Rexroth
Bosch Group

Rexroth MKE synchronous motors for potentially explosive areas UL/CSA design

R911292555
Edition 01

Project Planning Manual

Title
Digital MKE AC Motors
for potentially explosive areas
UL/CSA design

Type of Documentation
Project Planning Manual

Document Typecode
DOK-MOTOR*-MKE*UL/CSA*-PR01-EN-P

Internal File Reference
Document number: 120-1500-B317-01/EN

Purpose of Documentation
This documentation...

- explains the features of the product, possibilities for use, conditions for use and operational limits
- contains technical data regarding the motors that can be supplied

provides information regarding product selection, handling and operation

Record of Revisions

Description	Release Date	Notes
DOK-MOTOR*-MKE*UL/CSA*-PR01-EN-P	07/01	First edition

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

Contents

1 Introduction

This chapter describes how this documentation is intended to be used (see “About this Documentation”). Section 1.1 provides a general introduction to the product.

1.1 Introduction to the product

Area of use

In connection with the intelligent Rexroth Indramat digital drive control devices, MKE*UL/CSA AC synchronous motors provide inexpensive drive system solutions with many functions for use in explosion-endangered areas.

Performance overview

Motors with the following continuous torques at standstill and nominal speeds are available:

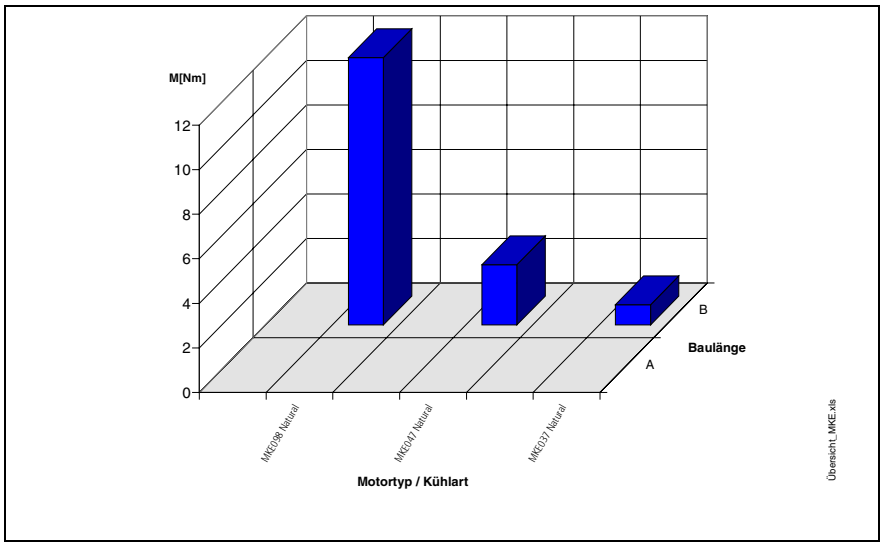


Fig. 1-1: Continuous torques at standstill of the available MKE UL/CSA motors

Advantages

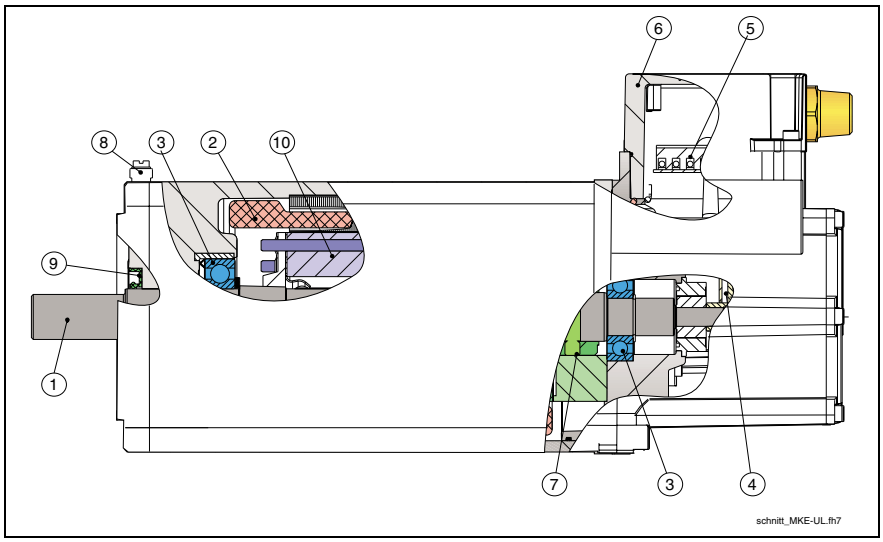
MKE UL/CSA motors have the following advantages:

- motors designed in “pressurized encapsulation” according to EN 50 014 :1992
- high operational reliability
- maintenance-free operation (due to brushless design and use of permanently lubricated bearing)
- use under adverse ambient conditions (due to completely closed motor design in protective class IP 65)
- overload protection (due to motor temperature monitoring)
- high performance
- high dynamics (due to favorable torque – inertia mass relationship)
- can be overloaded without problems (due to favorable heat diffusion from the stator coils to the external wall of the motor housing)
- peak torque can be used over a large speed range (due to electronic commutation)
- continuous start-stop operation with high repetition frequencies possible (due to electronic commutation)
- simple connection to the machine (due to flange according to DIN 42948 : 11.65)

- installation positions as desired
- direct construction of pinions and pulleys (due to bearing designed for high radial loads)
- simple cabling (due to complete ready-to-use cables; available in different models)
- quick and easy starting (due to data storage in the motor feedback)

Construction and components

MKE UL/CSA motors are permanently magnetically excited motors with electronic commutation. Special magnetic materials permit a design with low inertial masses. The following figure shows the basic construction of MKE UL/CSA motors.



(1): Shaft
(2): Stator with coil
(3): Bearing
(4): Motor transmitter
(5): Terminal (junction) unit
(6): Terminal (junction) box lid
(7): Holding brake (optional)
(8): Grounding terminal
(9): Packing ring
(10): Rotor with permanent magnets

Fig. 1-2: Construction of MKE UL/CSA motors

Models

MKE UL/CSA motors are available in different models:

Motor encoder

These are available with

- relative rotor position detection (standard) or
- absolute rotor position detection (option).

Holding brake

Option. For gripping the axle when the motor is not under power. For more information, see section 12.4 or Chapter 5 “Type key”.

Drive shaft

These are available with

- a plain shaft (standard) or
- a shaft with keyway (option).

For more information, see section 12.5 or Chapter 5 “Type key”.

Electrical connection

Depending on motor, via

- terminal box

1.2 About this documentation

Document structure of this edition

This documentation contains safety regulations, technical data and operating regulations for MKE UL/CSA motors. The individual chapters can be divided into the following subjects:

- General information
- Important safety-relevant information
- Information describing the product
- Use-based information
- Additional information

Chapter	Title		
1	Introduction	General information	
2	Important Notes Regarding Use	Safety	Required
3	Notes Regarding Safety for Electrical Drives and Controls		
4	Explosion-Endangered Areas		
5	Type Key	Product description	Planners and designers
6	MKE037		
7	MKE047		
8	MKE098		
9	Accessories		
10	Connection Techniques		Operating and maintenance personnel
11	Notes Regarding Application		
12	Handling	Use	
13	Assembly		
14	Commissioning, Operation and Maintenance		
16	Notes Regarding Servicing	Additional information	
17	Appendix		
18	Index		
19	Customer Service Centers		

Fig. 1-3: Document structure and index of standards

Additional documentation

Note: The documentation listed below is not required in its entirety for designing.

Material No.:	Title / description	System
00281668	Selection List -DOK-DIAX04-SERV*****G2-AU03-MS-P „DIAX04 Servodrives„	DIAX04
00274944	Project Planning- DOK-DIAX04-HDD+HDS****-PRJ2-EN-P „DIAX04 HDD and HDS Drive Controllers 1st Generation"	
00280446	Project Planning - DOK-DIAX04-HDD+HDS**G2-PR03-EN-P „DIAX04 HDD and HDS Drive Controller 2nd Generation„	
00275156	Project Planning - DOK-DIAX04-PLUG*IN*MOD-PR03-EN-P „DIAX04 Plug-in modules for digital intelligent drive controllers„	
00275432	Applications - DOK-POWER*-HVE+HVR****-ANW3-EN-P „DIAX04 HVE and HVR Power Supply Units„	
00280641	Application Manual - DOK-POWER*-HVE+HVR**G2-AW05-EN „DIAX04 HVE and HVR 2nd Generation Power Supply Units„	
00282801	Application Manual - DOK-POWER*-HZP******G2-ANW1-EN-P „Control Gear HZP for connecting HVR power supply unitis of the second generation„	
00280107	Project Planning Manual- DOK-ECODR3-DKC**.3****-PR04-EN-P „ECODRIVE03 Drive Controllers„	ECO-DRIVE03
00281042	Selection Lists - DOK-ECODR3-SERV-GEN***-AUS1-MS-P „ECORIVE03 Servo Applications with 1.5 s Acceleration Time„	
00281040	Selection Lists - DOK-ECODR3-SERV-WZM***-AU02-MS-P „ECORIVE03 Servo Applications with 400ms Acceleration Time„	
00259814	Project Planning Manual - DOK-GENERL-EMV********-PR02-EN-P „Electromagnetic Compatibility (EMC)in Drive and Control Systems„	EMC
00286117	Application Description - DOK-CONNEC-CAB*INSTR02-MA01-EN-P „Indramat Internal Connection System Assembly and Tools for DIAX04 and ECODRIVE03„	CABLES
00282688	Selection Data - DOK-CONNEC-CABLE*STAND-AU04-EN-P „Connecting Cables DIAX04, ECODRIVE03 and POWERDRIVE„	
00267635	Project Planning Manual - DOK-GEAR**-GTS********-PR06-EN-P „Planetary Gearboxes GTS for Mounting to AC Motors„	GEARS
00267495	Project Planning Manual - DOK-GEAR**-GTP********-PRJ1-EN-P „GTP Planetary Gearboxes for Mounting to AC„	
1) The index number (e.g. ...**06**-...) indicates the edition of the documentation		

Fig. 1-4: Additional documentation

Note: In the case of references to additional documentation, the edition is indicated by a bold and underlined number (e.g. **06**) in this documentation. When ordering documentation, the edition may be higher!

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 Rexroth Indramat. If necessary, please address the authorized sales outlets or, in Germany, directly to:

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Outside Systems

Documentation for external systems, which are connected to Rexroth Indramat 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 directions for use

2.1 Appropriate use

Introduction

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

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

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

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

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

Areas of use and application

MKE AC synchronous motors are designed to execute application-specific axle movements in explosion-endangered areas together with drive control devices of lines DIAX04 and ECODRIVE.

Typical areas where MKE motors can be applied are:

- enameling systems,
- chemical industry

Available for an application-specific use of the motors are unit types with differing drive power and different interfaces.

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

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

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

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

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

2.2 Inappropriate use

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

MKEs may not be used if

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

- Rexroth Indramat GmbH 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 this documentation 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 Indramat products are protective low voltages designed in accordance with international standards on electrical safety.

WARNING

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

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

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

3.7 Protection Against Dangerous Movements

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

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

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

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

DANGER

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

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

WARNING

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

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

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

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

3.9 Protection Against Contact with Hot Parts

CAUTION

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

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

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

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

3.10 Protection During Handling and Mounting

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

CAUTION

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

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

⇒ Use appropriate mounting and transport equipment.

⇒ Take precautions to avoid pinching and crushing.

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

⇒ Use lifting devices and tools correctly and safely.

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

⇒ Never stand under suspended loads.

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

3.11 Battery Safety

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

CAUTION

Risk of injury by incorrect handling!

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

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

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Do not damage electrical components installed in the equipment.

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

3.12 Protection Against Pressurized Systems

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

CAUTION

Danger of injury by incorrect handling of pressurized systems !

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

⇒ Observe the operation instructions of the respective manufacturer.

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

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

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

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

Notes

4 Potentially-explosive areas

4.1 Definitions

Terms

The following terms are used in European Standard EN 50014: 1992.

Electrical equipment
All objects that wholly or partially serve to use electrical energy. This includes, among others, objects to generate, conduct, distribute, store, measure, control, transform and consume electrical energy, as well as objects for telecommunications technology.

Potentially explosive area
An area in which the atmosphere is capable of being explosive (the danger is potential).

Potentially explosive gas atmosphere
A mixture of air under atmospheric conditions and flammable materials in the form of gas, steam or vapor, in which, after ignition, burning spreads into the unignited mixture.

Potentially explosive test mixture
A certain potentially explosive mixture that is used to test electrical equipment for potentially explosive areas.

Operating temperature
The equipment temperature that is reached during normal operation.

Maximum operating temperature
The highest attainable operating temperature.

NOTE: Each piece of equipment can have different operating temperatures on different parts.

Maximum surface temperature
The highest temperature that is attained in operation under the least favorable conditions (but within the recognized tolerance) on a part or surface of a piece of electrical equipment, whereby a surrounding potentially explosive atmosphere can be ignited.

Ignition protection class
The special standards that are enacted for electrical equipment to prevent the ignition of a surrounding potentially explosive atmosphere.

Class of protection of the housing (IP)
A numeric classification, preceded by the symbol "IP", that is used for the housings of electrical equipment in order to:

- provide the protection of persons against contact with parts that are under power or moving (excepting smooth shafts or similar parts) within the housing,
- provide protection of the electrical equipment against penetration by solid foreign substances, and, if provided by the classification,
- ensure the protection of the electrical equipment against the harmful penetration of water.

NOTE: The housing IP protective class is not necessarily identical to the housing of the equipment for the ignition protection class.

Rated value
A quantitative value, usually provided by the manufacturer, for a specific operating condition of a part, a unit or a piece of equipment.

Rated data
Summary of rated values and operating conditions.

Cable and line entrance
Device that permits the entrance of one or more electrical and/or fiber-optical cables or lines into a piece of electrical equipment; the corresponding ignition protection class remains unchanged.

Ex cable and line entrance
A cable and line inlet that is tested independently of the equipment housing, but is certified as an operating element ; it can be installed in the housing during assembly without the need for additional certifications.

Entrance for piping
Material that permits the introduction of piping into electrical equipment.

Pressure part
Element of a cable and line inlet which affects the sealing ring in such a manner that it can fulfill its sealing function.

Stress relief equipment Element of a cable and line inlet which prevents tension or torsion of the cable or line from being transferred to the connectors.

Sealing ring Ring that is used at the inlets of cables, lines or pipework in order to provide a seal between the inlet and the cable, line or pipework.

Connection space Space separating the main housing or a part thereof, that may or may not be connected with the main housing, and which contains connectors.

Connectors Terminals, screws or other parts that provide an electrical connection between the conductor and the outer electric circuits.

Guide Insulation device that guides one or more electrical conductors through an inner or outer wall of a housing.

Ex- component A piece of electrical equipment for potentially explosive areas, or a module (excepting an Ex cable and line entrance), designated by the symbol "U", which may not be used by itself in such areas and which requires additional certification when it is installed in electrical equipment or systems for use in potentially explosive areas.

Zones

Potentially explosive areas are classified into the following zones according to the probability of the presence of a potentially explosive atmosphere.

Note: The following information is based on EN 60079-14:1997 and BGBl 1996, Part 1. See these regulations for detailed information.

Zone 0 Zone 0 includes areas in which a potentially explosive atmosphere, consisting of a mixture of air and gases, vapors or steam, is constantly present, over an extended period of time..

Electrical equipment may be used in Zone 0 if it satisfies the requirements according to EN 50020 : 1994 (intrinsic safety “i”).

Zone 1 Zone 1 includes areas in which it can be assumed that a potentially explosive atmosphere consisting of gases, vapors or steam is occasionally present.

Electrical equipment may be used in Zone 1 if it is manufactured according to the requirements for Zone 0, or to one of the ignition protection classes in Fig. 4-1.

Zone 2 Zone 2 includes areas in which it can be assumed that an potentially explosive atmosphere consisting of gases, vapors or steam will not occur but, if it nevertheless does occur, then only rarely and for a short period of time.

Electrical equipment may be used in Zone 2 if it:

- is manufactured according to the requirements for Zones 0 or 1.
- is manufactured specifically for Zone 2.
- satisfies the requirements of a recognized standard for industrial electrical equipment and has no hot surfaces that can be ignited in uninterrupted operation.

Ignition protection classes, groups and temperature classes

Electrical equipment for potentially explosive areas is classified into:

Ignition protection classes

The manufacture of electrical equipment is designed according to the ignition protection class. The requirements are specified in special standards.

Ignition protection class	Designation	Standard
Oil immersion	o	EN 50015: 1998
Excess pressure immersion	p	EN 50016: 1995
Sand immersion	q	EN 50017: 1998
Compression-proof encapsulation	d	EN 50018: 1994
Increased safety	e	EN 50019: 1994
Intrinsic safety, category a	ia	EN 50020: 1994
Intrinsic safety, category b	ib	EN 50020: 1994
Encapsulation	m	EN 50028: 1987

Fig. 4-1: Ignition protection classes

Electrical equipment of these ignition protection classes is certified by a neutral party after an inspection of the design.

Groups

- **Group I:** Electrical equipment for firedamp-endangered excavations.
- **Group II:** Electrical equipment for all potentially explosive areas, other than firedamp-endangered excavations.

The electrical equipment of Group II is subdivided according to the characteristics of the potentially explosive atmosphere for which they are specified.

For ignition protection classes "d" (compression-proof encapsulation) and "i" (intrinsic safety), electrical equipment of Group II is subdivided into IIA, IIB and IIC (see Appendix A of EN 50014 :1992).

For all ignition protection classes, electrical equipment of Group II must be identified according to Fig. 4-2, depending on its maximum surface temperature.

Temperature classes

For electrical equipment of Group I, the maximum surface temperature must be indicated in the inspection documents.

Electrical equipment of Group II is categorized and identified; they must either be:

- preferably allocated into a temperature class in agreement with Fig. 4-2; or
- identified per the corresponding maximum surface temperature; or
- if applicable, identified per the specific gas for which the equipment is specified.

Temperature class	Maximum surface temperature °C
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Fig. 4-2: Breakdown of the maximum surface temperatures into classes for electrical equipment of Group II

4.2 Type designation of the motor series MKE UL/CSA

MKE motors are manufactured according to the American standards

- UL 508C/1996-11,
- UL 674/1994-04 and
- UL 1446/1997-05

and have been inspected and certified by UL (Underwriters Laboratories Inc.®) authority.

Motor type	Classification	UL number
MKE037	Class I, Groups C and D	E203009
MKE047	Class I, Groups C and D	E203009
MKE098	Class I, Groups C and D	E203009

Fig. 4-3: Type designations for MKE motors

Yellow Card certificate of conformance

Yellow cards, which confirm the construction and maintenance of the valid US standards, are available for all MKE motors. If required, the Yellow Cards can be ordered from the particular sales branch.

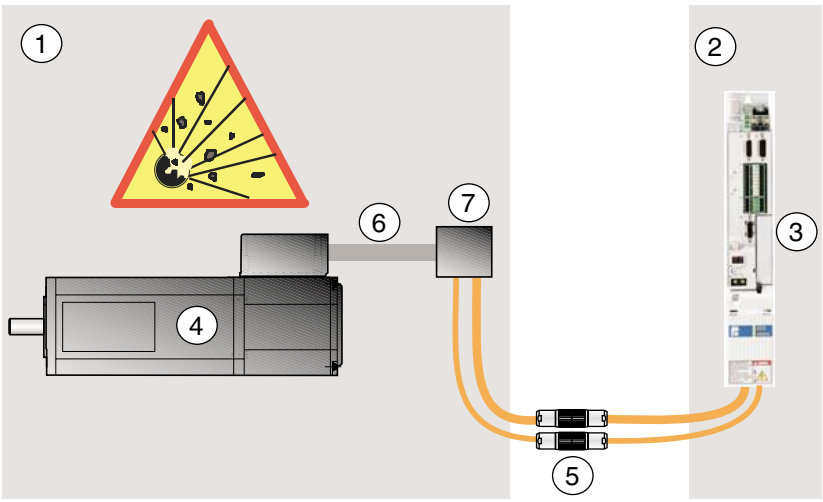
Note: MKE motors 037, 047 and 098 may be operated in potentially-explosive areas only in combination with Bosch Rexroth drive controllers.

4.3 Drives in potentially explosive areas

The installation of drives in potentially explosive areas is shown in the illustration below. The following supplied components must meet Ex protection requirements:

- motor with attachments
- electrical circuits leading into the potentially explosive area

Potentially explosive area



(1): Poentially explosive area with explosion-proof equipment
(2): cabinet
(3): Drive controller
(4): MKE motor
(5): Connectors (optional)
(6): Connection lines in steel pipe
(7): Ex terminal box (not included in delivery)

Fig. 4-4: Potentially explosive area

Use in Class I

The MKE motors described in this documentation are UL-listed and may be used in potentially explosive areas according to Class I, Groups C and D.

The associated drive controllers and any required connectors for the power lines (motor power and feedback connections) must be located outside of the potentially explosive area.

DANGER

Explosion danger, danger to life and limb, serious injury and material damage

⇒ Do not set up drive controllers or connectors within the potentially explosive area.

⇒ Ensure that connectors cannot enter the Ex area.

⇒ Do not disconnect connectors under power!

⇒ Ensure that ignition sparks cannot occur in the Ex area.

Notes

5 Type Code

The basis for ordering any Rexroth Indramat product is the type code. All available motor variants are uniquely described by the type code. The individual positions of the type code (Abbrevation columns) and their significance are described below.

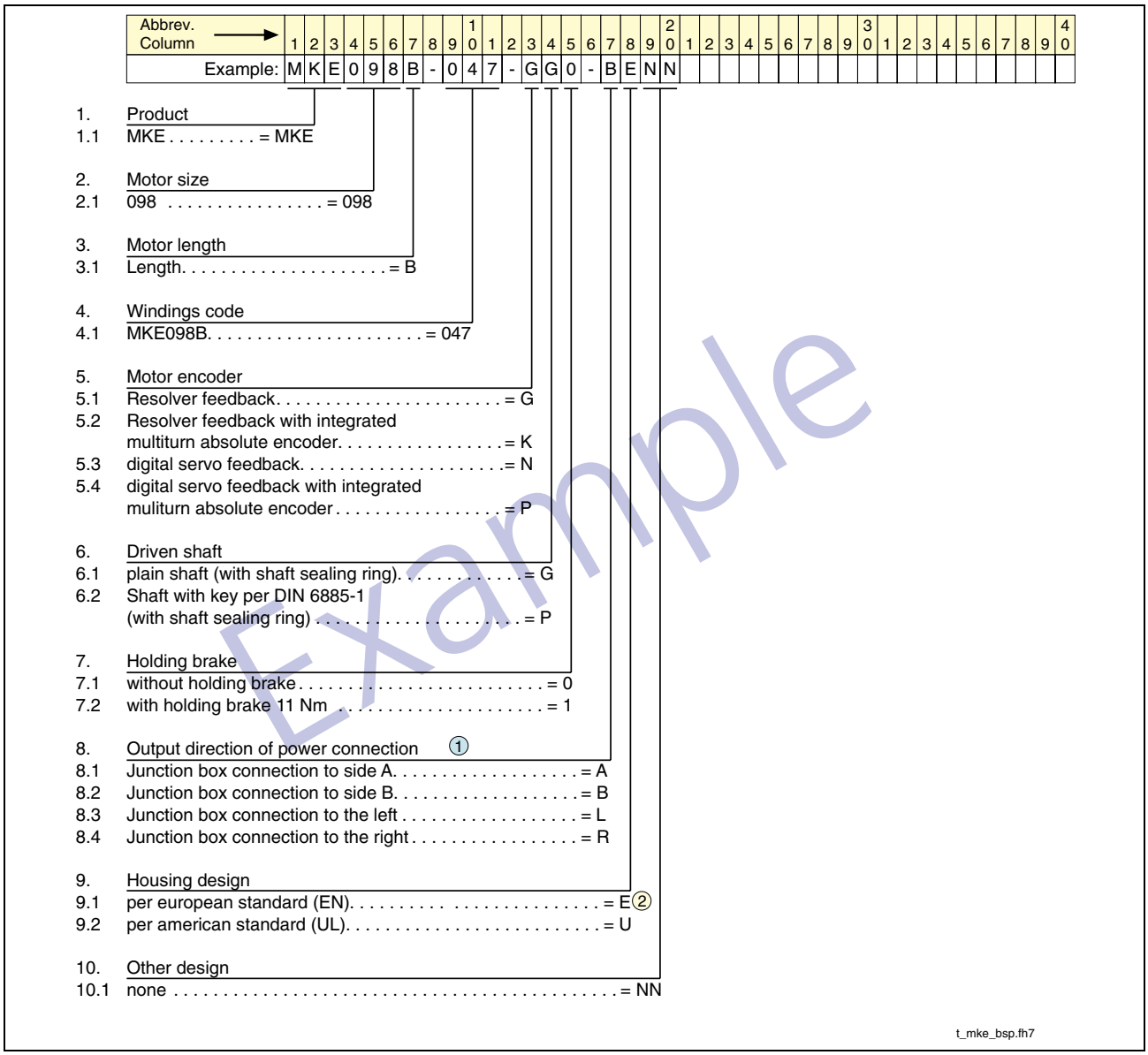


Fig. 5-1: Example of a type code

5.1 Product

Abbrevation columns 1 2 3

Three-digit Rexroth Indramat-specific designation of a line. Servo motors that are suitable for use in explosion-endangered areas are designated by product group MKE.

5.2 Motor size

Abbrevation columns 4 5 6

The motor size determines important mechanical motor specifications. In the following table, important mechanical motor specifications are assigned to the motor sizes.

Motor size	Flange size in mm	Central diameter in mm
037	60	40
047	88	50
098	144	110

Fig. 5-2: MKE motors flange size, central diameter

5.3 Motor length

Abbrevation column 7

The motor length determines different continuous torques at standstill within one motor size.

	Continuous torque at standstill	
Motor size	Motor length B	Motor length D
037	0.9	---
047	2.7	---
098	12.0	---

Fig. 5-3: MKE motors, continuous torque at standstill

5.4 Windings code

Abbrevation columns 9 10 11

The windings code determine the electrical performance data of the motors for all Rexroth Indramat motors in connection with the motor constructional size/length.

The type code indicates all possible coil identifiers that are available for a motor constructional size/length.

Example

Motor constructional size/length	Available coil identifier
MKE037B	144

Fig. 5-4: Example of windings code

In Chapters 7 to 9, the technical data and torque-speed characteristics are listed for every motor.

5.5 Motor encoder

Abbrevation column 13

MKE motors are equipped with an integrated encoder system (motor feedback). To control the motor speed or to position the motor, the drive control device requires the current motor position.

The integrated encoder system (motor feedback) provides the drive control device with corresponding signals for this purpose.

The following options are available:

Option	Type	Measuring principle	System precision	Position detection type
G	Digital resolver feedback (RSF)	Inductive	±8 minute angle	Relative
K	Digital resolver feedback (RSF with integrated multiturn absolute value encoder)	Inductive	±8 minute angle	Absolute (over 4096 revolutions)-
N	Digital servo feedback (HSF)	Optical	±0.5 minute angle	Relative
P	Digital servo feedback (HSF with integrated multiturn absolute value encoder)	Optical	±0.5 minute angle	Absolute (over 4096 revolutions)

Fig. 5-5: MKE motor encoder

5.6 Drive shaft

Abbrevation column 14

In order to connect the machine elements to be driven to the motor shafts, the following options are available for MKE motors.

Option	Design	Detail
G	plain shaft	With central hole on end and „DS“ threading according to DIN 332, Part 2, Edition 05.83
P	Shaft with keyway [1)]	
1) kayway according to DIN 6885, Sheet 1, Edition 08.68. For details, see motor specifications sheet.		

Fig. 5-6: MKE drive shafts

Note: MKE motors are balanced using **whole** fitting springs. The corresponding fitting spring does not belong to the scope of delivery.

5.7 Holding Brake

Abbrevation column 15

Option. For gripping the servo axle when the machine is not under power.

Option	Brakes	
0	Without holding brake	
1	With holding brake	For braking moments, see the individual motor type codes.

Fig. 5-7: MKE holding brakes

The holding brake works according to the “electrically releasing” principle. When not under power, a magnetic force affects the brake armature disk. As a result, the brake closes and holds the axle.

When 24 VDC (± 10%) are applied, the continuous magnetic field is compensated for by the electrically generated magnetic field: the holding brake opens.

Note: Heed the notes regarding installation and safety for the motor brakes in the “Notes regarding application” section!

5.8 Output direction of power connection

Abbrevation column 17

MKE motors are generally connected to power or the encoder via a terminal box. The desired cable exit direction can be set during assembly by turning the terminal (junction) box.

Definition of cable exit direction

The cable exit directions possible for Rexroth Indramat motors are defined as follows. Looking toward the drive shaft:

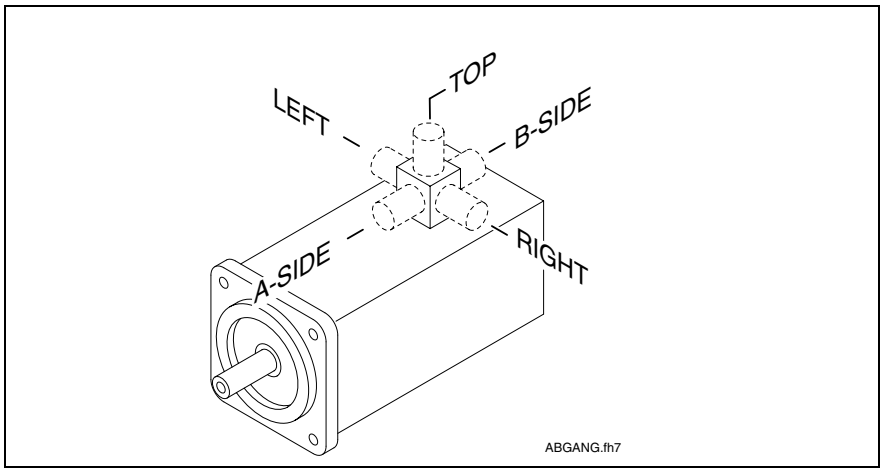


Fig. 5-8: Definition of cable exit directions

Supplied condition

MKE motors can be supplied with a terminal (junction) box. The cable exit direction of UL/CSA motors is supplied according to the order. For the EU model, only cable exit direction B is available. However, the cable exit direction can be changed when the motors are assembled.

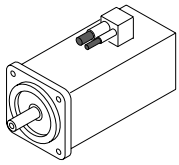
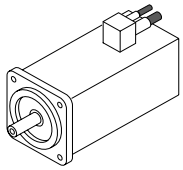
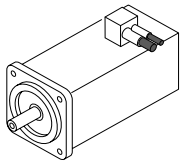
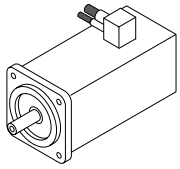
	Cable exit direction			
Motor type	**A side**	**B side**	**Right**	**Left**
				
MKE037	X	X	X	X
MKE047	X	X	X	X
MKE098	X	X	X	X

Fig. 5-9: Cable exit directions available during assembly

5.9 Housing design

Abbrevation column 18

Depending on the location of use (country), different regulations apply. The housing design is available in the following variants.

Option	Housing design	Remarks
E	According to European standard (EN)	in preparation
U	According to American standard (UL)	

Fig. 5-10: MKE housing design

5.10 Other designs

Abbrevation columns 19 20

No special designs available.

5.11 Standard references

“Standard references” indicates standards (e.g. DIN, EN, ISO, etc.) or similarly applicable production standards (INN, etc.) that are cited in the type code. The edition valid at the time that the type code is issued is listed in each case.

5.12 Notes

Additional information regarding the use of the type code can be found here. This includes descriptions for footnotes, notes regarding availability and exclusion clauses.

6 General Information Regarding Technical Data

6.1 Requirements

The torque-speed characteristic curves and Technical Data are provided taking the following conditions into account.

Note: Note the listed temperatures when selecting the Technical Data!

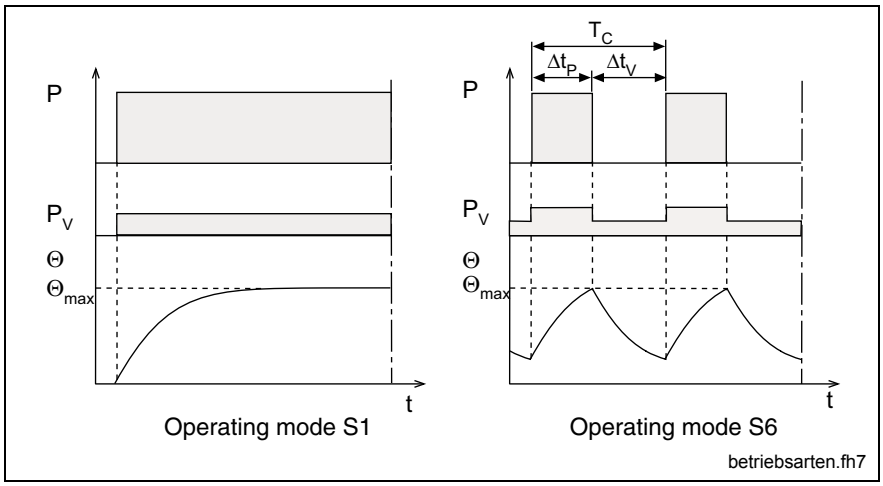
Setup and measurement of characteristic curves

The motor data and characteristic curves are valid for MKE motors under the following conditions:

- ambient temperature max. 40°C
- insulated setup (aluminum flange)
- in the case of motors with the brake option, data for motors **with** a brake is provided.
- motors with a radial shaft seal ring

6.2 Operating modes

Rexroth Indramat motors are documented according to the inspection criteria and measurement procedures of EN 60034-1. The performance curves shown correspond to operating mode S1 or S6.



P: load
P_V: electrical losses
Θ: temperature
$Θ_{max}$: maximum temperature (motor housing)
t: time
T_C: cycle time
$Δt_P$: operating time with constant load
$Δt_V$: idling time

Fig. 6-1: Operating modes according to EN 60034-1 :1998

Operating time

Operating mode S6 is supplemented by providing the operating time ED in percent. The operating time is calculated as follows:

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

ED: relative operating time in %
T_C: cycle time
$Δt_P$: operating time with constant load

Fig. 6-2: Relative operating time

The values given in the documentation are based on the following criteria:

Cycle time: 15 min

Operating time ED: 25%

Note: If different conditions apply, these are indicated.

6.3 Definition of characteristic quantities

Electrical characteristic quantities

Nominal motor speed n_K
The torque that can be released; at an intermediate circuit voltage of $540V_{DC}$, the characteristic speed is ca. ½ of the continuous torque at standstill.

Continuous torque at standstill M_{dN}
Continuous torque that can be released to the motor drive shaft at a speed of n=0.

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

Peak current I_{max}
Maximum short-term branch current (peak value) of the motor permitted without damaging the permanent magnetic circuit of the motor.

Torque constant at 20°C K_M
Relationship of the torque increase to the motor branch current (peak value) at a motor temperature of 20°C. Unit = Nm/A. Valid until ca. i = 2x I_{dN} .

Voltage constant at 20°C $K_{E(eff)}$
Effective value of the induced motor voltage at a motor temperature of 20°C and 1000 rpm. Unit = V/1000 rpm.

Winding resistance at 20°C R_{12}
Coil resistance measured between two branches; unit = Ohm (Ω).

Winding inductance L_{12}
Inductance measured between two branches; unit = mH.

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

Mechanical characteristic quantities

Maximum speed n_{max}

The maximum permitted speed of the motor. Limiting factors can be mechanical (centrifugal forces, bearing strain) or electrical (intermediate current) in nature.

Theoretical maximum torque M_{max}

The maximum torque that can be released for approx. 400 ms at peak current I_{max} (guaranteed value; due to error tolerance, can be up to 20% higher). The maximum torque that can be attained depends on the drive controller used. Only the maximum torques M_{max} that are listed in the selection lists for the motor/control device combination are valid.

Rotor inertia J_M

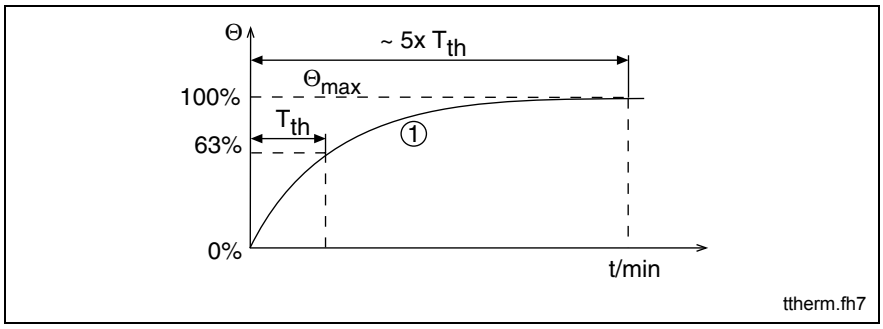
Moment of inertia of the rotor without the brake option. Unit = kgm².

Mass m_M

Motor mass without the brake and motor fan options, given in kg.

Thermal time constant T_{th}

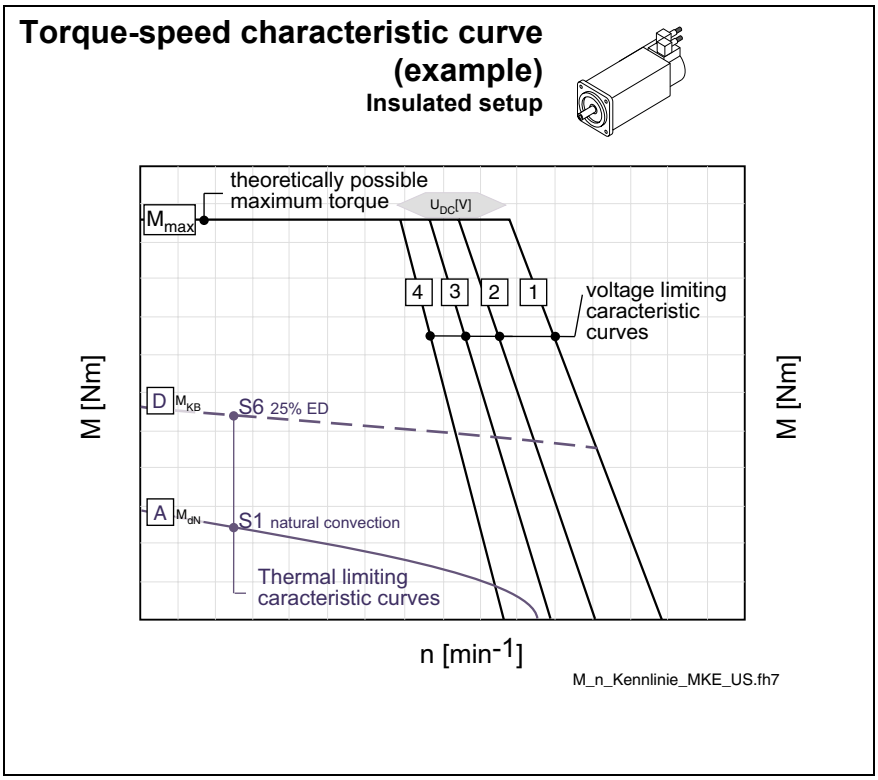
Duration of the temperature increase to 63% of the final temperature of the motor housing when the motor is loaded with the permitted S1 continuous torque. The thermal time constant is determined by the cooling method used.



(1): temporal progression of the motor housing temperature
T_{end}: final motor temperature
T_{th}: thermal time constant

Fig. 6-3: Thermal time constant

6.4 Sample characteristic curve



Thermal limiting characteristic curves

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

[B]: **M_{dN}** S1- continuous operation characteristic curve of the motor (according to EN 60034-1; 1998), Surface cooling.

[C]: **M_{dN}** S1- continuous operation characteristic curve of the motor (according to EN 60034-1; 1998), Liquid cooling.

[D]: **M_{KB}** S6- intermittent service characteristic curve at 25% operating time of the motor (according to EN 60034-1; 1998). The maximum cycle time is 15 min.

[**M_{max}**]: The theoretically possible maximum torque of the motor. It can be limited by the drive control device.

[1]-[4]: **Voltage limiting characteristic curves.** Starting at a breakpoint speed, the voltage limiting characteristic curve limits the available maximal moment M_{max}. The maximum motor speed is determined by the intermediate circuit voltage used. Separate characteristic curves result for the individual drive control devices in association with the supply device and the power connection voltage used.

[1]: HDS to HVR
[2]: HDS to HVE **or** DKCxx.3 for 3x AC 480V power connection
[3]: HDS to HVE **or** DKCxx.3 for 3x AC 440V power connection
[4]: HDS to HVE **or** DKCxx.3 for 3x AC 400V power connection

Fig. 6-4: Sample characteristic curves

7 MKE037

7.1 Technical data

Designation	Symbol	Unit	Data
Motor type			MKE037B-144
Nominal motor speed[1)]	n_K	rpm	9000
Continuous torque at standstill	M_{dN}	Nm	0.9 (0.8) [8)]
Continuous current at standstill	I_{dN}	A	4.7 (4.2) [8)]
Theoretical maximum torque [2)]	M_{max}	Nm	4.0
Peak current	I_{max}	A	21.2
Rotor inertia[3)]	J_M	kgm²	0.3 x 10^{-4}
Torque constant at 20ºC	K_m	Nm/A	0.21
Voltage constant at 20ºC	$K_{E(eff)}$	V/1000 rpm	18.2
Winding resistance at 20ºC	R12	Ohm	2.7
Winding inductance at 20°C	L12	mH	3.7
Thermal time constant	T_{th}:	min	15
Minimum cross-section of power wires	S	mm²	1.0
Mass [3)]	m_M	kg	2,5
Permissible ambient temperature [5)]	T_{um}	ºC	0 to +40
Permissiblestorage and transport temperature	T_L	ºC	-20 to +80
Maximum installation elevation [6)]	h	m	1000 above sea level
Protection category [7)]			IP 65
Insulation class (according to EN 60034-1 : 1998)			F
Hazard category			Class I, Groups C and D
UL listing			E203009
Housing coat			Black primary coat (RAL 9005)

1) Depending on moment required by application. For standard applications, see n_{max} in the selection lists for the motor/controller combination. For other applications, the real speed must be determined with the required torque using the torque-speed characteristics .
2) The maximum torque that can be attained depends on the drive control device used. **Only** the maximum torques M_{max} that are listed in the selection lists for the motor/control device combination are binding.
3) Without holdingbrake.
4) At 1000 rpm.
5) With devaiting ambient temperatures, see section 12.1.
6) With devaiting installation elevations, see section 12.1.
7) With proper mounting of power and feedback cables.
8) Value in parentheses applies for motor with brake.

Fig. 7-1: Technical data, MKE037

Designation	Symbol	Unit	Holding brake data
Holding torque	M_4	Nm	1.0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.4
Moment of inertia	J_B	kgm²	0.07×10^{-4}
Release delay	t_2	ms	4
Clamping delay	t_1	ms	3
Mass	m_B	kg	0.19

Fig. 7-2: Technical data, MKE037 holding brake (option)

7.2 Type code order designation

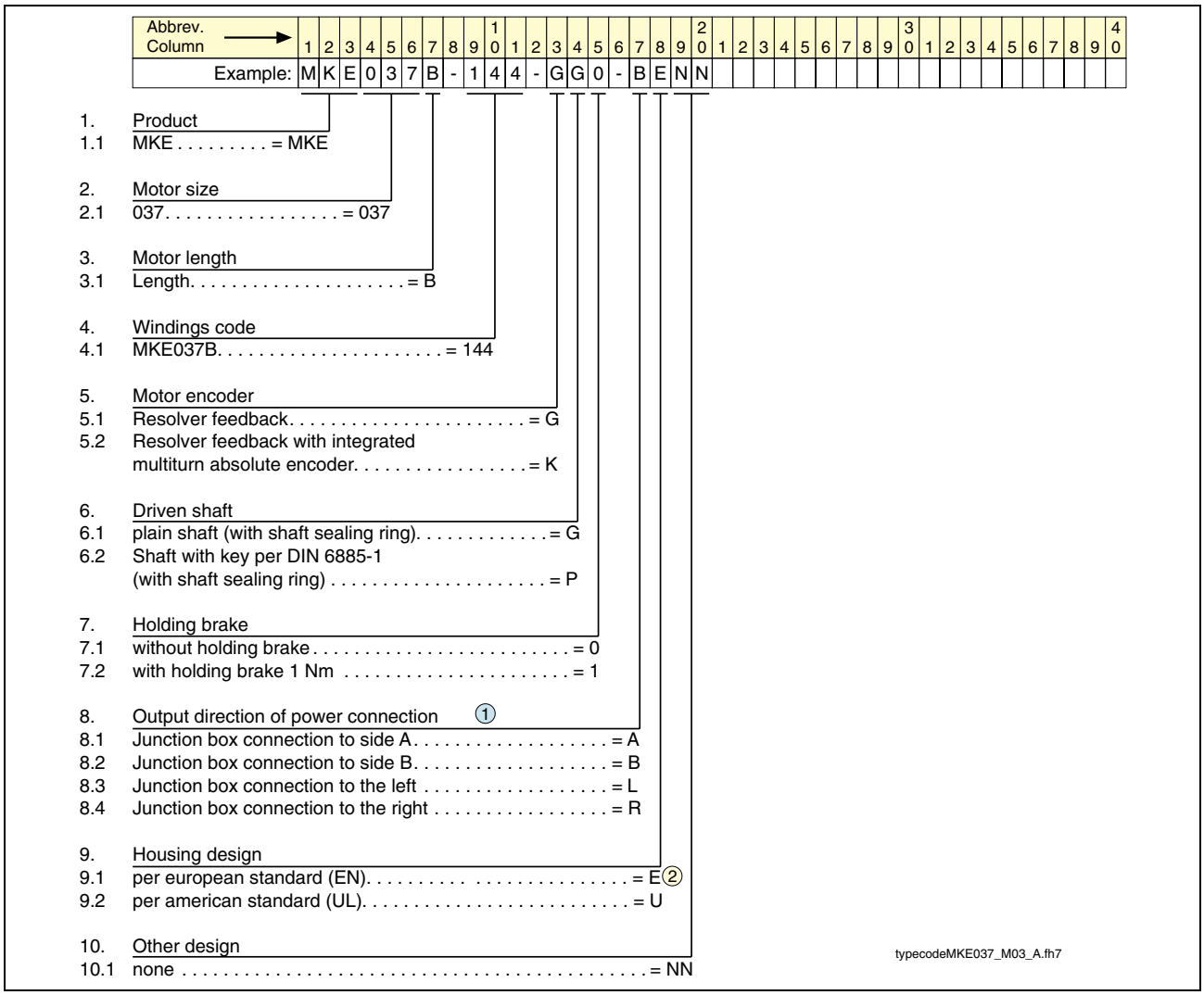


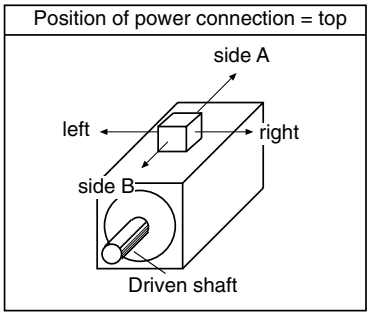
Fig. 7-3: Type code, MKE037 (page 1)

11. Standard reference

Standard	Title	Edition
DIN 6885-1	Drive Type with Fastenings without Taper Action; Parallel Keys, Keyways, Deep Pattern	1968-08
DIN EN 50014	Electrical apparatus for potentially explosive atmospheres - General requirements; Amendment AA; German version EN 50014:1997/prAA:1999	1998-02
DIN EN 50018	Electrical apparatus for potentially explosive atmospheres - Flameproof enclosures "d"; German version EN 50018:1994	1995-03
UL 508C	Power conversion equipment	1996-11
UL 674*ANSI 674	Electric motors and generators for use in division 1 hazardous (classified) locations	1994-04
UL 1446	Systems of insulating materials - General	1997-05

Note:
① Looking from front onto driven shaft (see picture 1)
② Housing design "E" is only available with output direction of power connection "B"

Illustration example: MKE037



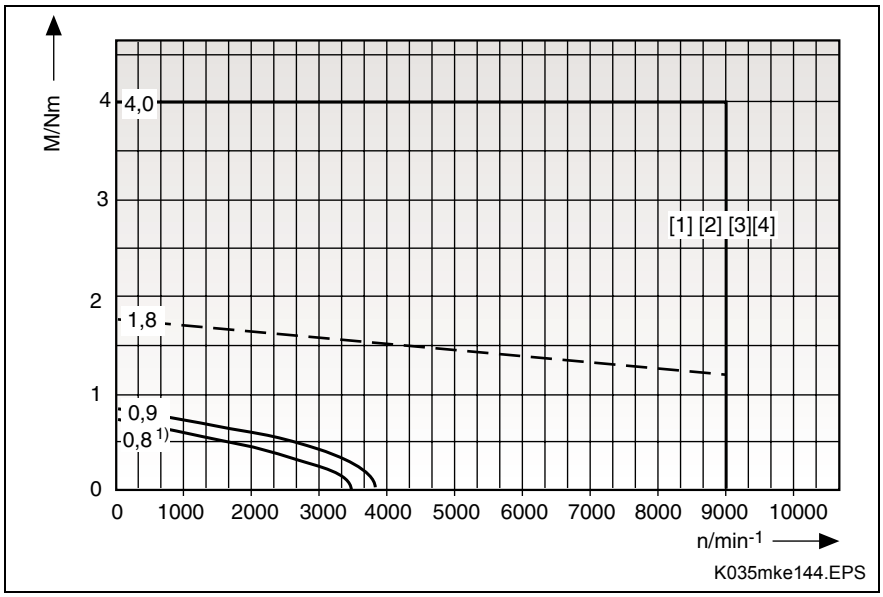
Picture 1

typecodeMKE037_M03_B.fh7

Fig. 7-4: Type code, MKE037 (page 2)

7.3 Torque-speed characteristics

For explanations, see section 12.7, “Speed and torque”.



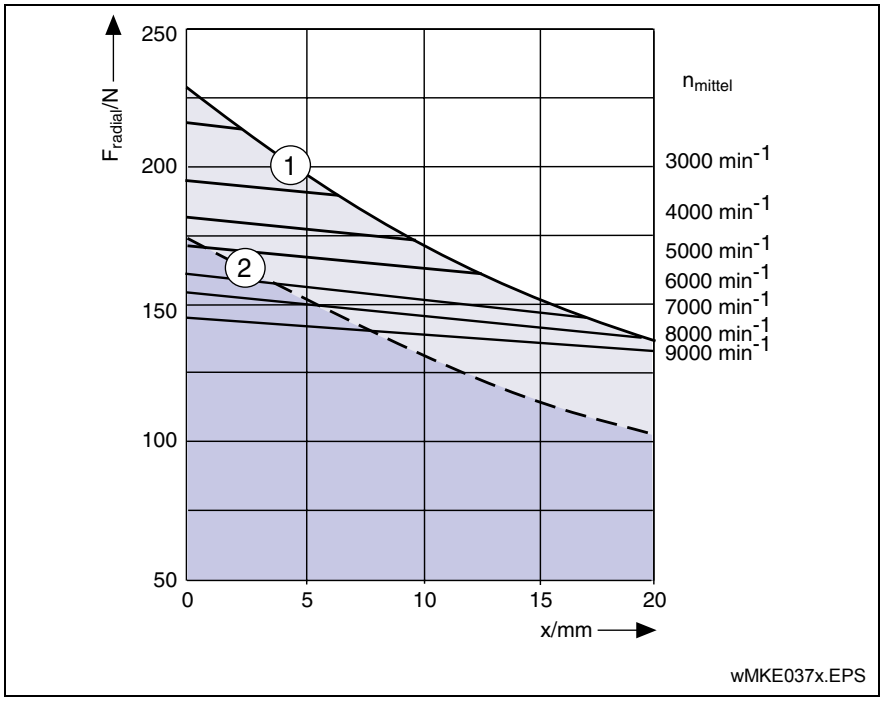
(1): for motor with holding brake

Fig. 7-5: Torque-speed characteristics , MKE037B-144

7.4 Maximum shaft load

For explanations, see section 12.6, “Shaft load and bearing lifespan”.

Maximum permitted radial force F_{radial_max} and permitted radial force F_{radial}



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

Fig. 7-6: MKE037: maximum permitted radial force F_{radial_max} and permitted radial force F_{radial}

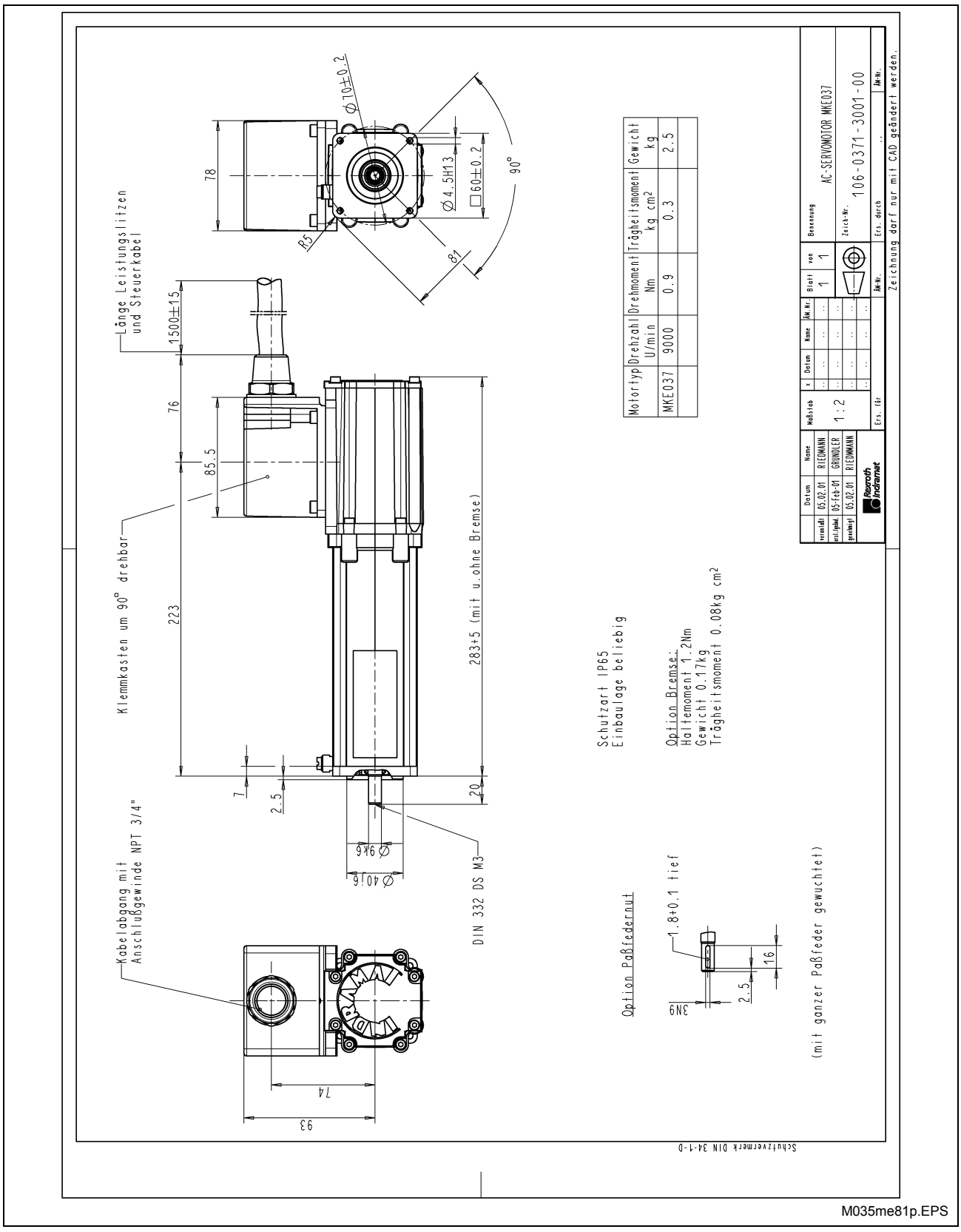
Permitted axial force F_{axial}

$$F_{axial} = 0{,}58 \cdot F_{radial}$$

F_{axial}: permitted axial force in N
F_{radial}: permitted radial force in N

Fig. 7-7: MKE037: permitted axial force

7.5 Dimensions



M035me81p.EPS

Fig. 7-8: Dimensional data, MKE037 (UL/CSA design)

Shaft end

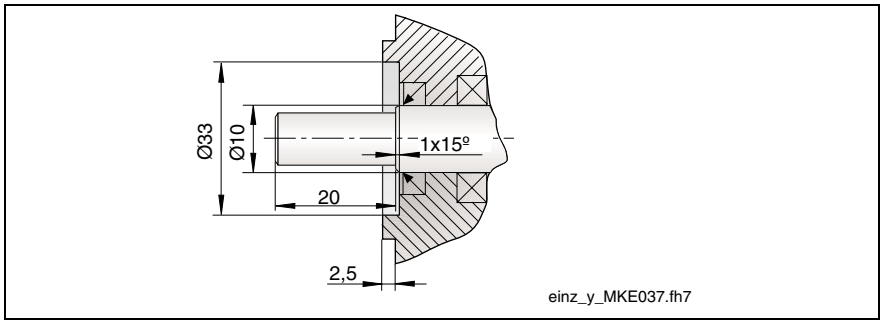


Fig. 7-9: Shaft end, MKE037

- Shaft end according to DIN 748 Part 3, Edition 07.75, IEC 60072 (1971), cylindrical.
- Center drill hole DS M3 according to DIN 332 Part 2, Edition 05.83; maximum screw tightening torque = 0.7 Nm.
- Vibration severity level N according to DIN VDE 0530 Part 14, Edition 02.93

Motor construction

- Motor construction B5 according to EN 60034-7/1993 for all mounting orientations.

Flange

- Flange according to DIN 42948, Edition 11.65
- Position accuracy of concentricity, excentricity and coaxiality to shaft according to DIN 42955, tolerance class N, Edition 12.81.

Driven shaft

- plain shaft (preferred type)

- or -

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

Note: Caution! Balanced with **entire** key!

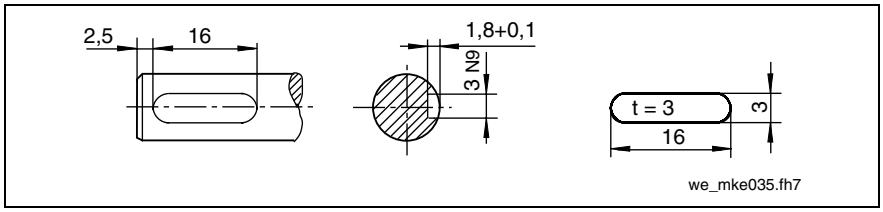


Fig. 7-10: Drive shaft with keyway, MKE037

Note: Corresponding matching key: DIN 6885-A 3 x 3 x 16; does not belong to the scope of delivery of the motor.

Options For options, see the type code / order designation

Notes

8 MKE047

8.1 Technical data

Designation	Symbol	Unit	Data
Motor type			MKE047B-144
Nominal motor speed[1)]	n_K	rpm	6000
Continuous torque at standstill	M_{dN}	Nm	2.7
Continuous current at standstill	I_{dN}	A	7.1
Theoretical maximum torque [2)]	M_{max}	Nm	11.3
Peak current	I_{max}	A	32.0
Rotor inertia[3)]	J_M	kgm²	1.7×10^{-4}
Torque constant at 20ºC	K_m	Nm/A	0.42
Voltage constant at 20ºC	$K_{E(eff)}$	V/1000 rpm	36.3
Winding resistance at 20ºC	R12	Ohm	1.8
Winding inductance at 20°C	L12	mH	5.0
Thermal time constant	T_{th}	min	30
Minimum cross-section of power wires	S	mm²	1.0
Mass [3)]	m_M	kg	5.5
Permissible ambient temperature [5)]	T_{um}	ºC	0 to +40
Permissible storage and transport temperature	T_L	ºC	-20 to +80
Maximum installation elevation[6)]	h	m	1000 above sea level
Protection class [7)]			IP 65
Insulation class according to EN 60034-1 : 1998			F
Hazard category			Class I, Groups C and D
UL listing			E203009
Housing coat			Black primary coat (RAL 9005)

1) Depending on moment required by application. For standard applications, see n_{max} in the selection lists for the motor/controller combination. For other applications, the real speed must be determined with the required torque using the torque-speed characteristics .
2) The maximum torque that can be attained depends on the drive control device used. **Only** the maximum torques M_{max} that are listed in the selection lists for the motor/control device combination are binding.
3) Without holding brake.
4) At 1000 rpm.
5) With devaiting ambient temperatures, see section 12.1.
6) With devaiting installation elevations, see section 12.1.
7) With proper mounting of power and feedback cables.

Fig. 8-1: Technical data, MKE047

Designation	Symbol	Unit	Holding brake data
Holding torque	M_4	Nm	2.2
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.34
Moment of inertia	J_B	kgm²	0.1×10^{-4}
Release delay	t_1	ms	28
Clamping delay	t_2	ms	14
Mass	m_B	kg	0.25

Fig. 8-2: Technical data, MKE047 holding brake (option)

8.2 Type code – order designation

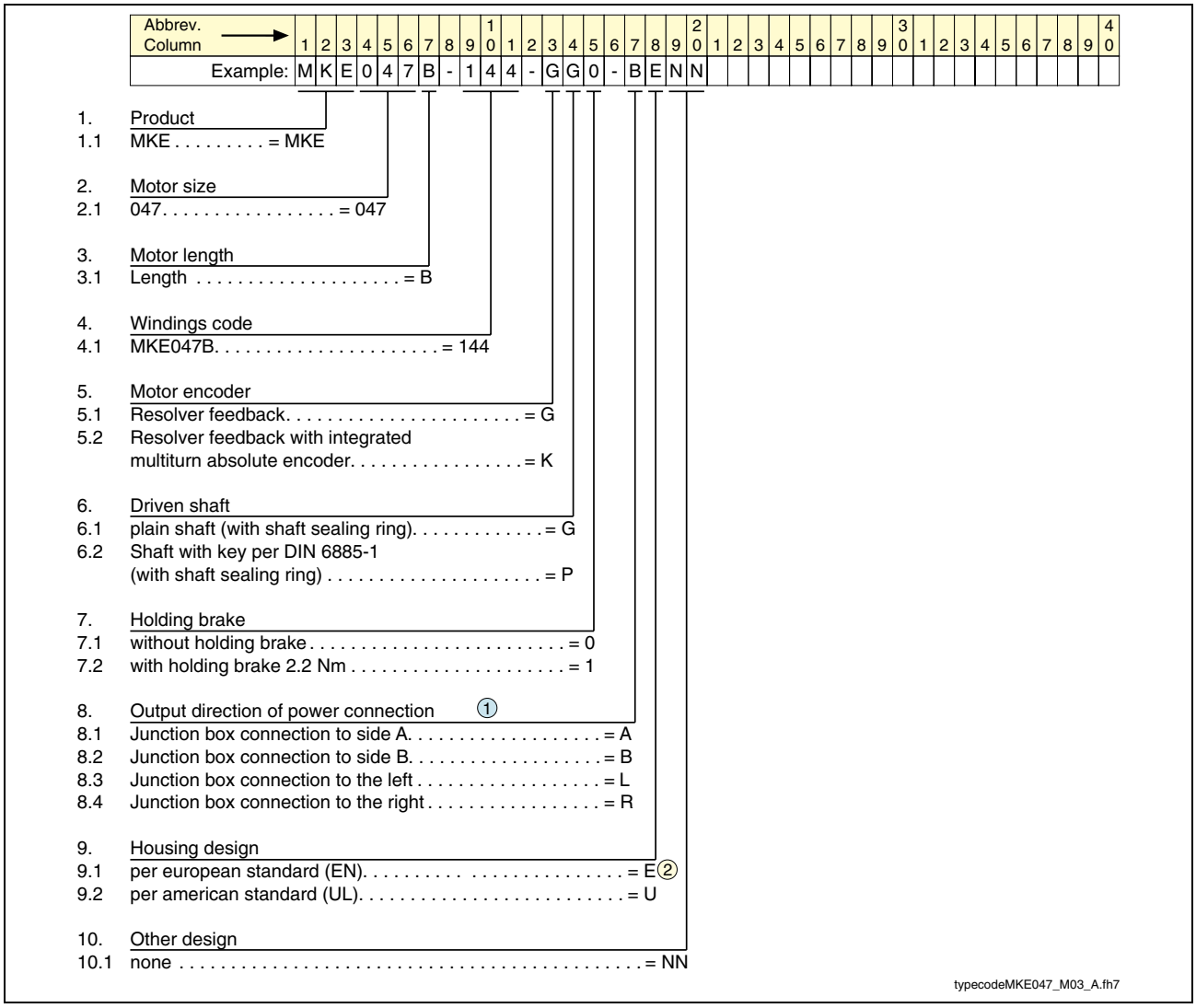


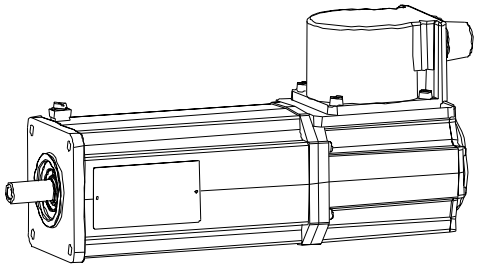
Fig. 8-3: Type code, MKE047 (page 1)

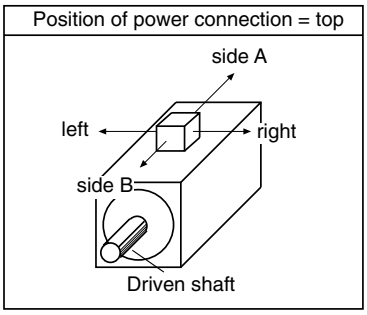
11. Standard reference

Standard	Title	Edition
DIN 6885-1	Drive Type with Fastenings without Taper Action; Parallel Keys, Keyways, Deep Pattern	1968-08
DIN EN 50014	Electrical apparatus for potentially explosive atmospheres - General requirements; Amendment AA; German version EN 50014:1997/prAA:1999	1998-02
DIN EN 50018	Electrical apparatus for potentially explosive atmospheres - Flameproof enclosures "d"; German version EN 50018:1994	1995-03
UL 508C	Power conversion equipment	1996-11
UL 674*ANSI 674	Electric motors and generators for use in division 1 hazardous (classified) locations	1994-04
UL 1446	Systems of insulating materials - General	1997-05

Note:
① Looking from front onto driven shaft (see picture 1)
② Housing design "E" is only available with output direction of power connection "B"

Illustration example: MKE047





Picture 1

typecodeMKE047_M03_B.fh7

Fig. 8-4: Type code, MKE047 (page 2)

8.3 Torque-speed characteristics

For explanations, see section 12.7, “Speed and torque”.

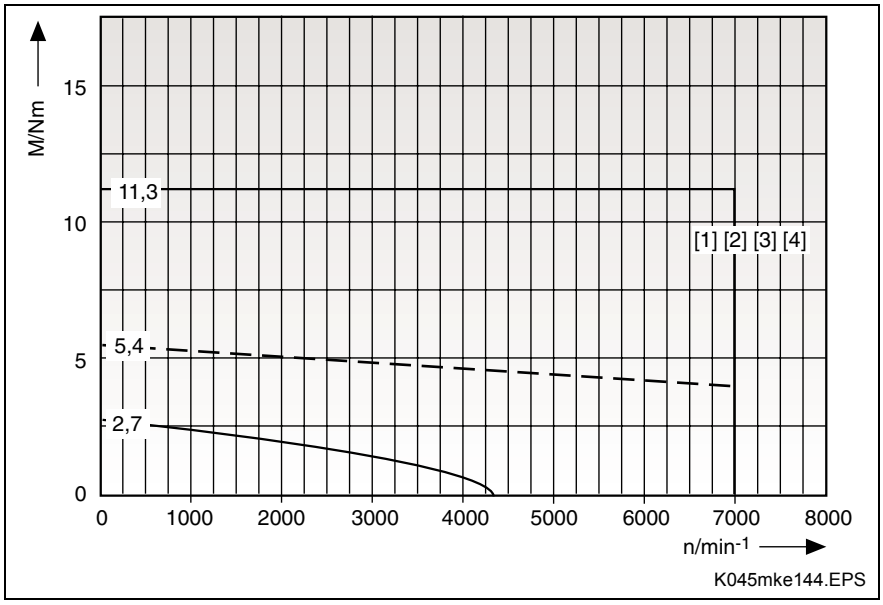
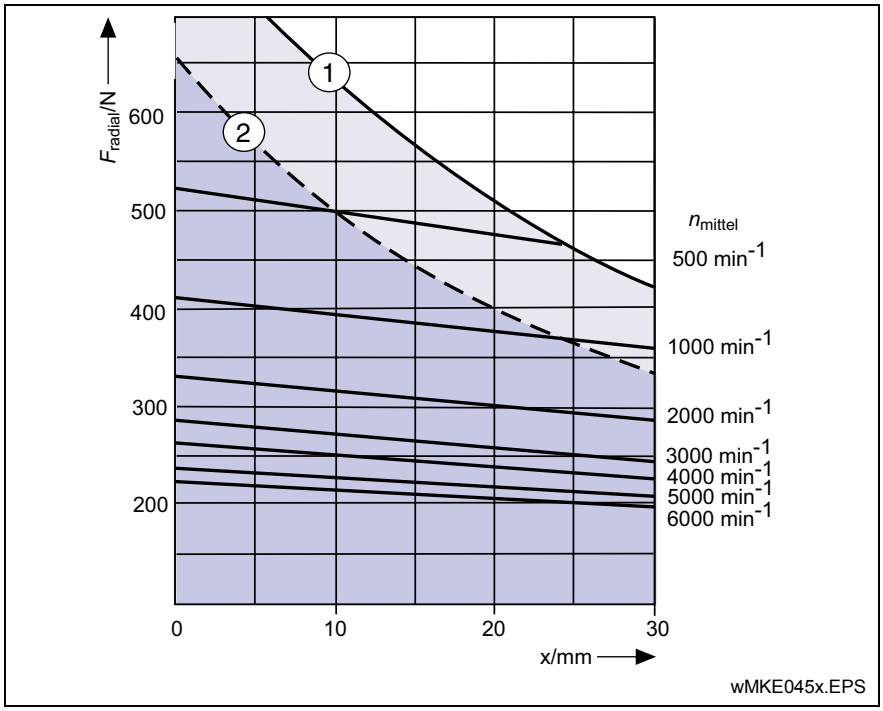


Fig. 8-5: Torque-speed characteristics , MKE047B-144

8.4 Maximum shaft load

For explanations, see section 12.6, “Shaft load and bearing lifespan”.

Maximum permitted radial force F_{radial_max} and permitted radial force F_{radial}



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

Fig. 8-6: MKE047: maximum permitted radial force F_{radial_max} and permitted radial force F_{radial}

Permitted axial force F_{axial}

$$F_{axial} = 0{,}44 \cdot F_{radial}$$

F_{axial}: permitted axial force in N
F_{radial}: permitted radial force in N

Fig. 8-7: MKE047: permitted axial force F_{axial}

8.5 Dimensions

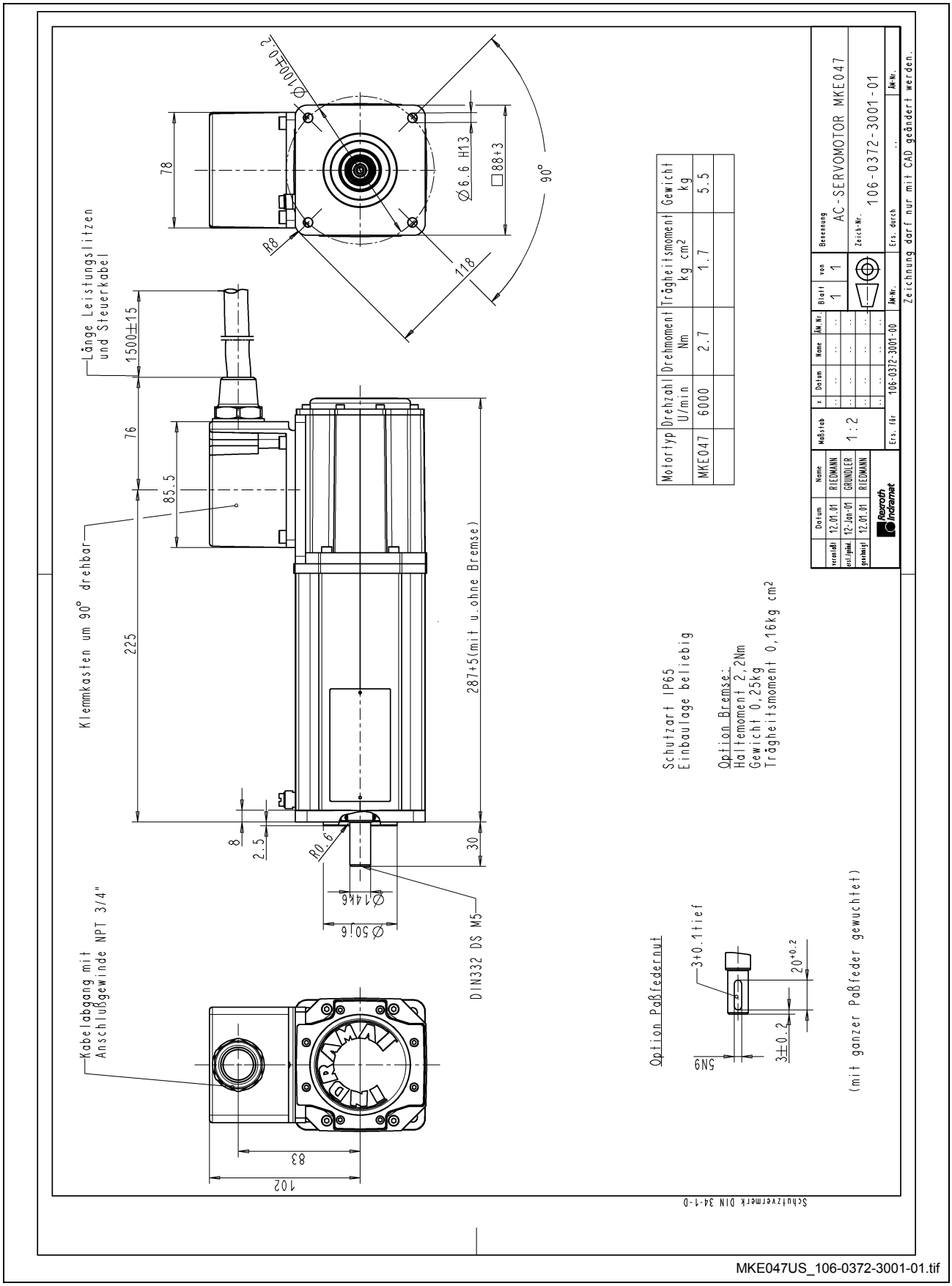


Fig. 8-8: Dimensional data, MKE047 (UL/CSA design)

Shaft end

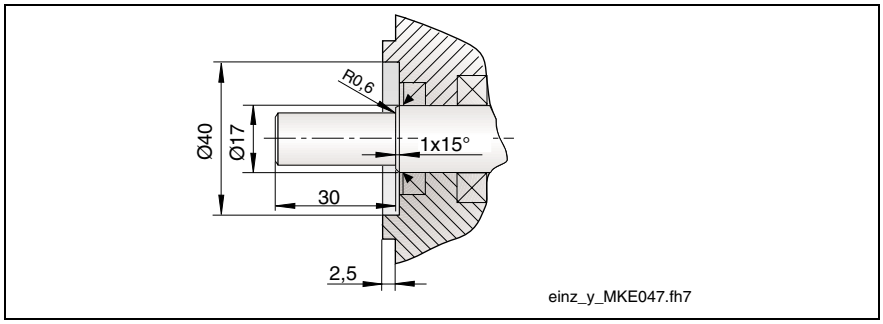


Fig. 8-9: Shaft end, MKE047

- Shaft end according to DIN 748 Part 3, Edition 07.75, IEC 60072 (1971), cylindrical.
- Center drill hole DS M5 according to DIN 332 Part 2, Edition 05.83; maximum screw tightening torque = 3.0 Nm.
- Vibration severity level N according to DIN VDE 0530 Part 14, Edition 02.93

Motor construction

- Motor construction B5 according to EN 60034-7 / 1993 for all mounting orientations.

Flange

- Flange according to DIN 42948, Edition 11.65
- Position accuracy of concentricity, excentricity and coaxiality to shaft according to DIN 42955, tolerance class N, Edition 12.81.

Driven shaft

- Plain shaft (preferred type)

- or -

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

Note: Caution! Balanced with **entire** keyway!

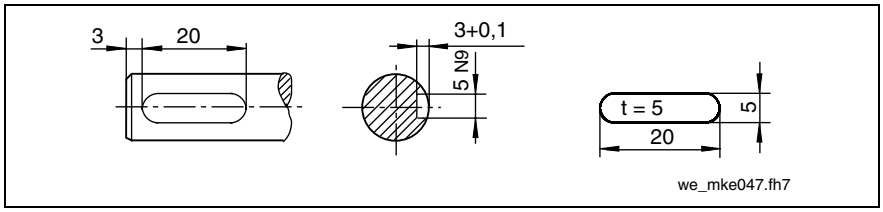


Fig. 8-10: Drive shaft with keyway, MKE047

Note: Corresponding matching key: DIN 6885-A 5 x 5 x 20; does not belong to the scope of delivery of the motor.

Options For options, see the type code / order designation

9 MKE098

9.1 Technical data

Designation	Symbol	Unit	Data
Motor type			MKE098B-047
Nominal motor speed [1]	n_K	rpm	3200
Continuous torque at standstill	M_{dN}	Nm	12.0
Continuous current at standstill	I_{dN}	A	13.9
Theoretical maximum torque [2]	M_{max}	Nm	43.5
Peak current	I_{max}	A	62.6
Rotor inertia [3]	J_M	kgm²	43.0 x 10^{-4}
Torque constant at 20ºC	K_m	Nm/A	1.0
Voltage constant at 20ºC	$K_{E(eff)}$	V/1000 rpm	91.0
Winding resistance at 20ºC	R12	Ohm	1.2
Winding inductance at 20°C	L12	mH	10.1
Thermal time constant	T_{th}	min	60
Minimum cross-section of power wires	S	mm²	1.0
Mass [3]	m_M	kg	18
Permissible ambient temperature [5]	T_{um}	ºC	0 to +40
Permissible storage and transport temperature	T_L	ºC	-20 to +80
Maximum installation elevation[6]	h	m	1000 above sea level
Protection category [7]			IP 65
Insulation class according to EN 60034-1 : 1998			F
Hazard category			Class I, Groups C and D
UL listing			E203009
Housing coat			Black primary coat (RAL 9005)

1) Depending on moment required by application. For standard applications, see n_{max} in the selection lists for the motor/controller combination. For other applications, the real speed must be determined with the required torque using the torque-speed characteristics .
2) The maximum torque that can be attained depends on the drive control device used. **Only** the maximum torques M_{max} that are listed in the selection lists for the motor/control device combination are binding.
3) Without holding brake.
4) At 1000 rpm.
5) With devating ambient temperatures, see section 12.1.
6) With devating installation elevations, see section 12.1.
7) With proper assembly of the power and feedback cables.

Fig. 9-1: Technical data, MKE098

Designation	Symbol	Unit	Holding brake data
Holding torque	M_4	Nm	11.0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.71
Moment of inertia	J_B	kgm²	3.6×10^{-4}
Release delay	t_2	ms	13
Clamping delay	t_1	ms	30
Mass	m_B	kg	1.1

Fig. 9-2: Technical data, MKE098 holding brake (option)

9.2 Type code – orderdesignation

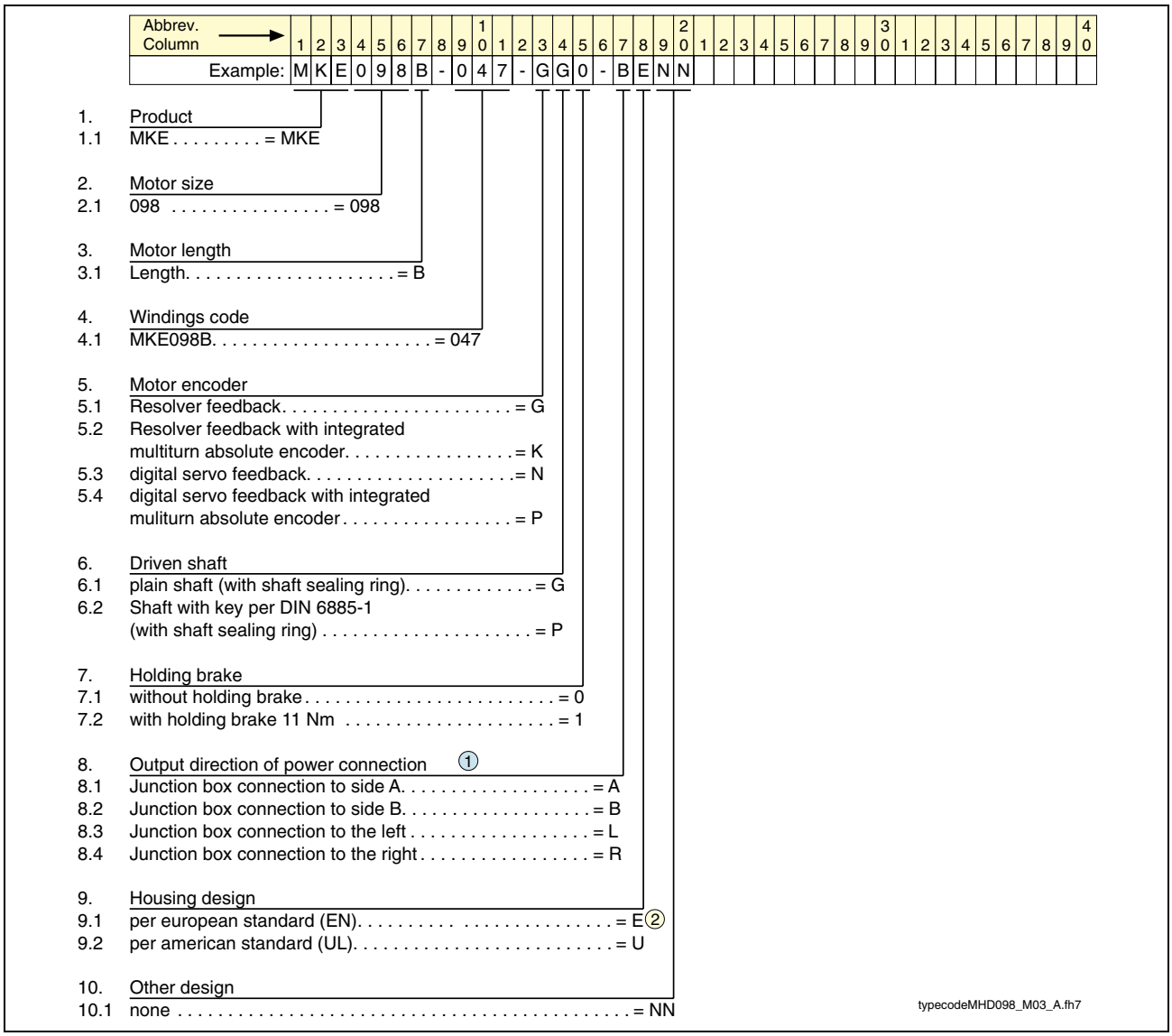


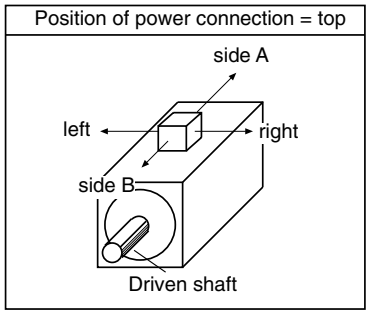
Fig. 9-3: Type code, MKE098 (page 1)

11. Standard reference

Standard	Title	Edition
DIN 6885-1	Drive Type with Fastenings without Taper Action; Parallel Keys, Keyways, Deep Pattern	1968-08
DIN EN 50014	Electrical apparatus for potentially explosive atmospheres - General requirements; Amendment AA; German version EN 50014:1997/prAA:1999	1998-02
DIN EN 50018	Electrical apparatus for potentially explosive atmospheres - Flameproof enclosures "d"; German version EN 50018:1994	1995-03
UL 508C	Power conversion equipment	1996-11
UL 674*ANSI 674	Electric motors and generators for use in division 1 hazardous (classified) locations	1994-04
UL 1446	Systems of insulating materials - General	1997-05

Note:
① Looking from front onto driven shaft (see picture 1)
② Housing design "E" is only available with output direction of power connection "B"

Illustration example: MKE098



Picture 1

typecodeMKE098_M03_B.fh7

Fig. 9-4: Type code, MKE098 (page 2)

9.3 Torque-speed characteristics

For explanations, see section 12.7, “Speed and torque”.

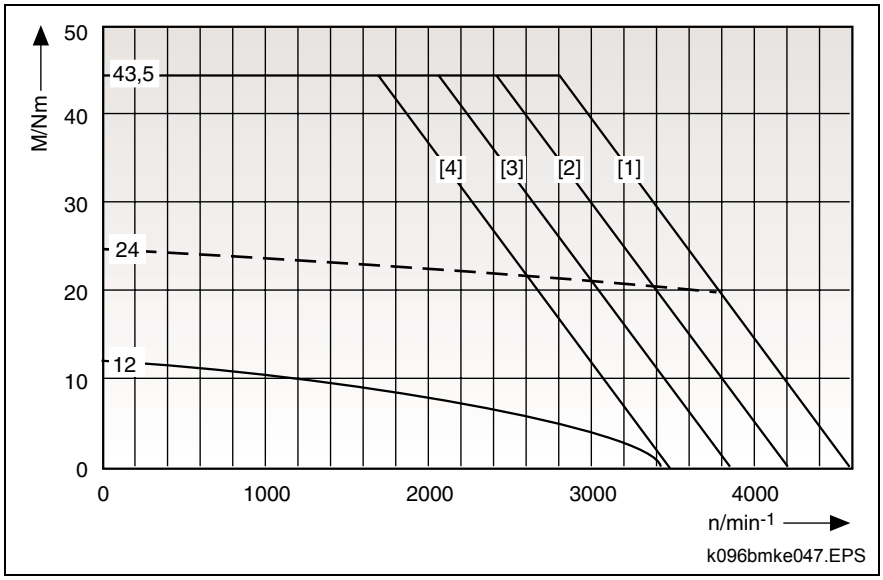
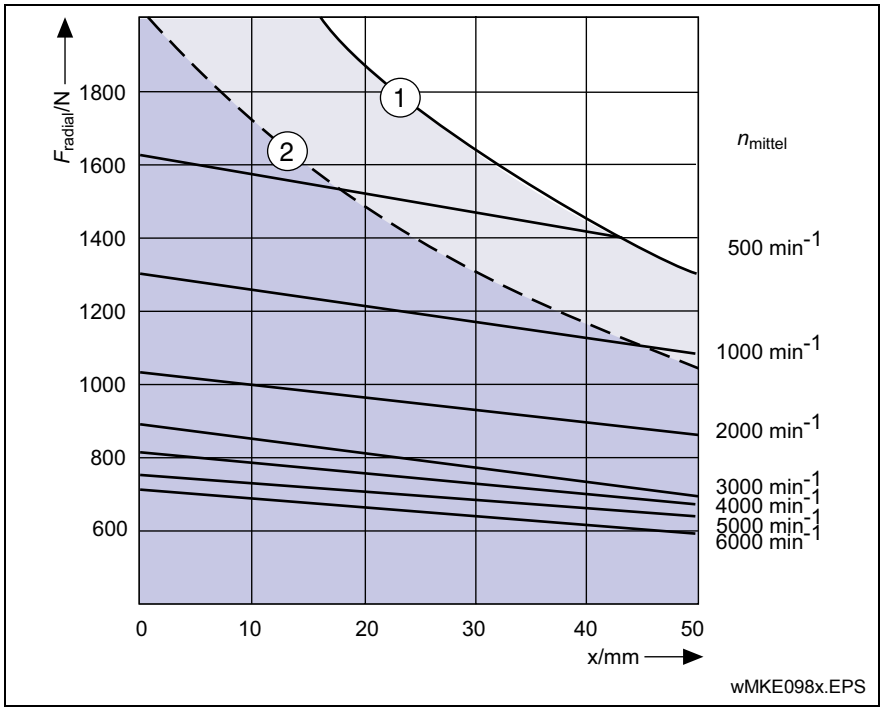


Fig. 9-5: Torque-speed characteristics , MKE098B-047

9.4 Maximum shaft load

For explanations, see section 12.6, “Shaft load and bearing lifespan”.

Maximum permitted radial force F_{radial_max} and permitted radial force F_{radial}



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

Fig. 9-6: MKE098: maximum permitted radial force F_{radial_max} and permitted radial force F_{radial}

Permitted axial force F_{axial}

$$F_{axial} = 0{,}33 \cdot F_{radial}$$

F_{axial}: permitted axial force in N
F_{radial}: permitted radial force in N

Fig. 9-7: MKE098: Permitted axial force F_{axial}

9.5 Dimensions

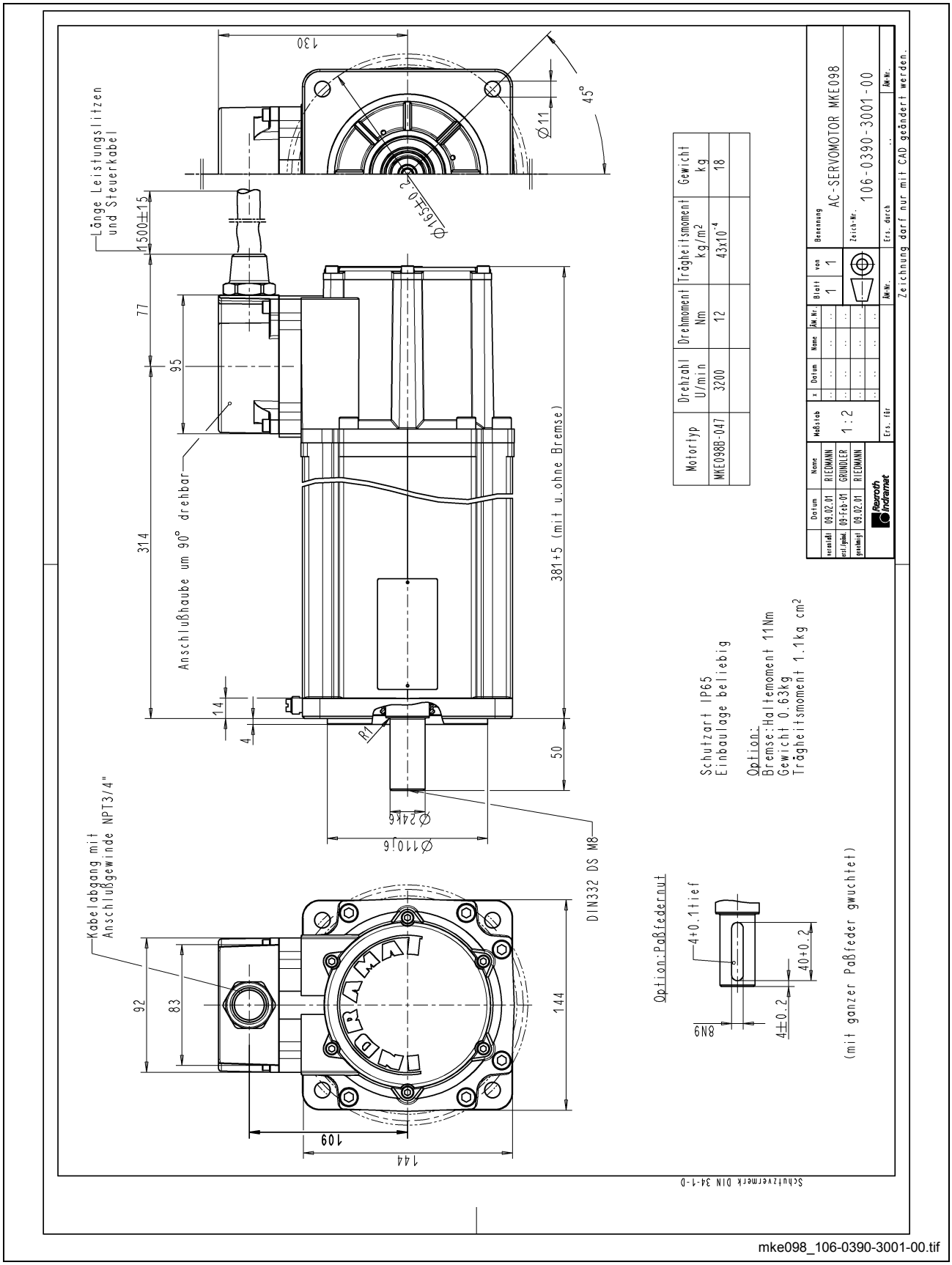


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Fig. 9-8: Dimensional data, MKE098 (UL/CSA design)

Shaft end

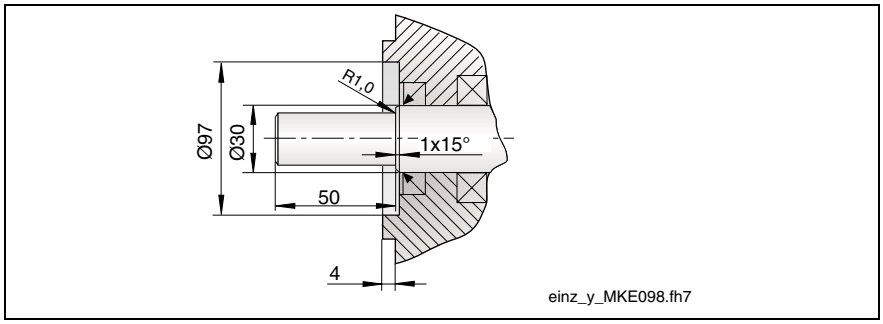


Fig. 9-9: Shaft end, MKE098

- Shaft end according to DIN 748 Part 3, Edition 07.75, IEC 60072 (1971), cylindrical.
- Centrer drill hole DS M5 according to DIN 332 Part 2, Edition 05.83; maximum screw tightening torque = 3.0 Nm.
- Vibration severity level N according to DIN VDE 0530 Part 14, Edition 02.93

Motor construction

- Motor construction B5 according to EN 60034-7 / 1993 for all mounting orientations.

Flange

- Flange according to DIN 42948, Edition 11.65
- Position accuracy of concentricity, excentricity and coaxiality to shaft according to DIN 42955, tolerance class N, Edition 12.81.

Drive shaft

- Plain shaft (preferred type)

- or -

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

Note: Caution! Balanced with **entire** key!

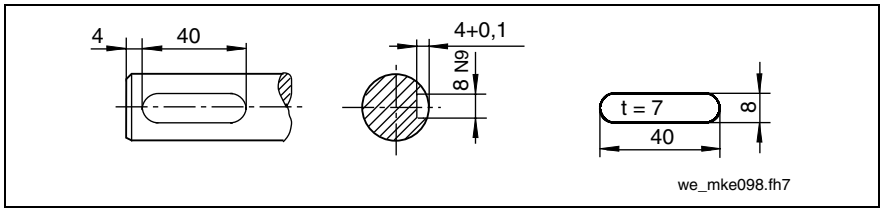


Fig. 9-10: Drive shaft with keyway, MKE098

Note: Corresponding matching key: DIN 6885-A 5 x 5 x 20; does not belong to the scope of delivery of the motor.

Options For options, see the type code / order designation

Notes

10 Accessories

10.1 Battery

Motors with the “resolver feedback with integrated multiturn absolute encoder” variant require a battery to retain the information stored in the feedback data storage when the control voltage is switched off. The batteries have a nominal lifespan of ca. 10 years.

DANGER

Danger of explosion! Danger to life, severe injury and property damage.

⇒ Exchange the battery only in a not hazardous area!

Note: Include the batteries in the maintenance plan of the system/machine.

The following table lists the order numbers of the replacement batteries for the individual motor types.

Motor type	Replacement battery order number
MKE035 and MKE045	277133
MKE096	281394

Fig. 10-1: Replacement batteries

Replacement of the batteries is described in Section 15.3 “Maintenance”.

10.2 Gearboxes

Planetary gearboxes

Planetary gearboxes of lines GTS and GTP are suitable for mounting to MKE motors.

Note: Gearboxes do not undergo an inspection for Ex protection. Rexroth Indramat does not provide any guarantee or responsibility when it supplies MKE motors with connected gearboxes. The Ex protection inspection certificates are solely for the MKE motors. All other mechanical attachments are not taken into account and require an explicit acceptance in the responsibility of the machine/system manufacturer.

In S5 operation, they are especially suitable for use in gear racks or toothed belt drives in handling systems with high velocity and accelerations (e.g. loaders, robots).

High operation reliability

- Maintenance-free operation due to use of service-life lubrication
- Use under adverse ambient conditions due to completely closed housing in protective category IP65

High level performance

- A gear-tooth system with low backlash due to gear wheel pairs.
- High torsional strength because the load is distributed over three planet pinions.
- High degree of efficiency due to the planet pinion principle.
- High dynamics due to favorable torque/inertia ratio.
- Compact construction means light weight.

Easy mounting to the machine

- Pinions and belt pulleys can be directly mounted onto the shaft because the bearing assemlby design makes high radial loads possible.
- The flange design permits drill holes in the flange as per B5 (DIN 42959 Sec. 1, ed. 08.77) with dril holes in flange.

The output elements can be mounted in two different ways:

- force-locked shaft-hub connection with a plain output shaft

- form-fitting shaft-hub connection with output shaft with keyway.

11 Electrical connections

11.1 Overview of connections

The electrical connections of MKE motors include the following components:

- a power connection includes a connection for temperature sensors and holding brake, with single-wire design
- an encoder feedback connection with a standard encoder cable design, and
- an additional external connector for a grounded conductor or for an equipotential bonding conductor (according to EN 50014: 1992).

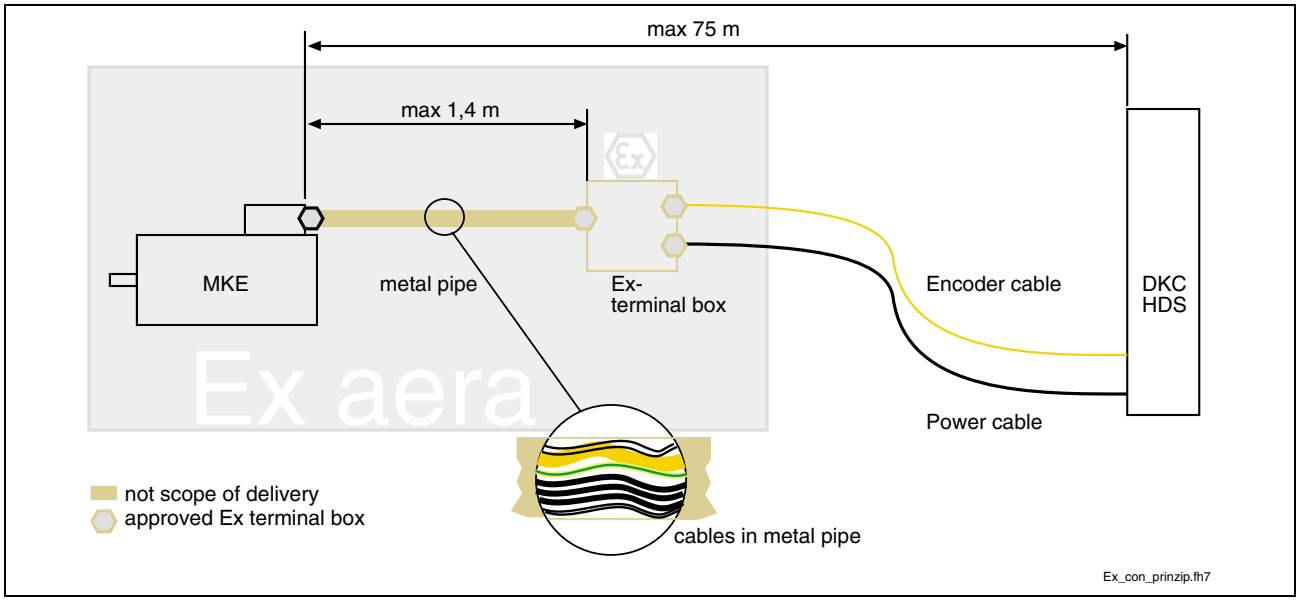


Fig. 11-1: Connection principle, MKE037 (UL/CSA design)

Power and feedback connection

The power and feedback lines of MKE-UL/CSA motors enter the motor through a special line duct. The approx. 1.5 meter long connection lines must be guided through a ¾“ metal pipe into an approved Ex terminal box; see Fig. 11.2. Standard connection lines lead from the Ex terminal box to the drive controller.

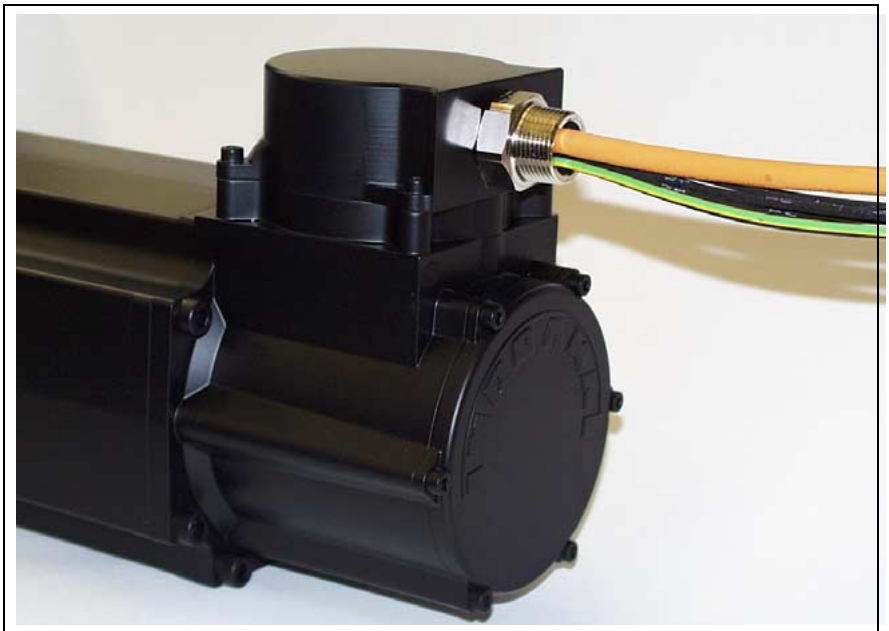

MKE_con.JPG

Fig. 11-2: Line duct

Grounded or equipotential bonding conductor

The grounded conductor is connected to MKE motors using the grounded conductor in the motor power cable: from the Ex terminal box via single wires to the motor.

An additional connection of a grounded or equipotential bonding conductor is required for MKE motors according to EN 50014: 1992. All MKE motors must be grounded via the additional connection (grounded conductor terminal on the motor flange).

Grounded terminal for	Nominal cross-section	Conductors that can be connected
MKE037B-144 MKE047B-144 MKE098B-047	2.5 mm²	2.5 mm² fine strand to 4.0 mm² single-wire

Fig. 11-3: Additional connection of a grounded conductor

11.2 Connecting MKE motors

Connection plan

Note: In each case, only the direct connection between the motor and the drive controller is shown. However, the connection schematics also apply for all other connection types (e.g. with adapter) because the assignment of the motor and drive controller connections does not change.

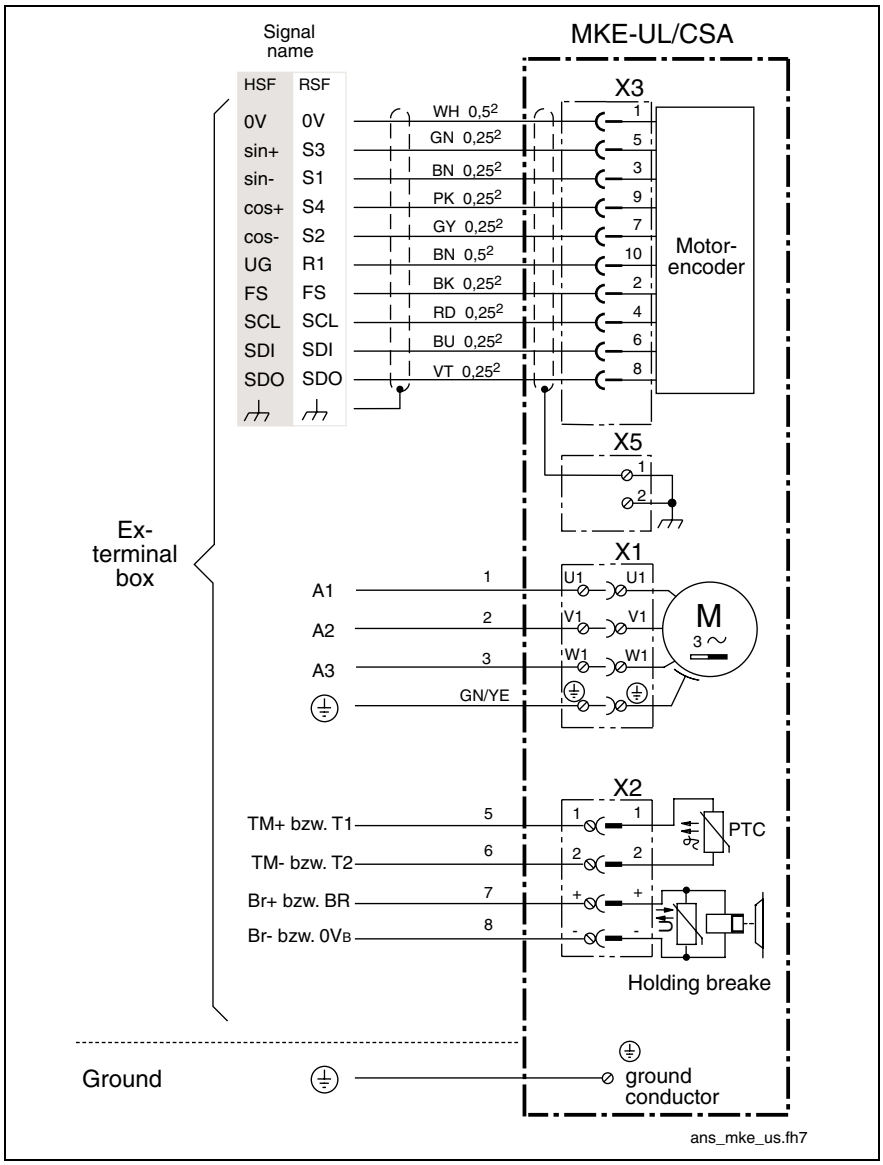


Fig. 11-4: Connection plan, MKE UL/CSA motors

Connecting the temperature monitor

When MKE motors are used in potentially explosive areas, the motor temperature monitoring must be done in conjunction with Rexroth Indramat drive controllers DKC, HDD or HDS.

The PTC resistors for the motor temperature evaluation are connected according to the appropriate wiring diagrams of the drive controllers c

Caution!

Temperature evaluation of the motors can be done only in conjunction with Rexroth Indramat drive controllers
⇒ Connectors [1] and [2] of the PTC resistor must be connected to the temperature monitor of the drive controllers [TM+ ; TM-]!

MKE motors correspond to temperature class T4 according to EN 50014 :1992 (European Standard). Therefore, the highest permitted equipment surface temperature is ≤ 135 °C. The triple PTC resistor installed in MKE motors, together with the evaluation circuit of the drive control devices, ensure a reliable and safe over-temperature switch-off.

11.3 Power cable dimensions

The cable cross-section calculations provided in the Rexroth Indramat documentation are based on effective currents and the assumption of a “turning motor”. The basis for the calculation are the continuous stall currents as provided in the Technical Data; these are given as peak values.

The relevant currents have the following relationship:

“Turning motor”

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

$I_{(cable)}$: current relevant for setting cable dimensions
$I_{dN(Motor)}$: continuous stall current for motor (peak value)

Fig. 11-5: Effective and peak values (“turning motor”)

In general, dimensioning according to the effective current with a “turning motor” is sufficient.

“Standing motor”

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

$I_{(cable)}$: current relevant for setting cable dimensions
$I_{dN(Motor)}$: continuous stall current for motor (peak value)

Fig. 11-6: Effective and peak values (“standing motor”)

In certain application cases that require a continuous stall torque at a speed of = 0 rpm from the motor over long periods of time (for guidelines, see Fig. 11-7), it is recommended that the cable dimensions be set according to the peak values (“standing motor”) in the Technical Data.

Motor type		Time interval
MKE	037	10 min
MKE	047, 098	15 min

Fig. 11-7: Time intervals

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

12 Notes Regarding Application

12.1 Conditions of use

Maximum installation elevation and ambient temperature

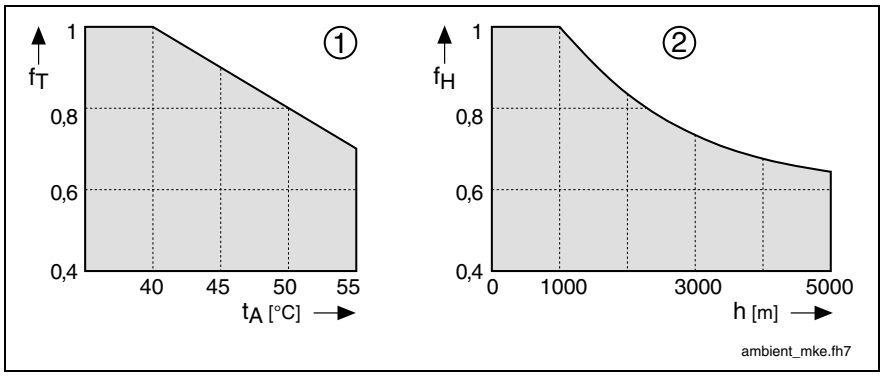
Nominal data

The power data of the motor apply :

- an ambient temperature range of 0º to +40º C
- and an installation elevation of 0 to 1000 meters above sea level

Exceeding the nominal data

If the motor is to be used above this range, then the “load factors” must be taken into consideration. This derates the output data.



(1): load fator depending on ambient temperature
(2): load factor depending on installation elevation
t_A: ambient temperature in °C
f_T: load factor for temperature
h: installation elevation in meters
f_H: load factor for installation elevation

Fig. 12-1: MKE load factors

If **either** ambient temperature **or** installation elevation exceed nominal ratings, then:

Multiply the “continuous standstill torque ” listed in the selection data with the determined load factor.

Make sure that the derated torque is not exceeded by your application.

If **both** ambient temperature **and** the installation elevation exceed nominal ratings then :

Multiply the determined load factors f_T and f_H .

Multiply the determined value by the “continuous standstill torque” of the motor indicated in the selection data.

Make sure that the derated torque is not exceeded by your application.

Vibration and shock stress

MKE motors may be used in areas with excessive vibrations and shocks such as those that typically occur during pressing, punching or press feeds, but only if shock absorbers or couplers are used. The design of such attachments must be checked for each individual application.

According to IEC 721-3-3, edition 1987 and EN 60721-3-3 edition 06/1994, MKE motors may be operated in stationary and weather-protected locations under the following conditions:

- longitudinal axis of the motor as per class 3M1
- lateral axis of the motor as per class 3M4

⇒ Make sure that, in terms of storage, transport and operation. MKE motors do not exceed values as depicted in Fig. 12-2 and Fig. 12-3.

Influencing variable	Unit	Maximum value of longitudinal axis	Maximum value in lateral axis
Amplitude of the displacement at 2 to 9 Hz	mm	0.3	3.0
Amplitude of acceleration at 9 to 200 Hz	m/s²	1	10

Fig. 12-2: Limit data for sinusoidal oscillations

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

Fig. 12-3: Limit data of shock loads

12.2 Protection class

The design of MKE motors meets the protection category requirements as described in EN 60 529: 1991

Area of motor	Protection category
Motor housing, drive shaft, power and feedback connections (only with proper mounting)	IP 65

Fig. 12-4: Protection class of MKE motors

The protection category is defined with the letters IP (International Protection) and two digits for the protection category.

The **first digit** denotes the protection level against contact and penetration of extrinsic objects

The **second digit denotes the protection level** against water.

First digit	Degree of protection
6	Protection against penetration of dust (dustproof); complete contact protection
Second digit	**Degree of protection**
5	Protection against a jet of water from a nozzle that is aimed from all directions against the housing (hoseproof)

Fig. 12-5: IP protection classes

Note: The second digit assumes the use of fresh water. If cleaning procedures with high pressure and/or solvents, cooling lubricants or creep oils are used, a higher protection class may be required.

WARNING

Danger to personnel or damage to equipment!
Due to improper power and encoder connections, persons may be endangered or the motor may be damaged!

⇒ Ensure that the power and encoder connections are connected properly.

⇒ Use the MKE motors only in environments for which the provided protection class is sufficient.

12.3 Type of construction and mounting orientation

MKE motors are supplied in construction shape B05 for flange mounting. The permitted mounting orientation according to EN 60034-7:1993 can be found in the following table.

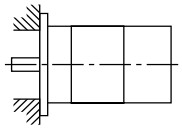
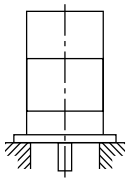
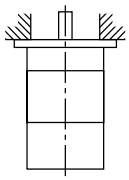
Motor construction shape:	Permitted mounting orientation		
	Designation	Diagram	Setup
B05	IM B5		Horizontal, flange connection on drive side of flange
	IM V1		Vertical, flange connection on drive side of flange, drive shaft downward
	IM V3		Vertical, flange connection on drive side of flange, drive shaft downward

Fig. 12-6: Mounting orientation

DANGER

Seeping of liquids! Motors mounted as per IM V3are are susceptible to seeping liquids that collect over extended periods at the shaft end, then penetrate the motor, causing damage.

⇒ Make sure that liquids cannot collect at the drive shaft.

Primary coat and housing finish

condition at delivery: black priming (RAL 9005)

Resistance: against weathering, yellowing, chalking, diluted acids and lyes.

An additional coat may be applied to the housing (maximum. thickness equals 40 µm).

12.4 Holding brake

Optional. Holds the servo axis when no power is being supplied to the machine.

DANGER

Falling axes! Danger to personnel. Extremities could be pinched or severed.

⇒ The holding brake itself does not guarantee personnel safety!

⇒ Ensure the personnel protection by using additional protective measures

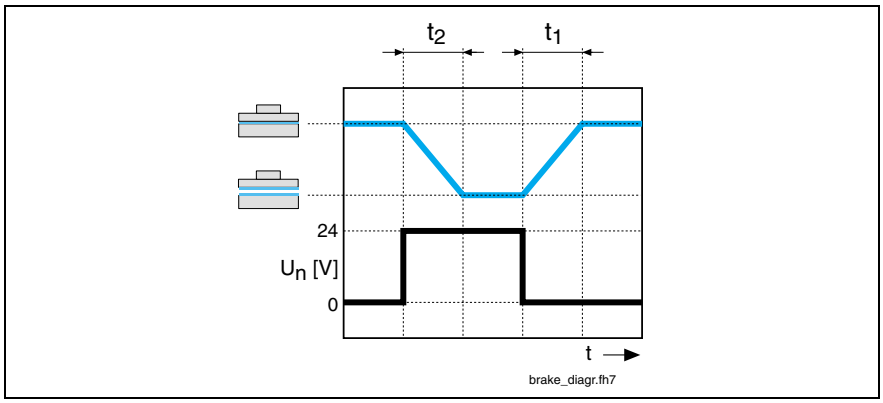
⇒ block off the hazardous area using protective bars or gratings.

⇒ in addition, secure vertical axes against falling or lowering after the motor is switched off by, for example:

- mechanically locking the vertical axis
- attaching an external braking/catching/clamping device, or
- sufficiently balancing the weight of the axis

The holding brake works according to the “electrically releasing” principle. When not under power, a magnetic force acts on the brake armature disk. As a result, the brake closes and holds the axis.

When 24 VDC is applied, the continuous magnetic field is compensated for by the electrically generated magnetic field: the brake opens.



t_1: Clamp time
t_2: Release time

Fig. 12-7: Brake operation

The brake is controlled by the drive controller. This ensures the correct sequence of switching on/off in all operating modes.

Note: Premature wear of the holding brake is possible!

The brake wears out after approx. 20,000 motor revolutions in a closed state. Therefore, do not use the brake to stop a moving axis during operation! This is permitted only for EMERGENCY STOP (E-stop) situations.

Note the guidelines regarding commissioning the brake in the “Commissioning, Operation and Maintenance” chapter.

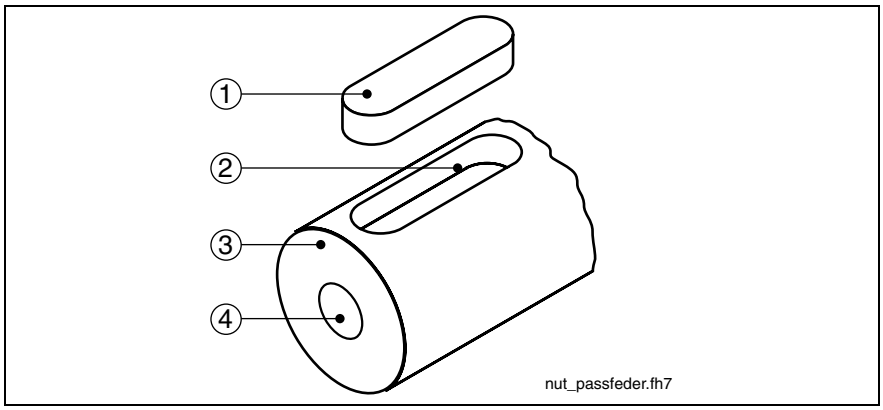
12.5 Driven shaft and motor bearing

Plain driven shaft

The recommended standard model for MKE motors provides a force-actuated, zero backlash shaft-hub connection with a high degree of quiet running. Use clamping sets, tension sleeves or other tension elements to attach the machine elements that are to be driven.

Drive shaft with keyway

The optional keyed shaft, according to DIN 6885, Sheet 1, Edition 08-1968, provides a form-fitting transmission of torque with low demands at the shaft-hub joint.



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

Fig. 12-8: MKE keyed shaft

In addition, axially securing the machine elements to be driven is required using the central bore at the shaft end.

CAUTION

Damage to the shaft! During powerful reverse operations, the bottom of the key can turn out and reduce the quality of concentricity Ever-increasing deformations can cause fractures.

⇒ Therefore, we recommend that you use plain shafts.

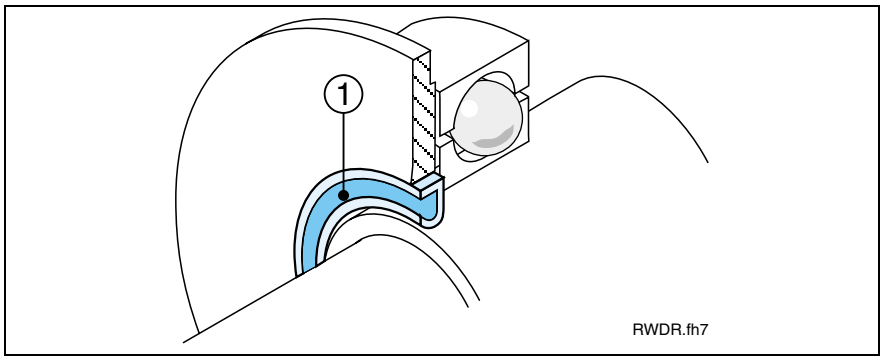
Balancing with whole key

MKE motors are balanced using **whole** keys. Therefore the machine element to be driven must be balanced without a key. The groove length in the hub is independent of the length of the key.

Modifications of keys may only be made by the user himself and is his responsibility alone. Rexroth Indramat does not assume any liability for shaft keys or motor shafts.

Drive shaft with shaft seal ring

MKE motors are equipped with radial shaft seal rings according to DIN 3760 – Design A.



(1) Radial shaft seal ring

Fig. 12-9: MKE radial shaft seal ring

Wear

Radial shaft seal rings are grinding seals. Therefore, they are fundamentally exposed to wear and generate frictional heat.

Wear effects of the grinding seal can be reduced only by sufficient lubrication and cleanliness of the area to be sealed. The lubrication is simultaneously a coolant and supports the dissipation of the frictional heat away from the sealing area.

⇒ Avoid having the area being sealed from running dry and being contaminated. Always ensure sufficient cleanliness and lubrication.

Resistance

The materials used for radial shaft sealrings have a high resistance against oils and chemicals. However, the machine manufacturer is responsible for testing the their suitability for the corresponding conditions of use.

The following material assignment applies (as of the time of printing of this document):

Motor	Seal material	Abbreviation
MKE	Viton	FPM

Fig. 12-10: MKE shaft seal ring

The complex interrelationship between the seal ring, the shaft and the liquid being sealed against, as well as the corresponding conditions of use (frictional heat, contamination, etc.) make it impossible to calculate the lifetime of the shaft seal ring. Experience has shown that, under unfavorable conditions, an increase in the failure probability can already occur after 2000 operating hours.

Vertical installation positions IM V3

Motors with a shaft seal ring have protection class IP65 on the flange. Impermeability is thus ensured only in the case of spraying liquids. Liquid levels pooling on the A side require a higher protection class. In the case of the vertical installation position (shaft pointing up) of the motor, please regard the notes in the “Structural shape and installation positions” section of this chapter.

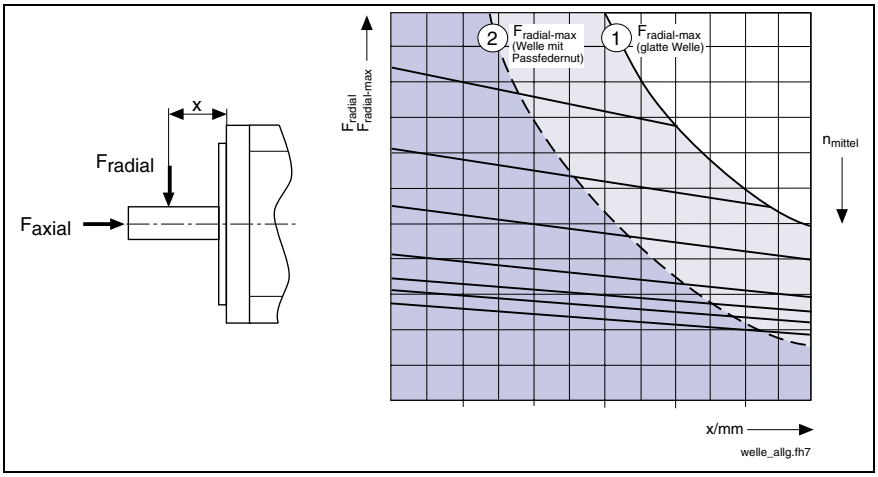
Note regarding construction

Rexroth Indramat recommends that direct contact of the drive shaft and the shaft seal ring with the processing medium (coolant lubricant, material wear) due to the machine/system construction, be avoided.

Bearing and shaft load

During operation, radial and axial forces affect the motor shaft and the motor bearing. The construction of the machine and the attachment of drive elements to the shaft must be attuned to one another in order to ensure that the provided load limits are not exceeded.

Radial load, axial load



(1): F_{radial_max} (smooth shaft)
(2): F_{radial_max} (keyed shaft)

Fig. 12-11: Example diagram of shaft load

Maximum permissible radial force F_{radial_max}

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

- shaft /force load
- distance x of the point of application of force (see Fig. 12-11)
- design of the drive shaft (plain or with keyway)

Permissible radial force F_{radial}

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

- arithmetically determined average rotational speed (n_{avg})
- distance x of the point of application of force (see Fig. 12-11)
- Bearing lifespan

Permissible axial force F_{axial}

The maximum permissible axial force F_{axial} is proportional to the radial force. The factor of proportionality factor can be found in the Technical Data, in the “Shaft load” section.

Note:

- Thermal effects can shift the flanged end of the drive shaft to the motor housing by up to 0.6 mm. If helical toothed drive pinions or bevel gear pinions are used and mounted directly to the output shaft, then these changes in the length can lead to the shifting of position of the axis, if the drive pinions are not axially fixed to the machine, or.
- a thermally dependent component of the axial force if the driving pinions are axially fixed fastened on the machine side. There is the danger, in this case, that the maximum permissible axial force can be exceeded, or that the clearance within the toothing is unacceptably increased.

  The use of drive elements with bearings which are connected to the motor shaft via an axial compensating coupling is therefore recommended

Bearing lifespan

If MKE motors are operated within the stated limits for radial and axial loads, the nominal bearing life span is:

bearing lifespan

L_{10h} = 30,000 operating hours

(calculated per ISO 281, Edition 12/1990)

Bearing lifespan otherwise drops to:

$$L10h = \left(\frac{F_{radial}}{F_{radial\_ist}} \right)^3 \cdot 30000$$

L_{10h}: bearing lifespan (according to ISO 281, Edition 12/1990)
F_{radial}: determined permissible radial force in N (Newtons)
F_{radial_act}: actual effective radial force in N (Newtons)

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

Note: The actually effective radial force F_{radial_act} may at no time exceed maximum permissible radial force F_{radial_max}.

Mounting drive elements

Mounting drive elements

When mounting drive elements to the motor shaft, do not use fixed supported bearings, but rather bearings that are simply supported. The unchanging tolerances generate additional forces to the bearings of the motor shaft and may lead to a significantly drop in service life of the bearing.

Note: If a fixed type of mounting cannot be avoided, please contact Rexroth Indramat before you proceed.

12.6 Motor feedback encoder

To regulate motor speed or to position the motor, the drive controller device requires the current position of the motor.

The integrated encoder system (motor feedback) provides the drive controller with such signals as are needed to perform this function. The drive controllers are, in turn, equipped to transmit the thereby determined position value to a superordinate CNC or PLC.

Feedback data storage

Feedback electronics are equipped with a data memory in which motor type designation, control loops and motor parameters are stored.

Rexroth Indramat intelligent digital drive controllers can read this data, thereby guaranteeing

- a quick and easy startup.
- an automatic adjustment between motor and drive controllers, avoiding any damage to the motor.

The following encoder options can be supplied with MKE motors:

Option [1)]	Encoder type	Measuring principle	System precision	Position detection type	Position resolution on motor
G	Digital resolver feedback (RSF)	Inductive	±8 angle minutes	Relative	**MKE037, 047** 3 x 2^{13} = 24,576 **MKE098** 4 x 2^{13} = 32,768 information / rotation
K	Digital resolver feedback (RSF with integrated multiturn absolute encoder)	Inductive	±8 angle minutes	Absolute (over 4096 revolutions)	
N	Digital servo feedback (HSF)	Optical	±0.5 angle minutes	Relative	**MKE098** 512 x 2^{13} = 4,194,304 information / rotation
P	Digital servo feedback (HSF with integrated multiturn absolute encoder)	Optical	±0.5 angle minutes	Absolute (over 4096 revolutions)	

1): Options N, P available only for MKE098

Fig. 12-13: MKE motor encoder

Resolver feedback (RSF)

For relative indirect position evaluation. Replaces a separate incremental encoder on the motor.

Note: Characteristics of resolver feedback: After a power failure or after the first POWER ON, the axis must always be first run to its reference point before work can begin.

⇒ When placing the reference point switches and during the referencing procedure itself, note that several zero pulses are generated by the resolver during the course of a mechanical motor revolutionThis is the result of the operating principle of the motor. Therefore, please note:

- for **MKE037** and **MKE047**: 3 zero pulses per rotation
- for **MKE098**: 4 zero pulses per rotation

⇒ For this reason, avoid transmission ratios that are too large and feed constants that are too small.

Resolver feedback (RSF) with integrated multiturn absolute encoder

For absolute indirect position detection within a range of 4096 motor revolutions. Replaces a separate absolute encoder on the motor.

Note: Due to its battery backup, the absolute axis position is retained for this encoder option even after the power has been shutdown. The batteries have a lifespan of approx. 10 years.

Digital servo feedback (HSF)

For relative indirect position detection. Replaces a separate incremental encoder on the motor.

Note: After a power failure or after the first POWER ON, the axis must always first be run to its reference point.

Digital servo feedback (HSF) with integrated multiturn absolute encoder

For absolute indirect position detection within a range of 4096 motor revolutions. Replaces a separate absolute encoder on the motor.

Note: The absolute axis position is retained for this encoder option even after power has been shut down.

12.7 Acceptance protocols, permits

UL, CSA listing

The MKE motors listed below were examined by UL (Underwriters Laboratories Inc.®).

- MKE037B
- MKE047B
- MKE098B

The motors have UL certification with file number **E203009** and are identified with the following symbol on the motor nameplate.

Fig. 12-14: UL symbol

13 Handling

13.1 Identifying the merchandise

Delivery note

One copy of the delivery note is included in the delivery. This lists all components, with their order designation and names. If the contents are contained within several packages (transport containers), this is noted on the delivery note or can be seen on the freight papers.

Barcode sticker

A barcode sticker with the following information is located on each motor package:

- type designation of motor
- customer
- delivery note number
- commission
- freight company

The barcode sticker is used for the identification of the contents during order processing.

13.2 Type plate

Motor

The motor is supplied with a type plate. This is attached to the motor housing. In addition, a second type plate is attached with double-stick tape to the original type plate on the motor housing. You can place this in an easily visible position on the machine if the original type plate on the motor is covered by part of the machine.

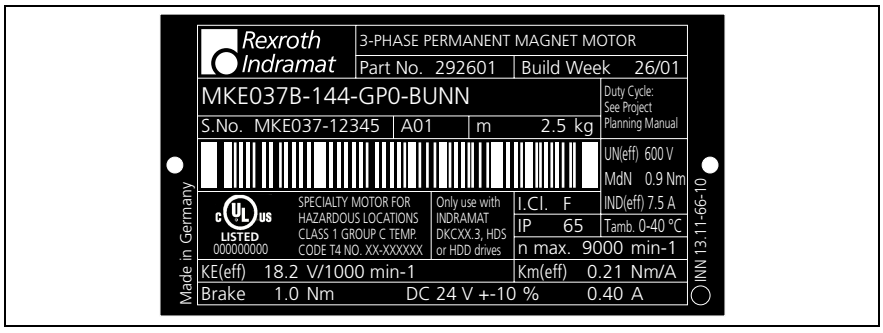


Fig. 13-1: Type plate (example)

The type plate is used for

- identification of the motor
- ordering spare parts in case of breakdowns
- service information

Note: The type designation of the motor is also stored in the encoder data memory.

Ready made cable

Rexroth Indramat ready made cables are indicated by a cable type label (attached to the end of the cable). The cable type label shows the order designation and the length of the cable.

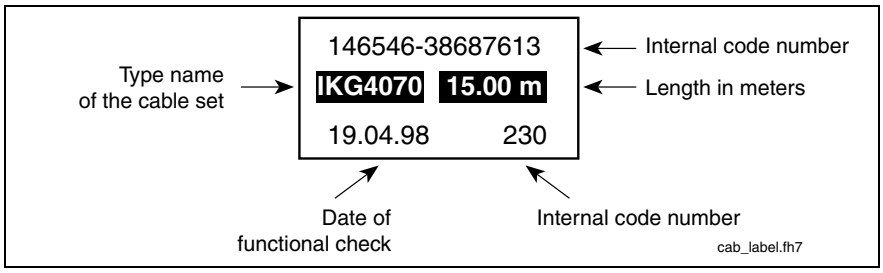


Fig. 13-2: Cable type label

Not ready made cable raw cable

The designation of the raw cable is printed on the cable sheath. To order raw cable, both the type of pipe-type cable and the desired length in meters are to be provided.

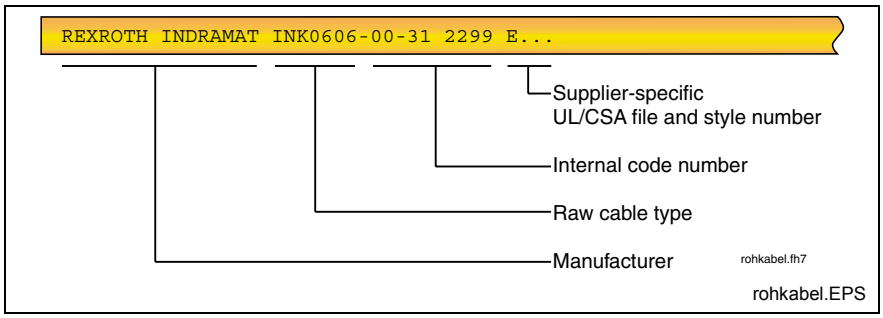


Fig. 13-3: Raw cable designation

13.3 Notes on packaging

Notes regarding the storage, transport and handling of the packages are printed on the packages. It is required that they be heeded.

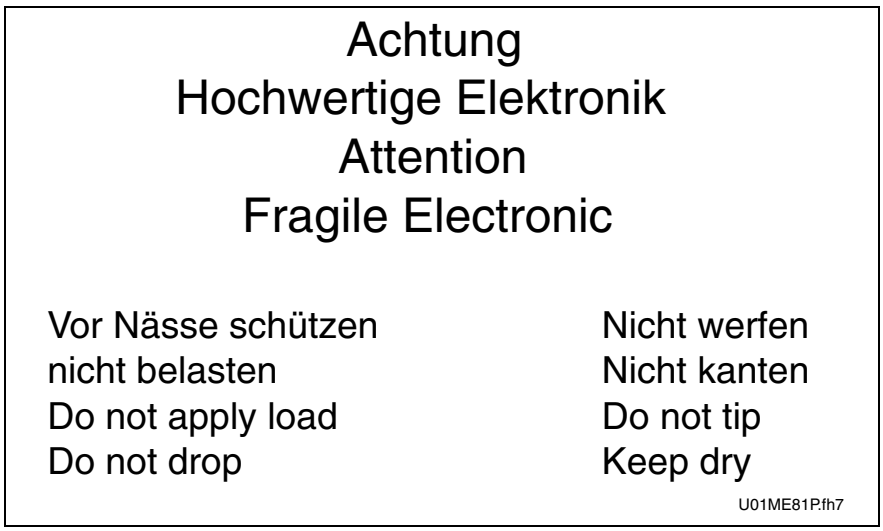


Fig. 13-4: Notes regarding storage, transport and handling on packages

13.4 Storage

WARNING

Motor damage and loss of guarantee possible!
Improper storage can damage the motor. In addition, all claims to guarantees are void.
⇒ Therefore, heed the following instructions.

During storage, maintain the following conditions:

- permitted temperature range: -20° C to +80° C.
- store the motors so that they are dry and free of dust and vibrations.
- store the motors horizontally.
- do not remove the protective plastic sleeve from the drive shaft. It protects from humidity and mechanical damage.

13.5 Transport and handling

WARNING

Motor damage and loss of guarantee possible!
Improper transport and handling can damage the motor. In addition, all claims to guarantees are void.
⇒ Therefore, heed the following instructions.

During transport and handling, maintain the following conditions:

- Use suitable means of transportation. Take into account the weight of the components (weight data can be found in the individual chapters for the motors in the Technical Data and on the type plate of the motor).
- Use shock absorbers if many vibrations can occur during transport. Also heed the limit data in Section 12.5 “Maximum vibration and shock stress”.
- Transport only in the horizontal position.
- To lift the motors, use cranes with loop lifting belts.
- Do not damage 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 assembling the motors.

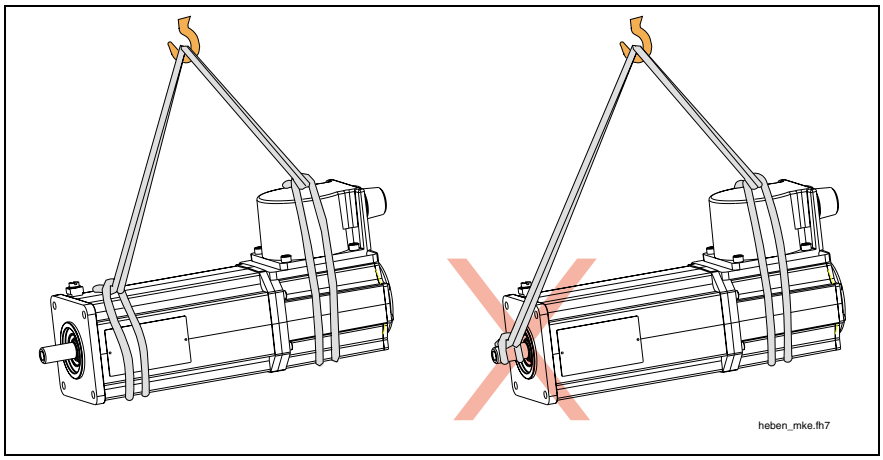
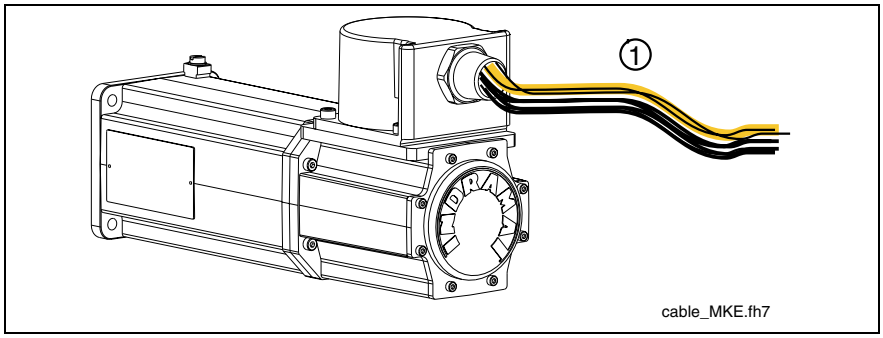


Fig. 13-5: Lifting and transporting motors using loop lifting belts

- Protect the cable connection from damage caused by compression and tension. The power wires are designed as single wires; therefore they must be handled with special care.



(1): Cable connection with single wires

Fig. 13-6: MKE cable connection

14 Mounting

14.1 Qualified personnel

Only appropriately trained qualified personnel may work on the system and the drives or in their vicinity. The system operator must ensure that all persons who carry out

- installation work
- maintenance work or
- operation duties

on the system are sufficiently familiar with the contents of this documentation, including all warnings and safety measures. Qualified personnel are trained, instructed or authorized to switch electrical circuits on/off, to ground them and to identify them according to the safety regulations. Qualified personnel possess appropriate safety equipment and are trained in First Aid.

14.2 Mounting the motor

General notes on mounting

- All warnings and notes regarding safety listed in Chapter 3 must be heeded. This minimizes the risk of accidents and prevents damage to the system or motor.
- Carry out all handling instructions with care. This ensures problem-free assembly and disassembly of the components.

MKE motors type of construction is B5 according to DIN EN 60034-7. All relevant dimensions can be found in the dimensional data sheets in Chapters 7 to 9.

Before mounting:

1. Provide tools, aids and measuring and testing equipment.
2. Check all components for cleanliness.
3. Check whether components show visible damage. Do not mount damaged components.
4. Ensure that assembly can be carried out in a dry, dust-free environment.
5. Ensure that the motor flange is free of burrs.

Resolver feedback

6. If the motor is equipped with the "resolver feedback", note when arranging the reference point switch that several zero pulses are generated by the working principle of the resolver in the course of a complete motor rotation (also see Section 5.5, “Motor feedback”).

Resolver feedback with integrated multiturn absolute encoder

7. If the motor is equipped with the "resolver feedback with integrated multiturn absolute encoder" , ensure that the battery of the feedback electronics is in proper condition. Empty or used batteries must be disposed of separately. If the battery must be replaced, proceed according to Section 15.3 “Battery exchange”.

Brake option

8. Check whether the motor brake attains the braking moment provided in the datasheet. If the brake does not attain the moment provided, first grind the brake according to Section 15.3 “Brake”. Then proceed as follows:

Mounting of MKE motors

Mounting the motor. All dimensions and tolerances on the system side must be maintained.

To fasten the flange, use of the following screws and torques is recommended.

Motor constructional size	Recommended screw size	Torque [Nm]	Minimum tightness
MKE037	M4	3.1	8.8
MKE047	M6	10.4	8.8
MKE098	M10	51	8.8

Fig. 14-1: Fastening screws

Note: If the motor is replaced, the connection lines in the terminal box lid can remain. Only the motor must be replaced and the connection plugs attached to the new motor. This ensures simple, service-friendly and fast replacement of the MKE motor!

14.3 Connecting the motor

After proper mechanical mounting, the motor can be connected.

DANGER

Danger to life and limb due to electrical power!

Work in the vicinity of parts that are under power is mortally hazardous. Therefore:

⇒ work on the electrical system may only be carried out by professional electricians. Electrician's tools are absolutely required.

⇒ before work, the system power must be switched off and the power switch must be secured against being accidentally or improperly switched back on.

⇒ before starting work, a suitable measuring device must be used to check whether parts of the system are still under residual power (e.g. due to capacitors, etc.). Wait until these have discharged.

WARNING

Injury to persons or damage to equipment possible!

Disconnecting or connecting lines that are live can cause conditions with unpredictable dangers or lead to damage to equipment. Therefore:

⇒ connect or disconnect plug connectors only when they are dry and not live.

⇒ all plug connectors must be tightly screwed in during operation of the system.

WARNING

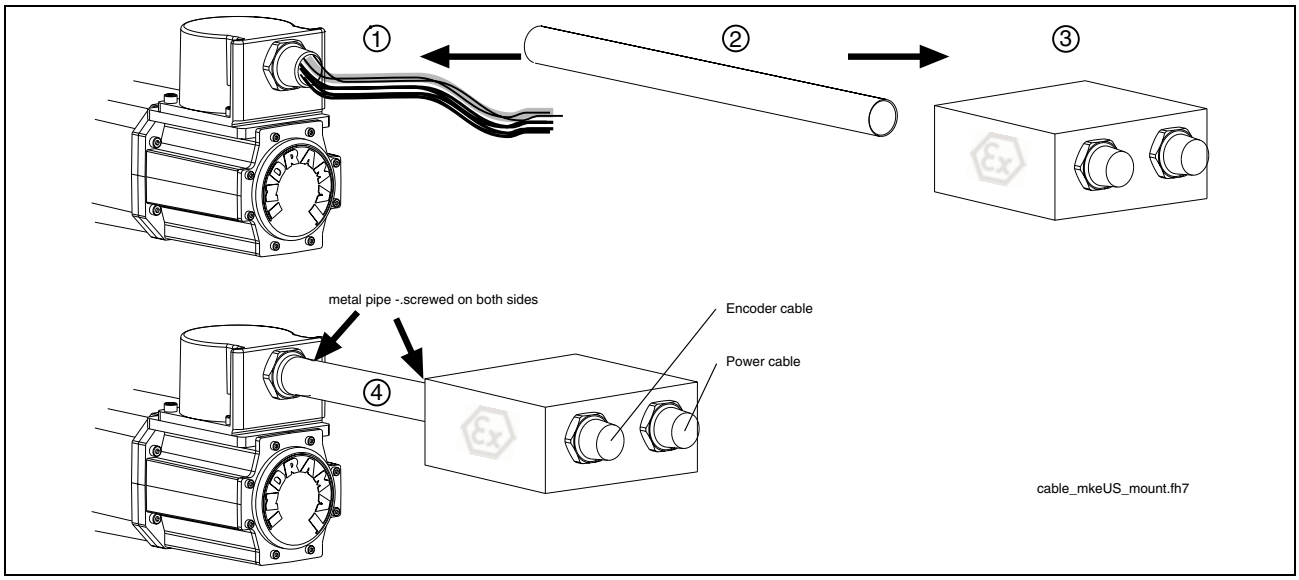
Danger of short circuits due to coolant or lubricant!

Short-circuiting lines that are live can cause conditions with unpredictable dangers or lead to damage to equipment. Therefore:

⇒ apply protective caps to the open plug locations of power plug connectors during installation or while replacing drive components if moistening by coolants or lubricants cannot be excluded.

Rexroth Indramat terminal diagrams are intended solely to generate system terminal diagrams!

- Connect the motor according to the system terminal diagram of the machine manufacturer. The relevant terminal diagram (see Section 11.2 "Terminal diagram") can be used as an aid.



(1): MKE with connection lines (single wires)
(2): NPT ¾“ steel pipe
(3): Ex terminal box
(4): Connection lines in steel pipe

Fig. 14-2 Electrical connection

Note: The components metal pipe (2) and Ex terminal box (3) are not included in the scope of delivery.

The system/machine manufacturer is responsible for maintaining the corresponding valid standards and regulations.

Provide large-scale shielding in Ex terminal boxes – see documentation DOK-GENRL*-EMV********-PRJ1-EN-P.

15 Commissioning, Operation and Maintenance

15.1 Commissioning

Proper, careful assembly and a proper electrical connection are required for commissioning.

Before commissioning

Before MKE motors are commissioned, the following must be checked/ensured:

- It must be possible to turn the runner manually when the brake is released; running noises (e.g. scraping) must not exist. If necessary, the brake must be opened by applying a 24V ±10% direct current.
- The motor must be properly assembled and aligned. The attachment of the motor flange to the machine construction / transmission must be according to the plan.
- Ensure that all electrical connections (motor and drive control device) are made according to regulations and that the screwed connections are tight.
- Ensure that the grounded conductor / protection ground is properly executed.
- Ensure that any optionally existing brake functions safely.
- Measures for protection against accidental contact must exist for parts that are under power or that move.

Commissioning

Commissioning of MKE motors is permitted only with Rexroth Indramat drive control devices. After proper connection and maintenance of the requirements mentioned above, the drive control device of the MKE motor can be put into operation.

Note: Commissioning of the drives is described in the corresponding product documentation of the drive control devices. Request the corresponding product documentation from the responsible sales branch.

15.2 Operation

During operation, make sure that the ambient conditions described in Ch. 12 “Notes Regarding Application” are maintained.

15.3 Maintenance

Cleaning

Excess dirt, dust or filings can negatively influence the functioning of the motors; in extreme cases, the motors may break down. Therefore, you should maintain the motor regularly as follows:

Radiator fins

- Clean the radiator fins of the motors in order to obtain a sufficiently large heat dissipation surface. If some of the radiator fins are covered by dirt, heat dissipation using the ambient air is no longer sufficient.

Insufficient heat dissipation can have undesired results. The bearing durability is decreased due to operation at unacceptably high temperatures (bearing lubrication decomposes). This can lead to switching off due to excess temperature, despite operation according to the selection data, because the corresponding cooler is missing.

Cable entrance

Check the cable entrance for:

- check for proper fit in the connection box lid using a torque wrench (for nominal values, see table below). tighten if necessary.

Part	Torque (nominal value)
Screwed connection M30 x 1.5	110 Nm ± 10%

Fig. 15-1: Torques of cable entrance

- Check for seal. It must be ensured that no liquid enters the interior of the motor.

Bearing

The bearings have a nominal lifetime of L10h = 30,000 h according to DIN ISO 281, Edition 1990 if the permitted radial and axial forces are not exceeded (see Section 12.6). Already insignificant overload of the bearings affects negatively the bearing lifespan.

The motor bearings should be replaced if:

- the nominal bearing lifetime has been attained,
- running noises occur

Note: We recommend that the bearing be replaced by the Rexroth Indramat service department.

Connecting cables

Check connecting cables for damage in regular intervals; replace if necessary.

Check any optional power guide chains (drag chains) that may be present for defects.

DANGER

Death by electrocution possible due to live parts with more than 50V!

⇒ Do not make any temporary repairs to connecting cables. If there is even only a small defect in the cable sleeve, the system must be shut down immediately and the cable replaced.

Check and, if necessary, replace the grounded conductor connection at regular intervals for proper condition and tight fit.

Holding brake

The holding brake function must be checked prior to motor installation. Check procedures are described in following section.

Prior to initial commissioning

Check holding torque of brake and perform grinding-in sequence if required.

Procedure:

1. Shut down motor power supply and secure the drive system against unauthorized operation.
2. When brake is locked check the effective holding torque with a torque wrench. Refer to brake data sheet for brake data.
3. If the rated holding torque is achieved then the holding brake is ready for operation.
   If the rated holding torque is **not achieved** then proceed to step 4 for grinding-in procedures.
4. **Initial grinding-in procedure**: With brake being locked turn motor shaft manually for 5 revolutions and check the effective holding torque again with the torque wrench.
5. If the rated holding torque is achieved then the holding brake is ready for operation.
   If the rated holding torque is **not achieved** then carry out steps 4. and 5. for **one more time**.

If the rated holding torque is not achieved after the second grinding-in then the holding brake is **not usable**. Contact Rexroth Indramat service.

In Operation

If the holding brake is used sporadically only (i.e. once in 48 hours or longer) a rust film could develop on the brake disk surface.

In that case additional maintenance grinding is recommended to avoid a drop of holding torque below specified values.

Maintenance Grinding	
Interval	1x in 48 hours
Motor speed during grinding	100 min^{-1}
Required grinding revolutions	1
Ambient temperatures	-20°C to +50°C

Fig. 15-2: Holding brake, maintenance grinding

Note: Rexroth Indramat drive controllers can be programmed for automatic execution of maintenance grinding. Refer to drive controller documentation for details.

Under normal conditions any additional grinding of the brake is not required. For maintaining the brake operatability under normal conditions it is sufficient to lock the brake twice (2x) a day by switching off brake supply voltage.

Battery exchange

Rexroth Indramat drive control devices reliably monitor the battery voltage and issue the warning “F248 Low battery voltage” in time.

DANGER

Danger of explosion! Death, severe injury and damage to equipment by opening the motor housing in explosion-endangered areas!

⇒ Do not unscrew the housing screws if the motor is located in an explosion-endangered area.

⇒ In order to exchange the battery, the MKE motor **must** be removed from the Ex area.

Battery exchange when control voltage is switched on

The battery should be exchanged when the control voltage is switched on. This is required to prevent data loss in the motor feedback (switching off the control voltage can lead to the loss of absolute values).

Battery exchange

Prepare the following tools and spare parts:

- Allen key for
  MKE037 size 2.5
  MKE047 size 3
  MKE098 size 4
- pointed pliers
- torque wrench with 1.3 – 6.8 Nm adjustment range
- new ready-made battery for
  MKE037 and MKE047 part No. 277 133
  MKE098 part No. 281 394

DANGER

Danger to life and limb due to electrical power!

In order to exchange the battery, work must be carried out while the control voltage is switched on. Therefore:

⇒ work on the electrical system may only be carried out by professional electricians.

⇒ switch off the power supply on the drive control devices and ensure that it cannot be accidentally switched back on!

DANGER

Dangerous movements!
Danger to life and limb, extreme injury and damage to material!

⇒ Switch off the power supply on the drive control devices and ensure that it cannot be accidentally switched back on.

⇒ Replace the battery only when the control voltage of the drive control devices is switched on. If the control voltage is switched off while the battery is removed, the dimensional references are lost and can lead to improper movements after the voltage is switched back on.

Battery removal

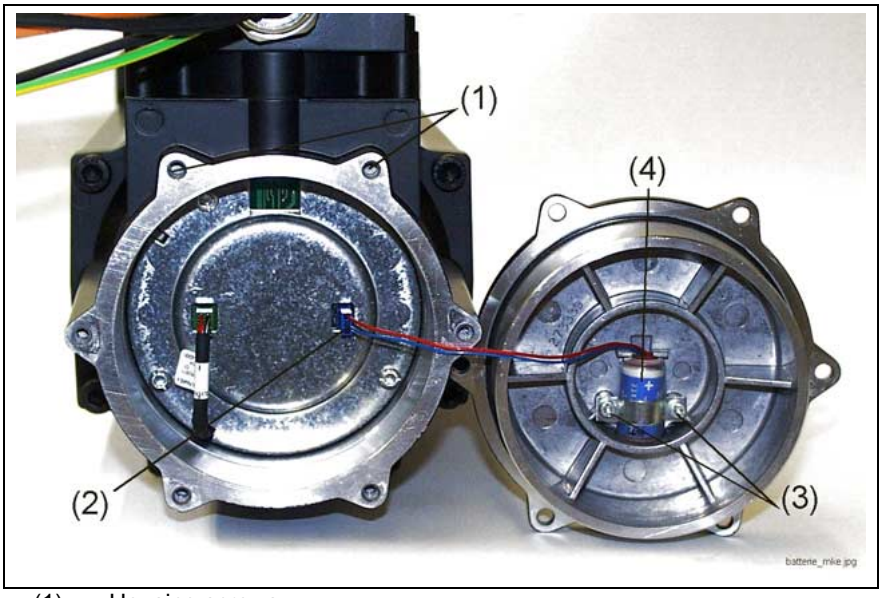
1. Unscrew the housing screws (1) with the allen key, size 2.5, 3 or 4.
2. Remove the lid of the motor feedback.
3. Remove the plug of the battery (2).
4. Unscrew the screws (3) of the battery's clamping device (4) and remove the battery.

Battery installation

6. Insert the ready-made battery corresponding to the motor type (part No. 277133 or 281394) and reattach the clamping device (3) with the screws (4) (max. torque 1.0 Nm).

Note: Do not pinch the battery cable!

7. Attach the plug of the battery (2).
8. Close the lid of the motor feedback.
9. Tighten the housing screws (1) using a torque wrench: 3.1 Nm for MKE037, 1.3 Nm for MKE047 or 6.1 Nm for MKE098.



(1): Housing screws
(2): Battery plug
(3): Battery attachment screws
(4): Battery

Fig. 15-3: Battery exchange

Switching system back on

10. Switch the power supply of the drive control device back on.
11. Carry out a test run of the axles.

Notes

16 Appendix

16.1 List of Standards

Standard	Edition	Title	Concordance
89/336/EWG	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)	
89/392/EWG 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	
DIN 332-2	1983-05	Center holes 60° with thread for shaft ends for rotating electrical machines	
DIN 42948	1965-11	Mounting flanges for rotating electrical machinery	
DIN 42955	1981-12	Tolerances of shaft extension run-out and of mounting flanges for rotating electrical machinery, test	IEC 60072 (1971)
DIN 6885-1	1968-08	Drive Type Fastenings without Taper Action; Parallel Keys, Keyways, Deep Pattern	
DIN 748-3	1975-07	Cylindrical Shaft Ends for Electrical Machines	IEC 60072(1971)
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 50014/A3; VDE 0170/0171 Teil 1/A3	1998-08	Electrical apparatus for potentially explosive atmospheres - General requirements; Amendment A3; German version EN 50014:1997/prA3:1998	EN 50014/prA3(1998-03
DIN EN 50014/AA; VDE 0170/0171 Teil 1/AA	1999-09	Electrical apparatus for potentially explosive atmospheres - General requirements; Amendment AA; German version EN 50014:1997/prAA:1999	EN 50014/prAA(1999-02
DIN EN 50015; VDE 0170/0171 Teil 2	2000-02	Electrical apparatus for potentially explosive atmospheres - Oil-immersion "o"; German version EN 50015:1998	EN 50015(1998-09)
DIN EN 50016/A1; VDE 0170/0171 Teil 3/A1	1998-09	Electrical apparatus for potentially explosive atmospheres - Pressurized apparatus "p"; Amendement A1; German version EN 50016:1995/prA1:1998	EN 50016/prA1(1998-03)
DIN EN 50016; VDE 0170/0171 Teil 3	1996-05	Electrical apparatus for potentially explosive atmospheres; Pressurized apparatus "p"; German version EN 50016:1995	EN 50016(1995-10
DIN EN 50017; VDE 0170/0171 Teil 4	2000-02	Electrical apparatus for potentially explosive atmospheres - Powder filling "q"; German version EN 50017:1998	EN 50017(1998-09)
DIN EN 50018; VDE 0170/0171 Teil 5	1995-03	Electrical apparatus for potentially explosive atmospheres - Flameproof enclosures "d"; German version EN 50018:1994	EN 50018(1994-08)
DIN EN 50019; VDE 0170/0171 Teil 6	2001-06	Electrical apparatus for potentially explosive atmospheres - Increased safety "e"; German version EN 50019:2000	EN 50019(2000-07
DIN EN 50020; VDE 0170/0171 Teil 7	1996-04	Electrical apparatus for potentially explosive atmospheres - Intrinsic safety "i"; German version EN 50020:199	EN 50020(1994-08)
DIN EN 50178; VDE 0160	1998-04	Electronic equipment for use in power installations; German version EN 50178:1997	EN 50178(1997-10)
DIN EN 60034-1; VDE 0530 Teil 1	2000-09	Rotating electrical machines - Part 1: Rating and performance (IEC 60034-1:1996, modified + A1:1997	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 EN 60034-14; VDE 0530 Teil 14	1997-09	Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heighs 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)
DIN EN 60034-7; VDE 0530 Teil 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 EN 60079-14; VDE 0165 Teil 1	1998-08	Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines) (IEC 60079-14:1996); German version EN 60079-14:1997	N 60079-14(1997-08); IEC 60079-14(1996-12)
DIN EN 60529; VDE 0470 Teil 1	2000-09	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989 + A1:1999); German version EN 60529:1991+ A1:2000	EN 60529(1991-10); EN 60529/A1(2000-02); IEC 60529(1989-11); IEC 60529 AMD 1(1999-11)
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	EN 60721-3-3(1995-01); IEC 60721-3-3(1994-12)
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 VDE 0170/0171-9	1988-07	Electrical apparatus for potentially explosive atmospheres; encapsulation "m"; german version EN 50028:1987	EN 50028(1987-02)
IEC 60072-1	1991-02	Dimensions and output series for rotating electrical machines; part 1: frame numbers 56 to 400 and flange numbers 55 to 1080	
IEC 60072-2	1990-12	Dimensions and output series for rotating electrical machines; part 2: frame numbers 355 to 1000 and flange numbers 1180 to 2360	
IEC 60072-3	1994-03	Dimensions and output series for rotating electrical machines; part 3: small built-in motors; flange numbers BF10 to BF50	
IEC 60364-4-41	1992-10	Electrical installations of buildings; part 4: protection for safety; chapter 41: protection against electric shock	
IEC 60364-4-41 AMD1	1996-02	Electrical installations of buildings; part 4: protection for safety; chapter 41: protection against electric shock; Amendment 1	
IEC 721-1		replaced by DIN IEC 60721-1	
IEC 721-3-3		replaced by DIN IEC 60721-3-3	
UL 1446	1997-05	Systems of insulating materials - General	
UL 508C	1996-11	Power conversion equipment	
UL 674*ANSI 674	1994-04	Electric motors and generators for use in divisions 1 harzardous (classified) locations	

Fig. 16-1: List of standards

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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

- telefonisch: **+49 (0) 9352 40 50 60**
  über Service Call Entry Center Mo-Fr 07:00-18:00
- per Fax: **+49 (0) 9352 40 49 41**
- per e-Mail: **service@indramat.de**

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

- by phone: **+49 (0) 9352 40 50 60**
  via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm
- by fax: **+49 (0) 9352 40 49 41**
- by e-mail: **service@indramat.de**

18.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

+49 (0) 171 333 88 26
oder **+49 (0) 172 660 04 06**

After helpdesk hours, contact our service department directly at

+49 (0) 171 333 88 26
or **+49 (0) 172 660 04 06**

18.3 Internet

Ergänzende Hinweise zu Service, Reparatur und Training sowie die **aktuellen** Adressen unserer Service- und Vertriebsbüros finden Sie unter **www.indramat.de** – einige Angaben in dieser Dokumentation können inzwischen überholt sein.

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit Ihrem lokalen Ansprechpartner auf.

☐ Verkaufsniederlassungen
☐ Niederlassungen mit Kundendienst

Additional notes about service, repairs and training as well as the **actual** addresses of our sales- and service facilities are available on the Internet at **www.indramat.de** – some information in this documentation may meanwhile be obsolete.

Please contact the sales & service offices in your area first.

☐ sales agencies
☐ offices providing service

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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from abroad: don't dial (0) after country code!

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Rexroth Indramat GmbH Bgm.-Dr.-Nebel-Str. 2 97816 Lohr am Main **Kompetenz-Zentrum Europa** Tel.: +49 (0)9352 40-0 Fax: +49 (0)9352 40-4885	**Tel. +49 (0) 9352 40 50 60** service@indramat.de	**Tel.: +49 (0)172 660 04 06** **oder / or** **Tel.: +49 (0)171 333 88 26**	**Tel. +49 (0) 9352 40 42 22**
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R911292555

Printed in Germany
DOK-MOTOR*-MKE*UL/CSA*-PR01-EN-P