protective grounding have been executed properly.
- If the optional holding brake is used, its operational reliability must be ensured.
- Shock protection measures against live and moving parts must be provided for.

Startup

MKD motors may be put into operation only with drive controllers by Rexroth. After the connection has been properly established and the above requirements are complied with, the MKD motor can be put into operation via the drive controller.

Note: Startup of the drives is described in the product documentation of the particular drive controllers. Request the corresponding product documentation from your local sales office.

16.2 Operation

Ensure that the ambient conditions described in Chapter 16, “Application Instructions”, are kept during operation.

16.3 Maintenance

Cleaning

Excessive dirt, dust or shavings may affect the function of the motors adversely, may in extreme cases even cause a failure of the motors. For that reason, you should clean

Cooling ribs

- the cooling ribs of the motors at regular intervals, in order to obtain a sufficiently large heat radiation surface. If the cooling ribs are dirty in part, sufficient heat dissipation via the environmental air is not possible any longer.

An insufficient heat radiation may have undesired consequences. The bearing service life is reduced by operation at impermissibly high temperatures (the bearing grease is decomposing). Switch off caused by overtemperature despite operation on the basis of selected data, because the appropriate cooling is missing.

Bearings

The nominal service life of the bearings is L10h = 30.000 h according to DIN ISO 281, ed. 1990, if the permissible radial and axial forces are not exceeded (see Chapter 16.7). Even if the bearings are loaded with higher forces to a minor degree only, their service life is affected negatively.

The motor bearings should be replaced if

- the nominal bearing service life has been reached,
- running noise can be heard.

Note: We recommend that bearings are replaced by the Bosch Rexroth Service.

Connection Cable

Check connection lines for damage at regular intervals and replace them, if necessary.

Check any optionally present energy management chains (drag chains) for defects.

DANGER

Electrocution by live parts of more than 50 V!

⇒Do not repair any connection lines provisionally. If the slightest defects are detected in the cable sheath, the system must be put out of operation immediately. Then the cable must be replaced.

Check the protective conductor connection for proper state and tight seat at regular intervals and replace it, if necessary.

Holding brake

In order to ensure proper functioning of the holding brake, it must be checked before the motors are installed.

Before initial startup

Measure the holding torque of the brake; grind in the holding brake, if necessary.

Proceed as follows:

1. De-energize the motor and secure it against re-energization.
2. Measure the transmittable holding torque of the holding brake using a torque spanner. The holding torque of the brakes is specified in the data sheets.
3. If the holding torque specified in the data sheets is reached, the holding brake is ready for operation.
   If the holding torque specified in the data sheets **fails to be reached,** the holding brake must be ground in as described in step 4.
4. **Grinding in:** With the holding brake closed, manually turn the output shaft by approx. five revolutions and measure the transmittable holding torque of the brake using a torque spanner.
5. If the holding torque specified in the data sheets is reached, the holding brake is ready for operation.
   If the holding torque specified in the data sheets **fails to be reached,** repeat steps 4 and 5 of the grinding-in process.

If the holding torque specified fails to be reached after the second grinding-in process, the holding brake is not operable. Notify the Bosch Rexroth Service.

During operation

If holding brakes are required only sporadically (braking cycle >48 h) during operation, film rust may develop on the brake friction surface.

To prevent the holding torque specified from being fallen below, we recommend to proceed as described below:

Recommondation for seat grinding	
Interval	Once in 48 h
Grinding-in speed	100 min^{-1}
Number of grinding-in revolutions	1
Ambient temperature	–20 °C to +50 °C

Fig. 16-1: Recommended procedure for grinding in motor holding brakes

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

During normal operation, it is not necessary to grind in the brake. It is sufficient if the brake is activated twice a day by removing the controller enable signal.

Changing the battery

Drive control systems of Rexroth observe voltage of battery safely and give just in time a warning “change battery”.

Change battery when machine is under load

Changing the battery should be made, when machine is under load. This is necessary to avoid an overrun in the motor encoder (switch off control voltage can cause loss of absolute values).

Changing the battery is with change of the component “encoder cover with integrated battery”. For order description of “encoder cover with integrated battery” see the following table.

Motor	Order description (Part No.:)
MKD025*-***-***-*S	296044
MKD041*-***-***-*S	296046
MKD071*-***-***-*S	296048
MKD090*-***-***-*S	296048

Fig. 16-2: Encoder cover with integrated battery

For the tightening torque of the housing screws “encoder cover” see the following table.

Housing-screw	Thread	Screw driver size	Starting torque
MKD025, -041	M3	Torx T 10	1.4 Nm
MKD071, -090	M4	Torx T 20	3.0 Nm

Fig. 16-3: Overview housing-screws

DANGER

Danger to life by electric voltage! To change the battery you must work when machine ist under load. Therefore:

⇒ Any work required on the electric system may only be carried out by skilled electricans.

⇒ Switch off power supply at the drive control systems and save against re-start!

DANGER

Hazardous movements!
Danger to life, mayhem or material damage!

⇒ Switch off power supply at the drive control systems and save against re-start!

⇒ Change battery on drive control systems only when control voltage is inserted. Is the control voltage switched off when the battery is removed, the absolute value is lost and when the machine will be switched on, a failing movement could be possible.

17 Appendix

17.1 List of standards

Standard	Edition	Title	Concordance
94/9/EG	1994-03-23	DIRECTIVE 94/9/EC OF THE EUROPEAN PARLIAMENT AND THE COUNCIL of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, Publication date:1994-03-23 published in: ABl EG (1994)	
89/392/EEC replaced by **98/37/EG**	1998-06-22	Directive 98/37/EC of the european parlament and of the council of 22 June 1998 on the approximation of the laws of the member states relating to machinery	
89/336/EEC	1989-05-03	COUNCIL DIRECTIVE of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (89/336/EEC)	
DIN EN 50178; VDE 0160	1998-04	Electronic equipment for use in power installations; German version EN 50178:1997	EN 50178(1997-10)
DIN VDE 100-410; VDE 100 Part 410 IEC 60364-4-41	1997-01	Erection of power installations with nominal voltages up to 1000 V - Part 4: Protection for safety; Chapter 41: Protection against electric shock (IEC 60364-4-41:1992, modified); German version HD 384.4.41 S2:1996	HD 384.4.41 S2(1996-04); IEC 6036-4-41(1992-10)
DIN 332-2	1983-05	Center holes 60° with thread for shaft ends for rotating electrical machines	
DIN 6885-1	1968-08	Drive Type Fastenings without Taper Action; Parallel Keys, Keyways, Deep Pattern	
DIN EN 50014, VDE0170/0171 Teil 1	2000-02	Electrical apparatus for potentially explosive atmospheres - General requirements; German version EN 50014:1997 + Corrigendum:1998 + A1:1999 + A2:1999	EN 50014(1997-06); EN 50014/A1(1999-02); EN 50014/A2(1999-02
DIN EN 50021	2000-02	Electrical apparatus for potentially explosive atmospheres - Type of protection "n"; German version EN 50021:1998	
DIN EN 50281-1-1 /A1	2002-11	Electrical apparatus for use in the presence of combustible dust - Part 1-1: Electrical apparatus protected by enclosures; Construction and testing; Amendment A1; German version EN 50281-1-1:1998/A1:2001	
DIN EN 50281-1-2	1999-11	Electrical apparatus for use in the presence of combustible dust - Part 1-2: Electrical apparatus protected by enclosures; selection, installation and maintenance; German version EN 50281-1-2:1998 + Corrigendum 1999	
DIN EN 60034-1; VDE 0530 Part 1	2000-09	Rotating electrical machines - Part 1: Rating and performance (IEC 60034-1:1996, modified + A1:1997 + A2:1999); German version EN 60034-1:1998 + A1:1998 + A2:1999	EN 60034-1(1998-05); EN 60034-1/A1(1998-05); EN 60034-1/A2(1999-08); IEC 60034-1(1996-11); IEC 60034-1 AMD 1(1997-06); IEC 60034-1 AMD 2(1999-05)
DIN VDE 0298-4; VDE 0298 Part 4	1998-11	Application of cables and cords in power installations - Part 4: Recommended current-carrying capacity for sheathed and non-sheathed cables for fixed wirings in buildings and for flexible calbes and cords	
DIN EN 60204-1; VDE 0113 Part 1	1998-11	Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:1997 + Corrigendum 1998); German version EN 60204-1:1997 (In addition, DIN EN 60204-1 (1993.06) is applicable until 2001.07.01. DIN VDE 60204-1 (1993.06) is applicable until further notice as the reference standard for EN 60204-3-1 (1990.08), which has been published in Germany as DIN EN 60204-3-1 (1993.02).	EN 60204-1(1997-12); IEC 60204-1(1997-10)
DIN 42955	1981-12	Tolerances of shaft extension run-out and of mounting flanges for rotating electrical machinery, test	IEC 60072(1971)
DIN 748-3	1975-07	Cylindrical Shaft Ends for Electrical Machines	IEC 60072(1971)
DIN VDE 0530-14 replaced by **DIN EN 60034-14; VDE 0530 Part 14**	1997-09	Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher; measurement, evaluation and limits of vibration (IEC 60034-14:1996); German version EN 60034-14:1996	EN 60034-14(1996-12); IEC 60034-14(1996-11)
IEC 721-3-3 replaced by **DIN EN 60721-3-3**	1995-09	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities; section 3: Stationary use at weatherprotected locations (IEC 60721-3-3:1994); German version EN 60721-3-3:1995 Modified by DIN EN 60721-3-3/A2 dated July 1997	EN 60721-3-3(1995-01); IEC 60721-3-3(1994-12)

IEC 721-1 replaced by **DIN IEC 60721-1**	1997-02	Classification of environmental conditions - Part 1: Environmental parameters and their severities (IEC 60721-1:1990 + A1:1992 + A2:1995); German version EN 60721-1:1995 + A2:1995	EN 60721-1(1995-04); EN 60721-1/A2(1995-07); IEC 60721-1(1990-12); IEC 60721-1 AMD 1(1992-12); IEC 60721-1 AMD 2(1995-04)
DIN EN 60529; VDE 0470 Part 1	2000-09	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989 + A1:1999); German version EN 60529:1991 + A1:2000 (In addition, DIN VDE 0470-1 (1992-11) may still be used until 2003-01-01.)	EN 60529(1991-10); EN 60529/A1(2000-02); IEC 60529(1989-11); IEC 60529 AMD 1(1999-11)
DIN EN 60034-7; VDE 0530 Part 7	1996-06	Rotating electrical machines - Part 7: Classification of types of constructions and mounting arrangements (IM code) (IEC 60034-7:1992); German version EN 60034-7:1993	EN 60034-7(1993-01); IEC 60034-7(1992-12)
DIN 3760	1996-09	Rotary shaft lip type seals	
DIN ISO 281	1993-01	Rolling bearings; dynamic load ratings and rating life; identical with ISO 281:1990	

Fig. 17-1: Normenverzeichnis

17.2 Selecting Power Cables

The tables and diagrams shown on the following pages are intended to support you in selecting the power cables required. The example below explains how to proceed.

Example

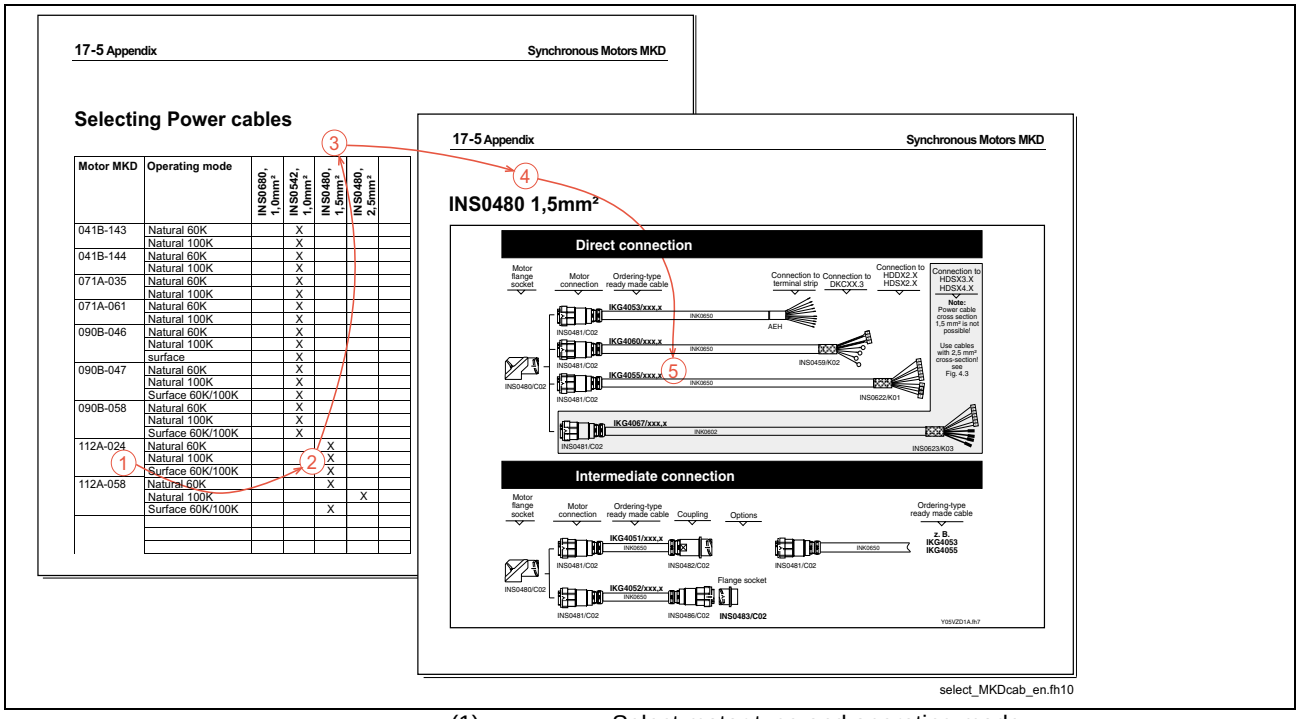
A power cable set, **5.0 m in length,** is needed for a **MKD112A-024** motor, **Natural 60K** operating mode, and an **HDS02.** drive controller.

Proceed as follows:

1. Select the motor and the operating mode in the cable selection table.
2. "X" identifies the connection cross-section required.
3. Read the size of the power connector and the connection cross-section from the table header.
4. On the following pages, select the corresponding selection diagram by connector size and connection cross-section.
5. Select the required power cable set in the diagram. Complete the selected ordering type **IKGxxxx/xxx.x** by the desired length.

In the example above, the ordering type IKG4055/xxx.x is taken from the selection diagram. For ordering, complete the ordering type by the desired length.

Ordering type: **IKG4055/005,0**



(1): Select motor type and operating mode.
(2), (3): Read the connector size and the cross-section off the column header.
(4): Consult the corresponding diagram.
(5): Select the desired cable.

Fig. 17-2: Instruction for cable selection (example)

Motor MKD	Mode of operation	INS0680, 1.0mm²	INS0542, 1.0 mm²
025A-144 Connector	Natural 60K Natural 100K	X X	
025A-144 Terminal box	Natural 60K Natural 100K		X X
025B-144 Connector	Natural 60K Natural 100K	X X	
025B-144 Terminal box	Natural 60K Natural 100K		X X
041B-058 Connector	Natural 60K Natural 100K		X X
041B-144 Connector	Natural 60K Natural 100K		X X
071B-024 Connector	Natural 60K Natural 100K		X X
071B-035 Connector	Natural 60K Natural 100K		X X
071B-061 Connector	Natural 60K Natural 100K		X X
090B-035 Connector	Natural 60K Natural 100K		X X
090B-047 Connector	Natural 60K Natural 100K		X X
090B-058 Connector	Natural 60K Natural 100K		X X

Fig. 17-3: Overview of power connector cross-sections

INS0680, 1.0mm²

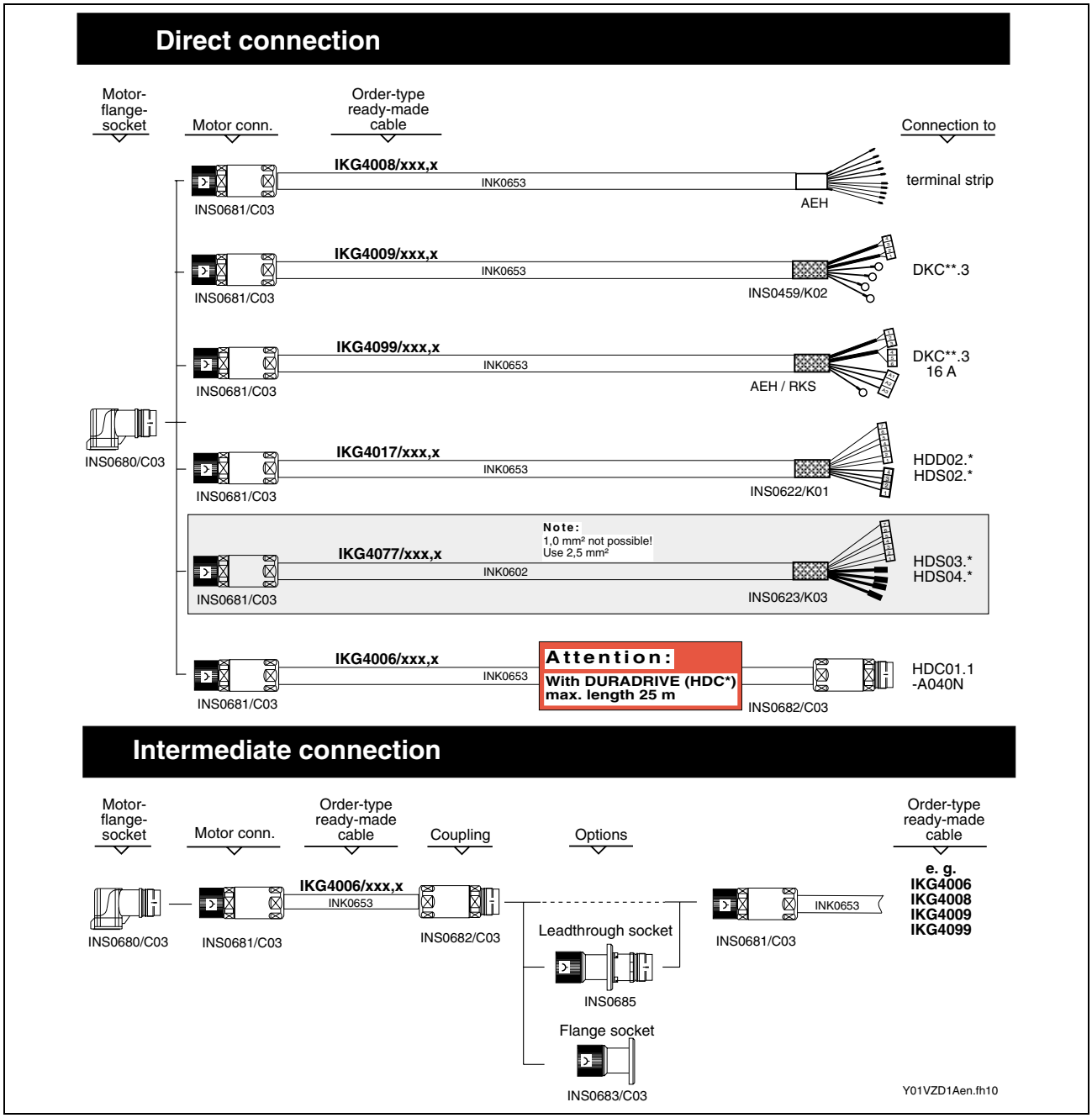


Fig. 17-4: Cable selection INS0680 -1.0mm²

INS0542, 1.0mm²

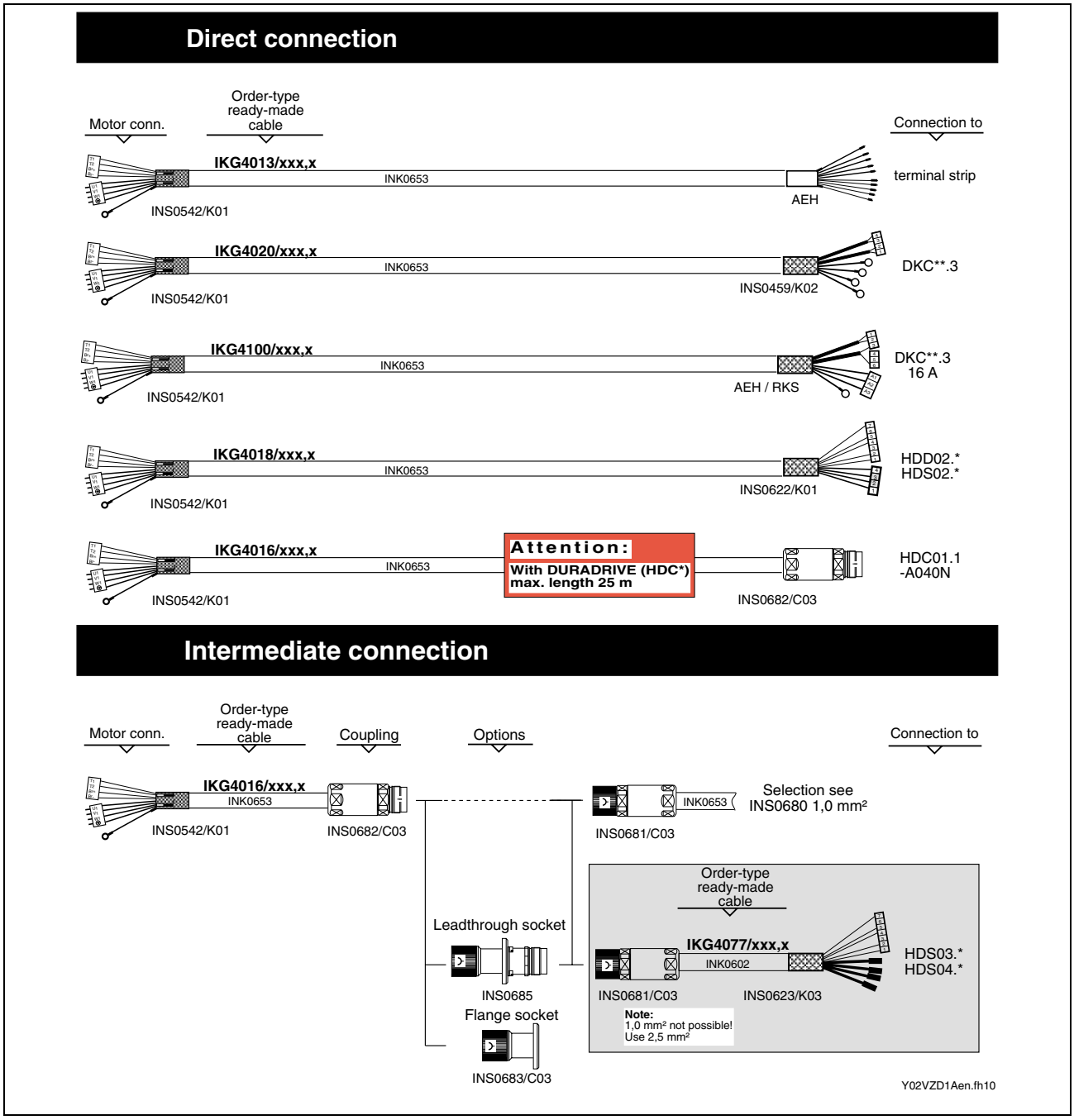


Fig. 17-5: Cable selection INS0542 -1.0mm²

17.3 Selecting Encoder Cables

For MKD motors various encoder cables are available. The tables and diagrams shown on the following pages are intended to support you in selecting the encoder cables required.

Motor	Encoder cable Connection box	Encoder cable Connector directly	Encoder cable for connection on REFUDRIVE
MKD025*-***-***-KS	see Fig. 17-7	---	see Fig. 17-9
MKD025*-***-***-US	---	see Fig. 17-8	see Fig. 17-9
MKD041	see Fig. 17-7	---	see Fig. 17-9
MKD071	see Fig. 17-7	---	see Fig. 17-9
MKD090	see Fig. 17-7	---	see Fig. 17-9

Fig. 17-6: Selecting Encoder Cables

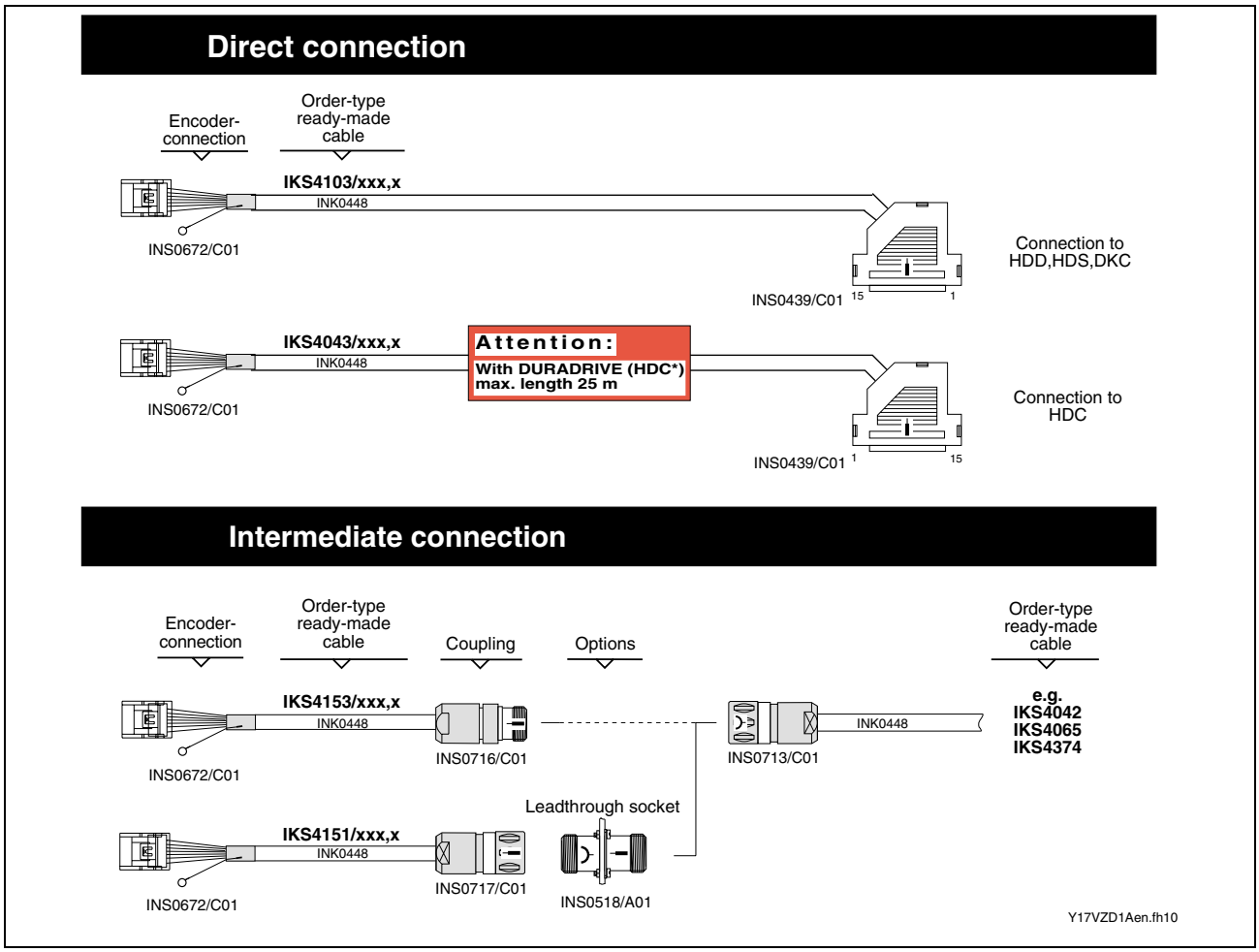


Fig. 17-7: Encoder cable for MKD025, -041, -071, -090 with connection box

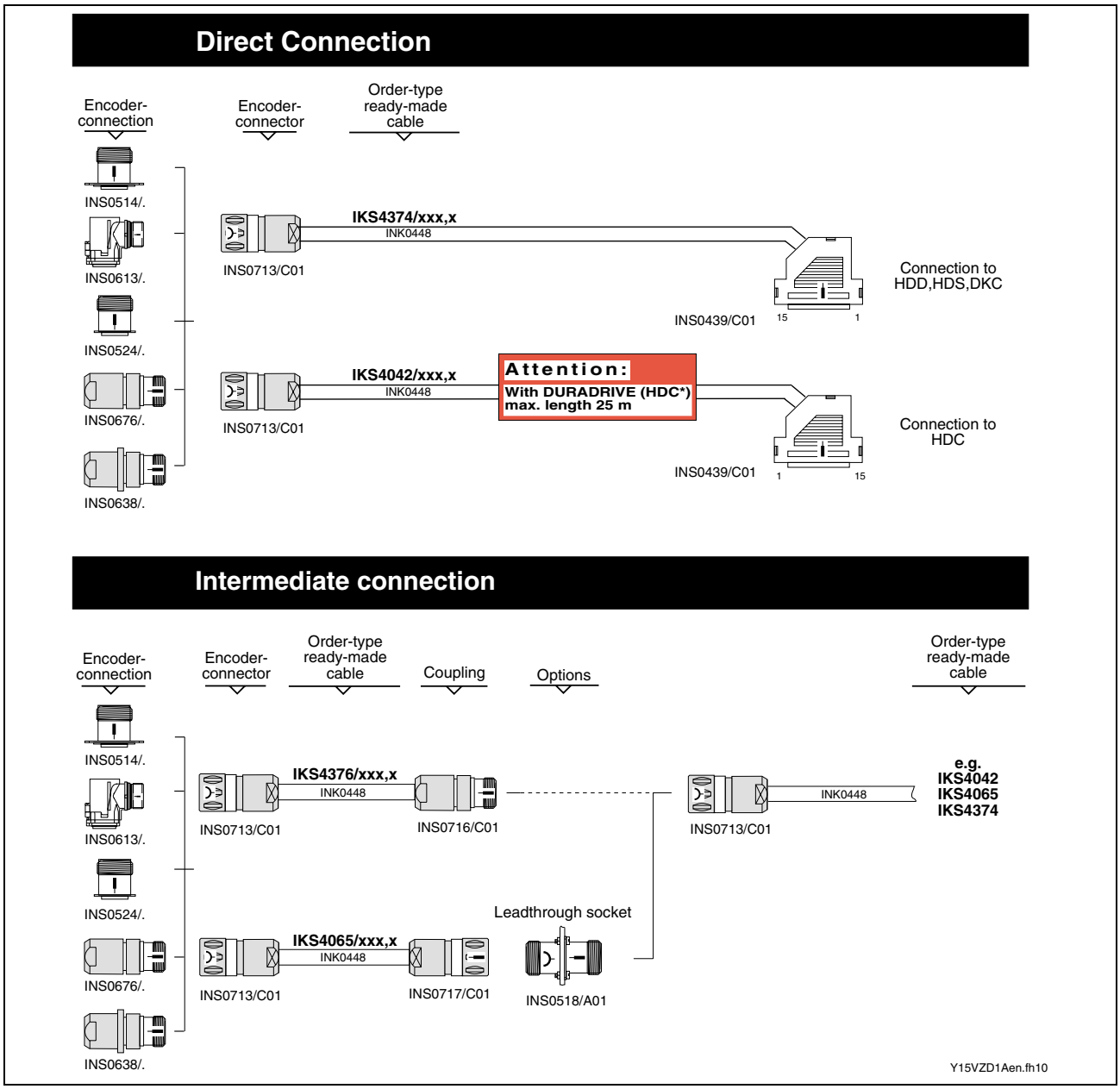


Fig. 17-8: Encoder cable direct for MKD025 with connection

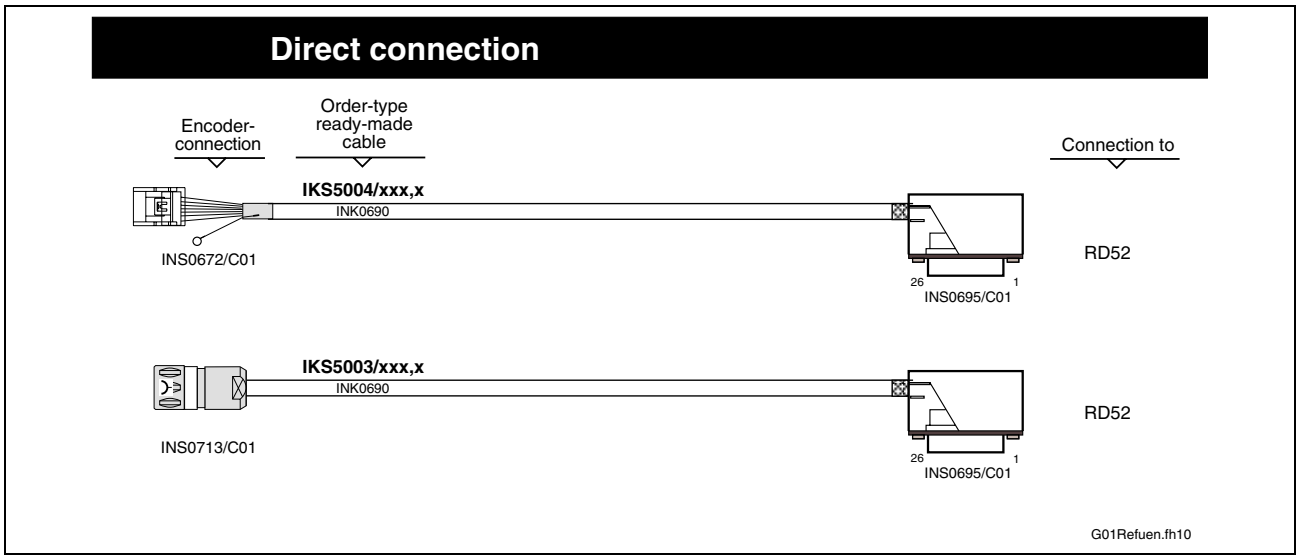


Fig. 17-9: Encoder cable MKD at REFUDRIVE RD52

18 Service & Support

18.1 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**

18.2 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**

18.3 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.

18.4 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.

18.5 Kundenbetreuungsstellen - Sales & Service Facilities

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