

KENDRION INDUSTRIAL BRAKES

Elevation Line

Spring-applied double-disc brake

Operating Instructions 76 451..A00

Types: 76 45119A00

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1. General information

1.1 Introduction

These operating instructions describe the operating principle and features of the 76 451..H00 series of spring-applied double-disc brakes. The safety information provided in this manual must be strictly observed during the set-up of the machine (e.g. motor) and during the start-up, operation and maintenance of the spring-applied brake.

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

1.2 Standards and directives

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

They are intended for installation and use in lifts according to the requirements and regulations specified in EN 81-1. Being classified as "electromagnetic components", spring-applied brakes are also subject to the Low Voltage Directive 2014/35/EU. The user is required to employ suitable switching devices and controls to ensure use of the brakes in accordance with EMC Directive 2014/30/EU.

1.3 Declaration of Incorporation

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

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

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

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

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Applied harmonized standards and other technical standards and regulations:

EN 60529 Enclosure protection ratings
DIN VDE 0580 Electromagnetic devices and components
EN 81-1 Safety rules for the construction and installation of lifts

Product: Electromagnetically released spring-applied double-disc brake

Types: 76 45119A00

Kendrion (Villingen) GmbH Villingen
13/03/2020

Authorized signatory: 
Dominik Hettich
(Head of Development)

1.4 EU Declaration of Conformity

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

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1.5 Manufacturer's liability

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

2. Product description

2.1 Operating principle

Spring-applied double-disc brakes in the 76 451..A00 series are electromagnetic components designed to operate dry. The armature system of the brakes with intermediate disc is torsion-proof, friction-free and axially movable in tangential direction. The force generated by an electromagnetic field is utilized to overcome the braking effect produced by the spring force. The spring-applied double-disc brake engages in unpowered condition and releases when DC voltage is applied to the field coil. The shaft to be braked is not exposed to any axial force by the brake. The firmly fitted hand release allows the brake to be released manually (e.g. in case of power failure) to neutralize the braking effect of the spring-applied brake. Built-in factory-set microswitches control the operating state of the brake and must be tied into the control circuit of the machine (e.g. lift machine). Owing to the form-fit connection between the two friction discs and the hub of the spring-applied double-disc brake and the torsion-proof and axially fixed position of the hub on the shaft of the machine (e.g. lift machine), the friction discs are decelerated and the brake torque is transmitted to the machine (e.g. lift machine) via the shaft when the brake is unpowered. The machine shaft is decelerated or held in its position. The special brake configuration with armature system, intermediate disc and microswitch monitoring system enables the user to identify the operating state of the brake (released – engaged – worn out – armature system / intermediate disc fault) and initiate corrective actions, where necessary. The armature system and intermediate disc are friction-free thanks to the use of spring segments, so that the torsion-proof armature with intermediate disc can be moved axially for torque transmission. Additional support elements (sleeves) are provided which support the armature system/intermediate disc assembly if (and only if) the segment springs fail. This ensures reliable generation of the braking torque at all times. The built-in microswitch monitoring unit is designed to detect segment spring failure and to report such failure to the machine control system.

Owing to the torsion-proof, friction-free and axially movable arrangement of the armature system and intermediate disc and the built-in microswitch monitoring unit, the spring-applied double-disc brake can be used wherever short overall lengths of motor/brake combinations or motor/gearbox/brake systems are necessary and safety requirements for the construction and installation of lifts according to EN 81-1 must be met. According to the requirements specified in EN 81-1, the user must select a suitable braking system with adequate braking torque to ensure that the brake, if used in applications according to EN 81-1, is by itself able to adequately decelerate a lift car loaded with the 1.25-fold of its rated load and moving at rated speed. Type 76 451..A00 spring-applied double-disc brakes are primarily intended for use as holding brakes with emergency stop function in lift machines with drive control inside buildings.

2.2 Brake design

The solenoid housing (1.1) of the spring-applied double-disc brake accommodates the firmly fitted field coil (1.2) with coil leads (12) that exit on the brake circumference. The solenoid housing (1.1) also includes the compression springs (4) which frictionally press the square socket friction disc (11) against the intermediate disc (30) via the studs (3) and the armature (2), causing the intermediate disc (30) to press against the second friction disc (11). A condition of balance is established by the disc (23). The compression springs (4) located in the outer part of the magnet housing (1.1) act on the armature (2) via the studs (3), thus generating a braking torque. The friction discs (11) can be moved axially on the hub (13). As a result, the braking torque is fully applied to the shaft of the machine (e.g. motor). Owing to the form-fit and frictional connection of the disc (23) with the flange (6) by means of three clamping sleeves (24), 25% of the braking torque is transmitted to the mounting surface (9), while 50% is transmitted via the intermediate disc (30) and the two segment springs (29) to the sleeves (5) and eventually to the flange (6) or mounting surface (9) (e.g. motor end shield). The sleeves (5) are tightly pressed into the solenoid housing (1.1). Together with the armature (2), intermediate disc (30) and friction discs (11), they result in the air gap 's' of the spring-applied double-disc brake.

A segment spring (18) linking the armature (2) with the solenoid housing (1.1) ensures that the armature (2) is torsion-proof and friction-free. Two additional segment springs (29) are provided which connect the intermediate disc (30) with the sleeves (5) such that they are torsion-proof and friction-free. The clearance between the armature (2) / intermediate disc (30) and the sleeves (5) is sufficient to prevent jamming of the individual components. The two microswitches (20 and 21) included in the built-in monitoring unit control the operating state of the spring-applied double-disc brake. The M_4 transmissible torque of the spring-applied double-disc brake can be changed by means of an adjusting ring (26). For this purpose, the adjusting ring clearance E needs to be changed by using a pin spanner (see Fig. 7/1).

The spring force of the compression springs (4) located inside the solenoid housing (1.1) can be changed by tightening or loosening the adjusting ring (26). After completing adjustment of the M₄ transmissible torque, the adjusting ring (26) is factory-secured by means of a set screw (27). The hub (13) – which is axially fixed to the shaft of the machine (e.g. lift machine) for coupling the two friction discs (11) – features a keyway so that the braking torque is transmitted to the shaft via a feather key provided in the shaft. Two O-rings (22+28) are installed between the armature (2) and solenoid housing (1.1) and between the flange (6) and disc (23) to reduce the switching noise produced by the spring-applied double-disc brake. The brake is fixed to the mounting surface (9) of the machine (e.g. lift machine) by means of the mounting screws (10) and flange (6). When using brakes with hand release (14), openings must be provided in the part enclosing the brake (e.g. fan cover) so that the hand release lever can be installed. The lever (14.1) can be removed in order to prevent unauthorized use of the hand release (14).

List of reference numerals in Fig. 7/1 and Fig. 8/1:					
1.1	Solenoid housing	13	Hub	19.1	Indicating label (2x)
1.2	Field coil	14	Hand release	19.2	Indicating label (hand release)
2	Armature	14.1	Lever	20	Microswitch
3	Stud	14.2	Disc	21	Microswitch
4	Compression spring	14.3	Locknut	22	O-ring
5	Sleeve	14.4	Tie bolt	23	Disc
6	Flange	14.5	Return spring	24	Clamping sleeve
7	Adjusting screw for microswitch 21	14.6	Tie bar	25	Socket head cap screw
8	Adjusting screw for microswitch 20	15	Locking screw	26	Adjusting ring
9	Mounting surface	16	Flexible insulating tubing	27	Set screw
10	Mounting screw	17	Identification sleeves	28	O-ring
11	Friction disc	18	Segment spring	29	Segment spring (intermediate disc)
12	Coil leads	19	Rating plate	30	Intermediate disc

Table 6/1: List of reference numerals for spring-applied double-disc brake

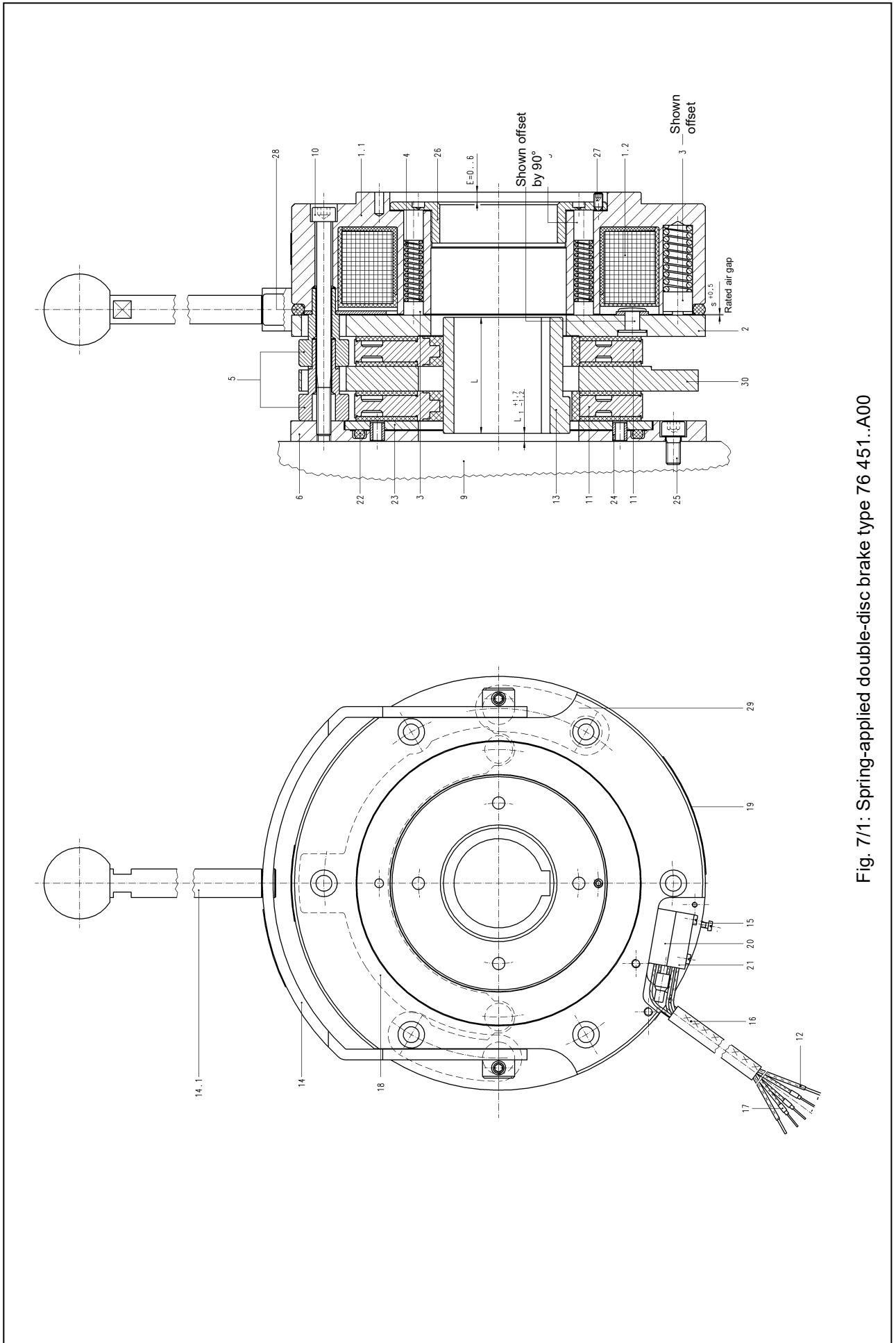


Fig. 7/1: Spring-applied double-disc brake type 76 451..A00

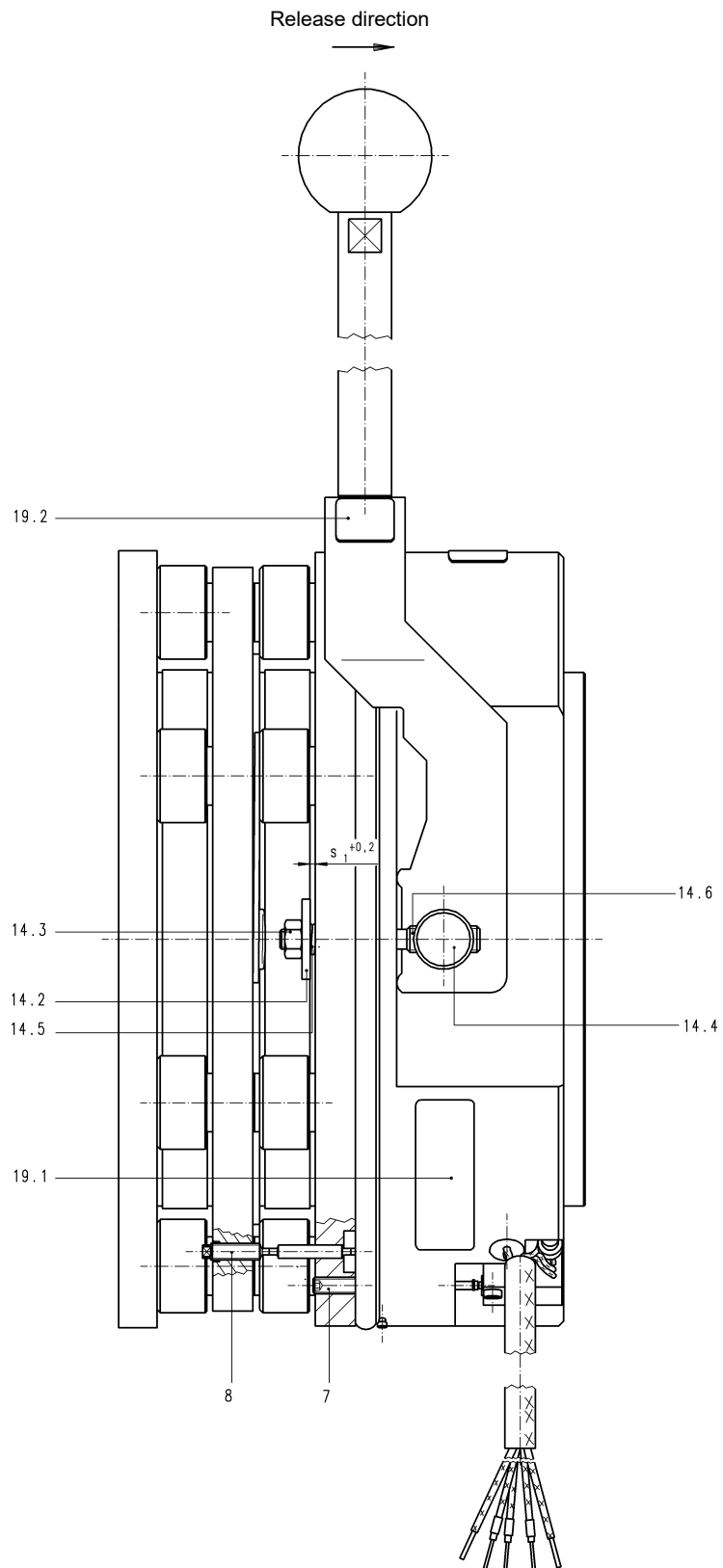


Fig. 8/1: Spring-applied double-disc brake type 76 451..A00 (lateral view)

2.3 Safety system

2.3.1 Monitoring unit design

The safety system of the spring-applied double-disc brake is formed by the torsion-proof, friction-free and axially movable armature (2) with intermediate disc (30) in combination with the built-in monitoring unit (microswitches 20 and 21). If the brake operates without failure, the armature (2) is coupled to the solenoid housing (1.1) through the segment spring (18) and the intermediate disc (30) is linked to the sleeves (5). The armature (2) and intermediate disc (30) are fixed in tangential and radial directions and movable in axial direction. The reduction in axial mobility frequently encountered with conventional brakes – caused by friction or by the armature (2) or intermediate disc (30) getting stuck on the sleeves (5), for example – is excluded with this configuration. Only failure of a high-fatigue-strength segment spring (18 and 29) may cause the armature (2) or intermediate disc (30) to turn in tangential direction until they bear against the sleeves (5) with their bores. In normal conditions, the clearance between the armature (2) / intermediate disc (30) and the sleeves (5) is sufficient to prevent accidental contact or jamming of the individual components. If the armature (2) / intermediate disc (30) turns or the maximum air gap s_{\max} is exceeded, the microswitch (20) is triggered to report the failure.

When the brake is open (released), contacts 1 and 2 of the microswitches (20 and 21) are connected. When the brake is closed (engaged), the connection is between contacts 1 and 3 of the microswitches (20 and 21). The microswitch (21) provided for release monitoring changes its switching state whenever the brake is shifted. The microswitch (20) provided for monitoring the max. air gap s_{\max} and the tangential position of the armature (2) or intermediate disc (30) is always actuated during normal operation. This means that when the brake is engaged (closed), there is connection between contacts 1 and 3. If the max. air gap s_{\max} is exceeded or if the tangential position of the armature (2) / intermediate disc (30) is changed because the segment spring (18 or 29) has broken, for example, microswitch (20) opens. In this case there will be no connection between contacts 1 and 3 or 1 and 2. If the armature (2) / intermediate disc (30) is displaced in tangential direction because a segment spring (18 or 29) has broken, for example, the appropriate functional measure (see Section 2.3.4) must be initiated by the control logic of the lift system. In the event of tangential displacement of the armature (2) / intermediate disc (30), the sleeves (5) located in the solenoid housing (1.1) act as torque support. If the friction discs (11) are worn and the maximum air gap s_{\max} of the brake is exceeded while there is a failure (e.g. fusing of contacts) of the microswitch (20) at the same time, a built-in blocking device blocks the spring-applied double-disc brake so that it cannot open (release). Any torque reduction caused by an excessive air gap 's' or by the armature (2) / intermediate disc (30) reaching the stroke limit of the brake is excluded. The microswitches (20 and 21) required for determining the operating state of the brake are set and secured at the factory by means of adjusting screws (7 and 8).

2.3.2 Microswitch (21) check

The microswitch (21) is automatically checked whenever the operating state of the brake changes. When the brake engages or releases, the switching state of the microswitch (21) must change. Any change in the switching state of the microswitch (21) must be evaluated by the control system of the equipment in which the brake is used.

Microswitch (21) state	Brake released	Connection between contacts 1 and 2
	Brake engaged	Connection between contacts 1 and 3



Attention!

If the microswitch (21) fails to change its switching state upon brake release or engagement, this may be due to a defective switch (21) or brake malfunction. However, a suspected malfunction of the brake will not necessarily cause any hazardous reduction of the brake torque.

2.3.3 Microswitch (20) check

The microswitch (20) can be checked for perfect operation during service, maintenance and repair work carried out on the lift machine or brake. The microswitch (20) can be uniquely identified by the identification sleeves (17) provided at the ends of its flying leads. Since it does not change its switching state during normal brake operation, the microswitch (20) cannot be evaluated continuously. When carrying out regular service, maintenance and/or repair work, the microswitch (20) should be checked for correct operation by loosening the mounting screws (10) while the brake is closed. As soon as the max. air gap s_{max} (see Technical Specifications) is exceeded, the microswitch (20) switching state must change.

Microswitch (20) state	Brake attached and released	Connection between contacts 1 and 2
	Brake engaged and mounting screws slightly loosened, air gap $s > s_{max}$	Connection between contacts 1 and 3 or 1 and 2



Attention!

If the microswitch (20) fails to change its switching state during the check, this may be due to a defective switch (20) or to a malfunction of the armature system.



Warning!

Before loosening the mounting screws (10) of the brake, the manufacturer of the lift system or the service or maintenance personnel must shut down the lift system and lock the lift car and counterweight in their positions (e.g. by placing the lift car and counterweight on the pads). The internal blocking device (see Section 4 – Maintenance) must be locked in its position with the locking screw (15).

2.3.4 Operating state analysis (OSA) with microswitches (20 and 21)

The evaluation of the microswitches (20 and 21) and the brake supply voltage is an essential part of the control logic of the lift system and serves to detect and analyse the operating state (OS) of the brake (operating state analysis OSA). The OSA serves to develop and define the control and functional measures (FM) which must be initiated by the control logic of the lift system. The control logic must analyse the states of the microswitches (20 and 21) during normal operation and in the event of potential faults (PF) within the brake and the status of the supply voltage of the spring-applied double-disc brake according to Table 11/1. In addition, the control logic must implement the control and functional measures (FM) specified in Table 11/1.

Micro-switch (20) state	Micro-switch (21) state	Supply voltage status	Operating state (OS) of brake Potential faults (PF) of brake
			Necessary control and functional measures (FM)
Off	Off	Off	OS: brake closed. PF: brake worn out; armature / intermediate disc bearing failure; microswitch (20) failure.
			FM: shut down the lift system by means of the lift control; initiate maintenance measures.
Off	Off	On	OS: brake closed (no opening). PF: coil system failure. OS: brake open. PF: microswitch (21) failure. PF: brake worn out; armature / intermediate disc bearing failure; microswitch (20) failure.
			FM: complete the travel cycle and shut down the lift system by means of the lift control; initiate maintenance measures.
Off	On	Off	OS: brake closed. PF: microswitch (21) failure; brake worn out; armature / intermediate disc bearing failure; microswitch (20) failure.
			FM: shut down the lift system by means of the lift control; initiate maintenance measures.
Off	On	On	OS: brake open. PF: brake worn out; armature / intermediate disc bearing failure; microswitch (20) failure.
			FM: complete the travel cycle and shut down the lift system by means of the lift control; initiate maintenance measures.
On	Off	Off	OS: brake closed.
			FM: no measures required (normal operating state).
On	Off	On	OS: brake closed (no opening). PF: coil system failure. OS: brake open. PF: microswitch (21) failure.
			FM: complete the travel cycle and shut down the lift system by means of the lift control; initiate maintenance measures.
On	On	Off	OS: brake closed. PF: microswitch (21) failure.
			FM: shut down the lift system by means of the lift control; initiate maintenance measures.
On	On	On	OS: brake open.
			FM: no measures required (normal operating state).

Table 11/1: Microswitch (20 and 21) states, supply voltage status, control and functional measures (FM) for control logic of lift system



Attention!

The control logic for continuous evaluation of the brake operating state (OS) must be provided by the system manufacturer of the lift system. The operating states (OS) detected by the control logic must be assured by appropriate control and functional measures (see Table 11/1).

Identification of leads	Number
Microswitch (20)	1
Microswitch (21)	2
Microswitch (21)	3

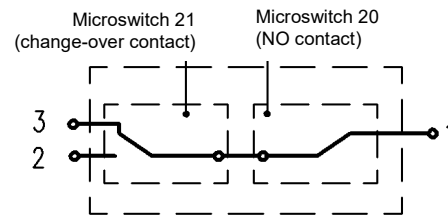


Table 12/1 and Fig. 12/1: Identification of electric connection and circuit diagram of microswitch wiring

3. Installation

3.1 Mechanical installation

Push or press the hub (13) onto a shaft provided with a feather key to DIN 6885, sheet 1. Secure it axially (by means of a shaft collar, circlip or the like). Ensure that the hub (13) is set back by L_1 (see Table 12/1 and Fig. 7/1) relative to the mounting surface (9) of the spring-applied double-disc brake. Attach the flange (6) with the disc (23), O-ring (22) and the clamping sleeves (24) to the mounting surface (9) (e.g. motor end shield) using ISO 4762-M8x16-8.8 socket head cap screws (25). Make sure to apply the specified tightening torque (see Table 12/1). Push the friction disc (11) onto the hub (13). Check that you feel only little resistance when sliding the friction disc (11) along the hub (13).

	Size 19
L [mm]	65
L_1 [mm]	4.5
M_A [Nm]	30

Table 12/1: Hub (13) dimensions; tightening torques of mounting screws (10) and socket head cap screws (25)

Using the mounting screws (10) (see offer drawing), screw the complete field coil system of the spring-applied double-disc brake to the flange (6). Tighten the mounting screws (10) evenly in diametrically opposite sequence and make sure not to exceed the specified tightening torque (see Table 12/1). After completion of these operations, remember to remove the locking screw (15) and screw it into the tapped hole provided for this purpose.

Check that the mounting surface (9) meets the following requirements before installing the brake:

- Axial runout relative to the shaft <0.1 mm (measuring radius = hole circle)
- Material: steel, aluminium, cast iron – with excellent thermal conductivity
- Absence of oil and grease

Centre the brake by means of the mounting screws (10) to ensure correct operation. The rated air gap 's' is factory-adjusted and cannot be changed.



Note!

During equipment installation, the flying leads (12) of the field coil (1.2) and microswitches (20, 21) must be connected as specified by the equipment manufacturer. Avoid any damage to the leads (12), e.g. by kinking the lead insulation. If the friction disc (11) and/or hub (13) are equipped with rubber buffers for noise reduction, the buffers must be slightly greased before installation to reduce fitting forces during brake mounting. Check that the friction disc (11) can be easily moved along the hub (13) by hand. The fitted components (especially the friction surfaces) must be free from grease.



Attention!

Remember that the locking screw (15) provided to block the built-in blocking device must be removed after completion of brake assembly and screwed into the tapped hole.



Attention!

Make absolutely sure that the friction disc (11) cannot get stuck or jammed on the hub (13). This is crucial to avoid any residual torque with open brake and any brake torque loss when the brake is closed.



Attention!

The M_A tightening torque specified for the mounting screws (10) must be strictly observed (see Table 12/1). We recommend that you mark the mounting screws (10) with locking compound after completion of brake mounting.

3.2 Installation of hand release (14)

Mounting of hand release (14) is only for service required. The hand release (14) is already mounted and adjusted at the factory (no accessories).

Insert the tie bolts (14.4) into the yoke of the hand release (14) (see Fig. 8/1) and, keeping them in this position, push them into the opening provided in the spring-applied brake. Screw the locknut (14.3) to the tie bar (14.6) and secure it with Loctite 241. Fit the disc (14.2) and the return spring (14.5) onto the tie bar (14.6). Apply Loctite 241 to the tie bar (14.6). Then insert the tie bar (14.6) with the disc (14.2), locknut (14.3) and return spring (14.5) through the bores provided in the armature (2) and the solenoid housing (1.1) and fasten it with the tie bolt (14.4).



Note!

Use a feeler gauge to adjust the distance s_1 (see Table 14/1) when the brake is released (attracted armature (2)). Check that s_1 is not exceeded. Adjust it uniformly on both tie bars (14.6). Apply Loctite 241 to the hand release lever (14.1) as required. Screw the lever (14.1) into the yoke of the hand release (14) applying a tightening torque of $M_A = 15 \text{ Nm}$. The release force F and the maximum permitted release force F_{\max} can be taken from Table 14/1 and refer to the highest transmissible torque M_4 (standard) of the brake. Complete brake release with zero residual torque is not possible due to design-related constraints. The maximum permitted residual torque is specified in

Size 19	
Release force F [N]	approx. 400
Max. permitted release force F_{max} [N]	450
Max. permitted residual torque M_5 [Nm]	$0,05 \cdot M_4$
$s_1^{+0,2}$ [mm]	1.9

Table 14/1: Release force F and max. permitted release force F_{max} . Distance s_1 of mechanical hand release (14) and max. permitted residual torque M_5 after brake release



Note!

Machinery-specific regulations and requirements must be observed when using brakes with hand release (14).



Caution!

The brake torque can be neutralized manually by means of the hand release (14). Consequently, the brake must be installed in such a way that any unintentional actuation of the hand release (14) is excluded. The maximum permitted release force F_{max} (see Table 14/1) during actuation of the hand release lever (14.1) must not be exceeded. Owing to the specific design of the system, the microswitch (21) cannot be actuated through contact with the hand release (14). When installing a hand release (14), check that the distance s_1 between the armature (2) and disc (14.2) is correctly adjusted when the spring-applied double-disc brake is open (released). Secure the tie bars (14.6) in the tie bolts (14.4) by applying Loctite 241.



Warning!

Check that the mechanical hand release (14) is in the position shown in Fig. 7/1 when not actuated. This is crucial to ensure correct brake engagement. Otherwise, the full braking effect of the spring-applied double-disc brake may not be reached. In this case, the machine (e.g. motor) must be stopped immediately and must not be restarted until correct operation of the hand release (14) and automatic return of the hand release lever (14.1) to its central position (see Fig. 7/1) has been ensured.

3.3 Electrical connection and operation

The spring-applied double-disc brake is a DC-operated system and must be connected to a DC power source via the (light blue) flying leads (12). Connect the field coil (1.2) by connecting the ends of the flying leads by means of screws, clamps or other equivalent fixtures to avoid interruptions in the power supply. Connection to an AC power source is via a bridge or half-wave rectifier. Various rectifier types are available from Kendrion (see examples in Table 14/1). Depending on the brake size and torque, voltage ripple due to intermittent power supply may cause brake humming or incorrect brake operation. Perfect brake operation must be ensured by the user or system manufacturer by providing suitable electrical controls.

Rectifier series	Rectifier type	Rated input voltage range U_1 /VAC (40-60 Hz)	Output voltage U_2 /VDC	Max. output current	
				R-load I/ADC	L-load I/ADC
32 07.22B.0	half-wave	0-500 ($\pm 10\%$)	$U_1 \cdot 0.445$	1.6	2.0
32 07.23B.0	bridge	0-400 ($\pm 10\%$)	$U_1 \cdot 0.890$	1.6	2.0

Specific rectifier specification sheets must be observed!

Table 14/1: Recommended rectifiers for single-phase AC voltage supply

3.3.1 DC power supply

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

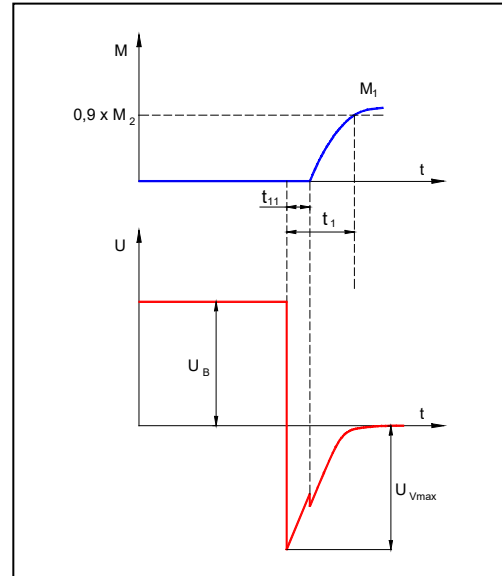


Attention!

The peak voltage U_{Vmax} during disconnection without protective circuit may reach **several thousand V** in the millisecond region. This may cause irreversible damage to the field coil (1.2), switching contacts and electronic components. Sparking will occur on the switch during disconnection. Consequently, a protective circuit must be provided to reduce the current during disconnection and to limit the voltage. The maximum permitted overvoltage during disconnection is 1500 V. If Kendrion rectifiers are used (see Table 14/1), the protective circuit required for the built-in electronic components and field coil (1.2) is included in the rectifier. This does not apply to the external contacts required for DC side switching as there would be no galvanic isolation of the external contact.



Attention!



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

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

3.3.2 AC power supply

Direct brake connection to an AC power source is only possible if a rectifier is used. The coupling times vary depending on the switching type (DC side switching or AC side switching).

Half-wave rectification:

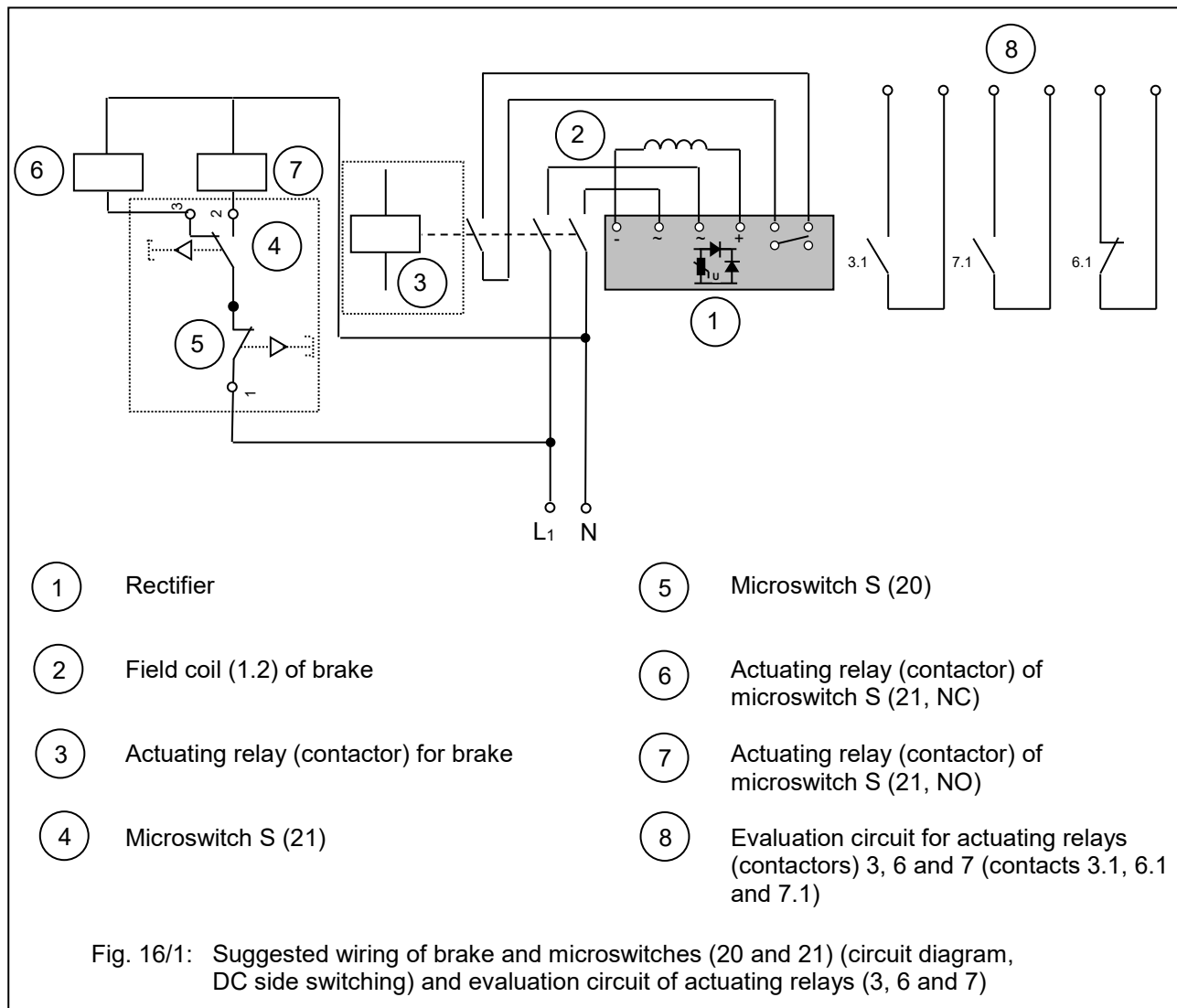
In case of half-wave rectification, the U_2 coil voltage is lower by factor 0.445 than the rectifier input voltage. Half-wave rectifiers produce voltage with high residual ripple.

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.

3.3.3 Electrical connection of brake and microswitches (20 and 21)

The two microswitches (20 and 21) must be tied into the control circuit of the machine (e.g. lift machine) by connecting the flying leads (12) (for identification see Table 12/1). Please refer to the suggested wiring of the brake and microswitches shown in Fig. 16/1. The microswitches (20 and 21), along with the brake supply voltage, are part of the safety system (see Section 2.3). The state of the microswitches and the supply voltage status are monitored by scanning and evaluating the control and evaluation circuit. The information is used to determine the operating state of the brake.



Connect the microswitches (20 and 21) by connecting the flying leads (12) by means of screws, clamps or other equivalent fixtures to avoid interruptions in the power supply.



Note!

Where applications subject to EN 81-1 (safety rules for the construction and installation of electrically powered passenger and goods lifts) are concerned, the spring-applied double-disc brake with microswitches (20 and 21) must be wired in accordance with the requirements of EN 81-1. The system user must ensure that the wiring of the brake and microswitches (20 and 21) complies with the requirements of EN 81-1.

AC side switching:

In case of AC side switching, the AC voltage supplied to the field coil is interrupted upstream of the rectifier (power supply side) by opening the switching contacts. If you use this switching type, bear in mind that the required freewheeling branch installed inside the rectifier may significantly extend the coupling time (by factor 5 or over). The disconnection times remain unchanged.

DC side switching:

In case of DC side brake switching, an auxiliary contact is provided to interrupt the power supply on the DC side (brake side). If you use this switching type, bear in mind that the reduction of the electric time constant causes the brake to close quickly and the switching noise to increase (see Section 6 – Emissions).



Attention!

In case of DC side switching, the brake must be provided with a protective circuit (see Section 3.3.1) to avoid overvoltage. Additional protective elements (e.g. varistors, spark arresters, etc.) must be installed to avoid damage such as burns or fusing of contacts.



Warning!

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



Warning!

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

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

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

3.4 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 double-disc brakes are designed for industrial applications to which the following EMC standards apply: Generic Immunity Standard EN 61000-6-2 and Generic Emission Standard EN 61000-6-3 / EN 61000-6-4. Other applications may be subject to different generic standards which must be considered by the manufacturer of the overall system. The requirements in terms of electromagnetic compatibility of devices and components are determined by basic standards derived from the generic standards. Brake wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial brake use and other applications. Please refer to the specification sheets for additional information on electromagnetic compatibility, especially with respect to the recommended electronic rectifiers specified in Section 3.3.

Immunity in accordance with EN 61000-4:

EN 61000-4-2 Electrostatic discharge:

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.3 conform to severity level 3 without additional measures.

EN 61000-4-3 Electromagnetic fields:

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.3 conform to severity level 3 without additional measures.

EN 61000-4-4 Fast transients (burst):

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.3 conform to severity level 3 without additional measures.

EN 61000-4-5 Surge:

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.3 conform to severity level 3 without additional measures.

EN 61000-4-9 Pulse magnetic fields, EN 61000-4-10 Damped oscillatory magnetic fields:

Since the operating magnetic fields of the electromagnetic brakes are stronger many times over than interference fields, the brake function will remain unaffected. The brakes comply at least with severity level 4. The recommended rectifiers specified in Section 3.3 conform to severity level 3 without additional measures.

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

a) Voltage interruptions:

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

b) Voltage dips and short supply voltage variations:

Electromagnetically released systems:

Voltage dips and supply voltage variations to below 60% of the rated voltage and lasting longer than the response delay specified by DIN VDE 0580 may cause the brake to be de-energised temporarily. Consequential damage as described under a) above must be avoided by the user by taking adequate precautions.

Electromagnetically engaged systems:

Voltage dips and supply voltage variations to below the minimum tolerance threshold will cause torque reductions. The user is required to take adequate precautions to avoid consequential damage.

Radio interference suppression in accordance with EN 55011:

The brakes and the 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. 19/1 must be taken to ensure compliance with the limit values applicable to Class A equipment. Interference suppression capacitors should be used which must be dimensioned to suit the connection data of the electromagnetic components and the specific mains conditions. The recommended rectifiers specified in Section 3.3 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, assemblies designed to limit the disconnection voltage (e.g. anti-parallel diode) or voltage limiting components (e.g. varistors, suppressor diodes, resistance diodes and the like) can be installed. However, such components will inevitably change the switching times of the brake and increase the generated noise level. The rectifiers specified in Section 3.3 are equipped with free-wheel diodes and/or varistors to limit the disconnection voltage. In case of DC side switching, a varistor rated for the type-specific maximum operating voltage and connected in parallel with the field coil (1.2) limits the peak voltage to the values specified in Table 19/1.

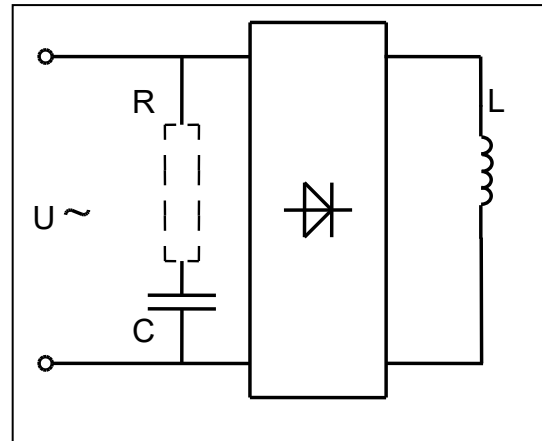


Fig. 19/1

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 shall not relieve the user and manufacturer of the overall system from their obligation to furnish proof of conformity of the overall system with such standards.

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

Table 19/1: Recommended disconnection voltage in case of DC side switching for rectifiers specified in Table 14/1

3.5 Start-up



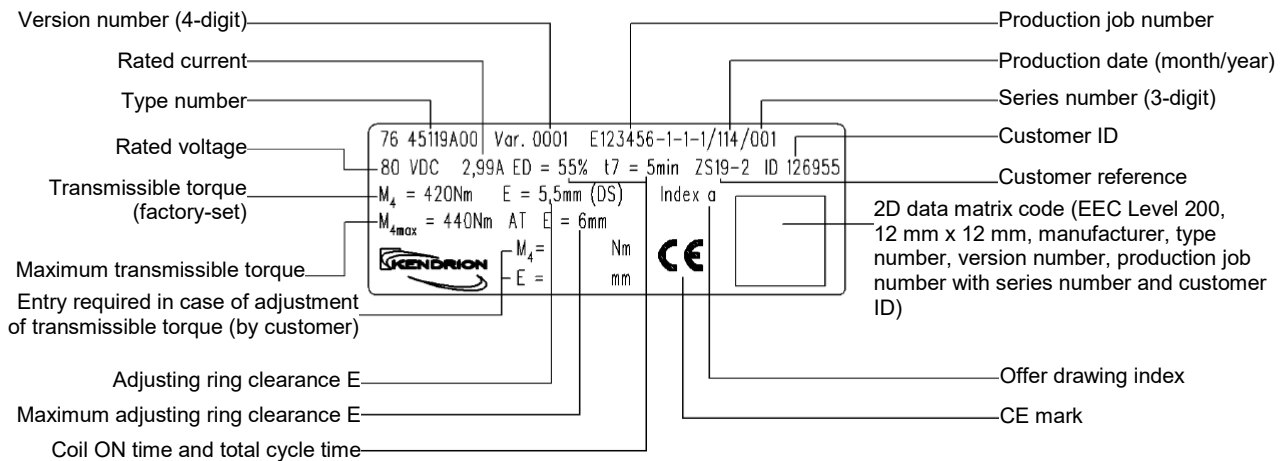
Warning!

The functional check of the brake must not be performed unless the machine (e.g. lift machine) has been switched off and secured against accidental or unintentional start-up.

3.5.1 Functional checks

Check compliance with the specifications provided on the rating plate with respect to the mounting position and protection class. After the brake has been connected, perform a functional test to check that the friction disc (11) runs smoothly. For this purpose, turn the shaft while the brake is energized and the machine (e.g. motor, lift machine) is unpowered. After completion of mounting, all necessary covers and guards must be installed.

Specifications on the rating plate (subject to order, example type 76 45119A00):



Note: The product number of the brake consists of the type number followed by the version number of the spring-applied double-disc brake, e.g. 76 45119A00-0001.



Warning!

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



Caution!

The brake surface temperature may rise to over 60°C. Heat-sensitive parts such as conventional cables or electronic components must not be fixed to or be in contact with these surfaces. If necessary, suitable protections and hand guards must be installed to avoid accidental contact with hot surfaces. If the shaft needs to be turned during set-up operations while the machine (e.g. motor, lift machine) is switched off, the brake must be released electromagnetically or by means of the hand release lever (14).



Attention!

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



Attention!

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

3.5.2 Manual brake release

The spring-applied double-disc brake can be released manually by means of the permanently mounted mechanical hand release. In case of a power supply failure, it is also possible to open the brake electrically with a commercially available UPS supply unit (e.g. UPS battery systems). To achieve this, the manufacturer of the lift system must install a UPS supply unit with a voltage rating that matches the specifications on the brake rating plate.



Warning!

Proceed with utmost caution if you intend to manually release (jog mode) the spring-applied double-disc brake in the mounted lift system, e.g. while servicing the lift system or if regular power supply fails during UPS operation. This is important because the load moment accelerates the lift car and the counterweight of the lift system if the drives are unbalanced. The user must ensure that the load moment does not cause any hazards when the brake is released and engaged in jog mode.

3.6 Setting the M₄ transmissible torque

The M₄ transmissible torque of the spring-applied double-disc brake can be changed by means of an adjusting ring (26) (see Fig. 7/1). For this purpose, the adjusting ring clearance E needs to be changed using a pin spanner (see Table 21/1). The spring force of the compression springs (4) located inside the solenoid housing (1.1) can be changed by tightening or loosening the adjusting ring (26). After completing adjustment of the M₄ transmissible torque, the adjusting ring (26) is factory-secured by means of a set screw (27).

Size 19	
Change in the transmissible torque $\Delta M_4/\text{mm}$ [Nm]	approx. 26.6
Permitted adjusting ring clearance E [mm]	0 – 6

Table 21/1: Change in the M₄ transmissible torque resulting from a 1 mm axial adjustment of the adjusting ring (26); permitted adjusting ring clearance E



Note!

The nominal adjusting ring clearance E at delivery (marking DS), is on the rating plate (see section 3.5.1) entered. Actual (adjusted) adjusting ring clearance E, may differ due to scattering of the friction parameters and the axial spring force from the nominal adjusting ring clearance E.






Attention!



While adjusting the adjusting ring (26) according to Table 21/1, ensure that the maximum clearance is not exceeded. The user must enter the changed adjusting ring clearance E and the theoretically set M_4 transmissible torque on the rating plate of the brake (in the specific field provided for entering the adjusting ring clearance E and the M_4 transmissible torque; see above, example of rating plate specifications). The user must ensure that the adjusted M_4 transmissible torque of the brake sufficiently decelerates the car of the lift system when it is loaded with the 1.25-fold of its rated load and moves at rated speed.




4. Maintenance


4.1 Checks and service

The spring-applied double-disc brake requires regular inspections, service and maintenance. Follow the instructions below and perform the jobs described at the specified intervals.

Test item	Job	Interval
Air gap 's'	<p>Check the air gap 's' using a feeler gauge between the armature (2) and the solenoid housing (1.1) while the spring-applied double-disc brake is securely mounted. Remove the O-ring (28) for this purpose.</p> <p> Note!</p> <p>The microswitch (20) installed for monitoring the max. air gap s_{max} signals a fault if the max. air gap s_{max} is exceeded. If the air gap measured during the air gap check is equal to or greater than $0.85 \times s_{max}$ (max. air gap) without any fault signal from the microswitch (20), replace the friction disc (11) by a new one. In this case, screw in the locking screw (15) (see Fig. 7/1) with a tightening torque of $M_A = 0.5 \text{ Nm}$ before loosening the mounting screws (10) of the spring-applied double-disc brake. After having removed the spring-applied double-disc brake from the machine (e.g. lift), send it to the manufacturer for maintenance.</p> <p> Attention!</p> <p>Removal and dismantling of the spring-applied double-disc brake (removal of sleeves (5)) must be carried out by the manufacturer. After replacement of the friction discs (11), the M_4 transmissible torque specified in the order is factory-set at the manufacturer's premises.</p> <p>After completion of brake installation (see Section 3), check the rated air gap 's' (see Technical Specifications) using a feeler gauge. Make sure to tighten the mounting screws to the specified M_A tightening torque (see Table 12/1) when mounting the brake. Remember to remove the locking screw (15) when you restart the brake.</p> <p> Attention!</p> <p>After replacement of the friction discs (11) and before the break-in procedure has been carried out, the M_4 transmissible torque may be reduced by up to 20%. In this case, slightly readjust the adjusting ring (26) to correct the transmissible torque (only if E_{max} has not been reached yet).</p> <p><u>Important:</u> If you use the spring-applied double-disc brake only as a holding brake where friction linings do not wear down as a result of emergency stops, you need not check the air gap 's' at regular intervals.</p>	<p>approx. 240,000 travels</p> <p>or</p> <p>every two years</p>

<p>Hand release (14)</p>	<p>Repeatedly actuate the hand release (14) while the system is shut down (brake not energized). Check that the armature (2) of the spring-applied double-disc brake can be moved in axial direction as far as necessary to enable machine operation (e.g. with the handwheel).</p>	<p>approx. 480,000 travels or every four years</p>
<p>Damping (noise)</p>	<p>Replace the O-rings (22 and 28) if the switching noise of the brake increases significantly (e.g. detected by airborne sound measurement) and every time the friction disc is replaced, however, no later than after 4 years.</p> <p>Tighten the locking screw (15) (see Fig. 7/1) to a tightening torque of $M_A = 0.5 \text{ Nm}$ before loosening the mounting screws (10) of the spring-applied double-disc brake. Then loosen the mounting screws (10) and disassemble the brake coil system (core assembly). In this condition, it is easy to remove the O-ring (28) between the armature (2) and the solenoid housing (1.1) and to replace it by a new one. To replace the O-ring (22) between the disc (23) and the flange (6), pull off the disc (23) from the clamping sleeves (24). Then you can easily remove the O-ring (22) from the groove provided and replace it. Proceed to install the spring-applied double-disc brake as described in Section 3. Remember to remove the locking screw (15) when you restart the brake.</p>	<p>approx. 360,000 travels or every three years</p>
<p>Microswitch (21)</p>	<p><u>Functional check with open brake:</u> Connection between contact 1 and contact 2.</p> <p><u>Adjusting the microswitch (21) in case of a failure:</u> While the brake is released (open), adjust the switching point of the microswitch (21) by turning the adjusting screw (7) clockwise (see Fig. 8/1) (The microswitch (21) closes). Subsequently, continue to turn the adjusting screw (7) clockwise by 50° to 60°.</p> <p> Attention!</p> <p>When adjusting the microswitch (21), the specified adjustment angle must be maintained to ensure reliable microswitch (21) operation and machine start-up (e.g. lift machine) controlled by the evaluation logic.</p> <p><u>Important:</u> The microswitch (21) is factory-adjusted by means of the adjusting screw (7). Any readjustment with the adjusting screw (7) is only required in case of failure (e.g. when the switching point has shifted). The adjusting screw (7) is equipped with a self-locking plastic element which enables repeated microswitch (21) adjustments. Additional locking of the adjusting screw (7) is not necessary.</p> <p> Note!</p> <p>We recommend that you have the microswitch (21) adjusted by the manufacturer or by an authorized repair shop (see Section 11). Please also follow the instructions given in Section 2.3.2 when adjusting the microswitch (21).</p>	<p>approx. 240,000 travels or every two years</p>

<p>Microswitch (20)</p>	<p>Since the microswitch (20) does not change its switching state when the brake is in fully mounted condition, continuous evaluation of the switching state is not possible. This is why the microswitch (20) function needs to be checked by loosening the mounting screws (10) with dropped-out armature (2). If the max. air gap s_{max} (see Technical Specifications) is exceeded, the microswitch (20) switching state must change.</p> <p><u>Functional check with closed brake and loosened mounting screws (10):</u></p> <p>Test condition: (air gap 's' > max. air gap s_{max})</p> <p>Interruption between contact 1 and contact 3.</p> <p><u>Adjusting the microswitch (20) in case of a failure:</u> When the air gap is at its maximum (s_{max}, see Technical Specifications) turn the adjusting screw (8) until the microswitch (20) reaches its switch-back point and opens.</p> <p> Attention!</p> <p>The microswitch (20) is factory-adjusted by means of the adjusting screw (8). Any readjustment with the adjusting screw (8) is only required in case of failure (e.g. when the switching point has shifted) and should only be performed by the manufacturer or by an authorized repair shop (see Section 11). When the air gap 's' is equal to or greater than the max. air gap s_{max} (see Technical Specifications) (simulated by loosening the mounting screws (10) with dropped-out armature (2)), the switching contact of the microswitch (20) must be open.</p> <p> Warning!</p> <p>Before loosening the mounting screws (10) of the brake, the manufacturer of the lift system or the service or maintenance personnel must shut down the lift system and lock the lift car and counterweight in their positions (e.g. by placing the lift car and counterweight on the pads). Lock the built-in blocking device in its position with the locking screw (15).</p>	<p>approx. 240,000 travels</p> <p>or</p> <p>every two years</p>
<p>Microswitches (20 and 21)</p>	<p>Replace the microswitches (20 and 21) when they have reached their maximum number of switching cycles. Loosen the mounting screws and remove the microswitches. Fasten and align the new microswitches. Applying a tightening torque of $M_A = 0.5 \text{ Nm}$, tighten the mounting screws of the microswitches (20 and 21) and secure them with Loctite 241. Also mark the mounting screws of the microswitches (20 and 21) with locking compound. After having installed the new microswitches (20 and 21), adjust them as described above.</p> <p> Note!</p> <p>We recommend that you have the microswitches (20 and 21) adjusted by the manufacturer or by an authorized repair shop (see Section 11).</p>	<p>approx. 240,000 travels</p> <p>or</p> <p>every two years</p>

Blocking device	<p>Remove the O-ring (28) so that you can check the blocking device. Perform a visual inspection of the blocking device to find out whether the blocking sleeve is still guided within the solenoid housing (1.1) when the air gap 's' is smaller than the max. air gap $s_{max} + 0.2$ mm. Check that the blocking sleeve easily moves in the bore of the solenoid housing (1.1) when you repeatedly actuate the hand release (14).</p> <p> Attention!</p> <p>Make sure that the mounting screws of the spring-applied double-disc brake are completely tightened when you perform this check. If the max. air gap $s_{max} + 0.2$ mm (see Technical Specifications for max. air gap s_{max}) is exceeded and the blocking sleeve is not locked, it is no longer possible to release the brake.</p>	<p>10⁶ switching operations</p> <p>or</p> <p>once a year</p>
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Warning!

Before loosening the mounting screws (10) of the brake, the manufacturer of the lift system or the service or maintenance personnel must shut down the lift system and lock the lift car and counterweight in their positions (e.g. by placing the lift car and counterweight on the pads). Lock the built-in blocking device in its position with the locking screw (15).



Attention!

If the air gap 's' exceeds the maximum air gap $s_{max} + 0.2$ mm (max. air gap – see Technical Specifications), a built-in blocking device blocks the spring-applied double-disc brake so that it cannot open (release). This means that the locking screw (15) needs to be tightened applying a tightening torque of $M_A = 0.5$ Nm before performing checks during which the air gap 's' of the spring-applied double-disc brake is equal to or greater than the maximum air gap s_{max} (see Technical Specifications) (e.g. when replacing the friction disc (11) or loosening the brake mounting screws (10)). Remember to remove the locking screw (15) when you restart the brake.



Attention!

When mounting the spring-applied double-disc brake, tighten the mounting screws (10) applying the tightening torques specified in Table 12/1.



Warning!

Whenever inspection and maintenance work is carried out, ensure that

- the machine (e.g. motor) is secured against accidental or unintentional start-up.
- no load torque acts on the shaft.
- the lock provided to prevent accidental start-up of the machine (e.g. motor) is removed after completion of inspection and maintenance work.
- all friction surfaces are free from grease and oil. An oily or greasy friction disc (11) cannot be cleaned.
- no swelling or glazing of the friction lining has occurred.

4.2 Spare parts and accessories

S	A	Designation	Type	Order number	Quantity
	X	Mounting screws (10)	ISO 4762-M8x120-8.8	304089	6
X		Friction disc (11)	-	76 46119A00300	1
X		Microswitch, complete	-	76 46119C00600	1

Table 26/1: Spare parts (S) and accessories (A)

5. Condition at delivery

A brief break-in process is completed at the manufacturer's premises so that the brake is ready for mounting upon delivery. The sleeves (5) are adjusted to the rated air gap 's'. The required M₄ transmissible torque is factory-adjusted before shipment. Ordered accessories as well as the hub are delivered together with the brake. Upon receipt of the shipment, the brake must be checked for transit damage before storage.



Note!

The environmental conditions specified in Table 26/1 and in EN IEC 60721-3-2 / EN IEC 60721-3-1 must be considered during transport and storage of the brake, especially when long-term storage is envisaged. The permissible ambient conditions only apply if the component is stored in the original packaging.

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

Table 26/1: Environmental conditions for storage and transport as specified in EN IEC 60721-3-1 and EN IEC 60721-3-2

6. Emissions

6.1 Noise

The brake produces switching noise during engagement and release. The noise level is determined by the installation conditions, circuitry (e.g. with overexcitation rectifier), switching type (AC side, DC side etc.) and air gap. To avoid excessive noise levels, AC side switching should be used and DC side switching should be avoided, if possible. Depending on the mounting position, operating conditions and state of the friction surfaces, audible vibrations (squealing) may be produced during braking.

6.2 Heat

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



Caution!

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

7. Troubleshooting

Fault	Cause	Corrective actions
Brake release failure	• Air gap 's' too large	Check the air gap 's'. Have the friction discs (11) replaced by the manufacturer, if necessary. Check the switching point of the microswitch (20) and adjust if, if necessary.
	• No voltage applied to brake	Check the electrical connection 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.
	• Damaged rectifier	Replace the rectifier.
	• Damaged field coil (1.2)	Check the resistance of the field coil (1.2). Install a new brake, if necessary.
	• Friction linings of friction discs (11) thermally overloaded	Check the friction discs (11). Have the friction discs (11) or the entire brake replaced by the manufacturer, if necessary.
Delayed brake release	• Air gap 's' too large	Check the air gap 's'. Have the friction discs (11) replaced by the manufacturer, if necessary. Check the switching point of the microswitch (20) and adjust if, if necessary.
	• 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 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.
Delayed brake engagement	• Voltage applied to field coil (1.2) too high	Check the supply voltage of the field coil (1.2) and correct faults, if found.
Microswitch (20) open	• Damaged microswitch (20) • Adjusting screw (8) of microswitch (20) not adjusted correctly	Have a new microswitch (20) installed by the manufacturer. Adjust the switching point of the microswitch (20) by means of the adjusting screw (8).
Microswitch (21) failure	• Damaged microswitch (21) • Adjusting screw (7) of microswitch (21) not adjusted correctly	Have a new microswitch (21) installed by the manufacturer. Adjust the switching point of the microswitch (21) by means of the adjusting screw (7).
	• Air gap 's' too large	Check the air gap 's'. Have the friction discs (11) replaced by the manufacturer, if necessary.
	• Air gap 's' too large	Check the air gap 's'. Have the friction discs (11) replaced by the manufacturer, if necessary.
Brake torque too low	• Oily or greasy friction surfaces	Check the friction surfaces. Have the friction discs (11) replaced by the manufacturer, if necessary.
	• Friction linings of friction discs (11) thermally overloaded	Check the friction discs (11). Have the friction discs (11) replaced by the manufacturer, if necessary.
	• Air gap 's' too large	Check the air gap 's'. Have the friction discs (11) replaced by the manufacturer, if necessary.
Noise	• Air gap 's' too large	Check the air gap 's'. Have the friction discs (11) replaced by the manufacturer, if necessary.

Table 27/1: Possible faults, causes and corrective actions (list not exhaustive)

Attention! Perform an operating state analysis (OSA) as described in Table 11/1!

8. Safety

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

The user is required to ensure that:

- the brakes are only used in accordance with their intended use (see Section 2 Product description).
- the brakes are in perfect working order and checked at regular intervals.
- a complete and fully legible copy of these operating instructions is kept available at the place of use of the brakes at all times.
- start-up, maintenance and repair work is only done by authorized and suitably qualified personnel.
- such personnel are kept informed on all relevant occupational safety and environmental protection issues and familiar with these operating instructions and with the safety information contained herein.
- the brakes are not exposed to other strong magnetic fields.

8.1 Intended use

The brakes are intended to be mounted on machines, specifically on gearless lift machines with drive control inside buildings, in accordance with the requirements of EN 81-1 and are designed for use in commercial or industrial facilities. The brake is type-tested in accordance with Lifts Directive 95/16/EC. Consequently, it is suitable for use as protection against “uncontrolled upward travel” in lift installations. Operation in potentially explosive or firedamp atmospheres is not allowed. The brakes must be used in accordance with the operating requirements detailed in this manual. The rated power limits specified herein must not be exceeded.

8.2 General safety information

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

8.2.1 Set-up

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

8.2.2 Start-up

The brakes must not be put into operation when:

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

8.2.3 Mounting

The voltage and voltage type specified on the rating plate must be strictly observed when connecting the brakes described in these operating instructions. Sufficient heat dissipation must be ensured when the brake is fitted to or incorporated into other equipment.

Adequate precautions must be taken to avoid overvoltage during disconnection or voltage peaks. The magnetic field of the products may cause interference outside the brake or even feedback to the brake in case of adverse installation conditions. Should you have queries concerning mounting and fitting conditions, please contact the brake manufacturer and ask for clarification.

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

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

8.2.4 Operation

Make sure that live components such as plug contacts or the field coil are not exposed to water. The brake cable connections must not be crushed, squeezed or exposed to mechanical loads. Make absolutely sure that the friction surfaces of the friction elements are not contaminated with grease, oil or other fluids to avoid substantial brake force reduction. Bear in mind that the original brake force cannot be restored even if the friction surfaces are cleaned after contact with fluids. The gradual brake wear (only with dynamic brakes) and the resulting brake force reduction of spring-applied brakes must be taken into consideration during set-up. Due to the diverse ambient conditions in which the brakes may be used, always check that the brake is in perfect working order before start-up. Reductions in the transmissible torque cannot be excluded if the brake is used for applications where only minimum friction work is required. In such cases, the user should ensure that the brake occasionally performs sufficient friction work. The brakes are factory-treated with a corrosion inhibitor to provide basic corrosion protection during storage and operation in dry environments (no condensation).



Note!

The maximum air gap s_{max} (see Table 34/1, Technical Specifications) must not be exceeded throughout the entire brake service life (please refer to Section 4 “Maintenance” for details). Torque reductions may also occur during the brake service life as a result of adverse factors in the brake environment (see Section 8.2) or if the brake is only used as holding brake. In this case, the brake user should ensure that a break-in process as specified in Table 34/2 is conducted at regular intervals.



Notice!

During brake operation, ensure that the coil temperature does not rise above the permissible limit temperature applicable to the insulating materials of the specified insulation class (see Table 34/1). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 33/2) is not exceeded.

8.2.5 Maintenance, repair and replacement

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

8.3 Warning symbols

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

9. Definitions

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

Switching torque M_1	torque acting on the shaft during brake or clutch slip
Rated torque M_2	switching torque specified by the manufacturer to identify the brake. The rated torque M_2 is the mean value of at least 3 measurements of the maximum switching torque M_1 after completion of the transient response.
Transmissible torque M_4	highest torque that can be applied to the engaged brake or clutch without causing the brake/clutch to slip
Residual torque M_5	torque transmitted by the released brake or clutch
Load torque M_6	torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed
Switching work W	heat generated by friction inside the brake or clutch as a result of the switching operation
Maximum switching work W_{\max}	maximum switching work to which the brake or clutch may be exposed
Switching power P	switching work converted into heat per unit of time
Maximum switching power P_{\max}	maximum permitted switching work converted into heat per unit of time
Coil ON time t_5	time between power on and power off
Coil OFF time t_6	time between power off and power on
Total cycle time t_7	coil ON time plus coil OFF time
Duty cycle	percentage relationship of coil ON time to total cycle time
Switching operation	one complete switching on and off operation
Switching frequency Z	number of regular switching operations per hour
Response delay during coupling t_{11}	time between power off (releasing systems) or power on (engaging systems) and beginning of torque increase
Rise time t_{12}	time it takes to reach 90% of the M_2 rated torque from the beginning of the torque increase
Coupling time t_1	response delay t_{11} plus rise time t_{12}
Response delay during disconnection t_{21}	time between power on (releasing systems) or power off (engaging systems) and beginning of torque decrease
Fall time t_{22}	time it takes for the torque from the beginning of the torque decrease to fall to 10% of the M_2 rated torque
Disconnection time t_2	response delay t_{21} plus fall time t_{22}
Slip time t_3	time from the beginning of the torque increase up to the end of the braking process (brakes) or until the synchronisation torque M_3 has been reached (clutches)
Making time t_4	response delay t_{11} plus slip time t_3 (braking or acceleration time)
Operating condition at operating temperature	condition at which the steady-state temperature is reached. The operating temperature corresponds to the overtemperature according to DIN VDE 0580 plus the ambient temperature. Unless otherwise specified, the ambient temperature is 35°C.
Overtemperature $\Delta\theta_{31}$	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature
Limit temperature of coil insulating materials	in accordance with DIN VDE 0580. The individual insulating materials are classified by insulation classes to DIN IEC 6085.
Rated voltage U_N	supply voltage specified by the manufacturer for voltage windings to identify the device or component
Rated current I_B	amperage determined by the manufacturer for the specified operating conditions. Unless otherwise specified, the rated current refers to the rated voltage, 20°C winding temperature and to the rated frequency for a given operating mode of voltage windings.

Rated power P_N

power value to identify the device or component

Rated power at 20°C winding temperature P_B

determined from the rated current of voltage-controlled devices and components and the R_{20} resistance at 20°C winding temperature

10. Technical specifications

Product built and tested to DIN VDE 0580

	Size 19
Transmissible torque range (standard) M_4 [Nm]	280 – 440
Max. speed n_{max} [rpm]	2500
Max. switching work W_{max} (Z=1) [kJ]	155
Rated power P_N [W]	230
Coupling time t_1 [ms]	95 ($M_4 = 440$ Nm)
Disconnection time t_2 [ms]	260 ($M_4 = 440$ Nm)
Moment of inertia J [kgcm ²] – hub and friction disc	75
Weight m [kg]	25
Rated air gap s [mm]	0.4 ^{+0.5}
Max. air gap s_{max} [mm]	1.4
Total cycle time t_T [min]	5
Duty cycle [%]	55
Standard rated voltage [VDC]	205
Insulation class	F
Pollution degree	2
Protection	IP 44
Brake type	holding brake with emergency stop function
Application	lift machine for use inside buildings in accordance with EN 81-1

Table 33/1: Technical specifications

	Rated operating conditions
Rated voltage tolerance	+10%, -15%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{13} [°C]	-5 to +35
Relative humidity	30% to 80% within ambient temperature
Other climatic environmental conditions	3Z2 and 3Z4 to EN 60721-3-3
Mechanical environmental conditions	3M8 to EN 60721-3-3
Biological environmental conditions	3B1 to EN 60721-3-3
Mechanically active substances	3S2 to EN 60721-3-3
Chemically active substances	3C1 to EN 60721-3-3
Installation height	up to 2000 m a.m.s.l.

Table 33/2: Rated operating conditions for spring-applied double-disc brakes

Size 19			
Switching operations (emergency stops) Z [h ⁻¹]	2	3	4
Max. switching work W _{max} [kJ]	124	102	86

Table 34/1: Max. switching work W_{max} in relation to the number of switching operations per hour (E-stops) Z (values apply to n = 1500 rpm)

Explanations on the technical specifications:

W_{max} (maximum switching work) 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. Such operation must be agreed with the manufacturer. The maximum number of switching operations (emergency stops) Z per hour and the resulting maximum permitted switching W_{max} are specified in Table 34/1. The W_{max} values are approximate values. They apply to mounted brakes without any additional cooling and to emergency stops. The specified times apply to the following conditions: DC side brake switching, operating temperature, rated voltage, and rated air gap. All values are mean values that are subject to variation. In case of AC side brake switching, the coupling time t₁ is substantially longer. The specified transmissible torques M₄ characterize the torque level of the brakes. Depending on the application the brake is used for, the switching torque M₁ and the transmissible torque M₄ may differ from the specified M₄ values. The switching torque M₁ depends on the speed (rpm). If the friction surfaces are contaminated with oil or grease or other dirt the transmissible torque M₄ and the switching torque M₁ may drop. The technical specifications apply after the break-in process has been completed (see Table 34/2). Vertical brake operation is only allowed after prior consultation with the manufacturer.

Size 19	
Speed n [rpm]	130
Coil ON time t ₅ [s]	6
Coil OFF time t ₆ [s]	1
Break-in period t _{tot} [min]	approx. 1

Table 34/2: Break-in process parameters for spring-applied double-disc brake

Technical specifications	
Switching power	250 VAC, 5A
Min. switching power	24 VDC, 100 mA (silver contacts)
Mech. lifecycle [switching operations]	5 x 10 ⁷
Contact type	Normal Open (NO) and Changeover contact (NO, NC)
Temperature range [°C]	-20 to +70
Protection rating	IP 67

Table 34/3: Microswitch specifications (20 and 21)

The required operating conditions specified in Table 33/2 and the information provided in the **ELEVATION LINE specification sheet** and offer drawing for the specific brake types must be observed during operation of the spring-applied double-disc brake.

Specifications subject to change without notice!

11. Product number / type number / version number

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

Example:

Type number: 76 45119A00 Version number: 0001

Product number: 76 45119A00-0001

12. Specialist repair shops

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13. Revision history

Date of issues	Changes
28/11/2013	Updated technical specifications. Added Declaration of Conformity in accordance with Low Voltage Directive 2006/95/EC and RoHS Directive 2011/65/EU. Changed company name. Text revisions.
13/03/2020	Operating instructions revised in content. Updated layout (design) of operating instructions.

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