KENDRION

KENDRION INDUSTRIAL BRAKES

Slim Line

Spring-applied single-face brake

Operating Instructions 76 13105C0.

Types: 76 13105C00 76 13105C05 76 13105C06
76 13105C07

PRECISION. SAFETY. MOTION.

Contents

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1. General

1.1 Introduction

These operating instructions describe the operating principle and features of spring-applied single-face brake types 76 13105C0.. The safety information provided in this manual must be strictly observed during the set-up of the machine (e.g. motor) and during the start-up, operation and maintenance of the spring-applied single-face brake.

Should any queries arise with respect to torques, torque variations, installation position, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion (Villingen) and ask for clarification before starting to use the brake. Spring-applied single-face brakes are not ready-to-use devices, but are intended to be incorporated into or assembled with other equipment. Consequently, they will be referred to as **components** in the following sections.

1.2 Standards and directives

The state-of-the-art brakes have been designed, built and tested in accordance with the requirements of DIN VDE 0580 concerning electromagnetic devices and components.

Being classified as "electromagnetic components", spring-applied brakes are also subject to the Low Voltage Directive 2014/35/EU. The user is required to employ suitable switching devices and controls to ensure use of the brakes in accordance with EMC Directive 2014/30/EU.

1.3 Declaration of Incorporation (in accordance with Annex II, part 1, Section B of Machinery Directive 2006/42/EC)

We hereby declare that the products below comply with the essential health and safety requirements specified in Annex I of Machinery Directive 2006/42/EC:

Annex I General Principles and Sections 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.5.1

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Machinery Directive 2006/42/EC. The relevant technical documentation required for the partly completed machinery has been compiled in accordance with Annex VII, part B of Machinery Directive 2006/42/EC. The manufacturer undertakes to submit an electronic copy of the relevant technical documentation compiled for the partly completed machinery if reasonably requested by national authorities.

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Applied harmonized standards and other technical standards and regulations:
EN 60529 Enclosure protection ratings
DIN VDE 0580 Electromagnetic devices and components

Product: Electromagnetically released spring-applied single-face brake

Types: 76 13105C00 76 13105C05 76 13105C06 76 13105C07

Kendrion (Villingen) GmbH Villingen 13/03/2020 Authorized signatory: ..... D. Hettich .....
Dominik Hettich
(Head of Development)

1.4 EU Declaration of Conformity

This Declaration of Conformity applies to products that have a CE mark on their rating plate.

We hereby declare that the products below, specifically the product versions brought into circulation, have been designed and built in accordance with the requirements of Directives 2014/35/EU (Low Voltage Directive) and 2011/65/EU (RoHS Directive). The products are classified as category 11 equipment subject to Directive 2011/65/EU (RoHS Directive). This declaration will cease to be valid if modifications are made to the product without prior permission from the manufacturer.

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Dominik Hettich
(Head of Development)

1.5 Manufacturer's liability

The manufacturer will not assume any responsibility for damage caused by failure to use the products in accordance with their intended use or by failure to observe safety information and other instructions provided in this manual. The information in this manual was correct and up-to-date before going to print. The information contained herein shall not entitle users to raise claims with respect to components purchased at an earlier date.

2. Product description

2.1 Operating principle

The spring-applied single-face brake is designed to operate dry. The force generated by an electromagnetic field is utilized to overcome the braking effect produced by the spring force. The spring-applied single-face brake engages in unpowered condition and releases when DC voltage is applied to the field coil. The force-locked frictional connection between the fan (acting as frictional element) and machine shaft (e.g. motor shaft) ensures that the torque generated by the spring-applied brake (brake torque) is reliably transmitted to the machine (motor).

2.2 Brake design

The solenoid housing (1.1) of the spring-applied single-face brake accommodates the loosely fitted field coil (1.2) and half-wave rectifier (5). The silicone-free coil leads of the rectifier exit on the rear side of the brake. The solenoid housing also includes the pressed-in flanged bushing (3). The compression springs (4) located in the former of the field coil (1.2) press the armature (2) against the fan (10) to generate the braking effect of the spring-applied brake. Pins are extruded onto the former of the field coil (1.2) to secure the armature (2) in its position. The fan (10) and shaft (12) are fitted together to achieve a press fit (interference fit). The core assembly of the spring-applied single-face brake – i.e. solenoid housing (1.1), field coil (1.2) and flanged bushing (3) – must be mounted on the shaft (12) in such a way that it can be moved by a maximum of 0.5 mm. The compression spring (6) with spacer disc (5) maintains the required distance between the fan (10) and the core assembly of the spring-applied single-face brake. This ensures zero residual torque during horizontal or vertical brake operation. The anti-rotation lock (7) and fixed pin (13) stabilize the generated torque.

When DC voltage is applied to the field coil (1.2) of the spring-applied single-face brake, the force of the electromagnetic field thus generated counteracts the spring force. The armature (2) is released and the braking action is neutralized. The shaft (12) to be braked is exposed to an axial force exerted by the brake.

List of reference numerals in Fig. 6/1:			
1.1	Solenoid housing	7	Anti-rotation lock
1.2	Field coil	8	Rating plate
2	Armature	9	Bushing
3	Flanged bushing	10	Fan
4	Compression spring (for brake torque)	11	Mounting clamp
5	Spacer disc	12	Shaft
6	Compression spring	13	Pin

Table 5/1: List of reference numerals for spring-applied single-disc brake

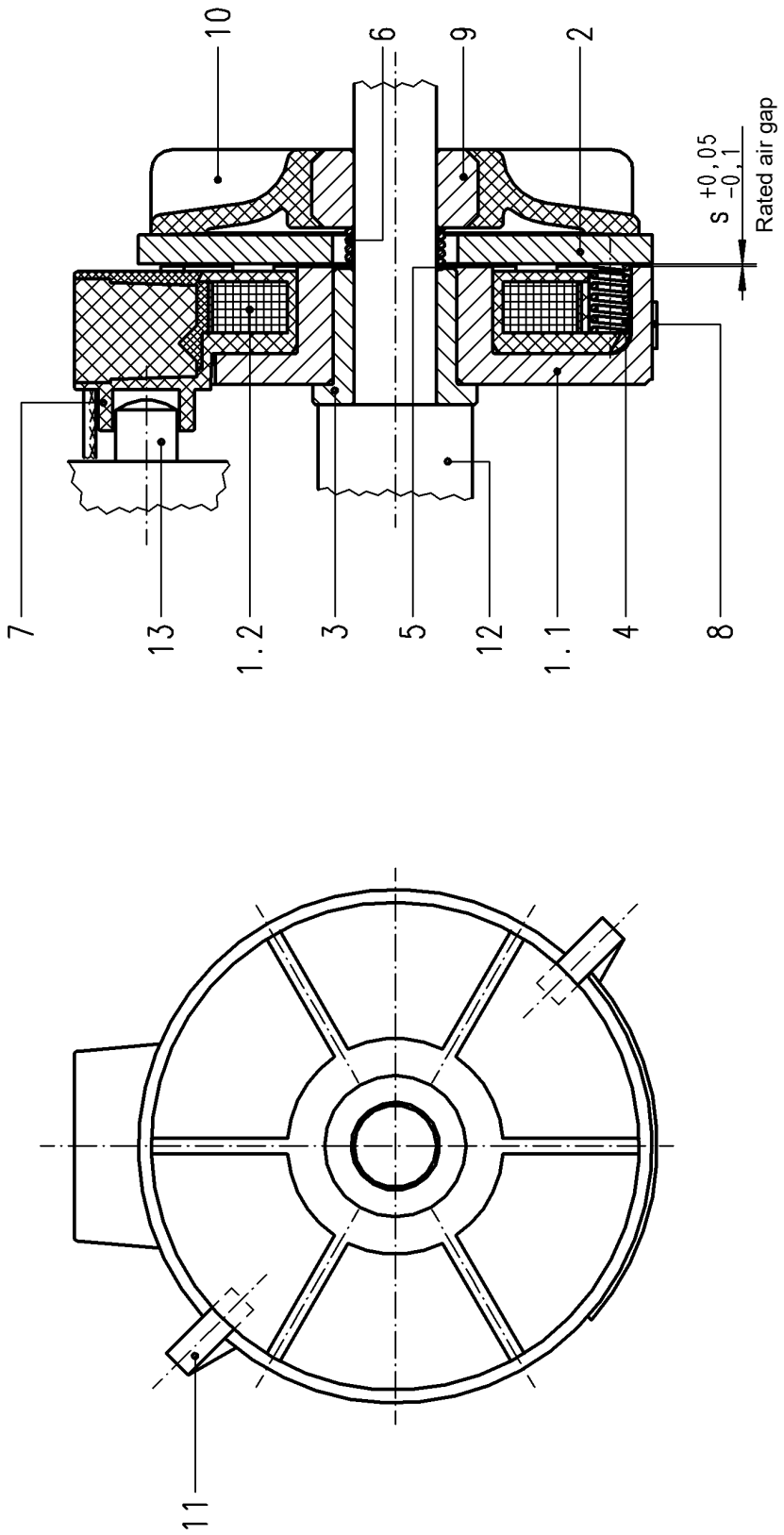


Fig. 6/1: Spring-applied single-face brake 76 13105C0.

3. Installation

3.1 Mechanical installation

Slide the complete coil system of the spring-applied single-face brake – i.e. solenoid housing (1.1), field coil (1.2) and flanged bushing (3) – onto the shaft (12) up to the limit stop. A fixed pin (13) projects into the long hole of the anti-rotation lock (7) to act as a torque arm for the coil system of the spring-applied single-face brake. Make sure that the pin (13) has hardly any play in the anti-rotation lock (7). Install the compression springs (4), armature (2), spacer disc (5) (raw side towards spring) and compression spring (6). Energize the field coil (1.2) (making sure that the armature is in contact with the pole faces). Push the fan (10) onto the shaft (12) by means of a mounting sleeve. Ensure that the mounting sleeve is in contact with the bushing (9) and not with the fan (10). Position the bushing (9) in such a way that the rated air gap 's' (see Table 23/1 “Technical specifications”) between the armature (2) and external pole of the solenoid housing (1.1) is achieved. The maximum slip-on force is 3500 N. Any mounting device used for these operations should be designed to ensure precise axial positioning of the fan (11) (e.g. by means of a threaded spindle).

Attention!

The brake owner has to ensure a correct interference fit of the fan (10) to the machine shaft (12) (e.g. motor shaft). This is crucial to achieve reliable transmission of the generated brake torque to the machine shaft (12) (e.g. motor shaft).

Note!

The air gap must not be larger or smaller than the rated air gap 's' (see Table 23/1 “Technical specifications”). The assembled brake components, especially the friction surface, must be free of oil and grease.

3.2 Electrical connection and operation

3.2.1 Electrical connection of components without integrated rectifier

The spring-applied single-disc brake must be connected to a DC power source. The supply voltage can be rectified by means of a bridge rectifier or half-wave rectifier or by using a combination of the two rectifier types. Various rectifier versions are available (see examples in Table 8/1) to allow the brake to be connected directly to an AC power source. Depending on the brake size and torque, voltage ripple due to intermittent power supply may cause brake humming or incorrect brake operation. Perfect brake operation must be ensured by the user or system manufacturer by providing suitable electrical controls.

Rectifier series	Rectifier type	Rated input voltage range U_1/VAC (40-60 Hz)	Output voltage U_2/VDC	Max. output current R-load I/ADC	Max. output current L-load I/ADC
32 07.22B.0	half-wave	0-500 (±10%)	$U_1 \bullet 0.445$	1.6	2.0
32 07.23B.0	bridge	0-400 (±10%)	$U_1 \bullet 0.890$	1.6	2.0
The relevant rectifier specification sheets must be observed!					

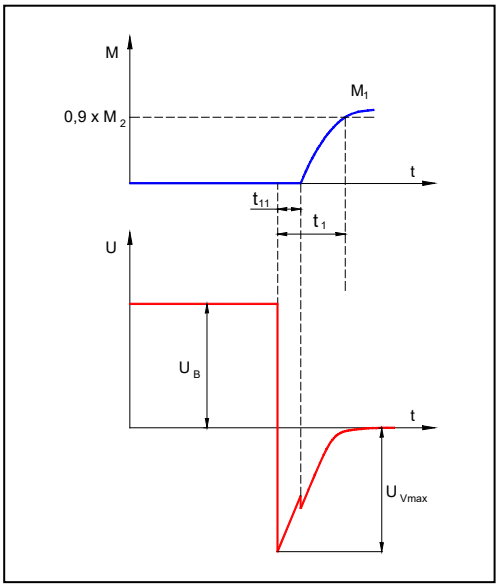
Table 8/1: Recommended rectifiers for single-phase AC voltage supply

DC power supply:

The figure to the right shows the voltage curve after the field coil (1.2) has been de-energized.

Attention!

The peak voltage U_{Vmax} during disconnection without protective circuit may reach **several thousand volts** in the millisecond region. This may cause irreversible damage to the field coil (1.2), switching contacts and electronic components. Sparking will occur on the switch during disconnection. Consequently, a protective circuit must be provided to reduce the current during disconnection and to limit the voltage. The maximum permitted overvoltage during disconnection is 1500 V. If Kendrion rectifiers are used (see Table 8/1), the protective circuit required for the built-in electronic components and field coil (1.2) is included in the rectifier. This does not apply to the external contacts required for DC side switching as there would be no galvanic isolation of the external contact.



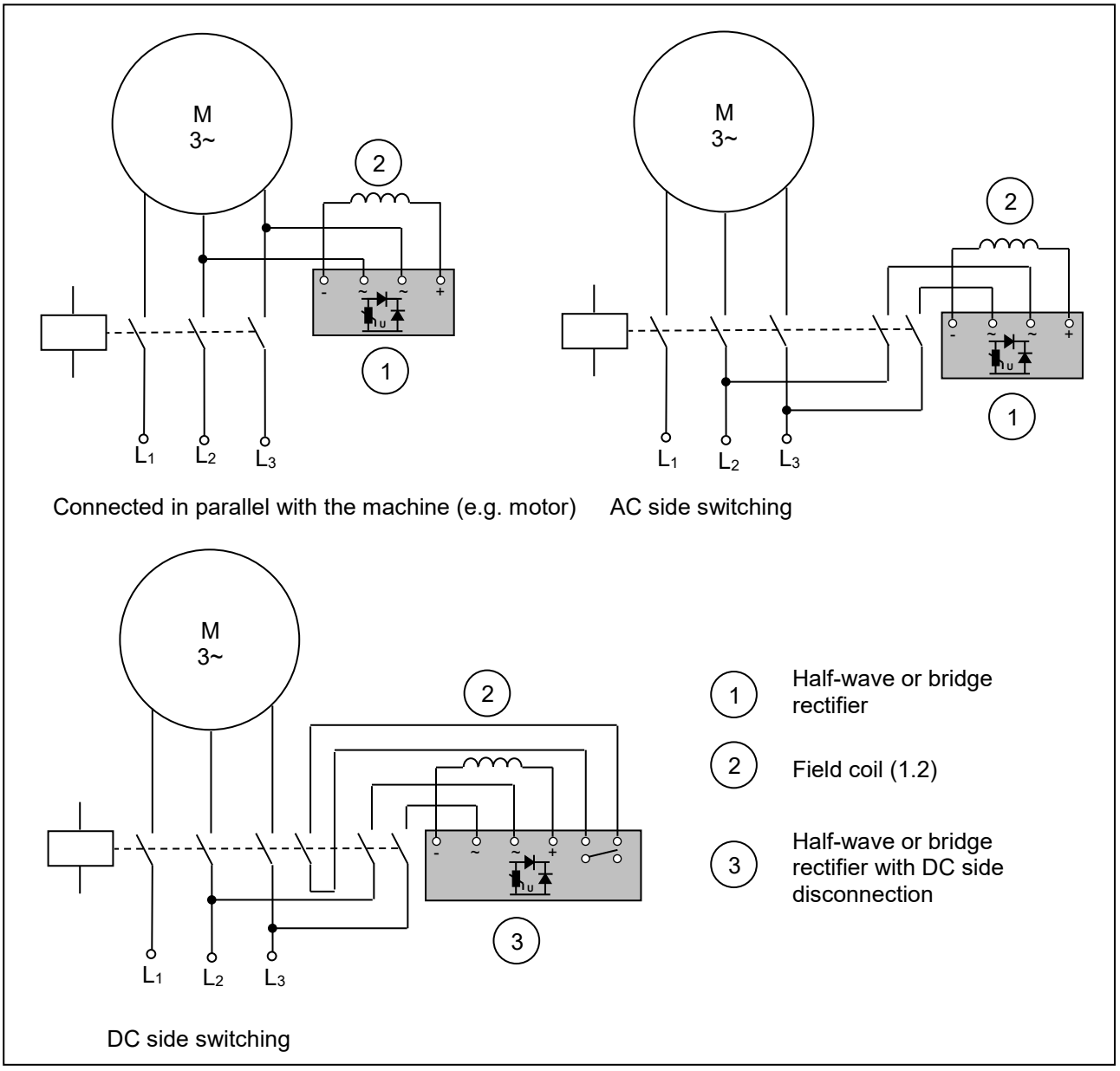
U_B operating voltage (coil voltage)
U_{Vmax} disconnection voltage

Attention!

Sensitive electronic components (e.g. logical components) may also be damaged by the lower voltage.

AC power supply:

Direct brake connection to an AC power source is only possible if a rectifier is used. Wiring of the brake in case of single-phase AC power supply must be performed in the same way as with three-phase voltage. The coupling times vary depending on the switching type (DC side switching or AC side switching).



Half-wave rectification:

In case of half-wave rectification, the U_2 coil voltage is lower by factor 0.445 than the rectifier input voltage. Half-wave rectifiers produce voltage with high residual ripple which, depending on the brake size, may slightly reduce the switching times when compared to bridge rectifiers. Due to the shorter switching times and the lower coil voltage, half-wave rectifiers are generally preferred to bridge rectifiers. However, brake humming may occur when small size brakes are used.

Bridge rectification:

Bridge rectifiers provide voltage with minimum residual ripple. This means that brake humming can be avoided even if small size brakes are used. In case of bridge rectification, the U_2 coil voltage is lower by factor 0.89 than the rectifier input voltage.

AC side switching:

The easiest wiring method is to connect the rectifier in parallel with the brake in the terminal box of the machine (e.g. motor). It must be considered, however, that the motor may act as a generator after AC voltage has been removed and thus extend the coupling time significantly (by factor 5 or over). The disconnection times remain unchanged.

DC side switching:

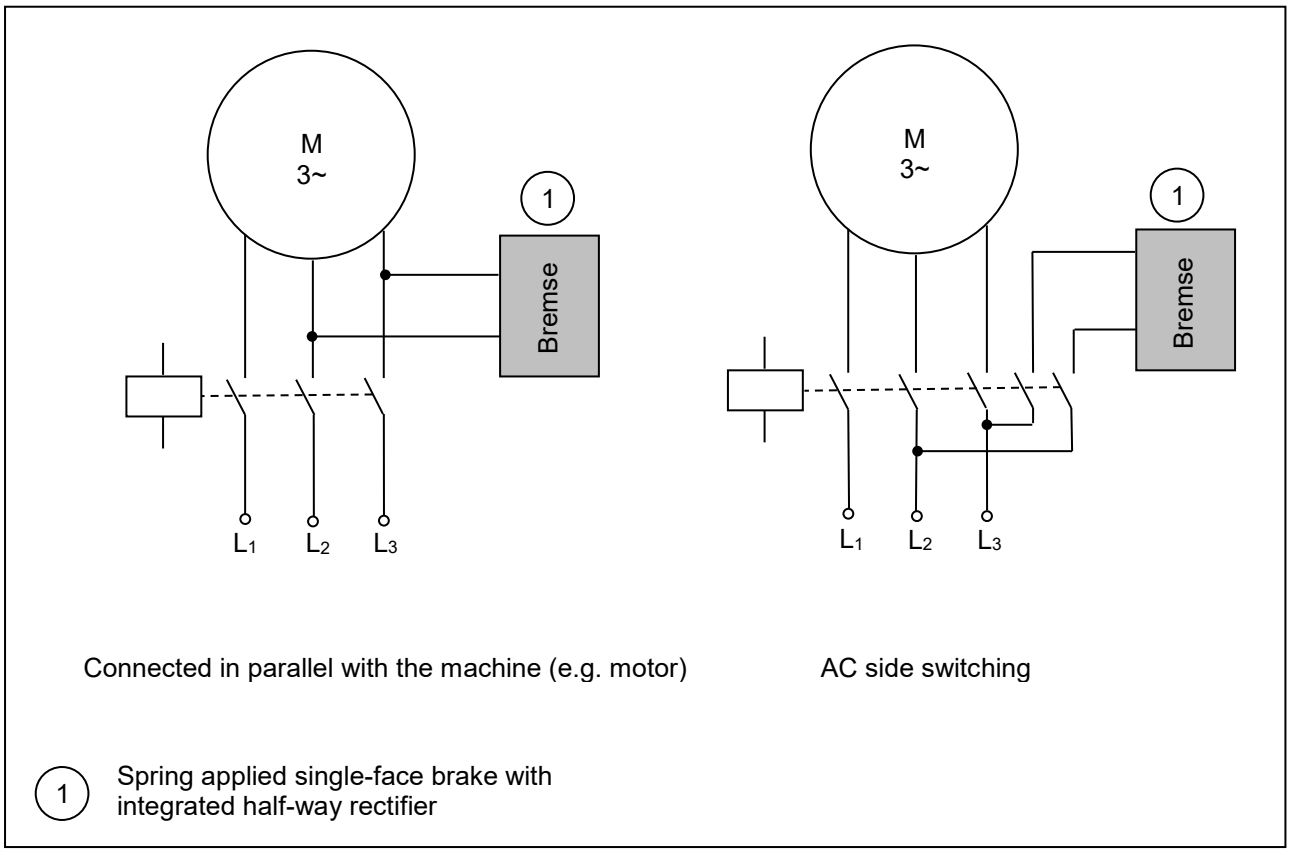
In case of DC side brake switching, an auxiliary contact is provided on the motor contactor, for example. This auxiliary contact is designed to interrupt the power supply on the DC side.

Attention!

In case of DC side switching, the brake must be provided with a protective circuit to avoid overvoltage. Additional protective elements (e.g. varistors, spark arresters, etc.) must be installed to avoid damage such as burns or fusing of contacts.

3.2.2 Electrical connection of components with integrated rectifier

Die Federdruck-Einscheibenbremse ist direkt an Wechselspannung anzuschließen. Die Gleichrichtung der Versorgungsspannung erfolgt über den integrierten Einweggleichrichter (ohne Darstellung). Welligkeiten der Spannung durch getaktete Versorgungen können je nach Größe und Momenten zu Brummen oder zu einem nicht bestimmungsgemäßen Betriebsverhalten der Komponente führen. Der Anwender oder Systemhersteller hat durch die elektrische Ansteuerung den bestimmungsgemäßen Betrieb zu gewährleisten.



Connected in parallel with the machine (e.g. motor)

AC side switching

1 Spring applied single-face brake with integrated half-way rectifier

AC side switching:

The easiest wiring method is to connect the integrated rectifier in parallel with the brake in the terminal box of the machine (e.g. motor). It must be considered, however, that the motor may act as a generator after AC voltage has been removed and thus extend the coupling time significantly (by factor 5 or over). The disconnection times remain unchanged.

3.2.3 General

Warning!

Work on the brake must only be carried out by suitably qualified personnel. Make sure that no voltage is applied during brake connection. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box or in the operating instructions must be strictly observed.

Warning!

The brake is a DC operated system. Permanent voltage variations on the power source of the electromagnetic brake must be limited to +/-10% of the rated voltage.

The following checks must be carried out when connecting the brake:

- Check that the connecting cables are suitable for the intended use and for the voltage and amperage of the brake.
- Check that the connecting cables are secured with screws, clamps or other suitable fixtures to avoid interruptions in the power supply.
- Check that the connecting cables are long enough for the intended use and that suitable torsion, strain and shear relief features as well as bending protections are provided.
- Check that the PE conductor (only for protection class I) is connected to the earthing point.
- Check that no foreign matter, dirt or humidity is trapped inside the terminal box.
- Check that unused cable entries and the terminal box are suitably sealed to ensure compliance with the protection class requirements to EN 60529.

3.3 Electromagnetic compatibility

As required by the German Electromagnetic Compatibility Act (EMVG), electromagnetic compatibility is essential to ensure immunity to external electromagnetic fields and conducted interference. Furthermore, the emission of electromagnetic fields and line-conducted interference during brake operation must be minimized. Since the brake features depend on the circuitry and operation, a declaration of conformity with the applicable EMC standard can only be furnished for the wiring type, but not for a specific brake. The spring-applied single-face brake type 76 13105C0. is designed for industrial applications to which the following EMC standards apply: Generic Immunity Standard EN 61000-6-2 and Generic Emission Standard EN 61000-6-3 / EN 61000-6-4. Other applications may be subject to different generic standards which must be considered by the manufacturer of the overall system. The requirements in terms of electromagnetic compatibility of devices and components are determined by basic standards derived from the generic standards. Brake wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial brake use and other applications.

Immunity according to EN 61000-4:

EN 61000-4-2 Electrostatic discharge:
The spring-applied single-face brakes 76 13105C0. comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.2.1 conform to severity level 3 without additional measures.

EN 61000-4-3 Electromagnetic fields:
The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3 without additional measures.

EN 61000-4-4 Fast transients (burst):
The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3.

EN 61000-4-5 Surge:
The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3.

EN 61000-4-9 Pulse magnetic fields, EN 61000-4-10 Damped oscillatory magnetic fields:
Since the operating magnetic fields of the electromagnetic brakes are stronger many times over than interference fields, the brake function will remain unaffected. The brakes comply at least with severity level 4. The recommended rectifiers conform at least to severity level 3.

EN 61000-4-11 Voltage dips, short interruptions, and short supply voltage variations:

a) Voltage interruptions:
Brakes that comply with the requirements of DIN VDE 0580 are de-energized after the specified switching times at the latest. The switching time depends on the control and mains conditions (e.g. generator effect of running down motors). Voltage interruptions of shorter duration than the response delay specified by DIN VDE 0580 will not cause any malfunctions. The user must ensure that any consequential damage is avoided (e.g. motor start-up before the brake has been released caused by phase failure in the case of two-phase energized motors or by the slipping of an electromagnetically engaged system due to torque drop). The functional reliability of the electromagnetic brake and its electronic accessories remains unaffected if the aforementioned consequential damage is avoided.

b) Voltage dips and short supply voltage variations:
Electromagnetically released systems:
Voltage dips and supply voltage variations to below 60% of the rated voltage and lasting longer than the response delay specified by DIN VDE 0580 may cause the brake to be de-energized temporarily. Consequential damage as described under a) above must be avoided by the user by taking adequate precautions.
Electromagnetically engaged systems:
Voltage dips and supply voltage variations to below the minimum tolerance threshold will cause torque reductions. The user is required to take adequate precautions to avoid consequential damage.

Radio interference suppression in accordance with EN 55011:
The brakes and the built-in electronic rectifier are classified as Group 1 equipment in accordance with EN 55011. As far as the emissions from this equipment are concerned, one distinguishes between field guided radiated interference and line-conducted interference.

a) Radiated interference:
When operated with DC voltage or rectified 50/60 Hz AC voltage, all brakes comply with the limit values applicable to Class B equipment.

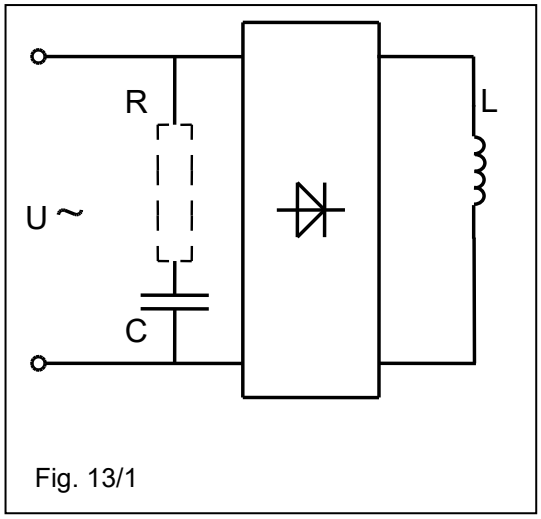


Fig. 13/1

b) Conducted interference:
When connected to a DC power source, the electromagnetic brakes meet the limit values applicable to Class A equipment. If the brakes are connected to a 50/60 Hz AC power source and equipped with electronic rectifiers or other electronic controls, interference suppression measures as shown in Fig. 13/1 must be taken to ensure compliance with the limit values applicable to Class A equipment. Interference suppression capacitors should be used which must be dimensioned to suit the connection data of the electromagnetic components and the specific mains conditions. The recommended rectifiers specified in Section 3.2.1 are CE mark certified in accordance with the EMC Directive. They have built-in interference suppression components and comply at least with the requirements of EN 55011 for Class A equipment, unless otherwise specified in the specification sheet. When brakes are used with the specified rectifiers or at brakes with integrated half-way rectifier, the recommended values listed in Table 14/1 should be observed. Interference suppression components should be installed as close as possible to the consumer. Interference caused during switching operations of the electromagnetic component is generally attributable to the inductive load. Where necessary, assemblies designed to limit the disconnection voltage (e.g. anti-parallel diode) or voltage limiting components (e.g. varistors, suppressor diodes, resistance diodes and the like) can be installed. However, such components will inevitably change the switching times of the brake and increase the generated noise level. The rectifiers specified in Section 3.2.1 resp. the integrated half-way rectifier are equipped with free-wheel diodes and/or varistors to limit the disconnection voltage. In case of DC side switching, a varistor rated for the type-specific maximum operating voltage and connected in parallel with the field coil (1.2) limits the peak voltage to the values specified in Table 14/2.

If the brake is used in connection with other electronic accessories, the user is responsible to ensure compliance with EMC requirements. Compliance with applicable standards concerning the design and operation of components, sub-assemblies or equipment employed shall not relieve the user and manufacturer of the overall system from their obligation to furnish proof of conformity of the overall system with such standards.

Rectifier series	Rated input voltage range U_1/VAC (40-60 Hz)	DC at L-load (ADC)	Capacitor nF (VAC)
Bridge rectifier 32 07.23B.0	up to 400 (±10%)	up to 2.0	no additional interference suppression measures required
Half-wave rectifier 32 07.22B.0	up to 500 (±10%)	up to 2.0	no additional interference suppression measures required

Table 14/1

Max. rectifier operating voltage (VAC)	Recommended disconnection voltage for DC side switching (V)
250	700
440	1200
550	1500

Table 14/2

3.4 Set-up & start-up

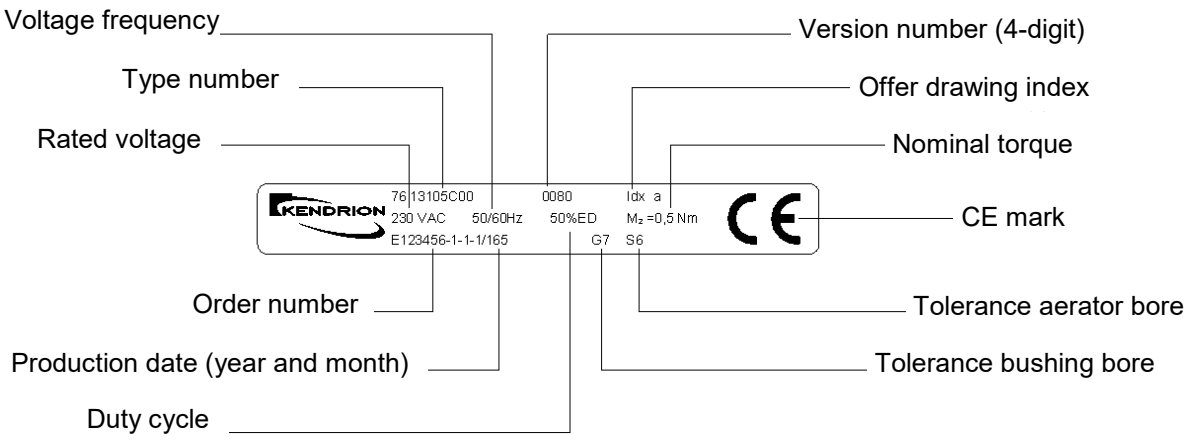
Warning!

Functional testing of the brake must not be performed unless the machine (e.g. motor) has been switched off and secured against accidental or unintentional start-up.

The following checks must be carried out:

Check compliance with the specifications provided on the rating plate with respect to the mounting position and protection class. After connection of the brake, a functional test must be performed to check that the fan (10) runs smoothly. For this purpose, turn the shaft (12) while the brake is energized and the machine (e.g. motor) is unpowered. After completion of mounting, all necessary covers and guards must be installed.

Specifications on rating plate (order-specific, example brake type 76 13105C00):



Note: The product number of the spring-applied single-disc brake consists of the type number followed by the version number, e.g. 76 13105C00-0080.

Warning!

Before starting the machine (e.g. motor) test run without driven components, the feather key (if used) must be secured in such a way that it cannot be hurled out. The shaft (12) must not be exposed to load torques. Before the machine is re-started, the brake must be de-energized.

Caution!

The brake surface temperature may rise to over 60°C. Heat-sensitive parts such as conventional cables or electronic components must not be fixed to or be in contact with these surfaces. If necessary, suitable protections and hand guards must be installed to avoid accidental contact with hot surfaces! If the shaft (12) needs to be turned during set-up operations while the machine (e.g. motor) is switched off, the brake must be released electromagnetically.

Attention!

High-voltage tests performed during brake installation within an overall system or during start-up must be carried out in such a way that damage to the built-in electronic accessories is avoided. The limits for high-voltage tests and follow-up tests specified by DIN VDE 0580 must be observed.

Attention!

Check that the brake has been connected in accordance with the specifications provided on the rating plate before it is put into operation. Even short-term operation outside the specified supply voltage limits may cause irreversible damage to the brake or electronic accessories. Such damage may not be apparent immediately. DC side brake switching without protective circuit as described in Section 3.3 will cause damage to electronic rectifiers, electronic accessories, switching contacts and to the field coil (1.2).

4. Maintenance

4.1 Checks and service

The spring-applied single-face brake does not require any particular maintenance except that the air gap 's' must be measured at regular intervals. When the maximum air gap s_{max} between the armature (2) and the solenoid housing (1.1) has been reached (see Table 23/1 “Technical specifications”), the fan (10) must be replaced. To this end, use a withdrawal device to pull the complete spring-applied single-face brake off the shaft (12). When replacing the fan (10), check the armature (2). If necessary, replace the entire brake.

Attention!

Repeated removal and installation of the same fan (10) is not allowed as this would adversely affect reliable torque transmission.

Caution!

Depending on its operating condition, it may no longer be possible to release the spring-applied single-face brake when the maximum air gap s_{max} (see Table 23/1 “Technical specifications”) has been exceeded. In this case, the braking action cannot be neutralized. This may cause thermal overloading of and irreversible damage to the brake if the machine (e.g. motor) is started before the brake has been released. Thermal overloading of the machine (e.g. motor) may occur if the machine (e.g. motor) is not started while the brake is still engaged.

Warning!

Whenever inspection and maintenance work is carried out, ensure that

- the machine (e.g. motor) is secured against accidental or unintentional start-up.
- no load torque acts on the shaft (12).
- the lock provided to prevent accidental start-up of the machine (e.g. motor) is removed after completion of inspection and maintenance work.
- all friction surfaces are free from grease and oil. An oily or greasy friction surface cannot be cleaned.
- no swelling or glazing of the friction lining has occurred.

4.2 Spare parts and accessories

S	A	Designation	Type	Order number	Quantity
X		Fan (10)	Bore Ø5^{S6} Bore Ø6^{S6} Bore Ø8^{S6} Bore Ø8^{H7}	76 13705C16100 76 13105C06100 76 13505C00100 76 13705C13100	1

Table 16/1: Spare parts (S)

5. Condition at delivery

Upon receipt of the shipment, the brake must be checked for transit damage before storage. The spring-applied single-face brake is delivered ready for mounting. The armature, compression springs (4) and the entire coil system of the brake are held together by the mounting clamp. The fan, compression spring (6) and spacer disc are delivered loose.

Note!

If the brake is not installed immediately upon delivery, it must be stored in a dry, dust-free and vibration-proof place.

Note!

The environmental conditions specified in Table 17/1 and in EN IEC 60721-3-2 / EN IEC 60721-3-1 must be considered during transport and storage of the brake, especially when long-term storage is envisaged.

	Environmental conditions	
	Conditions for storage to EN IEC 60721-3-1	Conditions for transport to EN IEC 60721-3-2
Mechanical environmental conditions	1M11	2M4
Climatic environmental conditions	1K21 and 1Z2	2K12
Biological environmental conditions	1B1	2B1
Mechanically active substances	1S11	2S5
Chemically active substances	1C1	2C1

Table 17/1: Environmental conditions for storage and transport as specified in EN IEC 60721-3-1 and EN IEC 60721-3-2

6. Emissions

6.1 Noise

The spring-applied single-face brake produces switching noise during engagement and release. The noise level is determined by the installation conditions, circuitry (e.g. with overexcitation) and air gap. Depending on the mounting position, operating conditions and state of the friction surfaces, audible vibrations (squealing) may be produced during braking.

6.2 Heat

Braking operations and gradual heating of the field coil cause the solenoid housing temperature to increase substantially. Under adverse conditions, the surface temperature may rise to well over 60°C.

Caution!

Risk of burns in case of contact with hot surfaces! Suitable covers and hand guards must be installed to provide protection against accidental contact.

7. Troubleshooting

Fault	Cause	Corrective actions
Brake release failure	• Air gap too large	Check the air gap. Install a new fan, if necessary.
	• No voltage applied to brake	Check the electrical connection and correct faults, if found.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
	• Armature plate blocked mechanically	Eliminate mechanical blocks.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil	Check the resistance of the field coil. Install a new brake, if necessary.
	• Friction disc thermally overloaded	Install a new fan or a new brake, if necessary.
Delayed brake release	• Air gap too large	Check the air gap. Install a new fan, if necessary.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
Brake engagement failure	• Voltage applied to field coil in unpowered condition too high (residual voltage)	Check whether residual voltage is applied to the field coil and correct faults, if found.
	• Armature plate blocked mechanically	Eliminate mechanical blocks.
Delayed brake engagement	• Voltage applied to field coil too high	Check the field coil supply voltage and correct faults, if found.
Brake torque too low	• Air gap too large	Check the air gap. Install a new fan, if necessary.
	• Oily or greasy friction surfaces	Check the friction surfaces. Install a new fan, if necessary.
	• Broken compression spring	Check the spring force. Install a new brake, if necessary.

Table 18/1: Possible faults, causes and corrective actions (list not exhaustive)

8. Safety

The brakes described in these operating instructions have been designed and built on the basis of an analysis of hazards and in accordance with the requirements of the applicable harmonized standards and technical specifications. They correspond to the state of the art and provide maximum safety. However, safety hazards can only be avoided if the user of the equipment takes adequate precautions and makes sure that safety instructions are strictly adhered to. It is the duty of the machine owner to plan these measures and to check their implementation.

The machine owner is required to ensure that:

- the brakes are only used in accordance with their intended use (see "Product description" section).
- the brakes are in perfect working order and checked at regular intervals.
- a complete and fully legible copy of these operating instructions is kept available at the place of use of the brakes at all times.
- start-up, maintenance and repair work is only done by authorized and suitably qualified personnel.
- such personnel are kept informed on all relevant occupational safety and environmental protection issues and familiar with these operating instructions and with the safety information contained herein.
- the brakes are not exposed to other strong magnetic fields.

8.1 Intended use

The brakes described in these operating instructions are intended to be assembled with machines, in particular electric motors, for use on industrial plant. Operation in potentially explosive or firedamp atmospheres is not allowed. The brakes must be used in accordance with the operating requirements detailed in this manual. The rated power limits specified herein must not be exceeded.

8.2 General safety information

Brakes fitted to motors feature hazardous live components and rotating parts and may exhibit hot surfaces. Any work associated with the transport, connection, start-up and periodical maintenance of the brakes must be carried out by authorized and suitably qualified specialist personnel in accordance with EN 50110-1, EN 50110-2, IEC 60364-1. Failure to observe safety, operating and maintenance instructions may cause serious personal injury and severe damage to the equipment. Whenever special measures are required in accordance with the instructions contained herein, such measures should be agreed with the brake manufacturer before the machinery into which the brake is to be incorporated is set up. Should any queries arise with respect to torques, torque variations, installation positions, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion and ask for clarification before using the brake. Retrofitting or modification work to be carried out on the brake is subject to the approval from Kendrion (Villingen). Accident prevention regulations applying to the specific field of application of the brake must be strictly observed. The brakes described in this manual are **not designed for use as "safety brakes"**. This means that torque reductions caused by factors beyond the user's control cannot be excluded.

8.2.1 Set-up

Requirements in terms of the permitted number of switching operations per hour and the maximum switching work per switching operation specified in the technical specifications must be strictly observed during the set-up of machines and plant (inching mode). Failure to observe these instructions may irreversibly diminish the braking effect and cause malfunctions. Normal operating conditions are those specified by DIN VDE 0580. The protection rating conforms to EN 60529. In case of deviations, special measures must be taken after prior consultation with the manufacturer. Bear in mind that the fan may freeze if ambient temperatures fall below -5°C or if the brake remains unpowered for prolonged periods of time. In this case, special precautions must be taken after consultation with the manufacturer.

8.2.2 Start-up

The brakes must not be put into operation when:

- power supply cables/wires or connections are damaged.
- the solenoid housing or coil sheath is damaged.
- other defects are suspected.

8.2.3 Installation

The voltage level and voltage type specified on the rating plate must be strictly observed when connecting the brakes described in these operating instructions. Sufficient heat dissipation must be ensured when the brake is fitted to or incorporated into other equipment. Adequate precautions must be taken to avoid overvoltage during disconnection or voltage peaks. The magnetic field of the products may cause interference outside the brake or even feedback to the brake in case of adverse installation conditions. Should you have queries concerning mounting and fitting conditions, please contact the brake manufacturer and ask for clarification.

Adequate safety measures (DIN 31000; DIN VDE 0100-420) must be taken by the brake user to avoid hazards to persons and animals or damage to equipment caused by:

- direct or indirect effects of electromagnetic fields,
- heated components,
- mobile parts.

8.2.4 Operation

Ensure that live components such as plug contacts or the field coil are not exposed to water. The brake cable connections must not be crushed, squeezed or exposed to mechanical loads. Make absolutely sure that the friction surfaces of the friction elements are not contaminated with grease, oil or other fluids to avoid substantial torque reduction. Bear in mind that the original torque cannot be restored even if the friction surfaces are cleaned after contact with fluids. The gradual brake wear and the resulting torque reduction of spring-applied brakes must be taken into consideration in the set-up of the machine or overall system. Due to the diverse ambient conditions in which the brakes may be used, always check that the brake is in perfect working order before start-up. Torque reductions cannot be excluded if the brake is used for applications where only minimum friction work is required. In such cases, the user should ensure that the brake occasionally performs sufficient friction work. Operation of the brake as pure holding brake without friction work is only allowed after prior consultation with the manufacturer.

Notice!

During brake operation, ensure that the coil temperature does not rise above the permissible limit temperature applicable to the insulating materials of the specified insulation class (see Table 23/1). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 23/2) is not exceeded.

Note!

The maximum air gap s_{max} (see Table 23/1 “Technical specifications”) must not be exceeded throughout the entire brake service life. (Please refer to Section 4 "Maintenance" for details.)

8.2.5 Maintenance, repair and replacement

Brake service, maintenance, repair or replacement must only be carried out by qualified specialist personnel in accordance with EN 50110-1, EN 50110-2, IEC 60364-1. Failure to perform repairs according to requirements may cause serious personal injury or equipment damage. Make sure that no voltage is applied to the brakes when carrying out maintenance work.

8.3 Warning symbols

Personal injury or equipment damage			
Symbol / Term		**Warns against...**	**Potential risks and hazards**
	Danger	imminent personal injury	fatal accidents or serious injury
	Warning	potential risk of serious personal injury	fatal accidents or serious injury
	Caution	potential risk of personal injury	minor injury
	Attention	potential risk of equipment damage	damage to components or other equipment
Information			
Symbol / Term		**Provides information on …**	
	Note	the safe use and operation of the product	

9. Definitions

(based on: DIN VDE 0580: 2011-11, not exhaustive)

Switching torque M_1 — torque acting on the shaft during brake or clutch slip

Rated torque M_2 — switching torque specified by the manufacturer to identify the brake. The rated torque M_2 is the mean value of at least 3 measurements of the maximum switching torque M_1 after completion of the transient response.

Transmissible torque M_4 — highest torque that can be applied to the engaged brake or clutch without causing the brake/clutch to slip

Residual torque M_5 — torque transmitted by the released brake or clutch

Load torque M_6 — torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed

Switching work W — heat generated by friction inside the brake or clutch as a result of the switching operation

Maximum switching work W_{max} — maximum switching work to which the brake or clutch may be exposed

Switching power P — switching work converted into heat per unit of time

Maximum switching power P_{max} — maximum permitted switching work converted into heat per unit of time

Coil ON time t_5 — time between power on and power off

Coil OFF time t_6 — time between power off and power on

Total cycle time t_7 — coil ON time plus coil OFF time

Duty cycle — percentage relationship of coil ON time to total cycle time

Switching operation — one complete switching on and off operation

Switching frequency Z — number of regular switching operations per hour

Response delay during coupling t_{11} — time between power off (releasing systems) or power on (engaging systems) and beginning of torque increase

Rise time t_{12} — time it takes to reach 90% of the M_2 rated torque from the beginning of the torque increase

Coupling time t_1 — response delay t_{11} plus rise time t_{12}

Response delay during disconnection t_{21} — time between power on (releasing systems) or power off (engaging systems) and beginning of torque decrease

Fall time t_{22}	time it takes for the torque from the beginning of the torque decrease to fall to 10% of the M_2 rated torque
Disconnection time t_2	response delay t_{21} plus fall time t_{22}
Slip time t_3	time from the beginning of the torque increase up to the end of the braking process (brakes) or until the synchronization torque M_3 has been reached (clutches)
Making time t_4	response delay t_{11} plus slip time t_3 (braking or acceleration time)
Operating condition at operating temperature	condition at which the steady-state temperature is reached. The operating temperature corresponds to the overtemperature according to DIN VDE 0580 plus the ambient temperature. Unless otherwise specified, the ambient temperature is 35°C.
Overtemperature $\Delta\vartheta_{31}$	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature
Limit temperatures of coil insulating materials	in accordance with DIN VDE 0580. The individual insulating materials are classified by insulation classes to DIN IEC 60085.
Rated voltage U_N	supply voltage specified by the manufacturer for voltage windings to identify the device or component
Rated current I_B	amperage determined by the manufacturer for the specified operating conditions. Unless otherwise specified, the rated current refers to the rated voltage, 20°C winding temperature and to the rated frequency for a given operating mode of voltage windings.
Rated power P_N	power value to identify the device or component
Rated power at 20° winding temperature P_B	determined from the rated current of voltage-controlled devices and components and the R_{20} resistance at 20°C winding temperature

10. Technical specifications

Product built and tested to DIN VDE 0580

	Size 05
Rated torque M_2 [Ncm]	25
Max. speed n_{max} [rpm]	3600
Max. switching power P_{max} [kJ/h]	22
Rated power P_N [W]	9
Coupling time t_1 [ms]	26
Disconnection time t_2 [ms]	5
Moment of inertia J [kgcm²] – fan and bushing [kgcm²]	0.044
Weight m [kg]	0.16
Rated air gap s [mm]	$0.25^{+0,05}_{-0,1}$
Max. air gap s_{max} (at 70% of rated current) [mm]	0.4 (if operated with bridge rectifier)
	0.8 (if operated with half-wave rectifier)
Duty cycle [%]	100
Standard rated voltage [VDC]	102
Insulation class	F
Pollution degree	2
Protection	IP00
Brake type	dynamic brake

Table 23/1: Technical specifications

	Rated operating conditions
Rated voltage tolerance	±10%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{13} [°C]	-5 to +35
Relative humidity	30% to 80% within ambient temperature range
Other climatic environmental conditions	3Z2 and 3Z4 to EN 60721-3-3
Mechanical environmental conditions	3M8 to EN 60721-3-3
Biological environmental conditions	3B1 to EN 60721-3-3
Mechanically active substances	3S2 to EN 60721-3-3
Chemically active substances	3C1 to EN 60721-3-3
Installation height	up to 2000 m a.m.s.l.

Table 23/2: Required operating conditions for spring-applied single-face brake

Explanations on the technical specifications:

W_{max} (maximum switching work) is the switching work that must not be exceeded during braking operations at maximum speeds of 1500 rpm. Braking operations at speeds greater than 1500 rpm substantially reduce the maximum permitted switching work per switching operation. Such operation must be agreed with the manufacturer. The maximum switching power P_{max} is the switching work W that can be converted by the brake per hour. In case of applications where the number of switching operations per hour is Z>1, Fig. 24/1 applies (W_{max} as a function of the number of switching operations per hour Z). The P_{max} and W_{max} values are approximate values. They apply to brakes mounted to motors. The specified times apply to the following conditions: AC side brake switching, operating temperature, rated voltage, and rated air gap. All values are mean values that are subject to variation. The specified rated torques M_2 characterize the torque level of the brakes. Depending on the application the brake is used for, the switching torque M_1 and the transmissible torque M_4 may differ from the specified M_2 values. The switching torque M_1 depends on the speed (rpm). If the friction surfaces are contaminated with oil or grease the transmissible torque M_4 and the switching torque M_1 may drop. The technical specifications apply after the break-in process has been completed (see Table 24/1).

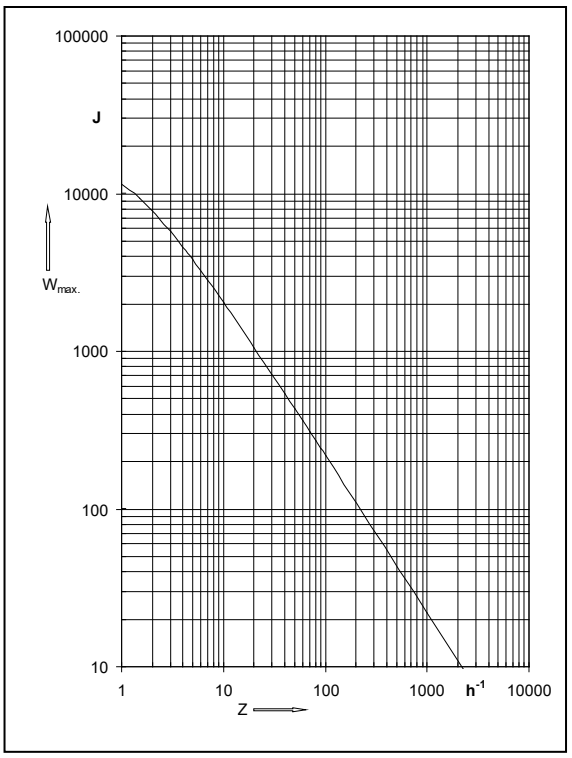


Fig. 24/1: Max. switching work W_{max} per switching operation as a function of the number of switching operations per hour Z (values based on n=1500 rpm)

	Size 05
Speed n [rpm]	750
Coil ON time t_5 [s]	5.5
Coil OFF time t_6 [s]	1.5
Break-in period t_{total} [min]	approx. 2

Table 24/1: Break-in process parameters for the spring-applied single-face brake

Note: A current level corresponding to 70% of the rated current is reached when the brake is operated at rated voltage and at a coil temperature of 130°C.

The required operating conditions specified in Table 23/2 and the information provided in the **SLIM LINE specification sheet** and offer drawing for the specific brake types must be observed during operation of the spring-applied single-face brake.

Specifications subject to change without notice!

11. Product number / type number / version number

The product number to be quoted in purchase orders and required to identify the brake version consists of the type number followed by the 4-digit version number. Individual brake types may be available in different versions. So the version number identifies the relevant brake model.

Example:

Type number: 76 13105C00 Version number: 0080

Product number: 76 13105C00-0080

12. Specialist repair shops

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13. Revision history

Date of issue	Changes
19/10/2016	Added Declaration of Conformity with RoHs Directive 2011/65/EU. Reference to Low Voltage Directive 2006/95/EC replaced by 2014/35/EU. Updated rating plate. Changed company name. Updated Standards (Section 3.3). New layout (design) of operating instructions.
13/03/2020	Operating instructions revised in content. Updated layout (design) of operating instructions.

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