



KENDRION INDUSTRIAL BRAKES

Vario Line

Spring-applied single-disc brake

Operating Instructions 76 431..H00

Types: 76 43110H00 76 43111H00 76 43113H00
76 43114H00 76 43116H00 76 43119H00
76 43124H00 76 43129H00

Contents

1. General	3
1.1 Introduction	3
1.2 Standards and directives	3
1.3 Declaration of Incorporation (in accordance with Annex II, part 1, Section B of Machinery Directive 2006/42/EC)	3
1.4 EU Declaration of Conformity	4
1.5 Manufacturer's liability	4
2. Product description	5
2.1 Operating principle	5
2.2 Brake design	5
3. Installation	7
3.1 Mechanical installation	7
3.2 Installation of accessories	8
3.3 Electrical connection and operation	9
3.3.1 DC power supply	10
3.3.2 AC power supply	10
3.4 Electromagnetic compatibility	13
3.5 Set-up & start-up	15
3.6 M ₂ rated torque adjustments	16
4. Maintenance	17
4.1 Checks and service	17
4.2 Spare parts and accessories	18
5. Condition at delivery, transportation and storage	18
6. Emissions	19
6.1 Noise	19
6.2 Heat	19
7. Troubleshooting	20
8. Safety	21
8.1 Intended use	21
8.2 General safety information	21
8.2.1 Set-up	22
8.2.2 Set-up & start-up	22
8.2.3 Installation	22
8.2.4 Operation	22
8.2.5 Maintenance, repair and replacement	23
8.3 Warning symbols	23
9. Definitions	24
10. Technical specifications	26
11. Product number / type number / version number	28
12. Authorized repair shops for service & maintenance	29
13. Revision history	29

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1. General

1.1 Introduction

These operating instructions describe the operating principle and features of the spring-applied brake types 76 431..H00. 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 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 brakes have been designed, built and tested in accordance with the requirements of DIN VDE 0580 concerning electromagnetic devices and components.

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

The products listed in Section 1.3 are entitled to bear the CSA certification mark to indicate that they are approved to CSA standards (Canadian Standards Association).

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

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

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

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

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Applied harmonized standards and other technical standards and regulations:

EN 60529 Enclosure protection ratings
DIN VDE 0580 Electromagnetic devices and components

Product: Electromagnetically released spring-applied single-disc brake

Types: 76 43110H00 76 43111H00 76 43113H00 76 43114H00
76 43116H00 76 43119H00 76 43124H00 76 43129H00

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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Villingen
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Authorized signatory:


Dominik Hettich
(Head of Development)

1.5 Manufacturer's liability

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

2. Product description

2.1 Operating principle

The spring-applied single-disc brakes described in these operating instructions are intended for direct attachment to electric motors. The brakes are designed to operate dry. The force generated by an electromagnetic field is utilized to overcome the braking effect produced by the spring force. The spring-applied single-disc brake engages in unpowered condition and releases when DC voltage is applied. The brake is connected with the motor shaft via a centrally arranged hub. The friction disc of the brake is connected with the hub in such a way that it is axially movable and tangentially fixed. The hub and motor shaft are firmly connected with each other. This ensures that the motor shaft is blocked / slowed down when the brake is engaged.

2.2 Brake design

The solenoid housing (1.1) of the spring-applied single-disc brake accommodates the firmly fitted field coil (1.2) with connecting cable (1.3) – which exits on the brake circumference – and the compression springs (4). The compression springs (4) press the friction disc (7) over the armature (2) against the friction plate or flange¹⁾ (12) and thus against the mounting surface (9) (e.g. motor end shield). The frictional connection obtained in this manner between the friction surfaces of the friction disc (7) and armature (2) or friction plate (12) / flange (12) produces the braking effect of the spring-applied brake. The rated air gap 's_n' is factory-adjusted by means of the spacer sleeves (5). The spacer sleeves (5) are tightly pressed into the solenoid housing (1.1). They ensure that the armature (2) is kept in a fixed tangential position. The friction disc (7) is connected with the hub (13) via a spline connection or square socket ²⁾. This connection ensures that the friction disc (7) is tangentially fixed, but movable in axial direction. The hub (13) is firmly fixed to the shaft (e.g. motor shaft) (17). The brake is firmly mounted to the mounting surface (9) (e.g. motor end shield) with the mounting screws (14) (see Fig. 6/1). When DC voltage is applied to the brake field coil (1.2), the force of the electromagnetic field thus generated counteracts the spring force of the compression springs (4). The armature (2) is moved axially towards the solenoid housing (1.1) and the braking action is neutralized. The shaft to be braked (17) (e.g. motor shaft) is not exposed to any axial loads exerted by the spring-applied single-disc brake. When using spring-applied single-disc brakes with hand release (10), openings must be provided in the part enclosing the brake (e.g. fan cover) so that the hand release can be installed. The hand release (10) allows the brake to be released manually (e.g. in case of power failure). When a collar (11) is fitted to the brake, the hand release (10) can only be operated by pushing the lever away from the mounting surface (9).

List of reference numerals in Fig. 6/1:

1.1	Solenoid housing	10.2	Tie bolt
1.2	Field coil	10.3	Socket head cap screw
1.3	Connecting cable	10.4	Return spring
2	Armature	10.5	Disc
3	Adjusting ring	10.6	Yoke
4	Compression spring	11	Collar
5	Spacer sleeve	12	Friction plate / Flange ¹⁾
6	Pole enlargement	13	Hub
7	Friction disc	14	Mounting screws
8	Rating plate	15	Screw plug
9	Mounting surface (e.g. motor end shield)	16	Sealing ring
10	Hand release	17	Shaft (e.g. motor shaft)
10.1	Lever	18	Feather key
		19	Circlip

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

¹⁾ Sizes 19 to 29.

²⁾ Sizes 13, 16, 19, 24.

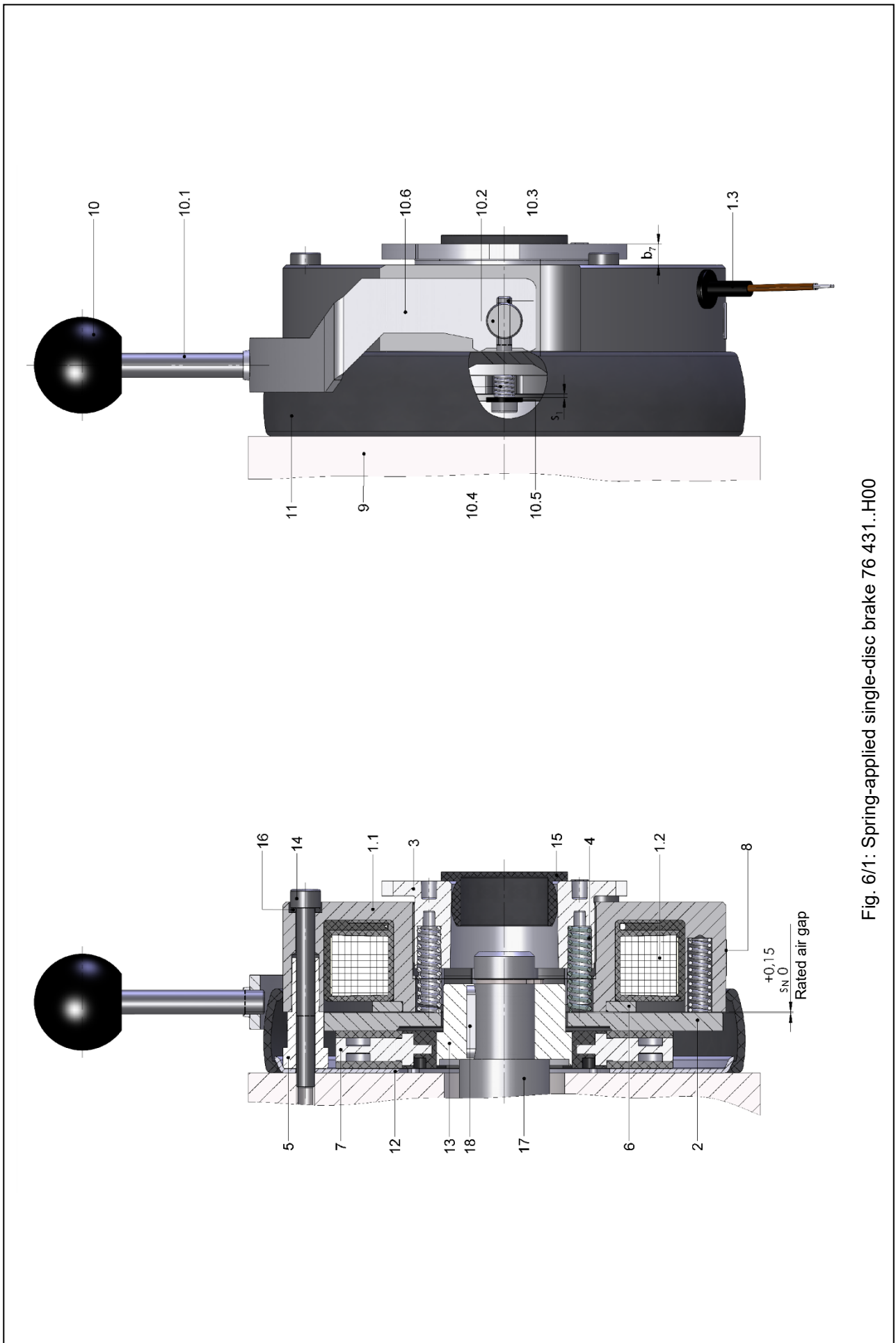


Fig. 6/1: Spring-applied single-disc brake 76 431..H00

3. Installation

3.1 Mechanical installation

Slip the hub (13) on a shaft (17) provided with a feather key (18) to DIN 6885, sheet 1, and secure it axially (with a shaft collar, circlip (19) or the like). Make sure that the hub (13) is set back by L_1 (see Fig. 7/1 and Table 7/1) relative to the friction surface of the friction disc (7). If a friction plate (12) or flange ³⁾ (12) (accessories) is used, mount the friction plate (12) or flange ³⁾ (12) to the mounting surface (9) (e.g. motor end shield). Push the friction disc (7) onto the hub (13). Check that you feel only little resistance when sliding the friction disc (7) along the hub (13). Then fix the field coil of the spring-applied single-disc brake to the mounting surface (9) (e.g. motor end shield) by means of the mounting screws (14). If sealing rings (16) (accessories) are used, they must be slipped on the mounting screws (14).

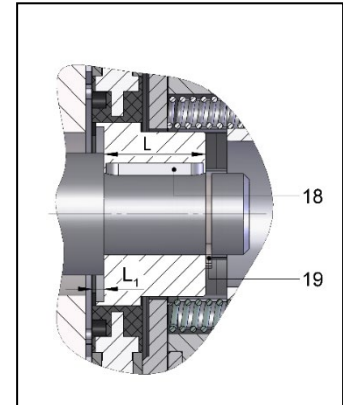


Fig. 7/1: Hub (13) position

Warning!

The brake user has to ensure that the tolerance, strength and quality of the shaft (17) (e.g. motor shaft) and the type of feather key (18) employed are suitable to achieve reliable transmission of the generated brake torques from the hub (13) to the shaft (17) (e.g. motor shaft).

Attention!

The M_A tightening torque (see Table 7/1) specified for the mounting screws (14) must be strictly observed. Tighten the mounting screws (14) evenly in several steps. The axial position of the hub (13) (see Fig. 7/1 and Table 7/1) must be maintained to ensure reliable torque transmission by the hub (13).

	10	11	13	14	16	19	24	29
L [mm]	20	20	25	30	30	35	40	50
L_1 [mm]	2.5	3.5	3	3	3	4	5	4.5
M_A [Nm]	6	10	10	25	25	25	40	40

Table 7/1: Hub (13) dimensions; tightening torques for mounting screws (14)

Check that the mounting surface (e.g. motor end shield) (9) meets the following requirements before installing the brake:

- Axial runout relative to the shaft $<0.1\text{mm}$ (measuring radius = pitch circle)
- Surface roughness max. R_z16
- Surface hardness min. 100HB
- Material: steel, cast iron – with excellent thermal conductivity. If other materials are used (e.g. aluminium), the friction plate (12) or flange (12) must be installed.
- Absence of oil and grease

Centre the brake on the mounting surface (e.g. motor end shield) (9) by means of the mounting screws (14) to ensure correct operation. Correct tightening of the mounting screws (14) is essential to ensure sufficient centring of the spring-applied single-disc brake. The rated air gap 's_N' (see Table 26/1) is factory-adjusted and need not be changed.

³⁾ Sizes 19 to 29.



Note!

If the friction disc (7) 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 (7) can be easily moved along the hub (13) by hand.



Note!

Magnetic interference fields may affect reliable brake operation. Consequently, the brake should always be installed outside the reach of magnetic interference fields. The assembled brake components, especially the friction surfaces, must be free of grease and oil during operation. Make sure that lubricants and the like cannot seep from the motor bearing into the brake. (Sealed bearings can be used to prevent lubricant leaks.) Minor bearing play will not compromise safe and reliable brake operation. During installation of the power cable (1.3), make sure to avoid cable damage by kinking the insulation.

3.2 Installation of accessories

Hand release (10):

Insert the 2 tie bolts (10.2) into the bores provided in the yoke (10.6). Push the yoke (10.6) with the inserted tie bolts (10.2) into the cavity provided in the spring-applied single-disc brake. (Only brakes with hand release option will have this cavity.) Push the 2 discs (10.5) and the 2 return springs (10.4) on a socket head cap screw (10.3). Apply Loctite 241 to the 2 socket head cap screws (10.3). Insert the screws with the discs (10.5) and return springs (10.4) through the bores provided in the solenoid housing (1.1) and fasten them with the 2 tie bolts (10.2). Use a feeler gauge to adjust the distance s_1 (see Table 8/1 and Fig. 6/1) when the brake is released (attracted armature (2)). Check that s_1 is not exceeded and that it is evenly adjusted on both socket head cap screws (10.3). Screw the hand release lever (10.1) into the yoke (10.6) and secure it by applying Loctite 241. The required actuation forces F and the maximum permitted actuation forces F_{max} are specified in Table 8/1. The specified actuation forces F apply at the maximum rated torque (standard).

	Size							
	10	11	13	14	16	19	24	29
Required actuation force F [N]	approx. 25	approx. 30	approx. 60	approx. 110	approx. 130	approx. 200	approx. 270	approx. 200
$s_1^{+0.1}$ [mm]	1.0	1.0	1.25	1.5	1.5	1.7	2.0	2.5
Max. permitted actuation force F_{max} [N]	45	52	105	170	230	320	470	420

Table 8/1: Actuation force F , max. permitted actuation force F_{max} and distance s_1 of hand release (10)



Note!

Machinery-specific regulations and requirements (e.g. for hoists, cranes and elevators) must be observed when using brakes with hand release (10).



Warning!

Check that the hand release (10) is in a central position (see Fig. 6/1) when not in use. This is crucial to ensure reliable brake engagement. Otherwise, the full braking effect of the spring-applied single-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 (10) and automatic return of the hand release lever in its central position (see Fig. 6/1) has been ensured.



Caution!

The brake torque can be neutralized manually by means of the hand release (10). Consequently, the brake must be installed in such a way that any unintentional actuation of the hand release (10) is excluded. The maximum axial pre-travel s_1 (free travel) of the hand release (10) also limits the axial stroke of the armature (2). If the air gap 's' is equivalent to or greater than the pre-travel s_1 the armature (2) is in contact with the discs (10.5) of the hand release (10). This may affect the reliability of the brake system. The maximum air gap s_{max} (see Table 26/1) must not be exceeded throughout the entire brake service life. (Please refer to Section 4 Maintenance for details.) When installing the hand release (10), check that the distance s_1 (see Table 8/1) between the armature (2) and disc (10.5) is correctly adjusted after the brake has been released. Apply Loctite 241 to the socket head cap screws (10.3) to secure them in the tie bolts (10.2).

Collar (11):

Pull the collar (11) over the solenoid housing (1.1). Check that the sealing lip of the collar (11) is located precisely between the friction plate (12) and the mounting surface (e.g. motor end shield) (9) on the mounting surface side or precisely in the flange (12) groove (sizes 19 to 29) (see Fig. 6/1). Ensure that on the brake side the collar (11) sealing lip touches the circumference of the solenoid housing (1.1) or is located in the groove (sizes 19 to 29). When a collar (11) is fitted to the brake, the hand release (10) can only be operated by pushing the lever away from the mounting surface (e.g. motor end shield) (9).

Screw plug (15):

The screw plug (15), if used, must be inserted into the shaft opening on the rear of the brake (see Fig. 6/1).

3.3 Electrical connection and operation

The spring-applied single-disc brake must be connected to a DC power source using the power cable (1.3) provided. Connection to an AC power source is via a bridge rectifier or half-wave rectifier or by using a combination of the two rectifier types. Various Kendrion rectifier types (see Table 9/1 – list not exhaustive) can be provided for this purpose. 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 (40-60Hz)	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

The relevant rectifier specification sheets must be observed!

Table 9/1: 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.



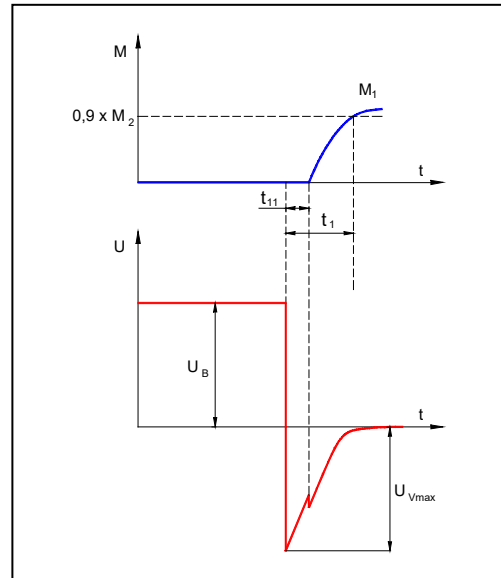
Attention!

The peak voltage U_{Vmax} during disconnection without protective circuit may reach **several thousand volts** in the millisecond region. This may cause irreversible damage to the field coil (1.2), switching contacts and electronic components. Sparking will occur on the switch during disconnection. Consequently, a protective circuit must be provided to reduce the current during disconnection and to limit the voltage. The maximum permitted overvoltage during disconnection is 1500V. If Kendrion rectifiers are used (see Table 9/1), 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!

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



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

3.3.2 AC power supply

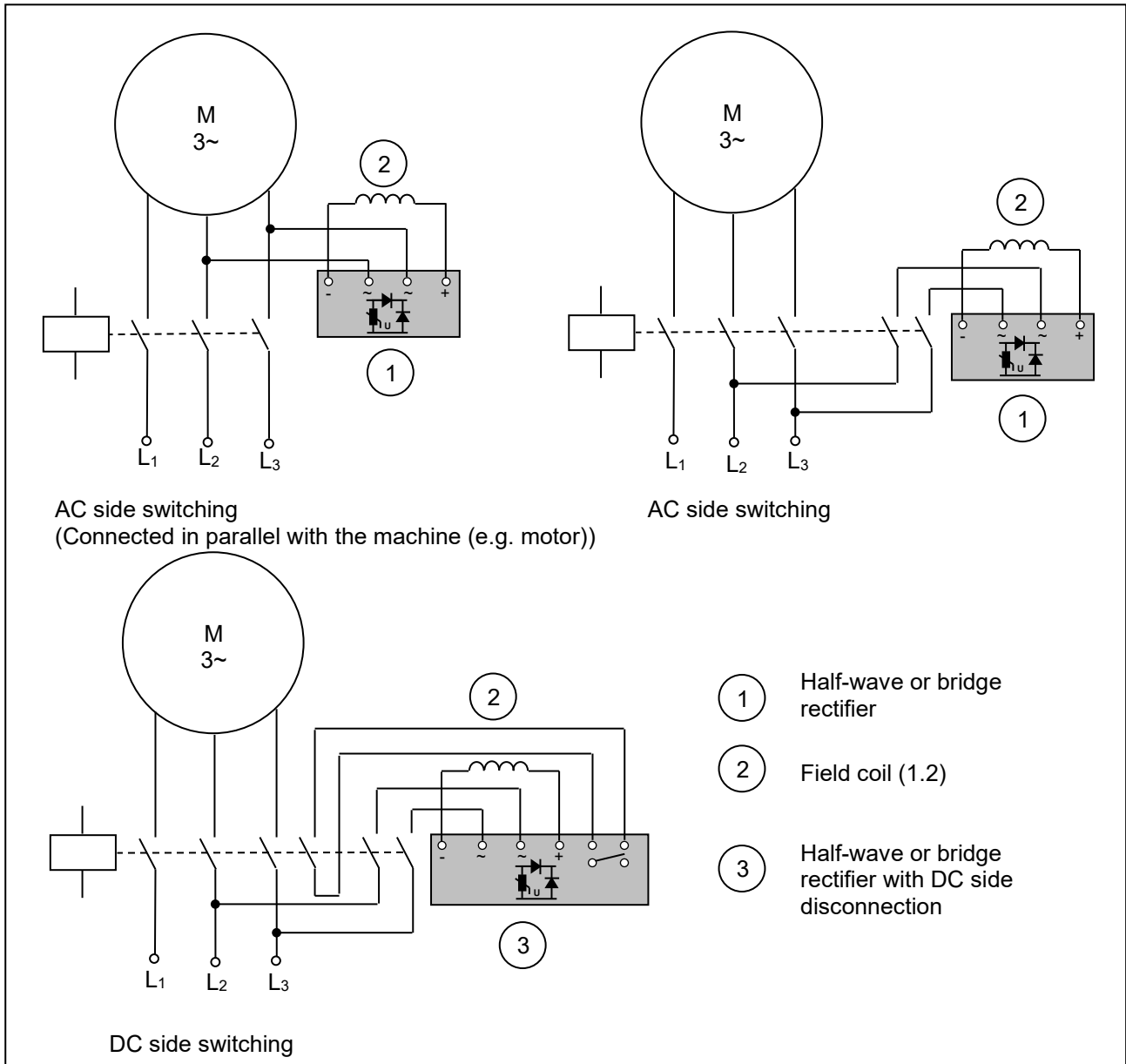
Direct brake connection to an AC power source is only possible if a rectifier is used. The coupling times vary depending on the switching type (DC side switching or AC side switching).

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 which, depending on the brake size, may slightly reduce the switching times when compared to bridge rectifiers. Due to the shorter switching times and the lower coil voltage, half-wave rectifiers are generally preferred to bridge rectifiers. However, brake humming may occur when small size brakes are used.

Bridge rectification:

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



AC side switching:

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

DC side switching:

In case of DC side brake switching, an auxiliary contact is provided on the motor contactor, for example. This auxiliary contact is designed to interrupt the power supply on the DC side. The significant reduction in the electric time constant results in fast brake engagement and shorter coupling times.



Attention!

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



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 single-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 according to EN 61000-4:

EN 61000-4-2 Electrostatic discharge:

The spring-applied single-disc 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 conform to severity level 3 without additional measures.

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

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

EN 61000-4-5 Surge:

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

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

Since the operating magnetic fields of the electromagnetic brakes are stronger many times over than interference fields, the brake function will remain unaffected. The brakes comply at least with severity level 4. The recommended rectifiers conform at least to severity level 3.

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

a) Voltage interruptions:

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

b) Voltage dips and short supply voltage variations:

Electromagnetically released systems:

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

Electromagnetically engaged systems:

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

Radio interference suppression in accordance with EN 55011:

The brakes and the 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 50/60Hz 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 50/60Hz AC power source and equipped with electronic rectifiers or other electronic controls, interference suppression measures as shown in Fig. 14/1 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. When brakes are used with the specified rectifiers or with other types of rectifiers, the recommended values listed in Table 15/1 should be observed. Interference suppression components should be installed as close as possible to the consumer. Interference caused during switching operations of the electromagnetic component is generally attributable to the inductive load. Where necessary, assemblies designed to limit the disconnection voltage (e.g. anti-parallel diode) or voltage limiting components (e.g. varistors, suppressor diodes, resistance diodes and the like) can be installed. However, such components will inevitably change the switching times of the brake and increase the generated noise level. The rectifiers specified in Section 3.3 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 15/2.

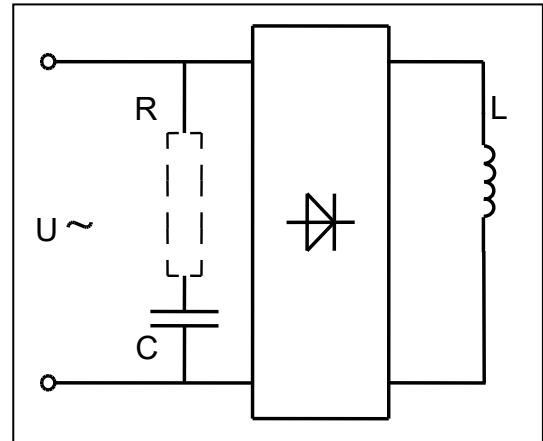


Fig. 14/1

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.

Rectifier series	Rated input voltage range U ₁ /VAC (40-60Hz)	DC at L-load (ADC)	Capacitor nF (VAC)
Bridge rectifier 32 07.23B.0	up to 400 (±10%)	up to 2.0	no additional interference suppression measures required
Half-wave rectifier 32 07.22B.0	up to 500 (±10%)	up to 2.0	no additional interference suppression measures required

Table 15/1

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

Table 15/2

3.5 Set-up & start-up



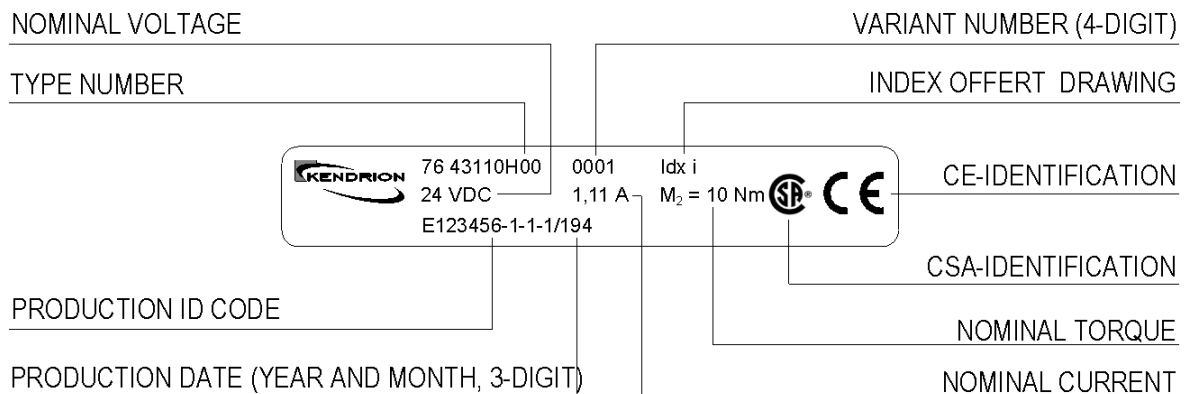
Warning!

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

The following checks must be carried out:

Check compliance with the specifications provided on the rating plate with respect to the mounting position and protection class. After connection of the brake, a functional test must be performed to check that the friction disc (7) runs smoothly. For this purpose, turn the shaft (17) (e.g. motor shaft) while the brake is energized and the machine (e.g. motor) is unpowered. After completion of mounting, all necessary covers and guards must be installed.

Specifications on rating plate (order-specific, example brake type 76 43110H00-0001):



Note: The product number of the brake consists of the type number followed by the version number, e.g. 76 43110H00-0001.



Warning!

Before starting the motor test run without driven components, the feather key (if used) must be secured in such a way that it cannot be hurled out. The shaft (e.g. motor shaft) (17) 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 100°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 (17) needs to be turned during set-up operations while the motor is switched off, the brake must be released electromagnetically or, if necessary, by means of the hand release (10).



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 3.4 will cause damage to electronic rectifiers, electronic accessories, switching contacts and to the field coil (1.2).

3.6 M₂ rated torque adjustments

The brakes are factory-adjusted to the M₂ rated torque (as specified in the purchase order). The factory-adjusted M₂ rated torque is specified on the rating plate (8) of the brake. The position of the adjusting ring (3) is marked by an arrow or notch ⁴⁾ / punch mark ⁴⁾ on the ring (3) and by a punch mark on the solenoid housing (1.1). The adjusting ring clearance b₇ (see Fig. 6/1) can be changed by fastening or loosening the adjusting ring (3) by means of a pin spanner or sickle spanner. The changes in the M₂ rated torque resulting from this adjustment are specified in Table 16/1. The max. adjusting ring clearance b₇ (see Table 16/1) must not be exceeded.

	Size							
	10	11	13	14	16	19	24	29
ΔM ₂ /mm [Nm]	2	3	5	7	8	10.5	24	50
b ₇ [mm]	3.5-6.5	4.0-8.0	5.0-10.0	5.0-10.0	5.5-13	6.0-14.5	7.0-15.0	7.0-13.5

Table 16/1: Change in the M₂ rated torque resulting from a 1 mm axial adjustment of the adjusting ring (3); minimum and maximum adjusting ring clearances b₇



Note!

The adjusting ring (3) of size 29 brakes is secured with a set screw (M5 thread) so that it cannot turn. Unscrew the set screw if you need to turn the adjusting ring. Make sure to retighten the set screw after you have adjusted the M₂ rated torque. The tightening torque to be applied is M_A = 3Nm. The adjusting ring (3) must be turned in such a way that the set screw can be located between the studs (only if size 24 and 29 brakes are used).

⁴⁾ Sizes 19 to 29.

**Note!**

Any adjustments of the M_2 rated torque must be performed with extreme caution by qualified and specifically trained specialist or service personnel.

4. Maintenance

4.1 Checks and service

The spring-applied single-disc brake does not require any maintenance except that the air gap 's' must be measured at regular intervals. Replace the friction disc (7) by a new one when the maximum air gap s_{max} (see Table 26/1) between the armature (2) and solenoid housing (1.1) has been reached. Unscrew the mounting screws (14) and remove the field coil assembly of the spring-applied single-disc brake. Remove the worn friction disc (7) from the hub (13) and replace it by a new one. The air gap 's' cannot be adjusted. Proceed to install the coil system as described in Section 3.1.

**Attention!**

When the spring-applied single-disc brake is mounted to the machine, it is crucial that the mounting screws (14) be tightened applying the M_A tightening torque specified in Table 7/1.

**Attention!**

Depending on its operating condition, it may no longer be possible to release the spring-applied single-disc brake when the maximum air gap s_{max} (see Table 26/1) has been exceeded. In this case, the braking action cannot be neutralized. This may cause thermal overloading of and irreversible damage to the brake if the motor is started before the brake has been released. Thermal overloading of the motor may occur if it is not started while the brake is still engaged.

**Caution!**

If a hand release (10) is fitted to the brake and the maximum air gap s_{max} has been exceeded (see Table 26/1), the tie bolts (10.2) of the hand release (10) will limit the axial movement of the armature (2). This will cause the torque to fall to zero. Whenever carrying out service and maintenance work, always check the air gap 's' and replace the friction disc (7) well before the maximum air gap s_{max} (see Table 26/1) is reached.

**Warning!**

Whenever inspection and maintenance work is carried out, ensure that

- the motor is secured against accidental or unintentional start-up.
- no load torque acts on the shaft (e.g. motor shaft) (17).
- the lock provided to prevent accidental motor start-up is removed after completion of inspection and maintenance work.
- all friction surfaces are free from grease and oil. An oily or greasy friction disc (7) cannot be cleaned.
- no swelling or glazing of the friction lining has occurred.



Note!

Any tests conducted to confirm correct brake function and operational safety and reliability must be performed with extreme caution and by qualified specialist personnel only.

4.2 Spare parts and accessories

Size	Designation, order number						
	Friction plate/ flange ⁵⁾ (12)	Hand release (10)	Mounting screw (14)	Collar (11)	Screw plug (15)	Friction disc (7)	Sealing ring (16)
	A	A	A	A	A	S	A
10	76 43110H00004	76 43110H00940	304065	76 43110H00005	412859	76 43110H00200	326005
11	76 43111H00004	76 43111H00940	304051	76 43111H00005	412842	76 43111H00200	326006
13	76 43113H00004	76 43113H00940	304052	76 43113H00005	412843	73 24113E00400	326006
14	76 43114H00004	76 43114H00940	304078	71 10116A3013	412843	76 43114H00400	326007
16	76 43116H00004	76 43116H00940	304079	76 43116H00005	412860	73 24116E00400	326007
19	76 43119H00024	76 43119H00940	304080	76 43119H00005	412841	76 14119E00400	326007
24	76 43124H00024	76 43124H00940	304117	76 43124H00005	412885	76 14124E00400	326008
29	76 43129H00024	76 43129H00940	304118	76 43129H00005	-	76 14129E00400	326008

Table 18/1: Spare parts (S) and accessories (A)

5. Condition at delivery, transportation and storage

The electromagnetic single-disc brake is delivered ready for mounting. A brief break-in process is completed at the manufacturer's premises before shipment. The rated air gap s_N is factory-adjusted. The hub (7) and mounting screws (9) are delivered together with the brake. 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.



Note!

The coil system and the armature are factory-adjusted to ensure reliable brake release (opening). Consequently, individual components cannot be replaced. If the brake is not installed immediately upon delivery, it must be stored in a dry, dust-free and vibration-proof place.



Note!

The environmental conditions specified in Table 19/1 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.

⁵⁾ Sizes 19 to 29.

	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 19/1: Environmental conditions for storage and transport as specified in EN IEC 60721-3-1 and EN IEC 60721-3-2

6. Emissions

6.1 Noise

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

6.2 Heat

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



Caution!

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

7. Troubleshooting

Fault	Cause	Corrective actions
Brake release failure	• Air gap too large	Check the air gap. Install a new friction disc (7), 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.
	• Armature (2) blocked mechanically	Eliminate mechanical blocks.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil (1.2)	Check the resistance of the field coil (1.2). Install a new brake, if necessary.
	• Irreversible thermal damage of friction disc (7) linings	Install a new friction disc (7) or a new brake, if necessary.
Delayed brake release	• Air gap too large	Check the air gap. Install a new friction disc (7), 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.
	• Armature (2) blocked mechanically	Eliminate mechanical blocks.
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.
Brake torque too low	• Air gap too large	Check the air gap. Install a new friction disc (7), if necessary.
	• Oily or greasy friction surfaces	Check the friction surfaces. Install a new friction disc (7), if necessary.
	• Axial movement of armature (2) blocked by hand release (10)	Check the distance s_1 and adjust it, if necessary. Check the air gap and install a new friction disc (7), if necessary.

Table 20/1: Possible faults, causes and corrective actions (list not exhaustive)

8. Safety

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

The machine owner is required to ensure that:

- the brakes are only used in accordance with their intended use (see 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 here in.
- the brakes are not exposed to other strong magnetic fields.

8.1 Intended use

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

8.2 General safety information

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

8.2.1 Set-up

Requirements in terms of the permitted number of switching operations per hour and the maximum switching work per switching operation specified in the technical specifications must be strictly observed during the set-up of machines and plant (inching mode). Failure to observe these instructions may irreversibly diminish the braking effect and cause malfunctions. Normal operating conditions are those specified by DIN VDE 0580. The protection rating conforms to EN 60529. In case of deviations, special measures must be taken after prior consultation with the manufacturer. If vertical brake operation is envisaged, any special requirements must be agreed with the manufacturer. Bear in mind that 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 Set-up & start-up

The brakes must not be put into operation when:

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

8.2.3 Installation

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

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

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

8.2.4 Operation

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



Note!

The maximum air gap s_{max} (see Table 26/1) must not be exceeded throughout the entire brake service life. (Please refer to Section 4 Maintenance for details.)



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 26/1). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 27/1) is not exceeded.



Note!

The torque of the spring-applied brake may be reduced if the brake has been stored for a prolonged period of time. Torque reductions may also occur during the brake service life 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 27/2 is conducted at regular intervals.

8.2.5 Maintenance, repair and replacement

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

8.3 Warning symbols

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

9. Definitions

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

Switching torque M_1	torque acting on the shaft during brake or clutch slip.
Rated torque M_2	switching torque specified by the manufacturer to identify the brake. The rated torque M_2 is the mean value of at least 3 measurements of the maximum switching torque M_1 after completion of the transient response.
Transmissible torque M_4	highest torque that can be applied to the engaged brake or clutch without causing the brake/clutch to slip.
Residual torque M_5	torque transmitted by the released brake or clutch
Load torque M_6	torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed.
Switching work W	heat generated by friction inside the brake or clutch as a result of the switching operation.
Maximum switching work W_{max}	maximum switching work to which the brake or clutch may be exposed.
Switching power P	switching work converted into heat per unit of time.
Maximum switching power P_{max}	maximum permitted switching work converted into heat per unit of time.
Coil ON time t_5	time between power on and power off.
Coil OFF time t_6	time between power off and power on.
Total cycle time t_7	coil ON time plus coil OFF time.
Duty cycle	percentage relationship of coil ON time to total cycle time.
Switching operation	one complete switching on and off operation.
Switching frequency Z	number of regular switching operations per hour.
Response delay during coupling t_{11}	time between power off (releasing systems) or power on (engaging systems) and beginning of torque increase.
Rise time t_{12}	time it takes to reach 90% of the M_2 rated torque from the beginning of the torque increase.
Coupling time t_1	response delay t_{11} plus rise time t_{12} .
Response delay during disconnection t_{21}	time between power on (releasing systems) or power off (engaging systems) and beginning of torque decrease
Fall time t_{22}	time it takes for the torque from the beginning of the torque decrease to fall to 10% of the M_2 rated torque.
Disconnection time t_2	response delay t_{21} plus fall time t_{22} .
Slip time t_3	time from the beginning of the torque increase up to the end of the braking process (brakes) or until the synchronization torque M_3 has been reached (clutches).
Making time t_4	response delay t_{11} plus slip time t_3 (braking or acceleration time).

Operating condition at operating temperature	condition at which the steady-state temperature is reached. The operating temperature corresponds to the overtemperature according to DIN VDE 0580 plus the ambient temperature. Unless otherwise specified, the ambient temperature is 35°C.
Overtemperature $\Delta\vartheta_{31}$	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature.
Limit temperatures of coil insulating materials	in accordance with DIN VDE 0580. The individual insulating materials are classified by insulation classes to DIN IEC 60085.
Rated voltage U_N	supply voltage specified by the manufacturer for voltage windings to identify the device or component.
Rated current I_B	amperage determined by the manufacturer for the specified operating conditions. Unless otherwise specified, the rated current refers to the rated voltage, 20°C winding temperature and to the rated frequency for a given operating mode of voltage windings.
Rated power P_N	power value to identify the device or component.
Rated power at 20° winding temperature P_B	determined from the rated current of voltage-controlled devices and components and the R_{20} resistance at 20°C winding temperature.

10. Technical specifications

Product built and tested to DIN VDE 0580

	Size							
	10	11	13	14	16	19	24	29
Rated torque range (standard) M_2 [Nm]	4-8	8-16	16-32	30-60	40-80	80-150	150-240	280-400
Max. reachable rated torque with fully tightened adjusting ring M_{2max} [Nm]	10	20	40	65	100	170	300	600
Max. speed n_{max} [rpm]	3500	3500	3500	3500	3500	3000	3000	3000
Max. switching power P_{max} [kJ/h]	320	430	650	800	1000	1200	1400	1600
Rated power P_N [W]	26	30	40	53	55	80	110	130
Coupling time t_1 [ms]	20 ($M_2=8Nm$)	30 ($M_2=16Nm$)	45 ($M_2=32Nm$)	86 ($M_2=60Nm$)	90 ($M_2=80Nm$)	130 ($M_2=150Nm$)	225 ($M_2=240Nm$)	115 ($M_2=400Nm$)
Disconnection time t_2 [ms]	95 ($M_2=8Nm$)	80 ($M_2=16Nm$)	90 ($M_2=32Nm$)	84 ($M_2=60Nm$)	190 ($M_2=80Nm$)	270 ($M_2=150Nm$)	235 ($M_2=240Nm$)	560 ($M_2=400Nm$)
Moment of inertia J – hub and friction disc [kgcm ²]	1.2	2	6	8	16	38	108	230
Weight m [kg]	1.3	2.8	3.7	5.7	8.4	13.1	22	36
Rated air gap $s_N^{+0.15}$ [mm]	0.2	0.2	0.25	0.3	0.35	0.35	0.4	0.45
Max. air gap (at 70% of rated current) $s_{max}^{6)}$ [mm]	0.8	0.95	0.8	0.9	1.2	1.5	1.5	1.5
Duty cycle [%]	100	100	100	100	100	100	100	100
Standard rated voltage [VDC]	24, 102, 178, 205							
Insulation class	F							
Pollution degree	2							
Protection	IP 55 (when installed under motor fan hood) IP 65 (with accessories and when installed under motor fan hood)							
Brake type	dynamic brake							

Table 26/1: Technical specifications

⁶⁾ Max. air gap s_{max} related to maximum rated torque (standard). Max. air gap s_{max} when M_{2max} rated torque is approx. 60% of values specified in the table (see "Technical specifications").

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

Table 27/1: Required operating conditions for spring-applied single-disc brakes

	Size							
	10	11	13	14	16	19	24	29
Speed n [rpm]	250	250	250	250	250	250	250	125
Coil ON time t_5 [s]	2	2	6	6	6	6	6	6
Coil OFF time t_6 [s]	1	1	1	1	1	1	1	1
Break-in period t_{total} [min]	approx. 1	approx. 1	approx. 1	approx. 1	approx. 1	approx. 1	approx. 1	approx. 1

Table 27/2: Break-in process parameters for the spring-applied single-disc brake after installation and during brake service life

Explanations on the technical specifications:

W_{max} (maximum switching work) is the switching work that must not be exceeded during braking operations at max. 1500rpm. Braking operations at speeds greater than 1500rpm substantially reduce the maximum permitted switching work per switching operation. Such operation must be agreed with the manufacturer. The maximum switching power P_{max} is the switching work W that can be converted by the brake per hour. In case of applications where the number of switching operations per hour is $Z > 1$, Fig. 29/1 applies (W_{max} as a function of the number of switching operations per hour Z). The P_{max} and W_{max} values are approximate values. They apply to applications where the brake is mounted between the B-face end shield of the motor and the motor fan. 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 t_1 is substantially longer. The specified rated torques M_2 characterize the torque level of the brakes. Depending on the application the brake is used for, the switching torque M_1 and the transmissible torque M_4 may differ from the specified M_2 values. The switching torque M_1 depends on the speed (rpm). If the friction surfaces are contaminated with oil or grease the transmissible torque M_4 and the switching torque M_1 may drop. The technical specifications apply after the break-in process has been completed (see Table 27/2). Vertical brake operation is only allowed after prior consultation with the manufacturer.

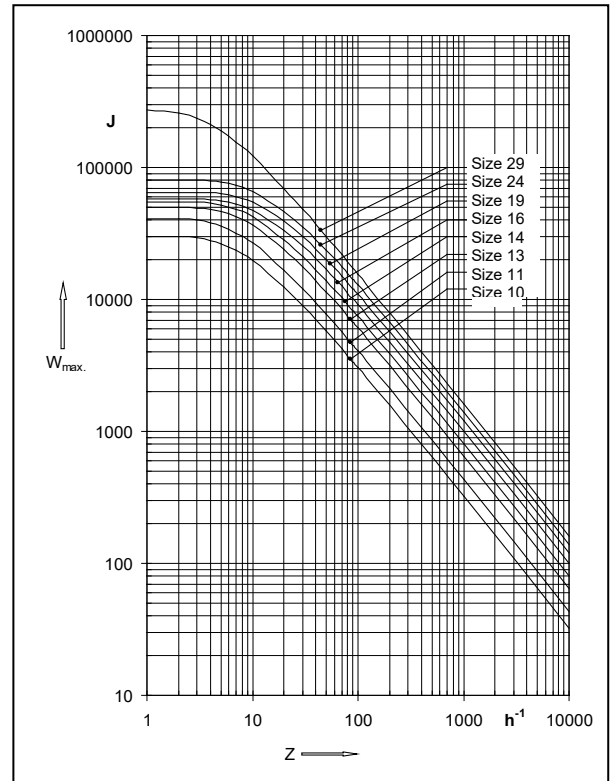


Fig. 28/1: Max. switching work W_{max} per switching operation as a function of the number of switching operations per hour Z (values based on $n=1500\text{rpm}$)

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

The required operating conditions specified in Table 27/1 and the information provided in the **VARIO LINE specification sheet** and offer drawing for the specific brake types must be observed during operation of the spring-applied single-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 43110H00

Version number: 0001

Product number: 76 43110H00-0001

12. Specialist repair shops

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13. Revision history

Date of issues	Changes
26/03/2002	New issue.
25/02/2003	Operating instructions revised in content.
18/06/2004	Operating instructions revised in content.
12/12/2008	Operating instructions revised in content.
30/12/2009	Operating instructions revised in content. Updated layout (design) of operating instructions.
20/03/2015	Added Declaration of Conformity in accordance with Low Voltage Directive 2006/95/EC and RoHS Directive 2011/65/EU. Changed company name. Text revisions.
25/03/2019	Standards updated. Information about storage and transportation of the component in chapter 5 added. Updated layout (design) of operating instructions
13/03/2020	Operating instructions revised in content. Updated layout (design) of operating instructions.

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