



KENDRION INDUSTRIAL BRAKES

Module Line

Spring-applied single-disc brake module

Operating Instructions 77 500..B..

Types: 77 50013B16 77 50019B15 77 50024B15
77 50029B15

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1. General

1.1 Introduction

These operating instructions describe the operating principle and features of the spring-applied single-disc brake modules type 77 500..B... The information and safety messages provided in this manual must be strictly observed during the set-up of the machine (e.g. motor) or installation and during the putting into service, use and maintenance of the spring-applied single-disc brake modules.

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 modules. Spring-applied single-disc brake modules are not ready-to-use products, but are intended to be incorporated into or assembled with machinery. Consequently, they will be referred to as **components** in the following sections. The output side of the spring-applied single-disc brake modules has the same fitting dimensions as the end shield on the machine side (e.g. motor side). As a result, the brakes are designed as fail-safe holding brakes with emergency stop function and are intended to be mounted to electric motors.

1.2 Manufacturer

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 Wilhelm-Binder-Str. 4-6
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1.3 Product, types, versions and product numbers

Product: Electromagnetically released spring-applied single-disc brake module

Types: 77 50013B16 77 50019B15
 77 50024B15 77 50029B15

Types	Version number	Product number ¹⁾	Versions
77 50013B16	XXXX	77 50013B16-XXXX	Rated voltage U _N UL-listed
77 50019B15	XXXX	77 50019B15-XXXX	Transmissible torque M ₄
77 50024B15	XXXX	77 50024B15-XXXX	Hand release (24)
77 50029B15	XXXX	77 50029B15-XXXX	Microswitch (27)

Table 4/1: List of spring-applied single-disc brake module types and versions

1.4 Standards, directives and approvals

The state-of-the-art brake modules 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 single-disc brake modules are also subject to the Low Voltage Directive 2014/35/EU and to the RoHS Directive 2011/65/EU. The user is required to employ suitable switching devices and controls to ensure use of the brake modules in accordance with EMC Directive 2014/30/EU.

Approvals: UL-listed



Some versions of the spring-applied single-disc brake modules (see Section 1.3) are UL-listed. In this case, the UL mark is applied to the rating plate of the products.

¹⁾ Please refer to Section 12 for more details on the product number.

1.5 Conventions used in these operating instructions

The conventions used in these operating instructions for the representation of information make the manual easier to read and understand. The conventions are listed in Table 5/1.

Conventions / Examples	Type of information	Meaning
Table 4/1	Table	Reference to information provided in a table
Fig. 4/1	Figure	Reference to information provided in a figure
•	Numbered items	Tasks or steps to be performed and/or additional information
Section 2.1	Section	Reference to one or more sections
¹⁾	Footnote	Additional information
(1.2)	Reference numeral	Reference to an item in a figure or table, accompanied by additional information relating to the designation or identification of a component part
(e.g. motor shaft)	Addition	Supplementary information
..	Wildcard	Wildcard for different brake sizes
XXXX	Wildcard	Wildcard for different versions
Components	Highlighting (bold text)	Highly relevant information

Table 5/1: Conventions used for the representation of information

Special conventions used for the representation of safety messages and safety-related information are explained in Section 2.1.

1.6 Manufacturer's liability

The manufacturer will not assume any responsibility for damage caused by failure to use the components in accordance with their intended use or by failure to observe safety information and other instructions provided in this document. 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.

1.7 Relevant documents

- Offer drawing 77 50013B16-O
- Offer drawing 77 50019B15-O
- Offer drawing 77 50024B15-O
- Offer drawing 77 50029B15-O

1.8 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, 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.

Manufacturer:	Kendrion (Villingen) GmbH Wilhelm-Binder-Str. 4-6 78048 Villingen-Schwenningen Germany	Person authorized to compile the documentation:	Dominik Hettich Kendrion (Villingen) GmbH Wilhelm-Binder-Str. 4-6 78048 Villingen-Schwenningen Germany
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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

Products: Electromagnetically released spring-applied single-disc brake module

Types: 77 50013B16 77 50019B15
77 50024B15 77 50029B15

Kendrion (Villingen) GmbH

Villingen
01/02/2021

Authorized signatory:


Dominik Hettich
(Head of Development)

1.9 EU Declaration of Conformity

We hereby declare that the products below, specifically the product versions placed on the market, 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.

Manufacturer: Kendrion (Villingen) GmbH
Wilhelm-Binder-Str. 4-6
78048 Villingen-Schwenningen
Germany

Authorized representative: Dominik Hettich
Kendrion (Villingen) GmbH
Wilhelm-Binder-Str. 4-6
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Germany

Applied harmonized standards and other technical standards and regulations:

EN 60529 Enclosure protection ratings
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Products: Electromagnetically released spring-applied single-disc brake module

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 77 50024B15 77 50029B15

Kendrion (Villingen) GmbH

Villingen
01/02/2021

Authorized signatory:


Dominik Hettich
(Head of Development)

2. Safety

The components 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 machine owner 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 monitor their implementation.

The machine owner is required to ensure that:

- the components are only used in accordance with their intended use (see Section 2.2 – Intended use, and Section 3 – Product description).
- the components 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 components at all times.
- putting into service, maintenance and repair are only performed 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 components are not exposed to other strong magnetic fields.

IMPORTANT!

**READ THESE OPERATING INSTRUCTIONS CAREFULLY
BEFORE STARTING TO USE THE PRODUCTS!**

KEEP THESE OPERATING INSTRUCTIONS IN A SAFE PLACE FOR FUTURE REFERENCE!

2.1 Symbols, signs and signal words in safety messages

Safety messages that warn users of potential risks of personal injury or property damage or indicate other important information are highlighted by the safety alert symbols, information signs and signal words shown in Table 8/1.






Personal injury			
Symbol	Signal word	Indicates...	Potential consequences
	DANGER	an imminent hazardous situation which, if not avoided, will result in death or serious injury	Death or serious injury
	WARNING	a potentially hazardous situation which, if not avoided, could result in death or serious injury	Death or serious injury
	CAUTION	a potentially hazardous situation which, if not avoided, could result in minor or moderate injury	Minor or moderate injury
Property damage			
Symbol	Signal word	Indicates...	Potential consequences
	NOTICE	potential property damage or environmental damage	Damage to the component or to the environment
Information			
Symbol	Signal word	Provides...	
	IMPORTANT	information on the safe use and operation of the component	

Table 8/1: Safety alert symbols, information signs and signal words used in safety messages


Structure and colour of hazard alerting, non-hazard alerting and instructional safety messages


Hazard alerting safety messages (potential personal injury):

 **Signal word: DANGER**


 **Hazard type and source**


- Potential consequences if not avoided
- Hazard prevention measures

 **Signal word: WARNING**

 **Hazard type and source**

- Potential consequences if not avoided
- Hazard prevention measures


 **Signal word: CAUTION**

 **Hazard type and source**

- Potential consequences if not avoided
- Hazard prevention measures

Non-hazard alerting safety messages (potential property damage):

Signal word: NOTICE

 **Type and source of potential property damage**

- Potential consequences if not avoided
- Property damage prevention measures

Instructional safety messages:

Signal word: IMPORTANT

 **Information for the safe use and operation of the component**

Other warning signs used:





Symbol	Warning	Symbol	Warning
	Magnetic field hazard		Hot surface hazard
	Electricity hazard		Hand injury hazard

Table 9/1: Specific warning signs used in this manual

2.2 Intended use

The components described in these operating instructions are intended to be assembled with electric machines, specifically electric motors, for use in industrial installations.

IMPORTANT



The components must be used in accordance with the operating requirements detailed in these operating instructions. The specified rated power limits must not be exceeded. The component must not be used as dynamic brake or safety brake. Operation in potentially explosive or firedamp atmospheres is not allowed.

2.3 General safety information

Brakes mounted to motors include hazardous live components and rotating parts and may have hot surfaces. Any work associated with the transport, connection, putting into service and periodical maintenance of the brakes must be carried out by authorized and suitably qualified specialist personnel in accordance with EN 50110-1, EN 501102 and IEC 60364-1. Failure to observe safety, operating and maintenance instructions may cause serious personal injury and property damage. Whenever special measures are required in accordance with the instructions contained herein, such measures should be agreed with the brake manufacturer before setting up the machinery into which the brake is to be incorporated. 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.

IMPORTANT



The components described in this manual are **not designed for use as “safety brakes”**. This means that negative effects on the brake torque (e.g. brake torque variations, reduced brake torque constancy) arising from adverse ambient conditions that are beyond the user's control (e.g. higher ambient temperatures or humidity, contaminated ambient air etc.) cannot be ruled out. In such cases the system user is required to ensure that the component is subjected to a break-in process at regular intervals to achieve the full braking effect. The break-in process parameters specified in Table 60/2 apply.

2.3.1 Set-up

Requirements in terms of the permissible number of switching operations per hour and the maximum switching work per switching operation specified in the technical specifications (see Table 59/1) must be strictly observed during the set-up of machinery and installations (jog mode). Failure to observe these instructions may irreversibly diminish the braking effect and cause malfunctions. The rated operating conditions are those specified in DIN VDE 0580. The protection rating conforms to EN 60529. In case of deviations, special measures must be taken after prior consultation with the brake manufacturer. Bear in mind that the friction disc (4) may freeze to the surfaces of the armature (2) or flange (3) involved in the friction process 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 brake manufacturer.

2.3.2 Putting into service

Do not use or operate the components if:

- power supply cables/wires or connections are damaged.
- the magnet housing (1.1) or the sheath of the field coil (1.2) is damaged.
- other defects are suspected.

**DANGER****Electricity hazards from incorrect electrical connection of the component!**

- Fatal electric shock hazard.
- All work must be performed by qualified specialist personnel only. Check that no voltage is present before connecting the component to the power supply. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box of the machine (e.g. motor) or in the operating instructions must be strictly observed.

2.3.3 Assembly

The voltage level and voltage type specified on the rating plate must be strictly observed when connecting the components described in these operating instructions. Sufficient heat dissipation must be ensured when the brake module 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 brake module 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 (to DIN 31000 / DIN VDE 0100-420) must be taken by the brake user to avoid hazards to persons or property damage caused by:

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

2.3.4 Operation and use

Ensure that live components such as plug contacts or the field coil (1.2) 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 wear of the friction linings and the resulting torque reduction (up to 10% at the end of the service life or when the max. air gap s_{max} is reached; see Table 59/1 – Technical specifications) must be taken into consideration in the set-up of the machine or installation. Due to the diverse ambient conditions in which the spring-applied single-disc brake module may be used, always check that the brake module is in perfect working order before start-up. Torque reductions cannot be ruled out if the spring-applied single-disc brake module is used for applications where only minimum friction work is required. In such cases, the user should ensure that the brake module occasionally performs sufficient friction work.

IMPORTANT

The friction disc (4) is balanced in accordance with the requirements of ISO 21940-11. The balance quality grade is specified in Table 59/1.

IMPORTANT

The maximum air gap s_{max} (see Table 59/1 – Technical specifications) must not be exceeded throughout the entire brake service life. Please refer to Section 5 (Maintenance, repair and replacement) for details. The brake torque may drop if the spring-applied single-disc brake module has been stored for a prolonged period of time. Torque reductions may also occur during the brake service life as a result of adverse factors in the brake environment (see Section 2.3) or if the brake is only used as a mere holding brake. In this case, the brake user should ensure that a break-in process specified in Table 60/2 is conducted at regular intervals.

NOTICE



Risk of damage to the field coil (1.2) in case of brake operation beyond the permissible limits!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Potential malfunction of the machine (e.g. motor).

- 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 59/1 – Technical specifications). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the relative humidity and ambient temperature remain within the permissible range (see rated operating conditions in Table 60/4).



DANGER



Electromagnetic field hazards during brake operation!

- Indirect effects of electromagnetic fields may cause disturbances and failures of cardiac pacemakers and other implants.
- Serious or even fatal injury hazard.

- Keep at a safe distance from the component during operation.

2.3.5 Maintenance, repair and replacement

Service, maintenance, repair or replacement of the components must only be carried out by qualified specialist personnel in accordance with EN 50110-1, EN 501102 and IEC 60364-1. Failure to perform repairs according to requirements may cause serious personal injury or property damage. Make sure that the components are unpowered when carrying out maintenance work.

3. Product description

3.1 Operating principle

The spring-applied single-disc brake module is an electromagnetic device with built-in electromagnetically released spring-applied single-disc brake. The brake is designed to operate dry. The braking effect is produced by the spring force and neutralized electromagnetically. The brake module with ball bearing supported brake shaft (13) should preferably be mounted to the A-face end shield of electric motors. The spring-applied single-disc brake module engages in unpowered condition and releases when DC voltage is applied to the field coil (1.2). This is because the magnetic force generated by the electromagnetic field offsets the spring force of the compression springs (7), causing the armature (2) to move in axial direction towards the poles of the field coil. When the brake is engaged, the spring force produced by the compression springs (7) causes the friction disc (4) to be clamped between the armature (2) and flange (3), thus producing the braking action.

The machine shaft (42) to be braked (e.g. motor shaft) is not exposed to any axial loads exerted by the spring force of the compression springs (7).

Spring-applied single-disc brake modules equipped with a hand release (24) can be released or applied manually (e.g. in case of power failure). The handle bar of the hand release (24) can only be operated by pushing it away from the mounting surface A (see Fig. 15/1). If the spring-applied single-disc brake modules are equipped with a microswitch (27) (see Fig. 16/1 and Fig. 16/2), the switching state of the component can be determined by means of the microswitch (27).

3.2 Brake design

The magnet housing (1.1) with the encapsulated field coil (1.2) accommodates the armature (2), friction disc (4) and flange (3). The flange (3) is fixed to the magnet housing (1.1) by means of socket head cap screws (10). The compression springs (7) located in the magnet housing (1.1) push the armature (2) against the friction disc (4) and thus the friction disc (4) against the fixed flange (8). As a result, the friction disc (4) is clamped between the armature (2) and flange (3) to produce the braking effect. Straight pins (5) are provided which act as tangential torque supports for the armature (2) relative to the magnet housing (1.1). The friction disc (4) has a square socket (brake module types 77 50013B16, 77 50019B15 and 77 50024B15) or internal teeth (type 77 50029B15). It engages with the brake shaft (13) by a positive-locking connection and can be moved in axial direction while being kept in a fixed tangential position. The brake shaft (13) and machine shaft (e.g. motor shaft) (42) are firmly assembled by interference fit. When the brake is fixed to the motor flange of the machine (e.g. motor), the ball bearing (15) located between the magnet housing (1.1) and the brake shaft (13) ensures correct centring of the brake relative to the brake shaft (13) and hence to the machine shaft (e.g. motor shaft). In addition to this, the built-in ball bearing (15) also absorbs the radial forces (transverse forces) acting on the brake shaft (13) during operation. The ball bearing (15) is factory-sealed. An additional sealing ring (6) is installed to provide extra protection against the ingress of dirt or grease in case the ball bearing seal is defective. The sealing ring (6) protects the friction disc (4) against dirt, grease and oil during brake operation and prevents the egress of abrasive grit and dust produced by the gradual wear of the friction linings of the friction disc (4). An additional sealing ring (11) is installed on the drive side between the flange (3) and the brake shaft (13).

The brake is connected directly to the terminals located in the terminal box (19). The transmissible torque M_4 of the spring-applied single-disc brake module can be changed with the adjusting ring (9). The rubber bolts (18) fitted to the brake shaft (13) or friction disc (4) (brake module type 77 50013B16) or the O-ring (26) reduce noise and vibrations produced by the friction disc (4).

List of reference numerals in Fig. 15/1:			
1.1	Magnet housing	19.3	Socket head cap screw
1.2	Field coil	19.4	Terminal block for microswitch (27)
2	Armature	19.5	Terminal block
3	Flange	19.6	Cable gland for connection of rectifier (19.2) or terminal block (19.5)
4	Friction disc	19.7	Cable gland for microswitch (27) (internal connection)
5	Straight pin	19.8	Cable gland for microswitch (27) (external connection)
6	Sealing ring	20	Feather key
7	Compression spring	21	Stud (additional item for size 13 brake module)
8	Stud (omitted for size 13 brake module)	22	Sealing disc
9	Adjusting ring (omitted for size 13 brake module)	23	Cap (x2, offset by 180°) ⁴⁾
10	Socket head cap screw	24	Hand release
11	Sealing ring	25	Set screw ²⁾
12	Disc	26	O-ring ⁵⁾
13	Brake shaft	36	Gamma ring
14	Spring washer	37	Washer (not supplied)
15	Ball bearing	38	Mounting screw (not supplied)
16	Circlip	42	Machine shaft (e.g. motor shaft)
17	Screw plug ²⁾	E	Adjusting ring clearance
18	Rubber bolt ³⁾	A	Contact surface on motor side
19	Terminal box	B	Brake shaft (13) contact surface
19.1	Cover	C ₁ , C ₂	Jaw puller position
19.2	Rectifier		

Table 14/1: List of reference numerals of spring-applied single-disc brake module

²⁾ Secured with Loctite 243, mounted in brake shaft (13).

³⁾ Accessories for size 19 and 24 brake modules; included as standard parts of friction disc (4) in size 13 brake modules.

⁴⁾ Only used in brake modules without hand release (24).

⁵⁾ Only for size 29 brake modules.

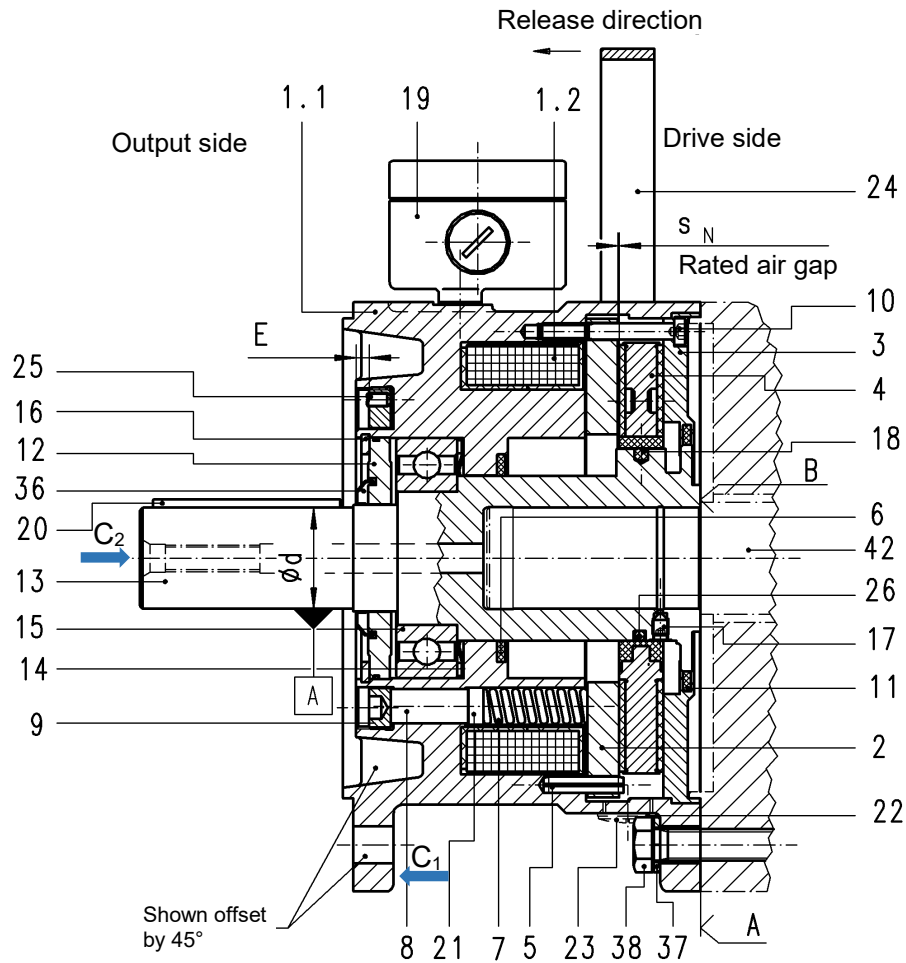


Fig. 15/1: Spring-applied single-disc brake module

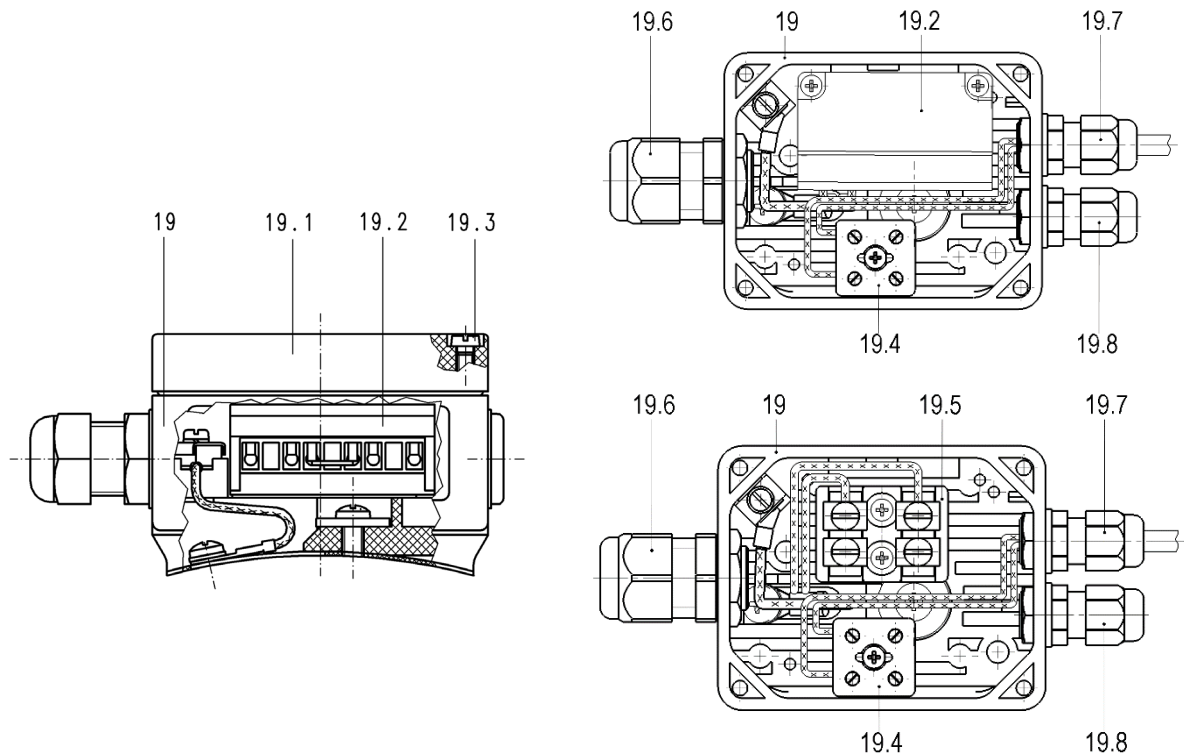


Fig. 15/2: Terminal box (19), optionally with terminal block (19.5) or rectifier (19.2) and terminal block (19.4) for microswitch (27)

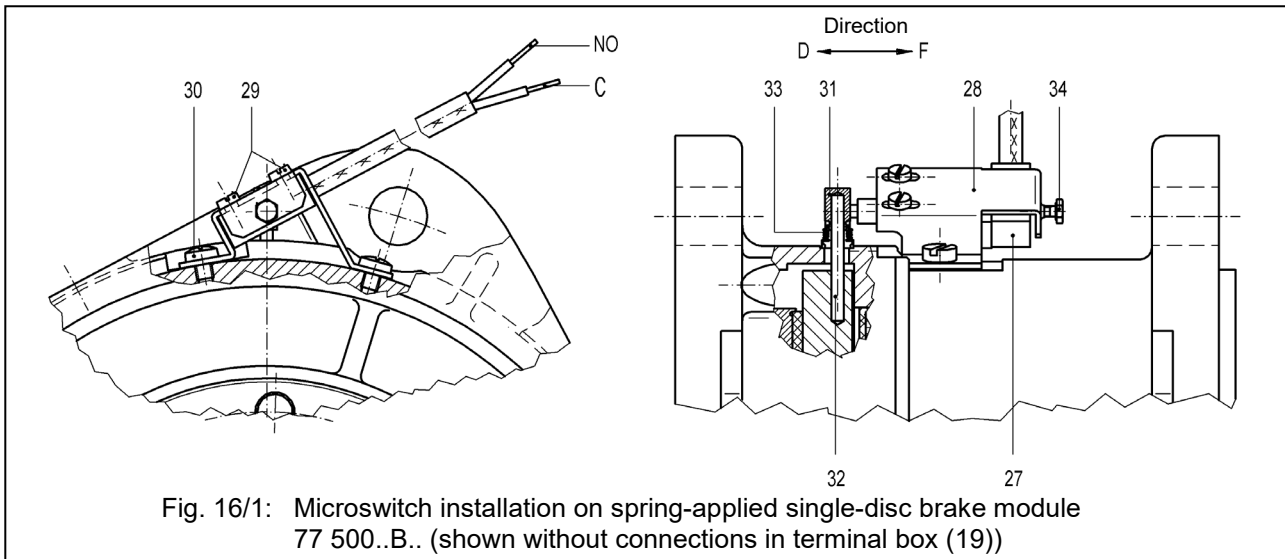


Fig. 16/1: Microswitch installation on spring-applied single-disc brake module 77 500..B.. (shown without connections in terminal box (19))

List of reference numerals in Fig. 16/1:

27	Microswitch	31	Stud
28	Actuator	32	Straight pin
29	Socket head cap screw (x2)	33	Bellows with fastener
30	Mounting screw (x2)	34	Adjusting screw M2.5x10 (not supplied)

Table 16/1: List of reference numerals for microswitch installation on spring-applied single-disc brake modules

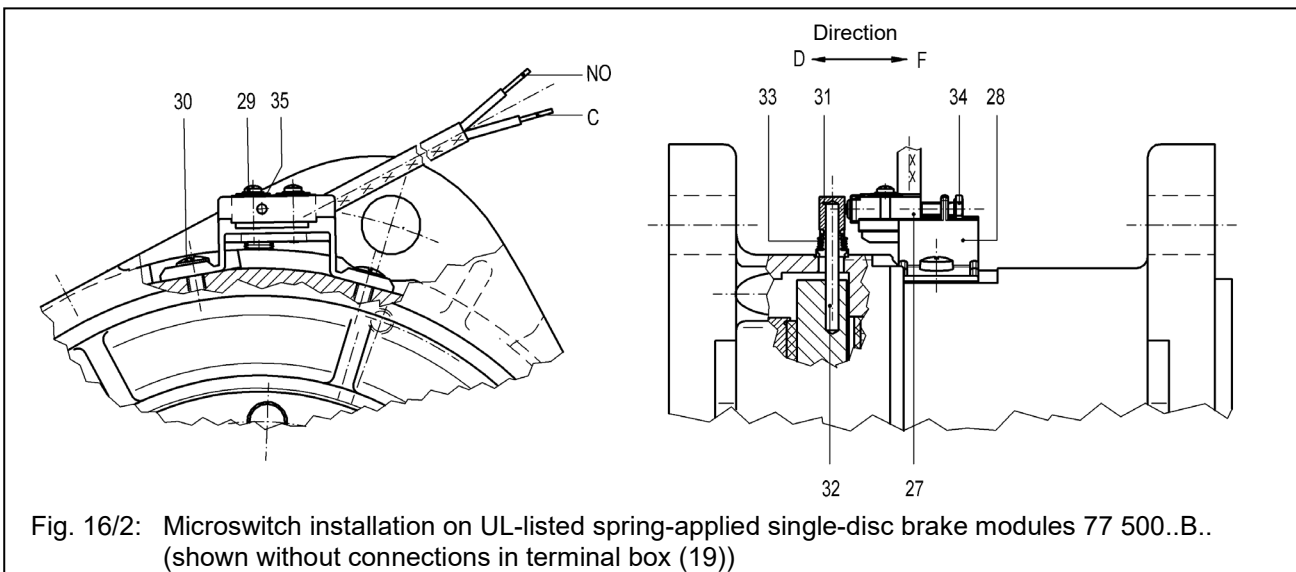


Fig. 16/2: Microswitch installation on UL-listed spring-applied single-disc brake modules 77 500..B.. (shown without connections in terminal box (19))

List of reference numerals in Fig. 16/2:

27	Microswitch	32	Straight pin
28	Actuator	33	Bellows with fastener
29	Oval head screw (x2)	34	Adjusting screw (e.g. M3x12 (not supplied))
30	Mounting screw (x2)	35	Disc spring (x2)
31	Stud		

Table 16/2: List of reference numerals for microswitch installation on UL-listed spring-applied single-disc brake modules

4. Installation

4.1 Mechanical installation

The mechanical installation of the spring-applied single-disc brake module requires two separate installation steps.

The first step is to connect the brake shaft (13) (see Section 5.3 – Spare parts and accessories, or to be provided by the user of the brake module) with the machine shaft (e.g. motor shaft) (42). The second step is to install the spring-applied single-disc brake module on the machine (e.g. motor).

The machine (e.g. motor) and brake shaft (13) have to meet specific requirements to ensure correct installation and operation of the spring-applied single-disc brake module with brake shaft (13):

- Frame type of machine (e.g. motor) IMB5 or IMB35
- Permissible tolerances (axial and radial runout) of machine shaft end (e.g. motor shaft end) (42) and mounting flange (centring diameter) of the machine (e.g. motor) in accordance with EN 50347
- Machine shaft (e.g. motor shaft) (42) without keyway because the brake shaft (13) is removed by using the oil injection method
- Surface roughness Rzmax 4 of machine shaft (e.g. motor shaft) (42) and bore of brake shaft (13)
- No impact marks or other damage to machine shaft (e.g. motor shaft) (42) and the brake shaft (13)
- Balancing of brake shaft (13) with half key (half key balancing) in accordance with ISO 21940-32

IMPORTANT



The permissible transverse forces acting on the shaft end of the machine/brake unit (e.g. motor/brake unit) and the permissible axial forces are specified in the specification sheet provided for the machine (e.g. motor). The mounted spring-applied single-disc brake module may cause heat build-up on the A-face end shield of the machine (e.g. motor) as heat dissipation towards the machine wall is inhibited. This must be taken into account when selecting the machine (e.g. motor with cooling).

4.1.1 Mechanical installation of the brake shaft (13) (accessory or customer-specific design)

The brake shaft (13) and machine shaft (e.g. motor shaft) (42) are firmly assembled by interference fit (shrink fit) to create a frictional connection for brake torque transmission.

IMPORTANT



An additional positive-locking connection is not required. The machine shaft (e.g. motor shaft) (42) must not have a keyway. If the brake shaft (13) is provided by the user of the component, the geometrical installation conditions specified in offer drawings 77 50013B16-O, 77 50019B15-O, 77 50024B15-O and 77 50029B15-O must be observed for the dimensioning and design of the customer-specific brake shaft (13).

Ensure that the brake shaft (13) is heated evenly in an electric oven or by means of an inductive heating system. Once heated, slip the brake shaft (13) onto the machine shaft (e.g. motor shaft) (42) until it is in contact with the shoulder (see Fig. 15/1). Secure it in axial direction during the cooling phase. After the brake shaft (13) has cooled down, insert the rubber bolts (18) (only for size 19 and 24 brake modules) (see Section 5.3 – Spare parts and accessories) into the bores provided in the shaft (13) (see Fig. 15/1). When using a size 29 brake module, insert the O-ring (26) (see Section 5.3 – Spare parts and accessories) into the groove machined into the brake shaft (13) for this purpose (see Fig. 15/1). The screw plug (17) of the brake shaft (13) (see Section 5.3 – Spare parts and accessories) is to be coated with a small amount of Loctite 241 and then screw it until flush or approx. 0.5mm deepened into the brake shaft (13) (see Fig. 15/1).

IMPORTANT



Before heating the brake shaft (13), make sure that the following component parts have been removed: screw plug (17) – any brake module; rubber bolts (18) – size 19 + 24 brake modules; O-ring (26) – size 29 brake modules. Check that the brake shaft (13) and the end of the machine shaft (e.g. motor shaft) (42) are dry and free from grease. Check the position of the contact shoulder of the machine shaft (e.g. motor shaft) (42) relative to the contact surface A (see Fig. 15/1) of the brake module on the motor flange and correct it by installing shim rings, if necessary. The permissible axial tolerance is ± 0.5 mm.

IMPORTANT



Before mounting the brake shaft (13), check the radial runout on the end of the machine shaft (e.g. motor shaft) (42) and mark the maximum runout angle on the front face of the machine shaft (e.g. motor shaft). When pressing the brake shaft (13) onto the machine shaft (e.g. motor shaft) (42), make sure that the mark identifying the maximum runout of the brake shaft (13) is offset by 180° to the corresponding maximum runout mark on the machine shaft (e.g. motor shaft) (42).

IMPORTANT



If rubber bolts (18) (size 19 + 24 brake modules) or an O-ring (26) (size 29 brake modules) are used, check that they are correctly positioned (rubber bolts (18): rounded end pointing outwards in the bores of the brake shaft (13) square socket; O-ring (26): located in the groove near the brake shaft teeth) (see Fig. 15/1). To reduce the push-on forces when mounting the spring-applied single-disc brake module, a small amount of talcum or equivalent material should be applied to the projecting rubber surfaces of the rubber bolts (18) or O-ring (26).



WARNING



Hazards from brake failure caused by incorrect design of the machine shaft (e.g. motor shaft) (42) and/or brake shaft (13)!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- The brake user is required to ensure that the tolerance, strength and quality of the machine shaft (e.g. motor shaft) (42) and brake shaft (13) are suitable to achieve reliable and safe transmission of the generated brake torques from the brake shaft (13) to the machine shaft (e.g. motor shaft) (42) over the entire brake service life.
- Ensure that the brake is mounted correctly and with maximum care.

NOTICE



Potential failure of the interference fit of the brake shaft (13) and machine shaft (e.g. motor shaft) (42) caused by incorrect design of the machine shaft (e.g. motor shaft) (42) and/or brake shaft (13)!

- Potential reduction of brake service life.
- Potential malfunction of the machine (e.g. motor).
- The brake user is required to ensure that the tolerance, strength and quality of the machine shaft (e.g. motor shaft) (42) and brake shaft (13) are suitable to achieve reliable and safe transmission of the generated brake torques from the brake shaft (13) to the machine shaft (e.g. motor shaft) (42) over the entire brake service life.

4.1.2 Mechanical installation of the spring-applied single-disc brake module

Install the spring-applied single-disc brake module in a vertical position with the machine shaft (e.g. motor shaft) (42) pointing vertically upwards. Slip the spring-applied single-disc brake module over the brake shaft (13) parallel to the machine shaft (e.g. motor shaft) (42) until it makes contact with the machine flange (e.g. motor flange).

Ensure that the brake shaft (13) engages with the square socket (size 13, 19 and 24 brake modules) or internal teeth (size 29 brake modules) of the friction disc (4) by a positive-locking connection.

IMPORTANT

- i** The friction disc (4) is factory-centred in the spring-applied single-disc brake module to facilitate installation. In order to avoid any shift of the friction disc (4), the brake module should only be released electromagnetically or by means of the hand release when the friction disc (4) is guided on the brake shaft (13).

Slightly tighten the mounting screws (38) with the washers (37) after having completed the preliminary assembly. Ensure that the spring-applied single-disc brake module is released electromagnetically after the power connections (see Section 4.3) have been made.

IMPORTANT

- i** Manual brake release by means of an attached hand release (24), for example, is not allowed.

To complete the brake installation procedure, use the ball bearing set (see Section 5.3 – Spare parts and accessories) provided for the spring-applied single-disc brake module. Place the spring washers (14) into the magnet housing (1.1) as shown in Fig. 15/1. Size 13 and 19 brake modules require only one spring washer each, size 24 and 29 brake modules must be equipped with two spring washers. To install the ball bearing (15), apply uniform pressure to the inner and outer rings of the ball bearing (15) to force it onto the brake shaft (13) until it touches the shaft shoulder. The necessary pressure is generated by a mounting sleeve and the thread provided at the front end of the brake shaft (13). The magnet housing (1.1) is thus centred by the ball bearing (15). Proceed to install the disc (12) and circlip (16).

Tighten the mounting screws (38) to the M_A tightening torque specified in Table 19/1. Refer to the table for information on the recommended type and size of the mounting screws.

	Brake module size			
	13	19	24	29
Recommended mounting screw (38) to ISO 4017 (property class 8.8)	M12	M14	M18	M18
Recommended washer (37) to ISO 7092 (property class 200 HV)	12	14	18	18
M_A tightening torque [Nm] for mounting screws (38)	38 – 46	63 – 77	148 – 182	148 – 182

Table 19/1: Recommended mounting screws (38) and washers (37), M_A tightening torque for mounting screws (38)



WARNING



Hazards from insufficient braking effect in case of contaminated friction surfaces of the friction disc (9) or damage to the sealing rings (6, 11) during assembly of the spring-applied single-disc brake module!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- Ensure that the friction surfaces of the friction disc (4), the guide surfaces of the square socket (size 19 & 24 brake modules) or the teeth of the friction disc (4) (size 29 brake modules) are free from grease or oil. Do not use any lubricant to improve longitudinal gliding of the friction disc (4).
- Adopt extreme caution when slipping the spring-applied single-disc brake module over the brake shaft (13). Avoid damage to the sealing rings (6) and (11). Likewise, avoid damage to the square sockets (size 19 & 24 brake modules) or teeth (size 29 brake modules) of the brake shaft (13) or friction disc (4) during assembly.

NOTICE



Risk of damage to the spring-applied single-disc brake module or individual component parts – e.g. brake shaft (13), ball bearing (15), friction disc (4), sealing rings (6, 11) – from incorrect installation!

- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- Reduced braking effect of the spring-applied single-disc brake module.
- Increased unbalance of the brake shaft (13).
- Potential reduction of service life, e.g. of ball bearing (15), friction disc (4) etc.
- Adopt extreme caution when slipping the spring-applied single-disc brake module over the brake shaft (13). Ensure that the friction disc (4) cannot get jammed on the brake shaft (13) and avoid damage to the sealing rings (6) and (11). Likewise, avoid damage to the square sockets (size 19 & 24 brake modules) or teeth (size 29 brake modules) of the brake shaft (13) or friction disc (4) during assembly. Check that you feel no resistance when sliding the friction disc (4) along the brake shaft (13) in axial direction. The brake shaft (13) and ball bearing (15) must not be exposed to any axial shocks. The disc (12) is essential to ensure correct operation of the brake module. If the disc (12) requires replacement, make sure to use an original spare part.

NOTICE



Risk of damage to the brake or mounting screws (38) if the M_A tightening torque is too high!

- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- The M_A tightening torque (see Table 19/1) specified for the mounting screws (38) must be strictly observed. Tighten the mounting screws (38) evenly in several steps.

NOTICE



Potential wear or failure of the ball bearing (15) due to incorrect design of the mounting surface or centring diameter of the machine (e.g. motor)!

- Potential reduction of brake service life.
- Potential malfunction of the machine (e.g. motor).
- The brake user is required to ensure that the tolerance, strength and quality (see Section 4.1) of the mounting surface of the machine (e.g. motor) are suitable to achieve reliable and safe operation of the component over the entire calculated service life.

IMPORTANT

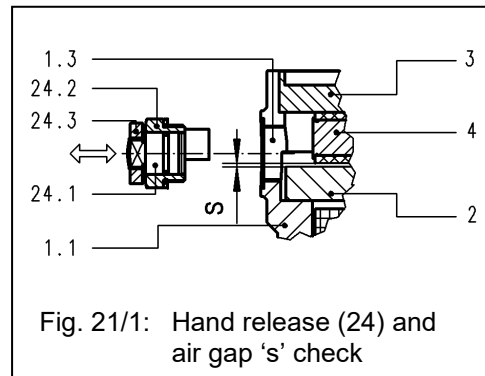


Magnetic interference fields may adversely affect reliable brake operation. Consequently, the brake should always be installed outside the reach of magnetic interference fields.

4.2 Installation of accessories (optional, not applicable to brake shaft (13))

4.2.1 Hand release (24) (only applicable to retrofitted hand release)

Remove the lateral caps (23) from the spring-applied single-disc brake module (see Fig. 21/1). Screw the threaded bushes (24.2) of the cams (24.1) into the bores of the caps (23), making sure they are in the right position (see Fig. 21/1). Apply Loctite 243 to secure them. Tighten the threaded bushes to the M_A tightening torque specified in Table 21/2. Insert the hand release handle (24.3) into the square socket provided in the cams (24.1). The hand release (24) can be operated by pushing the handle (24.3) in the direction of actuation (see Fig. 15/1). The hand release actuation force F required to release the spring-applied single-disc brake module and the maximum permissible actuation force F_{max} are specified in Table 21/2 for the individual brake module sizes.



List of reference numerals in Fig. 21/1:

1.1	Magnet housing	24.1	Cam
1.3	Bore for air gap measurement	24.2	Threaded bush
2	Armature	24.3	Handle bar
3	Flange	s	Air gap
4	Friction disc		

Table 21/1: List of reference numerals of hand release (24) and air gap 's' check

	Brake module size			
	13	19	24	29
Tightening torque M_A [Nm] for threaded bush (24.2)	20	26	35	35
Required actuation force $F^{6)}$ [Nm]	approx. 80	approx. 130	approx. 200	approx. 240
Max. permissible actuation force F_{max} [N]	120	180	280	330

Table 21/2: Required actuation force F and maximum permissible actuation force F_{max} of hand release (24), M_A tightening torque for threaded bush (24.2)

⁶⁾ Related to highest transmissible torque (standard) (see Table 59/1).

IMPORTANT

The regulations and requirements specific to the installation in which the brake is used (e.g. for hoists, cranes and elevators) must be observed when using brakes with hand release (24). When fitting the cams (24.1), ensure that the surface on the cams (24.1) points towards the armature (2).

**WARNING****Hazards from neutralization of the braking effect in case of unintentional actuation of the hand release (24)!**

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- The brake torque of the spring-applied single-disc brake module can be neutralized manually by means of the hand release (24). Consequently, the spring-applied single-disc brake module must be installed in such a way that any unintentional actuation of the hand release (24) is inhibited. If the maximum air gap s_{max} (see Table 59/1) is exceeded, the armature (2) may be in contact with the cams (24.1), causing the braking effect to be compromised. Ensure that the maximum air gap s_{max} (see Table 59/1) is not exceeded throughout the entire brake service life. Please refer to Section 5.1 (Maintenance and checks) for details.
- When the hand release (24) is not in use, ensure that the handle bar (24.3) is in a central position as shown in Fig. 15/1. Otherwise, the full braking effect of the spring-applied single-disc brake module may not be reached. Do not lock the handle bar (24.3) when actuated. If these requirements are not fulfilled, the installation or machine (e.g. motor) must be stopped immediately. Before you restart it, check that the hand release (24) is in perfect working order and that the handle bar (24.3) is in the central position.

**CAUTION****Hazards from incorrect handling of the hand release (24) during actuation!**

- Incorrect use of the hand release may cause injury hazards (e.g. hand entrapment).
- The hand release (24) must be actuated with utmost caution by pulling the handle bar (24.3). Only suitably qualified personnel are allowed to use the hand release (24).

4.2.2 Ball bearing set (ball bearing (15), spring washer (14), circlip (16), gamma ring (36))

The ball bearing set (see Section 5.3 – Spare parts and accessories) consists of the ball bearing (15), spring washer (14) and circlip (16). It is needed as a second bearing unit for the machine shaft (e.g. motor shaft) (42). The installation procedure is described in Section 4.1.2.

4.2.3 Rubber bolts (18) (size 19 & 24 brake modules) and O-ring (26) (size 29 brake modules)

Rubber bolts (18) (size 19 & 24 brake modules) or an O-ring (26) (size 29 brake modules) can be fitted to the brake shaft (13) to reduce noise during the operation of the spring-applied single-disc brake module (see Section 5.3 – Spare parts and accessories). The rubber bolts (18) for size 19 & 24 brake modules or the O-ring (26) for size 29 brake modules are installed as described in Section 4.1.1.

4.3 Electrical connection

4.3.1 Electrical connection of the spring-applied single-disc brake module

The spring-applied single-disc brake module must be connected to a DC power source. Connection to an AC power source is possible using a half-wave rectifier (19.2). Spring-applied single-disc brake modules equipped with a built-in rectifier (19.2) can be connected directly to the AC power source. The rectifier pinout is shown in Fig. 23/1. Spring-applied single-disc brake modules with terminal block (19.5) (2 poles, terminals BD1 and B2) (see Fig. 15/2) must be connected directly to the DC power source. Connect the customer-specific connecting cable to the terminal block (19.5) or to the built-in rectifier (19.2) (see Fig. 15/2) by means of a cable gland (M16x1.5, for cable diameters from 5 to 10 mm). Tighten the screws of the terminal block (19.5) or the screws of the built-in rectifier (19.2) to a tightening torque of $M_A = 0.4 \text{ Nm}$. Remove the cover (19.1) of the terminal box (19) so that the individual wires of the connecting cable can be connected to the terminal block (19.5) or to the terminals of the built-in rectifier (19.2).

Rectifier series	Rectifier type	Rated input voltage range U_1 ($\pm 10\%$) [VAC] (40 – 60 Hz)	Output voltage U_2 [VDC]	Max. output current I_2 [ADC]
32 07332B43UL	Half-wave	0 – 270	$U_1 \cdot 0.445$	2.0
The relevant rectifier specification sheets must be observed!				

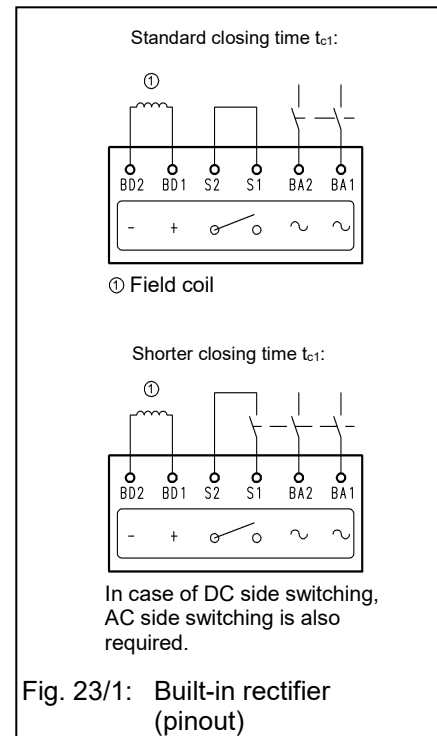
Table 23/1: Recommended external rectifiers for single-phase AC voltage supply via terminal block (19.4)

NOTICE



Risk of damage to the component (terminal box (19), cover (19.1), terminal block (19.5), rectifier (19.2), socket head cap screws (19.3) or screws of the terminal block (19.5)) if the M_A tightening torque is too high!

- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- Potential malfunction of the machine (e.g. motor).
- Ensure that you tighten the socket head cap screws (19.3) to a tightening torque of $M_A = 1.6 \text{ Nm}$ when you fix the cover (19.1) to the terminal box (19). Do not damage the seal between the terminal box (19) and cover (19.1).
- When connecting the customer-specific connecting cable, tighten the screws of the terminal block (19.5) or rectifier (19.2) to a tightening torque of $M_A = 0.4 \text{ Nm}$.



IMPORTANT



Brakes with built-in rectifiers (19.2) are equipped with a half-wave rectifier (19.2). The built-in rectifier (19.2) can be wired in such a way that AC side switching (normal closing time t_1) or DC side switching (short closing time t_1) is possible (see Fig. 23/1). Depending on the brake size and torque, voltage ripple due to intermittent power supply may cause humming or incorrect operation. Reliable operation must be ensured by the user or system manufacturer by providing suitable electrical controls.

Perform the following checks when connecting the brake:

- Check that the connecting cables and electrical components (e.g. switches, contacts etc.) are suitable for the intended use and for the voltage and amperage requirements.
- 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.



DANGER



Electricity hazards from incorrect electrical connection of the component!

- Fatal electric shock hazard.
- All work must be performed by qualified specialist personnel only. Check that no voltage is present before connecting the component to the power supply. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box of the machine (e.g. motor) or in the operating instructions must be strictly observed.

NOTICE



Risk of damage to the field coil (1.2) from incorrect electrical connection of the component!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- The brake is a DC operated system. The permissible permanent voltage variations on the power source of the electromagnetic brake are specified in Table 60/4.

4.3.2 DC power supply

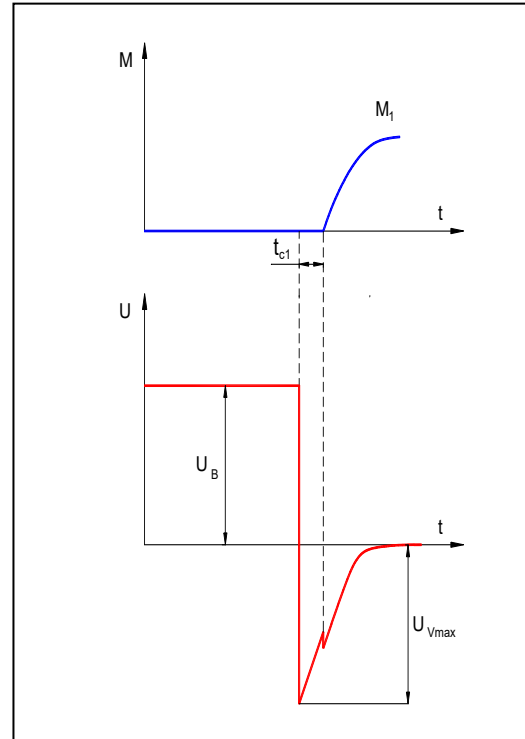
The figure to the right shows the voltage and torque curves after the field coil (1.2) has been de-energized without protective circuit (time t_{c1} specified in Section 10).

NOTICE



Risk of damage to or destruction of the brake field coil (1.2) from overvoltage!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Potential malfunction of the machine (e.g. motor).
- The peak voltage U_{Vmax} during turn-off 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 turn-off. Consequently, a protective circuit must be provided to reduce the current during turn-off and to limit the voltage. The maximum permissible overvoltage during turn-off is 1500 V.



U_B operating voltage (coil voltage)
 U_{Vmax} turn-off voltage

NOTICE



Risk of damage to or destruction of electronic components from overvoltage!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Potential malfunction of the machine (e.g. motor).
- The maximum permissible overvoltage during turn-off is 1500 V. If Kendrion rectifiers (see Table 23/1) or modules with built-in rectifier are used, the protective circuit (varistor S10K550) required for the built-in electronic components and field coil (1.2) is included in the rectifier and limits the disconnection voltage to approx. 750 V. This also applies to the external switching contact (DC side turn-off) required for terminals S1 and S2. Sensitive electronic components (e.g. logical components) and sensitive mechanical circuitry elements may also be damaged at a lower voltage.

4.3.3 AC power supply

Brake connection to an AC power source is only possible if a rectifier is used. The closing times t_{c1} (as defined in Section 10) 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 U_1 . Half-wave rectifiers produce voltage with high residual ripple which, depending on the brake module size, may slightly reduce the opening time t_o (as defined in Section 10) when compared to bridge rectifiers. This (plus the lower coil voltage) is the reason why half-wave rectifiers are generally preferred to bridge rectifiers. However, humming of the brake module may occur when small size modules are used.

Bridge rectification:

Bridge rectifiers provide voltage with minimum residual ripple. In case of bridge rectification, the U_2 coil voltage is lower by factor 0.89 than the rectifier input voltage U_1 .

AC side switching:

In case of AC side switching, the AC voltage is interrupted before the rectifier (mains side) by the switch at the terminals BA1 and BA2 (see Fig. 23/1 for built-in rectifier). However, when operating the spring-applied single-disc brake module in this way, bear in mind that the closing times t_{c1} (see Table 59/1, definition in Section 10) of the brake module are extended due to the free-wheeling diode located in the rectifier. The opening times t_o (see Table 59/1, definition in Section 10) are not extended.

DC side switching:

In case of DC side brake switching, the power supply to the brake module is interrupted on the DC side (brake module side) by an additional auxiliary contact at the terminals S1 and S2 (see Fig. 23/1 for built-in rectifier). When operating the spring-applied single-disc brake module in this way, bear in mind that the significant reduction of the electric time constant causes the brake to close quickly and the switching noise to increase (see Section 7 – Emissions).

NOTICE



Risk of damage to or destruction of electronic components and the brake field coil (1.2) if protection measures are insufficient or inadequate!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Potential malfunction of the machine (e.g. motor).
- When using rectifiers without internal protective circuitry and in case of DC side switching, the brake module must be operated with a protective circuit to avoid overvoltage (see Section 4.3.2). Additional protective elements (e.g. varistors, spark arresters, etc.) must be installed to avoid damage such as burns or fusing of contacts to external circuitry. (Circuit example and electrical components for protective circuitry: see Table 26/1 and Fig. 26/1)

Ref.	Designation	Ref.	Designation	Ref.	Designation
①	Field coil (1.2)	③	Varistor type S10K550 (for connection up to 400 VAC)	⑤	Varistor type S10K30 (for connection up to 24 VDC)
②	Rectifier (without internal protective circuitry)	④	Free-wheeling diode	S .. S ₃	Switch

Table 26/1: Electrical components and recommended varistors for external protective circuitry in case of DC side switching of the brake module

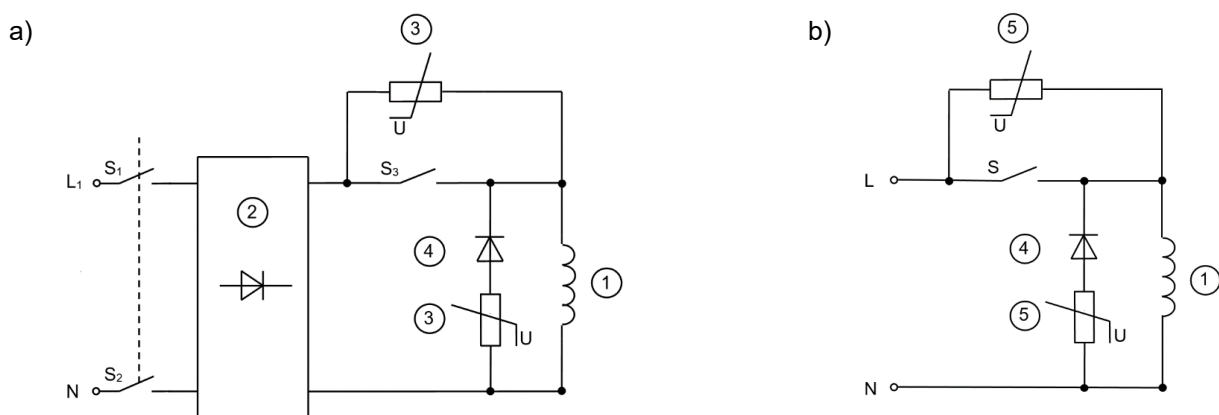


Fig. 26/1: Circuit examples for recommended protective circuitry with DC side switching of brake module

- a) Connection of field coil (1.2) to AC power source via external rectifier without internal protective circuitry
- b) Connection of field coil (1.2) directly to DC power source

4.3.4 Microswitch (27) connection (only applicable to brake modules with microswitch (27))

If the spring-applied single-disc brake module is equipped with a microswitch (27) to control the switching state of the brake, the microswitch (27) must be tied into the control circuit of the machine (e.g. motor) or into the safety circuit of the installation. If the microswitch is correctly wired into the control circuit of the machine (e.g. motor), it will prevent start-up of the machine (e.g. motor) before the brake module has been released. If the microswitch (27) is wired into a safety circuit, the switching state (open or closed) of the brake module can be determined by evaluating the contacts of the microswitch (27).

The spring-applied single-disc brake module is delivered with factory-adjusted microswitch (27) and with the microswitch connection cable wired to the terminal block (19.4) in the terminal box (19) (see Fig. 15/2). In order to connect the wires of the customer-specific connecting cable to the terminal block (19.4), remove the cover (19.1) (see Section 4.3.1) of the terminal box (19). Connect the customer-specific connecting cable for the microswitch (27) to the terminal block (19.4) by means of a cable gland (M12x1.5, for cable diameters from 3 to 6.5 mm) (see Fig. 15/2). When doing so, tighten the screws of the terminal block (19.4) to a tightening torque of $M_A = 0.4 \text{ Nm}$.

UL-listed brake module	Contact	Contact type	UL-unlisted brake module	Contact	Contact type
Brown wire lead (br)	1.1 (C)	NO	Brown wire lead (br)	1.1 (C)	NO
Black wire lead (bk)	1.2 (NO)		Blue wire lead (bl)	1.2 (NO)	

Table 27/1: Assignment of the microswitch (27) contacts to the wire leads and design of the microswitches for UL-listed and unlisted brake modules

IMPORTANT



The microswitch (27) is an optional item. As it cannot be retrofitted at a later date, it must be ordered together with the brake module.

IMPORTANT



The correct integration of the microswitch (27) into the control circuit of the machine (e.g. motor) or into the safety circuit of the installation is the responsibility of the system user. If applications are subject to specific regulations and guidelines regarding the integration of the microswitch (27), the system user is required to ensure compliance with the applicable requirements. When the brake is used for applications with load torque impact, the system user is responsible to ensure correct and safe wiring of the microswitch (27).



DANGER



Electricity hazards from incorrect electrical connection of the microswitch (27)!

- Fatal electric shock hazard.
- All work must be performed by qualified specialist personnel only. Check that no voltage is present when connecting the microswitch to the power supply. The specific instructions provided by the manufacturer of the machine (e.g. motor) must be strictly observed.



WARNING



Hazards from accidental or unintentional start-up of the machine (e.g. motor) caused by incorrect electrical connection of the microswitch (27) to the power supply or by incorrect wiring of the machine (e.g. motor)!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- The motor circuitry must be protected in such a way that any accidental or unintentional start-up of the machine (e.g. motor) is avoided when the microswitch (27) contact closes.

NOTICE



Risk of damage to or malfunction of the microswitch (27) from incorrect microswitch connection to the power supply!

- Evaluation of the microswitch contacts to determine the operating state of the spring-applied single-disc brake module may not be possible.
- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- The correct integration of the microswitch (27) into the control and safety circuit of the machine (e.g. motor) and the correct evaluation of the microswitch contact signals are the responsibility of the system user.

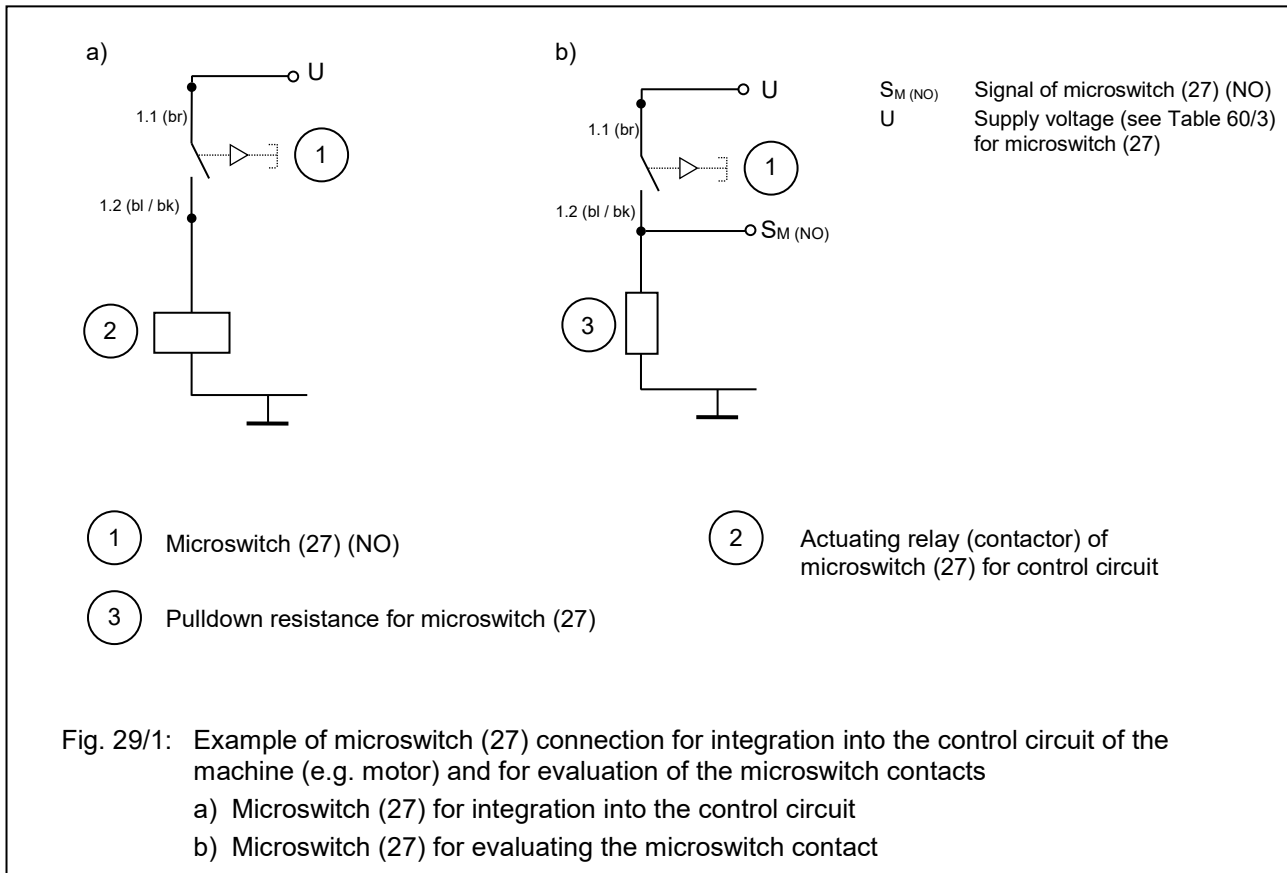
NOTICE



Risk of damage to the component (terminal box (19), cover (19.1), terminal block (19.4), socket head cap screws (19.3) or screws of the terminal block (19.4)) if the M_A tightening torque is too high!

- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- Potential malfunction of the machine (e.g. motor).
- Ensure that you tighten the socket head cap screws (19.3) to a tightening torque of $M_A = 1.6 \text{ Nm}$ when you fix the cover (19.1) to the terminal box (19). Do not damage the seal between the terminal box (19) and cover (19.1).
- When connecting the customer-specific connecting cable for the microswitch (27), tighten the screws of the terminal block (19.4) to a tightening torque of $M_A = 0.4 \text{ Nm}$.

The electrical connection of the microswitch (27) can be made as shown in Fig. 29/1 unless otherwise specified by the system user. The technical specifications of the microswitch (27) are listed in Table 60/3.



4.4 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-disc brake modules in the 77 500..B.. series are designed for industrial applications to which the following EMC standards apply: Generic Immunity Standard EN IEC 61000-6-2 and Generic Emission Standard EN 61000-6-3 / EN IEC 61000-6-4. Other applications may be subject to different generic standards which must be considered by the manufacturer of the installation. The requirements in terms of electromagnetic compatibility of devices and components are determined by basic standards derived from the generic standards. Wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial use and other applications. Please refer to the relevant specification sheets for additional information on electromagnetic compatibility, especially with respect to the recommended electronic rectifiers specified in Section 4.3.1.

Immunity according to EN 61000-4:

EN 61000-4-2 Electrostatic discharge:

The spring-applied single-disc brake modules comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 4.3.1 conform to severity level 3 without additional measures.

EN 61000-4-3 Electromagnetic fields:

The spring-applied single-disc brake modules 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 spring-applied single-disc brake modules 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 spring-applied single-disc brake modules 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 spring-applied single-disc brake modules 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:

Spring-applied single-disc brake modules 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 spring-applied single-disc brake module 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 component 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 spring-applied single-disc brake modules and the recommended electronic rectifiers 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.

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. 31/1 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 4.3.1 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. 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, devices designed to limit the turn-off 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 4.3.1 are equipped with free-wheeling diodes and/or varistors to limit the turn-off 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 31/1.

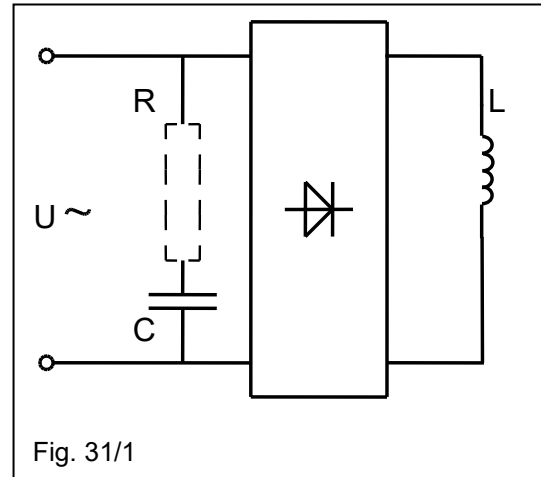


Fig. 31/1

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 will not relieve the user and manufacturer of the installation from their obligation to furnish proof of conformity of the installation with such standards.

Max. rectifier operating voltage [VAC]	Recommended turn-off voltage for DC side switching [V]
297	700

Table 31/1: Recommended turn-off voltage in case of DC side switching for rectifiers specified in Table 23/1

4.5 Putting into service

Check compliance with the specifications provided on the rating plate with respect to the mounting position and protection class. Establish a separate electrical test connection of the spring-applied single-disc brake module and release the brake module electromagnetically. Then check the friction disc (4) and brake shaft (13) for free movement by turning the machine shaft (e.g. motor shaft) (42). Check that the axial and radial runout is within the tolerance range specified in EN 50347. The running-in conditions for the ball bearing (15) and bearing replacement intervals are specified in the data sheets provided by the bearing manufacturer or in the machine operating instructions of the machine manufacturer (e.g. motor manufacturer). After completion of mounting, all necessary covers and guards must be installed. If necessary (e.g. after a prolonged storage period), a break-in process must be conducted in accordance with the parameters specified in Table 60/2.

IMPORTANT

i Connect the brake to the power source as described in Section 4.3 after the functional tests have been completed.

Specifications on the rating plate (subject to order, example brake type 77 50024B15):

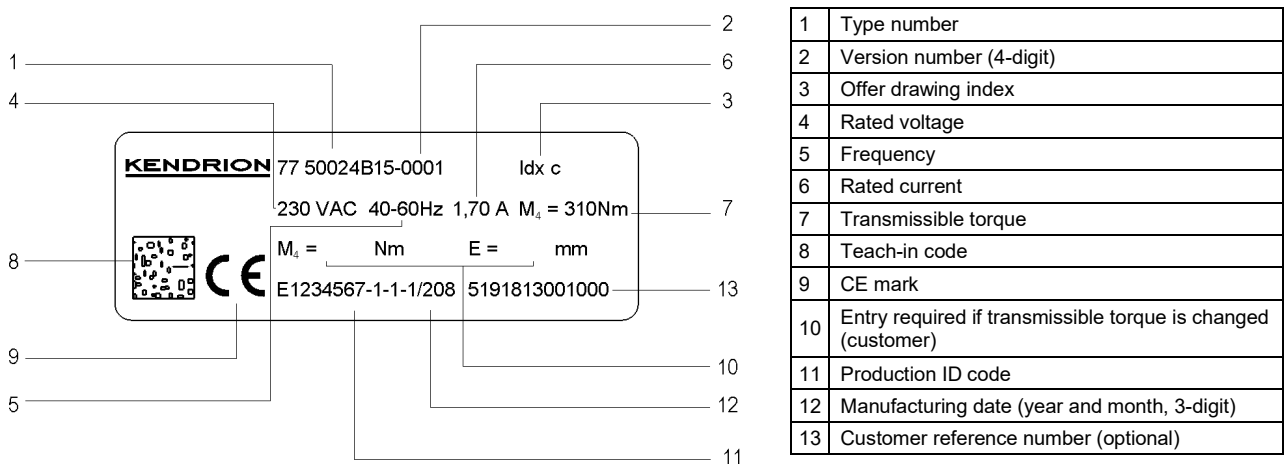


Fig. 32/1: Example of rating plate of UL-unlisted spring-applied single-disc brake modules

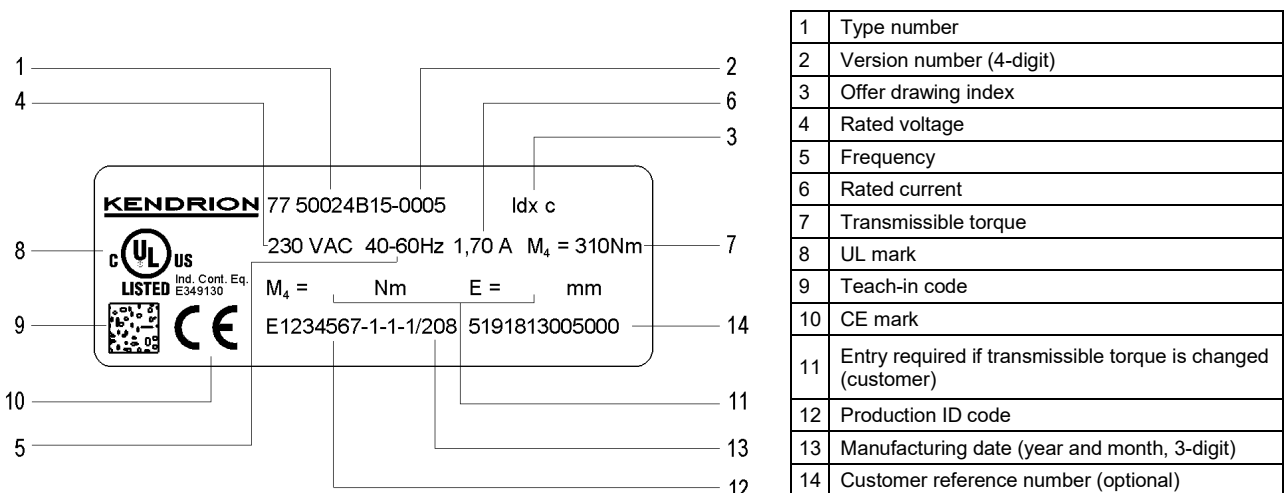


Fig. 32/2: Example of rating plate of UL-listed spring-applied single-disc brake modules

Note: The product number of the spring-applied single-disc brake module consists of the type number followed by the version number, e.g. 77 50024B15-0001.

**DANGER****Electricity hazards from incorrect electrical connection of the component!**

- Fatal electric shock hazard.
- All work must be performed by qualified specialist personnel only. Check that no voltage is present before connecting the component to the power supply. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box of the machine (e.g. motor) or in the operating instructions must be strictly observed.

**CAUTION****Hazards from contact with rotating parts (e.g. brake shaft (13), machine shaft (e.g. motor shaft) (42) etc.) during operation of the spring-applied single-disc brake module and/or machine (e.g. motor)!**

- Physical injury hazard (e.g. chafing, cuts etc.) to hands and limbs.
- Functional testing of the brake must not be performed unless the machine (e.g. motor) has been turned off and secured so that it cannot be turned back on inadvertently or by unauthorized persons. Do not touch rotating parts (e.g. brake shaft (13), machine shaft (e.g. motor shaft) (42) etc.).

**CAUTION****Hazards from contact with loose parts during operation of the spring-applied single-disc brake module and/or machine (e.g. motor)!**

- Physical injury hazard (e.g. cuts etc.) to limbs and other parts of the body.
- 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 machine shaft (e.g. motor shaft) (42) must not be exposed to load torques. Before the machine is re-started, the brake module must be de-energized.

**CAUTION****Hazards from contact with hot parts during operation of the spring-applied single-disc brake module!**

- Injury hazard (e.g. skin burns) to hands, limbs and other parts of the body.
- Depending on the operating state of the brake, its surface temperature may rise to over 60°C. If necessary, suitable protections and hand guards must be installed to avoid accidental contact with hot surfaces.
- Wear protective gloves, if necessary.

NOTICE**Risk of property damage caused by hot parts during operation of the spring-applied single-disc brake module!**

- Release of the spring-applied single-disc brake module may no longer be possible.
- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- 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 hot surfaces.

NOTICE



Risk of damage to or destruction of the brake field coil (1.2) if the high-voltage test is not performed correctly!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Putting into service of the spring-applied single-disc brake module and motor may not be possible.
- High-voltage tests performed when mounting the brake in an installation or when putting the brake into service 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 in DIN VDE 0580 must be observed.

NOTICE



Risk of damage to the field coil (1.2) from incorrect electrical connection of the component!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Putting into service of the spring-applied single-disc brake and machine (e.g. motor) may not be possible.
- Check that the brake has been connected in accordance with the specifications provided on the rating plate before it is put into service. 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 4.3.2 will cause damage to electronic rectifiers, electronic accessories, switching contacts and to the field coil (1.2).

NOTICE



Potential wear or failure of the ball bearing (15) due to incorrect installation or adverse operating conditions!

- Potential reduction of brake service life.
- Potential malfunction of the machine (e.g. motor).
- When using vertical machines (e.g. motors) with the brake shaft (13) pointing upwards, any ingress of fluids (water, drilling emulsion, cooling lubricant etc.) into the ball bearing (15) of the spring-applied single-disc brake module must be avoided.

Manual release of the spring-applied single-disc brake module:

The spring-applied single-disc brake module can be released manually by means of an attached mechanical hand release (24) (accessory). Instead of using the hand release in case of power failure, it is also possible to release the brake electrically with a UPS (e.g. UPS battery system). For this purpose, the brake user is required to install a UPS with a voltage rating that matches the specifications on the brake module rating plate.



WARNING



Hazards from neutralization of the braking effect in case of unintentional release of the spring-applied single-disc brake module!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- Proceed with utmost caution if you intend to release the spring-applied single-disc brake module manually (jog mode), e.g. while servicing the machine (e.g. motor) or when the regular power supply fails during UPS operation. If the drive system is unbalanced, the load torque may accelerate the drive. The user is responsible to ensure that the load torque does not cause any hazards when the brake module is released or engaged in jog mode.

4.6 M₄ transmissible torque adjustments

The spring-applied single-disc brake modules are factory-adjusted to the M₄ transmissible torque. The factory-adjusted M₄ transmissible torque is specified on the rating plate. The adjusting ring clearance 'E' (see Fig. 15/1) is marked on the bottom of the machined pocket in the magnet housing (1.1) near the set screw (25).

If necessary, the transmissible torque M₄ can be changed by turning the adjusting ring (9) (see Table 36/1) with a suitable pin spanner (see Section 9).

IMPORTANT



Remove the set screw (25) completely before turning the adjusting ring (9).

After having changed the torque, tighten the set screw (25) to a tightening torque of $M_A = 2.5 - 3.0$ Nm. The changed transmissible torque M₄ and the new clearance 'E' of the adjusting ring (9) must be entered on the rating plate (see Section 4.5) by the user of the component, making sure that the entry is wipe-proof and rub-proof.

IMPORTANT



After turning the adjusting ring, check that the set screw (25) is not within the reach of the studs (8). Secure the set screw (25) with Loctite 243, for example. A visual check can be carried with a torch, for example, when the set screw (25) is unscrewed. In addition, apply a medium-strength thread locker, e.g. Loctite 243, to the set screw (25) before tightening it. When changing the transmissible torque M₄, the closing times t_{c1} (see Table 59/1) change only insignificantly. The opening times t_2 (see Table 59/1) are reduced proportionally to the torque reduction. After the torque adjustment has been completed, deviations in the transmissible torque M₄ from the theoretically set value are still possible.

	Brake module size		
	19	24	29
Change in transmissible torque $\Delta M_4/\text{mm}$ [Nm]	approx. 22.5	approx. 37	approx. 70
Transmissible torque (standard) M_4 [Nm]	150	310	500
Max. transmissible torque $M_{4\text{max}}$ [Nm]	150	310	500
Min. transmissible torque $M_{4\text{min}}$ [Nm]	60	140	280
Range of permissible adjusting ring clearance E [mm]	2 – 6	2.1 – 6.6	4.25 – 7.5

Table 36/1: Change in the M_4 transmissible torque [Nm] from 1 mm axial adjustment of the adjusting ring (9); M_4 transmissible torque (standard value) and $M_{4\text{max}}$ maximum transmissible torque; range of permissible adjusting ring clearance E

IMPORTANT



The M_4 transmissible torque cannot be changed in size 13 spring-applied single-disc brake modules.



WARNING



Hazards resulting from a low braking effect due to incorrect adjustment of the M_4 transmissible torque!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- When adjusting the adjusting ring (9) on the basis of the values given in Table 36/1, ensure that the M_4 transmissible torque is not below the minimum torque required. Ensure that the adjusting ring clearance 'E' is within the permissible range (see Table 36/1). The adjusting ring clearance 'E' must be marked on the bottom of the machined pocket in the magnet housing (1.1) after the torque has been changed. After adjustment of the M_4 transmissible torque, the brake user is required to ensure that the adjusting ring (9) is secured with the set screw (25). The tightening torque to be applied is $M_A = 2.5 - 3.0$ Nm. The adjusting ring (9) must be turned in such a way that the set screw (25) can be located between the studs (8).

5. Maintenance, repair and replacement

5.1 Maintenance and checks

The spring-applied single-disc brake module does not require any particular maintenance. Tests performed to check the safety, reliability and correct operation of the brake must be conducted during the regular inspection and service of the machine (e.g. motor). The test features, test procedures, test criteria and intervals are specified in Table 37/1, Table 38/1 and Table 38/2.

Test features:

Electrical connection and overall appearance

Test procedures / criteria	<p><u>Checking the electrical connection:</u></p> <p>Perform a visual inspection of the electrical connection of the brake and microswitch (27) and check them (only relevant for brake modules with microswitch (27)).</p>
	<p><u>Test criterion:</u></p> <p>Complete absence of damage or defects to the electrical connection and connecting cable of the microswitch (27).</p>
	<p><u>Checking the overall appearance:</u></p> <p>Perform a visual inspection of the mechanical components of the brake module and check them. If dirt has accumulated in the brake or on the rating plate due to friction lining abrasion or foreign matter, clean the affected surfaces with oil-free compressed air or by using a brush.</p>
	<p><u>Test criterion:</u></p> <p>Complete absence of damage or defects to the mechanical brake components.</p>

IMPORTANT



Replace the brake module if any defects are suspected. The brake shaft (13) can be replaced, if necessary (see Section 5.2.5). A new spring-applied single-disc brake module must be mounted as described in Section 4. To put the new brake into service, follow the instructions in Section 4.5.

Table 37/1: Checking the electrical connection and overall appearance

Microswitch (27) switching state (only relevant for brake modules with microswitch (27))

Test procedures / criteria	<p><u>Checking the microswitch (27) when the brake module is disengaged:</u> Check that the microswitch (27) is actuated when the brake module is disengaged. Check the switching state of the microswitch (27) by connecting a continuity tester or multimeter (see Section 9) to the terminals on the terminal block (19.4) provided for the customer-specific connecting cable (see Fig. 16/1).</p> <p><u>Test criterion:</u> Electrical connection of NO and C contacts.</p>
	<p><u>Checking the microswitch (27) when the brake module is engaged:</u> Check that the microswitch (27) is not actuated when the brake module is engaged. Check the switching state of the microswitch (27) by connecting a continuity tester or multimeter (see Section 9) to the terminals on the terminal block (19.4) provided for the customer-specific connecting cable (see Fig. 16/1).</p> <p><u>Test criterion:</u> No electrical connection of contacts NO and C.</p>

IMPORTANT



If a microswitch failure is identified, adjust the microswitch (27) (see Section 5.2.1) or replace it (see Section 5.2.2). If faults occur that are not attributable to malfunctions of the microswitch (27) (see troubleshooting information in Section 8), replace the brake as described in Section 5.2.3.

Table 38/1: Checking the microswitch (27) of the brake module

Air gap 's' (see Fig. 15/1)

Test procedures / criteria	<p><u>Checking the air gap 's' of the brake module:</u> After removing the two caps (23) located opposite each other, release the spring-applied single-disc brake module electromagnetically while the machine (e.g. motor) is turned off. Insert a feeler gauge into the threaded bores (air gap measurement bore (1.3)) to check the distance 's' (see Fig. 21/1) between the armature (2) and the friction disc (4).</p>
	<p>IMPORTANT</p> <p>i If the brake module is equipped with a hand release (24), first remove the handle bar (24.3) of the hand release (24) and unscrew the threaded bushes (24.2) with the cams (24.1). The air gap 's' must be checked at each threaded bore (1.3).</p> <p><u>Test criterion:</u> The measured values of the air gaps 's' must not exceed the limit values specified for the rated air gap s_N and the maximum air gap s_{max} (see Table 59/1).</p>

IMPORTANT



When the maximum air gap s_{max} (see Table 59/1) is reached, replace the friction disc (4) to maintain the functional reliability and safety of the brake module (see Section 5.2.4). The air gap 's' cannot be adjusted. When replacing the friction disc (4), also check the armature (2) and the flange (3) for possible damage or contamination. Replace the brake module if any defects are suspected. To remove the brake module for replacement, follow the instructions in Section 5.2.3. To install the new brake module and put it into service, proceed as described in Sections 4 and 4.5 respectively.

Table 38/2: Checking the air gap 's' of the brake module

**DANGER****Electricity hazards from incorrect electrical connection or disconnection of the component!**

- Fatal electric shock hazard.
- All work must be performed by qualified specialist personnel only. Check that no voltage is present before connecting the component to the power supply. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box of the machine (e.g. motor) or in the operating instructions must be strictly observed.

**WARNING****Hazards from insufficient braking effect in case of contaminated friction surfaces of the friction disc (4) of the spring-applied single-disc brake module!**

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- Ensure that all surfaces involved in the friction process are free of grease and oil. An oily or greasy friction disc (4) cannot be cleaned.
- Check that no swelling or glazing of the friction lining has occurred.

**CAUTION****Hazards from contact with rotating parts (e.g. brake shaft (13), machine shaft (e.g. motor shaft) (42) etc.) during operation of the spring-applied single-disc brake module and/or machine (e.g. motor)!**

- Physical injury hazard (e.g. chafing, cuts etc.) to hands and limbs.
- Functional testing of the brake must not be performed unless the machine (e.g. motor) has been turned off and secured so that it cannot be turned back on inadvertently or by unauthorized persons. Do not touch rotating parts (e.g. brake shaft (13), machine shaft (e.g. motor shaft) (42) etc.). Ensure that no load torque acts on the machine shaft (e.g. motor shaft) (42).
- After completion of inspection and maintenance operations, remove the lock provided to prevent accidental start-up of the machine (e.g. motor).

NOTICE**Risk of damage to the spring-applied single-disc brake module caused by incorrect maintenance!**

- The correct function and operation of the spring-applied single-disc brake module may be compromised.
- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- The tests conducted to check the safety, reliability and correct operation of the brake module require extreme caution and must be performed by qualified specialist personnel only. Any adjustments of the microswitch (27) must only be carried out by the brake manufacturer (only relevant for brake modules equipped with microswitch (27)). The information on the rating plate attached to the spring-applied single-disc brake module must be strictly observed during maintenance and when putting the brake module back into service.

IMPORTANT



Service and maintenance of the brake module during operation is performed by the manufacturer of the machine (e.g. motor) in accordance with their specific maintenance instructions. The specific maintenance instructions of the machine manufacturer (e.g. motor manufacturer) must take account of the requirements specified in Section 5.1 (Maintenance and checks) of these operating instructions.



WARNING



Hazards from insufficient braking effect due to failure to comply with the specified service, maintenance and inspection requirements and intervals!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- Ensure that the maximum air gap s_{max} (see Table 59/1) is not exceeded during operation of the spring-applied single-disc brake module. Therefore, the test intervals must be determined by the manufacturer of the machine (e.g. motor) or by the user of the component in such a way that correct operation of the brake module is ensured throughout the entire service life.

NOTICE



Risk of damage to the spring-applied single-disc brake module due to failure to comply with the specified service, maintenance and inspection requirements and intervals!

- The correct function and operation of the spring-applied single-disc brake module may be compromised.
- Potential malfunction of the machine (e.g. motor).
- The test intervals must be determined by the manufacturer of the machine (e.g. motor) or by the user of the component in such a way that correct operation of the brake module is ensured throughout the entire service life.

5.2 Repair or replacement of the brake module or its component parts in case of failure

If a failure occurs, the entire spring-applied single-disc brake module has to be replaced by the manufacturer of the machine (e.g. motor). The brake module can only be repaired by the brake manufacturer or by specially trained and qualified specialist personnel of the machine manufacturer or motor manufacturer.

IMPORTANT



The replacement of the brake module must be performed in accordance with the specific maintenance instructions provided by the manufacturer of the machine (e.g. motor). These instructions must take account of the requirements specified in Section 4 (Installation) and Section 5.2 (Repair or replacement of the brake module or its component parts in case of failure) of this manual.



DANGER



Electricity hazards from incorrect electrical connection or disconnection of the component!

- Fatal electric shock hazard.
- All work must be performed by qualified specialist personnel only. Check that no voltage is present before connecting or disconnecting the component to/from the power supply. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box of the machine (e.g. motor) or in the operating instructions must be strictly observed.



DANGER



Hazards from incorrect brake replacement!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- Before loosening the mounting screws (38) or replacing the brake, the service or maintenance personnel of the machine or motor manufacturer or the system user must shut down the machine (e.g. motor). Brake replacement must not be performed unless the machine (e.g. motor) has been turned off and secured so that it cannot be turned back on inadvertently or by unauthorized persons. Do not touch rotating parts (e.g. friction discs (4), brake shaft (13), machine shaft (e.g. motor shaft) (42) etc.).



WARNING



Hazards from neutralization of the braking effect in case the maximum permissible air gap s_{max} of the spring-applied single-disc brake module is exceeded!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- Depending on the brake operating condition, the braking effect (brake function) may be compromised or even lost when the maximum air gap s_{max} (see Table 59/1) is exceeded. Replace the friction disc (4) or entire brake **at the latest** when the maximum air gap s_{max} (see Table 59/1) is reached.

NOTICE



Risk of damage to the brake or machine (e.g. motor) in case the maximum permissible air gap s_{\max} is exceeded!

- Release of the spring-applied single-disc brake module may no longer be possible.
- Potential malfunction of the machine (e.g. motor).
- Depending on its operating condition, it may no longer be possible to release the spring-applied single-disc brake module when the maximum air gap s_{\max} (see Table 59/1) has been exceeded. In this case, the braking effect can no longer be neutralized. This may cause thermal overloading of and irreversible damage to the spring-applied single-disc brake module if the machine (e.g. motor) is started before the brake module has been released. Thermal overloading of the machine (e.g. motor) may occur if the machine (e.g. motor) is not able to start while the brake module is still engaged.

NOTICE



Risk of damage to the brake or mounting screws (38) if the M_A tightening torque is too high!

- Potential breakage of the mounting screws (38).
- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- The M_A tightening torque (see Table 19/1) specified for the mounting screws (38) must be strictly observed. Tighten the mounting screws (38) evenly in several steps.

NOTICE



Risk of damage to the spring-applied single-disc brake module caused by incorrect maintenance or replacement!

- The correct function and operation of the spring-applied single-disc brake module may be compromised.
- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- The repair or replacement of the brake or individual component parts require extreme caution and must be performed by qualified and specifically trained specialist personnel only.

5.2.1 Microswitch adjustment (27)

The microswitch (27) may have to be adjusted if it fails to work correctly (e.g. faulty switching state).

Preparations:

- Disconnect the customer-specific connecting cable provided for the microswitch (27) from the terminal block (19.4) (removal of cover (19.1) see Section 4.3.1).
- To check whether an adjustment of the microswitch (27) is necessary, release or engage the spring-applied single-disc brake module electromagnetically.
- In both switching states (brake module released and brake module engaged), determine the switching state of the microswitch (27) by checking the microswitch contacts (see Table 38/1 – Microswitch (27) switching state). To do so, connect a continuity tester or multimeter (see Section 9) to the terminals of the terminal block (19.4) provided for the customer-specific connecting cable (see Fig. 16/1).

If the test criteria specified for the microswitch (27) in Table 38/1 are not met when the brake module is released or engaged, the microswitch (27) needs to be readjusted.

Adjustment of the microswitch (27) of UL-listed and unlisted brake modules (see Fig. 16/2 and Fig. 16/1 respectively):

- Slightly loosen the socket head cap screws (x2) (29) or the oval head screws (x2) with cross recess (29).
- Scenario A:
If the switching contact of the microswitch (27) is “closed” (NO and C contacts connected, i.e. circuit closed), move the microswitch (29) back in the direction marked F (see Fig. 16/1) beyond the reset point RP (switching contact opens) of the microswitch (27). Then screw in the adjusting screw (34) (e.g. hexagon head cap screw to ISO 4017, M2.5x8-8.8, not supplied) to move the microswitch in the direction marked D (see Fig. 16/1) exactly up to the switching point SP (switching contact closes).
- Scenario B:
If the switching contact of the microswitch (27) is “open” (NO and C contacts disconnected, i.e. circuit open), screw in the adjusting screw (34) (e.g. hexagon head cap screw to ISO 4017, M2.5x8-8.8, not supplied) to move the microswitch in the direction marked D (see Fig. 16/1) exactly up to the switching point SP (switching contact closes).
- At this point, continue to tighten the adjusting screw (34) by the axial distance “X” (see Table 43/1) or by the screw rotation angle α (see Table 43/1) and tighten one of the two socket head cap screws (29) to secure the microswitch in its position.
- Apply Loctite 241 to the second socket head cap screw (29) or oval head screw (29) and tighten it to the M_A tightening torque specified in Table 43/1. Then loosen the first socket head cap screw (29) or oval head screw (29), which is still unsecured at this stage, apply Loctite 241 and tighten it to the M_A tightening torque specified in Table 43/1.
- After completion of adjustment, remove the adjusting screw (34) and perform a functional test as specified in Section 5.1 and Table 38/1. For the electrical connection of the microswitch (27), follow the instructions provided in Section 4.3.4.

UL-unlisted brake modules	Brake module size			
	13	19	24	29
Axial adjustment X of adjusting screw (34) (informative) [mm]	approx. 0.11	approx. 0.15	approx. 0.2	approx. 0.2
Screw rotation angle α of adjusting screw (34) [°]	85 – 95	115 – 125	155 – 165	155 – 165
M_A tightening torque for socket head cap screw (29) [Nm]	0.7			
UL-listed brake modules	Brake module size			
	13	19	24	29
Axial adjustment X of adjusting screw (34) (informative) [mm]	approx. 0.13	approx. 0.15	approx. 0.21	approx. 0.21
Screw rotation angle α of screw (34) [°]	85 – 95	105 – 115	145 – 155	145 – 155
M_A tightening torque for oval head screw (29) [Nm]	0.14			

Table 43/1: M_A tightening torques for socket head cap screws (29) or oval head screws (29), tightening torque tolerance $\pm 10\%$; axial adjustment X (informative) and rotation range α of adjusting screw (34)

NOTICE

**Potential failure of the microswitch (27) due to incorrect electrical connection, adjustment or installation!**

- Evaluation of the microswitch contacts to determine the operating state of the spring-applied single-disc brake module may not be possible.
- Putting into service of the spring-applied single-disc brake and machine (e.g. motor) may not be possible.
- When adjusting the microswitch (27), ensure that the adjusting screw is not turned beyond the specified rotation angle α (see Table 43/1). Failure to comply with this requirement may cause failure of the microswitch (27) and thus prevent operation of the spring-applied single-disc brake module and machine (e.g. motor).
- The socket head cap screws (see Fig. 16/1) (29) or oval head screws (see Fig. 16/2) (29) must be secured with Loctite 241. For the electrical connection of the microswitch (27), follow the instructions provided in Section 4.3.4.

5.2.2 Microswitch replacement (27)

Replacement of the microswitch (27) must only be carried out by the manufacturer of the brake module or by qualified specialist or service personnel of the machine manufacturer (e.g. motor manufacturer). Disconnect the microswitch (27) from the power supply and loosen the mounting screws (x2) (30) of the microswitch actuator (28). Then remove the entire microswitch assembly.

Insert the connecting cable of the new microswitch (27) (see Section 5.3 – Spare parts and accessories) through the cable gland (see Fig. 15/2) into the terminal box (19). Fasten and align the microswitch and tighten the new mounting screws (30) to a tightening torque of $M_A = 0.8 - 0.9 \text{ Nm}$ to fasten the microswitch actuator (28) (see 5.3 – Spare parts and accessories). Follow the instructions in Section 4.3.4 to connect the microswitch (27) to the power source. Adjust the microswitch (27) as described in Section 5.2.1.

IMPORTANT



Apply some Loctite 241 to the threads of the mounting screws (30) provided for the microswitch actuator (28) before tightening the screws.

IMPORTANT



When replacing the microswitch, the straight pin (32), stud (31) and bellows with fastener (33) need not be replaced.

NOTICE

**Risk of damage to the microswitch actuator (28) and/or mounting screws (30) if the M_A tightening torque is too high!**

- Evaluation of the microswitch contacts to determine the operating state of the spring-applied single-disc brake module may not be possible.
- Putting into service of the spring-applied single-disc brake and machine (e.g. motor) may not be possible.
- The M_A tightening torque specified for the mounting screws (30) must be strictly observed. Tighten the mounting screws (30) evenly in several steps.

5.2.3 Replacement (removal) of the spring-applied single-disc brake module

Follow the instructions below to replace the spring-applied single-disc brake module:

- Before removing the brake module from the machine (e.g. motor), any components installed on the brake shaft (13), e.g. gear or feather key, must be pulled off carefully. Then disconnect the brake module from the power supply. Loosen the mounting screws (38) to allow the spring-applied single-disc brake module to be removed from the machine (e.g. motor).
- After removing the mounting screws (38) and washers (37), use a two-jaw puller (see Section 9) to pull the spring-applied single-disc brake module, including the ball bearing (15) and spring washer (14), off the brake shaft (13).

IMPORTANT

- i** Apply the two jaws of the jaw puller (see Section 9) at two opposite corners of the output-side mounting flange of the magnet housing (1.1) or on the front side of the brake shaft (13) (positions C₁ for the puller jaws and C₂ for the puller spindle; see Fig. 15/1). To protect the centring bore in the brake shaft (13), a buffer plate (not shown) can be used as a support (position C₂).

IMPORTANT

- i** The removal of the spring-applied single-disc brake module and ball bearing (15) requires extreme caution. Once removed, the ball bearing (15) and spring washer (14) must not be reinstalled. The brake shaft (13) remains mounted on the machine shaft (e.g. motor shaft) (42).

5.2.4 Friction disc replacement (4)

When the maximum air gap s_{max} (see Table 59/1 – Technical specifications) of the brake module is reached (see Table 38/2 – Checking the air gap s of the brake module), replace the friction disc (4) (see Section 5.3 – Spare parts and accessories) to maintain the functional reliability and safety of the brake module.

Preparations for friction disc replacement (4):

- After removing the brake module from the machine (e.g. motor) (see Section 5.2.3), first lock the armature (2) in its axial position. This is done by using two suitable locking bolts (see Table 45/1, Fig. 45/2 and Section 9 – Tools and measuring instruments for installation, maintenance and troubleshooting).
- Remove the caps (23) (see Fig. 21/1) located on the side of the spring-applied single-disc brake module. Screw the locking bolts (see Fig. 45/2) into the bores provided in the caps (23). The required M_A tightening torque is identical to the M_A tightening torque for the threaded bush (24.2) (see Table 21/2).

	Brake module size			
	13	19	24	29
Diameter D ₁ [mm]	3	4	10	10
Diameter D ₂ [mm]	19	22	24	24
Length L ₃ [mm]	7.5	8.5	12.5	12.5
Length L ₄ [mm]	5	7	10	10
PG thread	9	11	13.5	13.5

Table 45/1: Locking bolt dimensions (steel bolt)

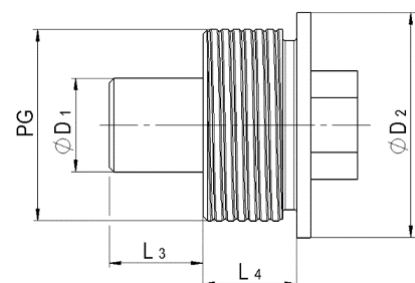


Fig. 45/2: Possible design of locking bolt

IMPORTANT



For brake modules with attached manual release (24), locking of the armature (2) is not necessary as the armature (2) is secured in its axial position by the cams (24.1) (see Fig. 21/1).

IMPORTANT



For spring-applied single-disc brake modules with microswitch (27), axial locking of the armature (2) and loosening of the socket head cap screws (10) is only possible after removing the bolt (31) and straight pin (32) (see Fig. 16/1 and Fig. 16/2) with a suitable disassembly tool. The bolt (31) and the straight pin (32) (see Section 5.3 –Spare parts and accessories) must not be reused and must be replaced after the spring-applied single-disc brake module has been reassembled (see “Installation of bolt (31) and straight pin (32)” below). The bellows with fastener (33) do not need to be replaced and remain mounted on the brake module. The microswitch (27) has to be adjusted again after replacing the bolt (31) and straight pin (32) (see Section 5.2.1).

Friction disc replacement (4):

- Loosen the socket head cap screws (10) and remove the flange (3). Then remove the exposed friction disc (4).
- Place a new friction disc (4) into the spring-applied single-disc brake module making sure that it is in the correct position and correctly centred (see Fig. 15/1). Install the flange (3) and lock it by tightening the socket head cap screws (10) to the M_A tightening torque specified in Table 46/1.

IMPORTANT



When replacing the friction disc (4), visually inspect and check the other mechanical components of the spring-applied single-disc brake module and the power supply connections. If dirt has accumulated in the brake or on the rating plate due to foreign matter or other contamination, clean the affected surfaces with oil-free compressed air or by using a grease-free brush (see Table 37/1 – Checking the electrical connection and overall appearance).



WARNING



Hazards from neutralization of the braking effect due to incorrect replacement of the friction disc (4)!

- Uncontrolled movements of the machine shaft (e.g. motor shaft) (42) may cause injury hazards if persons are present within the confines and/or working range of the installation.
- Uncontrolled **extremely fast** movements of the machine shaft (e.g. motor shaft) (42) may cause death if persons are present within the confines and/or working range of the installation.
- The locking bolts (x2) (not shown) installed in the caps (23) for axial locking of the armature (2) when replacing the friction disc (4) must be removed after the replacement procedure has been completed.
- The replacement of the friction disc (4) requires extreme caution and must be performed by qualified and specifically trained specialist personnel only. When installing the new friction disc (4), keep the friction surfaces absolutely free of grease and oil. Bear in mind that the friction disc (4) cannot be cleaned.

	Brake module size			
	13	19	24	29
M_A tightening torque [Nm] for socket head cap screws (10) of flange (3)	4.5 – 5	8 – 10	12.5 – 15.5	20 – 24

Table 46/1: M_A tightening torque [Nm] for socket head cap screws (10) of flange (10)

Installation of bolt (31) and straight pin (32) (see Section 5.3 – Spare parts and accessories) for brake modules with microswitch (27):

- The straight pin (32) is to be fully pressed into the bolt (31) in a first assembly step.
- After pre-assembly, push the unit (straight pin (32) and bolt (31)) through the bellows with fastener (33) and press it completely into the bore provided in the armature (2) (see Fig. 16/1 and Fig. 16/2) using a suitable press-in tool. Ensure that the pin/bolt unit is in the correct position (surface of the square perpendicular (90°) to the axis of the actuator of the microswitch (27)).

IMPORTANT



A deviation of the bolt (31) by $\pm 10^\circ$ from the ideal perpendicular (90°) position to the axis of the microswitch actuator is permissible.

5.2.5 Replacement (removal) of the brake shaft (13)

If the brake shaft (13) is damaged, it can be removed from the machine shaft (e.g. motor shaft) (42) by using the oil injection method (see Table 49/1).

IMPORTANT



Before removing the brake shaft (13), remove the adjusting ring (12) and the circlip (16) (see Fig. 15/1) and then pull the spring-applied single-disc brake module with ball bearing (15) and spring washer (14) from the machine (e.g. motor). Proceed with extreme caution and follow all relevant safety instructions when removing the brake shaft (13). Use suitable hydraulic oil for disassembly, e.g. LHDF 900 with a viscosity of 900 mm²/s (20°C) from SKF.



CAUTION



Hazards caused by hydraulic fluid leaks during removal of the brake shaft (13) from the machine shaft (e.g. motor shaft) (42) due to failure to follow the specific disassembly instructions!

- Injury hazard (e.g. irritations, acid burns etc.) to hands, limbs and other parts of the body.
- Use suitable protections (face guards, protective gloves, covers etc.) when removing the brake shaft (13) with hydraulic oil.
- The specified M_A tightening torque (see Table 49/1) must be strictly observed when connecting the oil injector (40) or the oil pump (40).

IMPORTANT



A pulling device consisting of a forcing screw (41), a forcing pin (39) and an oil injector (40) or oil pump (40) is required to remove the brake shaft (13) (see Fig. 48/1). The technical specifications applicable to the brake shaft (13) removal are given in Table 49/1.

Brake shaft removal (13):

- Remove the screw plug (17) (shown in Fig. 15/1) and securely screw the oil injector (40) or oil pump (40) joint into the oil inlet bore (17.1). Apply the M_A tightening torque specified in Table 49/1.
- Insert the forcing pin (39) (dimensions specified in Table 49/1) on the front face of the brake shaft (13) up to the stop and slightly tighten it by means of the forcing screw (41) (dimensions specified in Table 49/1).
- The hydraulic oil must be supplied through the oil inlet bore (17.1). The oil pressure should be gradually increased to about 60% of the maximum pressure p_{max} (see Table 49/1). Keep the pressure constant for about 60 minutes.
- Then increase the pressure to the maximum oil pressure p_{max} (see Table 49/1). After the maximum pressure has been reached, screw in the forcing screw (41) evenly and quickly so that the brake shaft (13) can be pulled off the machine shaft (e.g. motor shaft) (42).

IMPORTANT



To prevent the machine shaft (e.g. motor shaft) (42) and the brake shaft (13) from turning during the extraction process, the brake shaft (13) must be locked at the external square (size 13, 19 and 24 brake modules) or at the external teeth (size 29 brake modules).

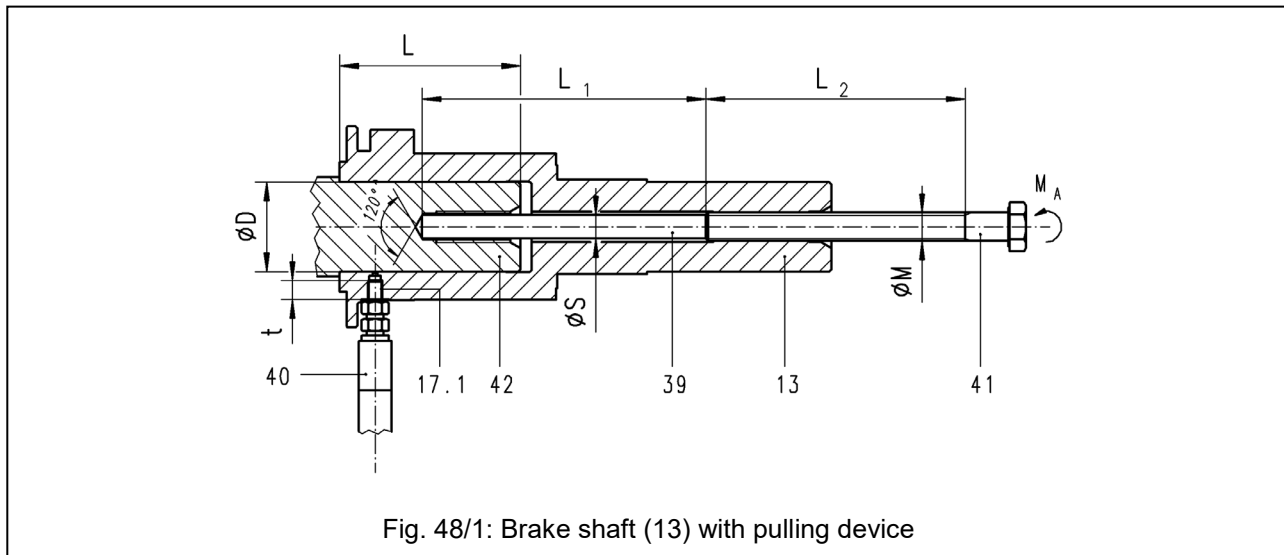


Fig. 48/1: Brake shaft (13) with pulling device

List of reference numerals in Fig. 48/1:

13	Brake shaft	41	Forcing screw
17.1	Oil inlet bore	42	Machine shaft (e.g. motor shaft)
39	Forcing pin	L	Shaft end length (motor)
40	Oil injector or oil pump		

Table 48/1: List of reference numerals for brake shaft (13) and pulling device (forcing screw (41), forcing pin (39), oil injector or oil pump (40))

	Brake module size			
	13	19	24	29
Machine or motor shaft height	AH 80	AH 100	AH 132	AH 160
Oil inlet bore (thread) and thread reach t [mm]	M6 / 7.5	M6 / 8	Rp1/8" / 9.5	Rp1/8" / 10
Oil pressure p_{max} [bar]	1400	1400	1400	1400
Forcing pin (39) length L_1 [mm]	124	124	160	170
Forcing screw (41) thread length L_2 [mm]	130	130	170	170
Forcing pin (39) diameter S [mm]	9.8	9.8	13	17
Forcing screw (41) thread M [mm]	M12	M12	M16	M20
Forcing screw (41) loosening torque M_A [Nm]	15	35	60	90
Oil pump / oil injector tightening torque M_A [Nm]	4	4	10	10

Table 49/1: Technical specifications for brake shaft (13) removal

IMPORTANT



Before installing a new brake shaft (13), clean the machine shaft (e.g. motor shaft) (42) and check it for damage. Replace the machine shaft (e.g. motor shaft) (42) if defects are suspected. Follow the instructions in Section 4.1.1 to install the new brake shaft (13).

5.3 Spare parts and accessories

Type 77 50013B16:

S	A	Designation	Qty.	Type / Version	Order number
X		Friction disc (4)	1	-	77 50013A00400
	X	Hand release (24)	1	-	77 50013B16940
X		Microswitch unit (set) for UL-unlisted brake modules	1	-	77 50013B00200
X		Microswitch unit (set) for UL-listed brake modules	1	-	77 50013B15260
X		Straight pin (32)	1	DIN 7344-4x30	328911
X		Bolt (31)	1	-	77 50013A00203
X	X	Ball bearing set	1	Ball bearing 62207-2RS1	77 50013B00700
	X	Brake shaft cpl.	1	Keyway	77 50013B00810
			1	Without keyway	77 50013B00800

Table 50/1: Spare parts (S) and accessories (A) for brake module type 77 50013B16

Type 77 50019B15:

S	A	Designation	Qty.	Type / Version	Order number
X		Friction disc (4)	1	-	77 50019B15400
	X	Hand release (24)	1	-	76 14119B00940
X		Microswitch unit (set) for UL-unlisted brake modules	1	-	77 50013B00200
X		Microswitch unit (set) for UL-listed brake modules	1	-	77 50013B15260
X		Straight pin (32)	1	DIN 7344-4x30	328911
X		Bolt (31)	1	-	77 50013A00203
X	X	Ball bearing set	1	Ball bearing 62210-2RS1	77 50019B00700
	X	Rubber bolt (18)	4	-	334690
	X	Brake shaft cpl.	1	Keyway	77 50019B00810
			1	Without keyway	77 50019B00800

Table 50/2: Spare parts (S) and accessories (A) for brake module type 77 50019B15

Type 77 50024B15:

S	A	Designation	Qty.	Type / Version	Order number
X		Friction disc (4)	1	-	77 50024B15400
	X	Hand release (24)	1	-	76 14124B00940
X		Microswitch unit (set) for UL-unlisted brake modules	1	-	77 50024B00200
X		Microswitch unit (set) for UL-listed brake modules	1	-	77 50024B15260
X		Straight pin (32)	1	DIN 7344-4x30	328900
X		Bolt (31)	1	-	77 50013A00203
X	X	Ball bearing set	1	Ball bearing 62212-2RS1	77 50024B00700
	X	Rubber bolt (18)	4	-	334690
	X	Brake shaft cpl.	1	Keyway	77 50024B00810
				Without keyway	77 50024B00800

Table 51/1: Spare parts (S) and accessories (A) for brake module type 77 50024B15

Type 77 50029B15:

S	A	Designation	Qty.	Type / Version	Order number
X		Friction disc (4)	1	-	77 50029B15410
	X	Hand release (24)	1	-	77 50029A00940
X		Microswitch unit (set) for UL-unlisted brake modules	1	-	77 50024B00200
X		Microswitch unit (set) for UL-listed brake modules	1	-	77 50024B15260
X		Straight pin (32)	1	DIN 7344-4x30	328900
X		Bolt (31)	1	-	77 50013A00203
X	X	Ball bearing set	1	Ball bearing 62215-2RS1	77 50029B00700
	X	O-ring (26)	1	-	602542
	X	Brake shaft cpl. (13)	1	Keyway	77 50029B00810
			1	Without keyway	77 50029B00800

Table 51/2: Spare parts (S) and accessories (A) for brake module type 77 50029B15

Additional information on accessories:

1. Microswitch unit (set):
Consisting of microswitch (27), actuator (28), straight pin (32), bolt (31), bellows with fastener (33), mounting screws (30) and socket head cap screws (29) or oval head screws (29) with disc springs (35).
2. Ball bearing set:
Consisting of ball bearing (15) (type see Table 50/1, Table 50/2, Table 51/1), spring washer (14), gamma ring (36) and circlip (16).
3. Brake shaft cpl.:
Consisting of brake shaft (13) (design according to offer drawing, see Section 1.7), screw plug (19) and rubber bolt (18) or O-ring (26) (size 29 brake modules only).

6. Condition at delivery, transport and storage

The spring-applied single-disc brake module is delivered ready for mounting with factory-adjusted rated air gap s_N and M_4 transmissible torque. The washer (12) with O-ring and the circlip (16) are not fitted before shipment. They are packaged separately and included in the delivery with other ordered accessories (see Section 5.3).

IMPORTANT



The brake shaft (13) (see Section 5.3 – Spare parts and accessories) with screw plug (17) can also be provided directly by the user of the component. In this case, the geometrical installation conditions specified in offer drawing 77 50013B16-O, 77 50019B15-O, 77 50024B15-O and 77 50029B15-O must be observed for the dimensioning and design of the customer-specific brake shaft (13).

The friction disc (4) is centred relative to the centre of the spring-applied single-disc brake module to facilitate brake mounting.

Upon receipt of the shipment, the brake must be checked for transit damage before storage. If the brake is not installed immediately upon delivery, it must be stored in a dry, dust-free and vibration-proof place.

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

Table 52/1: Environmental conditions for storage and transport as specified in EN IEC 60721-3-1 and EN IEC 60721-3-2

NOTICE



Risk of damage to the microswitch (24) due to incorrect storage and transport of the spring-applied single-disc brake module!

- Putting into service of the spring-applied single-disc brake module and machine (e.g. motor) may not be possible.
- Evaluation of the microswitch contacts to determine the operating state of the spring-applied single-disc brake module may not be possible.
- The brake module should be transported and stored in a vertical position with the output side flange (see Fig. 15/1) of the magnet housing (1.1) pointing upwards. The flange must be provided with two eye bolts (e.g. to DIN 580) to be fixed to two diagonally opposite fixing bores. The eye bolts are required to attach lifting and handling equipment secured with nuts for internal transport purposes and for mounting the spring-applied single-disc brake module to the machine (e.g. motor).

IMPORTANT



The environmental conditions specified in Table 52/1 and in EN IEC 60721-3-2 / EN IEC 60721-3-1 must be observed during transport and storage of the brake, especially when long-term storage is envisaged. The specified environmental conditions apply only if the brake is stored in its original packaging.

7. Emissions

7.1 Noise

The spring-applied single-disc brake module produces switching noise during engagement and release. The noise level is determined by the installation conditions, circuitry and air gap. To avoid excessive noise levels, AC side turn-off should be used and DC side turn-off should be avoided, if possible. Depending on the mounting position, operating conditions and condition of the friction surfaces, audible vibrations (squealing) may be produced during braking.

7.2 Heat

Braking operations and gradual heating of the field coil (1.2) cause the magnet housing (1.1) temperature to increase substantially. Under adverse conditions, the surface temperature may rise to well over 60°C.



CAUTION



Hazards from contact with hot parts during operation of the spring-applied single-disc brake module!

- Injury hazard (e.g. skin burns) to hands, limbs and other parts of the body.
- Depending on the operating state of the brake, its surface temperature may rise to over 60°C. If necessary, suitable protections and hand guards must be installed to avoid accidental contact with hot surfaces.
- Wear protective gloves, if necessary.

8. Troubleshooting

Fault	Cause	Corrective actions
Brake module release failure	• Air gap too large	Check the air gap. Install a new friction disc (4), if necessary (see Section 5.2.4).
	• No voltage applied to brake module	Check the power connections and correct faults, if found.
	• Voltage applied to field coil (1.2) too low	Check the supply voltage of the field coil (1.2) and correct faults, if found.
	• Armature (2) blocked mechanically	Eliminate mechanical blocks (see Section 5.2.4). Install a new brake module, if necessary.
	• Defective rectifier (19.2)	Check the rectifier (19.2) and replace it, if necessary.
	• Damaged field coil (1.2)	Check the resistance of the field coil (1.2). Install a new brake module, if necessary.
	• Thermal damage to friction disc (4) linings	Install a new friction disc (4) (see Section 5.2.4).
Delayed release of brake module	• Air gap 's' too large	Check the air gap 's'. Install a new friction disc (4), if necessary (see Section 5.2.4).
	• Voltage applied to field coil (1.2) too low	Check the supply voltage of the field coil (1.2) and correct faults, if found.
Brake module engagement failure	• Voltage applied to field coil (1.2) in unpowered condition too high (residual voltage)	Check whether residual voltage is applied to the field coil (1.2) and correct faults, if found.
	• Armature (2) blocked mechanically	Eliminate mechanical blocks (see Section 5.2.4). Install a new brake module, if necessary.
Delayed engagement of brake module	• Voltage applied to field coil (1.2) too high	Check the supply voltage of the field coil (1.2) and correct faults, if found.
Brake torque too low	• Air gap 's' too large	Check the air gap 's'. Install a new friction disc (4), if necessary (see Section 5.2.4).
	• Oily, greasy or dirty friction surface(s)	Install a new friction disc (4) (see Section 5.2.4).
Incorrect switching state of microswitch (27)	• Damaged microswitch (27)	Check the microswitch (27) and replace it, if necessary (see Section 5.2.2).
	• Loose mounting screws (29, 30) or loose microswitch (27)	Tighten the mounting screws (29, 30) (see Section 5.2.2). Then readjust the microswitch (14) (see Section 5.2.1).
	• Armature (2) blocked mechanically	Eliminate mechanical blocks (see Section 5.2.4). Install a new brake module, if necessary.

Table 54/1: Possible faults, causes and corrective actions (list not exhaustive)

9. Tools and measuring instruments for installation, maintenance and troubleshooting

Special tools and measuring instruments are required for installation (Section 4), maintenance and checks (Section 5.1) and troubleshooting (Section 8). The individual tools and instruments and their applications are described in Table 56/1. The tools and equipment required to remove the brake shaft (13) (see Section 5.2.5) are listed in Table 48/1.

Tools, measuring instruments	Description and application	Suitable for brake module size	Design details
	Calibrated torque wrench for precise torque-controlled tightening and loosening of all screws / set screws to a defined M _A tightening torque	13, 19, 24, 29	<ul style="list-style-type: none"> • 0 – 3 Nm • 0 – 80 Nm • 0 – 200 Nm
	Hexagon insert bit with hexagon socket for use with calibrated torque wrench for tightening and loosening the mounting screws (38)	13	AF 18 mm
		19	AF 21 mm
		24, 29	AF 27 mm
	Hexagon insert bit with hexagon socket for use with calibrated torque wrench for tightening and loosening the threaded bush (24.2)	13	AF 17 mm
		19	AF 20 mm
		24, 29	AF 22 mm
	Hex drive hexagon insert bit for use with calibrated torque wrench for tightening and loosening the socket head cap screws (10)	13	AF 3 mm
		19	AF 4 mm
		24	AF 6 mm
		29	AF 8 mm
	Slotted hexagon insert bit for use with calibrated torque wrench for tightening and loosening the socket head cap screws (19.3), set screw (25) and socket head cap screws (29) of the microswitch unit (set) of UL-unlisted brake modules	13, 19, 24, 29	Slot head thickness 0.5 mm and 0.8 mm
	Cross drive hexagon insert bit for use with calibrated torque wrench for tightening and loosening the socket head cap screws (29) of the microswitch unit (set) of UL-listed brake modules	13, 19, 24, 29	Cross drive type PH0
	Torx drive hexagon insert bit for use with calibrated torque wrench for tightening and loosening the mounting screws (30)	13, 19, 24, 29	Torx drive type T20
	Allen key for socket head cap screws (10)	See information on hex drive hexagon insert bit	
	Adjustable pin spanner (pin type face wrench) for adjusting ring (9)	19	Pin Ø6-Ø8 mm
		24, 29	Pin Ø8-Ø10 mm
	Open-end spanner for mounting screws (38) and threaded bushes (24.2)	See information on hexagon insert bit with hexagon socket	
	Open-end spanner for cable glands (19.6, 19.7)	13, 19, 24, 29	AF 15 and AF 20
	Slotted screwdriver for set screw (25), caps (23), socket head cap screws (19.3) and all other socket head cap screws of terminal box (19)	13, 19, 24, 29	Slot head thickness 0.5 mm and 0.8 mm


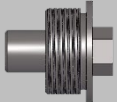


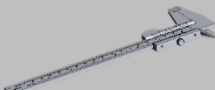
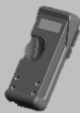
	Internal circlip pliers for circlip (16)	13, 19	Size 50 – 100
		24, 29	Size 85 – 170
	Locking bolt (x2) for armature (2) (not supplied with brake module)	13, 19, 24, 29	Geometrical dimensions see Table 45/1 Design see Fig. 45/2
	Two-jaw puller for removal of spring-applied single-disc brake module from machine (e.g. motor)	13, 19	Effective jaw clearance min. 250 mm
		24, 29	Effective jaw clearance min. 400 mm
	Feeler gauges for checking and measuring the air gap 's'	13, 19, 24, 29	Leaf thickness from 0.1 mm to 1.5 mm by 0.05 mm steps
	Caliper for checking and measuring the adjusting ring clearance E	13, 19, 24, 29	-
	Multimeter (voltage, current, resistance) for measuring the supply voltage and ohmic resistance of the field coil (1.2)	13, 19, 24, 29	-

Table 56/1: Tools and measuring instruments for installation, maintenance and troubleshooting

IMPORTANT

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Brake inspections and tests as well as service and maintenance operations must be carried out by the manufacturer of the machine (e.g. motor) and by qualified specialist or service personnel only. The specific maintenance instructions of the machine manufacturer (e.g. motor manufacturer) must take account of the requirements specified in Section 5.1 (Maintenance and checks) of these operating instructions.

10. 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. Note: In the case of brakes and clutches exposed to purely static loads, the M_4 torque is commonly referred to as rated torque.
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 permissible 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
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 ϑ_{23} is reached. The operating temperature corresponds to the overtemperature $\Delta\vartheta_{31}$ according to DIN VDE 0580 plus the ambient temperature ϑ_{13} . Unless otherwise specified, the ambient temperature ϑ_{13} is 35°C.
Overtemperature $\Delta\vartheta_{31}$	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature ϑ_{13}
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 field coils to identify the device or component
Rated power P_N	power value to identify the device or component

Other definitions (not included in DIN DE 0580) applicable to spring-applied single-disc brake module:

Air gap s	air gap of engaged spring-applied single-disc brake module
Rated air gap s_N	air gap of engaged spring-applied single-disc brake module when the brake is new
Max. air gap s_{max}	maximum air gap of engaged spring-applied single-disc brake module at which the brake module can be operated provided that the technical specifications are complied with (see Section 11)
Closing time t_{c1}	time it takes for the spring-applied single-disc brake module to close mechanically after power has been turned off (beginning of power drop) (see chart in Fig. 58/1)
Activation time t_{c2}	time it takes for the transmissible torque M_4 (holding torque) to be reached almost completely after power has been turned off (beginning of power drop) (see chart in Fig. 58/1)
Opening time t_o	time it takes for the spring-applied single-disc brake module to open mechanically after power has been turned on (beginning of power rise) (see chart in Fig. 58/1)

The switching times (disconnection time t_2 and coupling time t_1) are defined in DIN VDE 0580. When using static systems (holding operation), the switching times can also be determined on the basis of the current profile (see Fig. 58/1) instead of using the DIN VDE 0580 definitions.

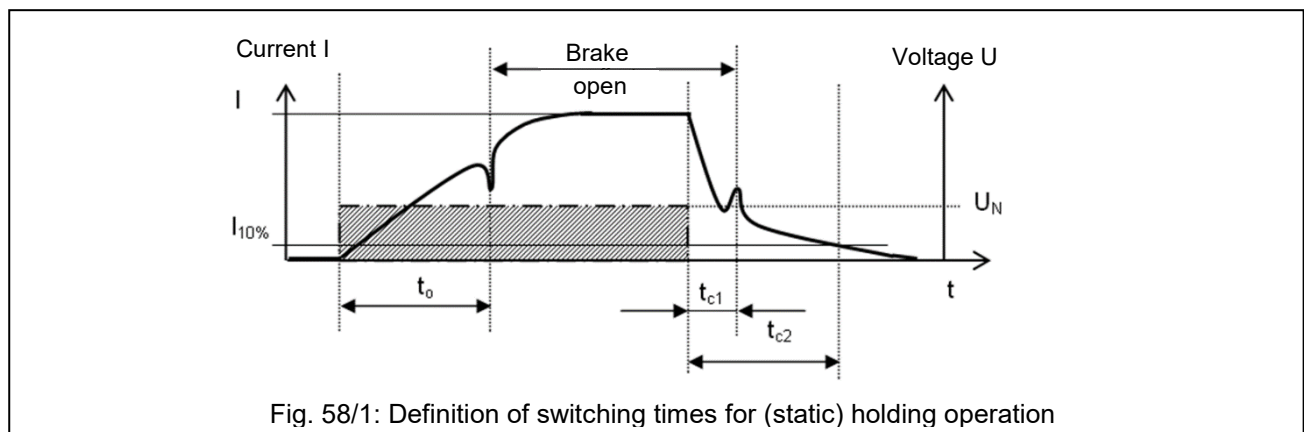


Fig. 58/1: Definition of switching times for (static) holding operation

11. Technical specifications

Product built and tested to DIN VDE 0580

	Brake module size			
	13	19	24	29
Transmissible torque range M_4 (standard) [Nm]	45	60 – 150	140 - 310	280 - 500
Max. speed n_{max} [rpm]	6000	5500	4500	4000
Max. switching work W_{max} ($Z=1$) ⁸⁾ [kJ]	13	55	130	250
Max. number of emergency stops Z_{total} with W_{max}	10	20	40	15
Rated power P_N [W]	97	131	167	190
Closing time t_{c1} ⁷⁾ with max. rated air gap s_{Nmax} [ms]	40	60	100	150
Closing time t_{c1} ⁷⁾ with max. air gap s_{max} [ms]	40	60	100	150
Opening time t_o ⁷⁾ with max. rated air gap s_{Nmax} [ms]	150	500	650	800
Opening time t_o ⁷⁾ with max. air gap s_{max} [ms]	220	700	800	1100
Moment of inertia of friction disc (4) J_R [kgcm ²]	approx. 4	approx. 19	approx. 63	approx. 215
Moment of inertia of brake shaft (13) J_M [kgcm ²]	approx. 4	approx. 14	approx. 43	approx. 81
Balance quality grade of friction disc (4) to ISO 21940-11	G6.3			
Balancing speed of friction disc (4) n_{BR} [rpm]	3600			
Balance quality grade of brake shaft (13) to ISO 21940-11	G2.5			
Balancing speed of brake shaft (13) n_{BM} [rpm]	6000	5500	4500	4000
Weight m ⁹⁾ [kg]	approx. 10	approx. 21	approx. 46	approx. 66
Rated air gap s_N [mm]	0.32 ^{+0.18}	0.35 ^{+0.2}	0.35 ^{+0.21}	0.45 ^{+0.25}
Max. air gap s_{max} (at 70% of rated current) [mm]	0.65	0.8	0.96	1.2
Duty cycle [%]	100	100	100	100
Standard rated voltage [VDC]	24, 102, 178			
Insulation class	F			
Pollution degree	2			
Protection rating	IP 55			
Brake type	holding brake with emergency stop function			

Table 59/1: Technical specifications

⁷⁾ Values apply at maximum transmissible (standard) torque M_4 .

⁸⁾ Values apply at a speed of 1500 rpm.

⁹⁾ Including brake shaft (13) and ball bearing set (see Section 5.3).

Speed n [rpm]	Brake module size			
	13	19	24	29
1500	10x13kJ & 150x2,2kJ	20x55kJ & 300x7kJ	40x130kJ & 650x16kJ	15x250kJ & 200x24kJ
3000	40x8kJ & 600x2.2kJ	10x45kJ & 180x7kJ	10x112kJ & 170x16kJ	10x200kJ & 200x24kJ
4000	60x5.5kJ & 1000x2.2kJ	10x40kJ & 150x7kJ	10x100kJ & 160x16kJ	4x170kJ & 70x24kJ
4500	80x4.5kJ & 1300x37kJ	10x37kJ & 150x7kJ	2x95kJ & 56x16kJ	
5500	120x2kJ & 2000x0.5kJ	3x32kJ & 50x7kJ		
6000	130x1.5kJ & 2200x0.5kJ			

Number of combined emergency stops Z_{total} with switching work W ($Z_{total} \times W$) and $Z=1$ (number of emergency stops per hour)

Table 60/1: Number of combined emergency stops Z_{total} as a function of the switching work W and speed n

Speed n [rpm]	Brake module size			
	13	19	24	29
Speed n [rpm]	160	100	60	60
Coil ON time t_5 [s]	2	2	2	2
Coil OFF time t_6 [s]	1.5	1.5	1.5	1.5
Break-in period t_{total} [s]	approx. 30	approx. 30	approx. 30	approx. 30

Table 60/2: Break-in process parameters for the spring-applied single-disc brake module after installation and during brake service life

	Technical specifications	
	UL-unlisted brake module	UL-listed brake module
Switching power	250 VAC, 5 A	250 VAC, 3 A
	24 VDC, 2 A	15 – 30 VDC, 3 A
Min. switching power	12 VDC, 10 mA	12 VDC, 100 mA
Mechanical service life [switching operations]	5×10^7	3×10^6
Contact type	normally open (NO)	normally open (NO)
Temperature range	-40°C to +130°C	-40°C to +65°C
Protection rating	IP 67	IP 67

Table 60/3: Microswitch specifications (27)

Rated operating conditions	
Rated voltage tolerance	±10%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{13} [°C]	-5 to +40
Relative humidity	30% to 80% within ambient temperature range
Other climatic conditions (Z)	3Z2 and 3Z14 to EN IEC 60721-3-3
Mechanical conditions (M)	3M12 to EN IEC 60721-3-3
Biological conditions (B)	3B1 to EN IEC 60721-3-3
Mechanically active substances (S)	3S6 to EN IEC 60721-3-3
Chemically active substances (C) or corrosivity category	C1 to EN ISO 9223
Installation height	up to 2000 m a.m.s.l.

Table 60/4: Required operating conditions for spring-applied single-disc brakes

Explanations on the technical specifications:

W_{\max} (maximum switching work) (see Table 59/1) is the switching work that must not be exceeded during braking operations at max. 1500 rpm. Braking operations at speeds greater than 1500 rpm substantially reduce the maximum permitted switching work per switching operation (see Table 60/1). The specified W_{\max} (maximum switching work) (see Table 59/1) and the switching work at the specified number of combined emergency stops ($Z_{\text{total}} \times W$) (see Table 60/1) apply to mounted brakes without any additional cooling. The specified transmissible torques M_4 characterize the torque level of the brakes. Depending on the application, the switching torque (dynamic torque) M_1 and the effective transmissible torque M_4 may differ from the specified M_4 transmissible torque values. The switching torque (dynamic torque) M_1 depends on the speed (rpm) and switching work. If the friction surfaces are contaminated with oil, grease or dirt, the transmissible torque M_4 and the switching torque (dynamic torque) M_1 may drop. The technical specifications apply after the break-in process has been completed with the specified break-in parameters (see Table 60/2).

Specific explanations of the opening and closing times:

Opening time t_o :

The defined maximum opening time values t_o apply under the following conditions:

- Operation at rated voltage U_N within the permissible voltage range as specified in Table 60/4
- Temperature range of field coil (1.2) -5°C to 100°C

Closing time t_{c1} :

The defined maximum closing time t_{c1} values apply under the following conditions:

- Operation at rated voltage U_N within the permissible voltage range as specified in Table 60/4
- Temperature range of field coil (1.2) -5°C to 100°C
- DC-side turn-off with varistor type S10K550 to limit the turn-off voltage

IMPORTANT



The closing time t_{c1} and the opening time t_o depend on the temperature of the field coil (1.2). At temperatures above the specified field coil (1.2) temperature, the closing times t_{c1} are shorter and the opening times t_o are longer. At temperatures below the specified field coil (1.2) temperature, the opening times t_o are shorter and the closing times t_{c1} are longer. As the air gap 's' of the brake module increases, the opening times t_o and the closing times t_{c1} are extended.

The technical specifications in Table 59/1 and Table 60/3 and the rated operating conditions specified in Table 60/4 must be strictly observed during operation of the spring-applied single-disc brake module.

The information provided in the offer drawings 77 50013B16-O, 77 50019B15-O, 77 50024B15-O and 77 50029B15-O must be followed.

Specifications subject to change without notice!

12. 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: 77 50024B15

Version number: 0001

Product number: 77 50024B15-0001

13. Specialist repair shops

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14. Revision history

Date of issue	Changes
02/07/2012	First issue.
12/12/2013	Page 16, tightening torques. Page 17, DC power supply.
01/02/2021	Complete revision of operating instructions. Revision of safety information.

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