



KENDRION INDUSTRIAL BRAKES

Servo Line

Spring-applied single-disc brake

Operating Instructions KS 100..A00

Types: KS 100..A.. KS 101..A.. KS 110..A..
 KS 111..A.. KS 120..A.. KS 121..A..

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1. General

1.1 Introduction

These operating instructions describe the operating principle and features of spring-applied single-disc brake types KS 100..A.., KS 101..A.., KS 110..A.., KS 111..A.., KS 120..A.. and KS 121..A... 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, they will be referred to as **components** in the following sections. The individual brake versions included in the "Servo Line" series differ in terms of their size and technical configuration. A list of the available versions is provided in Section 1.6.

1.2 Standards and directives

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

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

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

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

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

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

Manufacturer:	Kendrion (Villingen) GmbH Wilhelm-Binder-Str. 4-6 78048 Villingen-Schwenningen Germany	Person authorized to compile the documentation:	Dominik Hettich Kendrion (Villingen) GmbH Wilhelm-Binder-Str. 4-6 78048 Villingen-Schwenningen Germany
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Applied harmonized standards and other technical standards and regulations:

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

Product: Electromagnetically released spring-applied single-disc brake

Types: KS 100..A.. KS 101..A.. KS 110..A.. KS 111..A.. KS 120..A..
KS 121..A..

The “..” wildcard stands for the brake size and customer-specific brake versions.

Kendrion (Villingen) GmbH

Villingen
13/03/2020

Authorised signatory:


Dominik Hettich
(Head of Development)

1.4 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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Applied harmonized standards and other technical standards and regulations:

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

Types: KS 100..A.. KS 101..A.. KS 110..A.. KS 111..A.. KS 120..A..
KS 121..A..

The “..” wildcard stands for the brake size and customer-specific brake versions.

Kendrion (Villingen) GmbH

Villingen
13/03/2020

Authorised 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.

1.6 Brake versions

Type	Design details
KS 100..A..	Brake type for face mounting and flange mounting, (long) hub (7) for version with interference fit assembly
KS 101..A..	Brake type for face mounting and flange mounting, (short) hub (7) for version with feather key
KS 110..A..	Brake type for face mounting only, (long) hub (7) for version with interference fit assembly
KS 111..A..	Brake type for face mounting only, (short) hub (7) for version with feather key
KS 120..A..	Brake type for flange mounting only, (long) hub (7) for version with interference fit assembly
KS 121..A..	Brake type for flange mounting only, (short) hub (7) for version with feather key

Table 5/1: Spring-applied single-disc brake versions (Servo Line series)

The “..” wildcard stands for the brake size and customer-specific brake versions.

2. Product description

2.1 Operating principle

The spring-applied single-disc brakes in the Servo Line series are intended for direct integration into electric servo 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. This is because the magnetic force generated by the electromagnetic field offsets the spring force of the compression springs (3), causing the armature (2) to move axially towards the solenoid housing (1.1) of the brake. When the brake is engaged, the spring force produced by the compression springs (3) causes the friction disc (5) to be clamped between the armature (2) and flange (6), thus generating the braking action. The brake is connected with the motor shaft (11) by means of a centrally arranged hub (7). The servo motor shaft (11) to be braked is not exposed to any axial loads exerted by the spring force of the compression springs (3).

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 power supply wire leads (1.3) and the compression springs (3). The compression springs (3) press against the armature (2), pushing the friction disc (5) against the flange (6). The frictional connection obtained in this manner between the friction surfaces of the friction disc (5) and the armature (2) or flange (6) produces the braking effect of the spring-applied brake. The rated air gap s_N is factory-adjusted by means of the bushes (4). The bushes (4) are firmly connected with the solenoid housing (1.1) and flange (6). They ensure that the armature (2) is kept in a fixed tangential position. The spline connection between the friction disc (5) and the hub (7) ensures that the friction disc (5) is connected with the hub (7) in a tangentially fixed position with minimum circumferential backlash, while movement in axial direction is possible. The (long-version) hub (7) and the motor shaft (11) can be firmly assembled by interference fit (brakes types KS 100..A.., KS 110..A.. and KS 120..A..). The (short-version) hub (7) can be assembled with the motor shaft (11) by means of a feather key (13) (brake types KS 101..A.., KS 111..A.. and KS 121..A..). Depending on the specific brake version used (see Table 5/1), the brake is face-mounted or flange-mounted to the motor end shield (8) using two ⁵⁾ or three mounting screws (9 or 10) (see Fig. 7/1 and Fig. 8/1).

List of reference numerals in Fig. 7/1, Fig. 7/2, Fig. 8/1 and Fig. 8/2:

1.1	Solenoid housing	8	Motor end shield (mounting surface)
1.2	Field coil	9	Mounting screws for flange mounting ¹⁾
1.3	Wire lead	10	Mounting screws for face mounting ²⁾
2	Armature	11	Motor shaft
3	Compression springs	12	Motor bearing
4	Bushes	13	Feather key ³⁾
5	Friction disc	14	Countersunk screw
6	Flange	15	Rating plate
7	Hub (long and short version) ⁴⁾	16	Circlip for (short-version) hub

Table 6/1: List of reference numerals for spring-applied single-disc brakes

¹⁾ Types KS 100..A.., KS 101..A.., KS 120..A.. and KS 121..A..

²⁾ Types KS 100..A.., KS 101..A.., KS 110..A.. and KS 111..A..

³⁾ Types KS 101..A.., KS 111..A.. and KS 121..A..

⁴⁾ Long version for brake types with interference fit assembly; short version for brake types with feather key.

⁵⁾ Sizes 03 and 04.

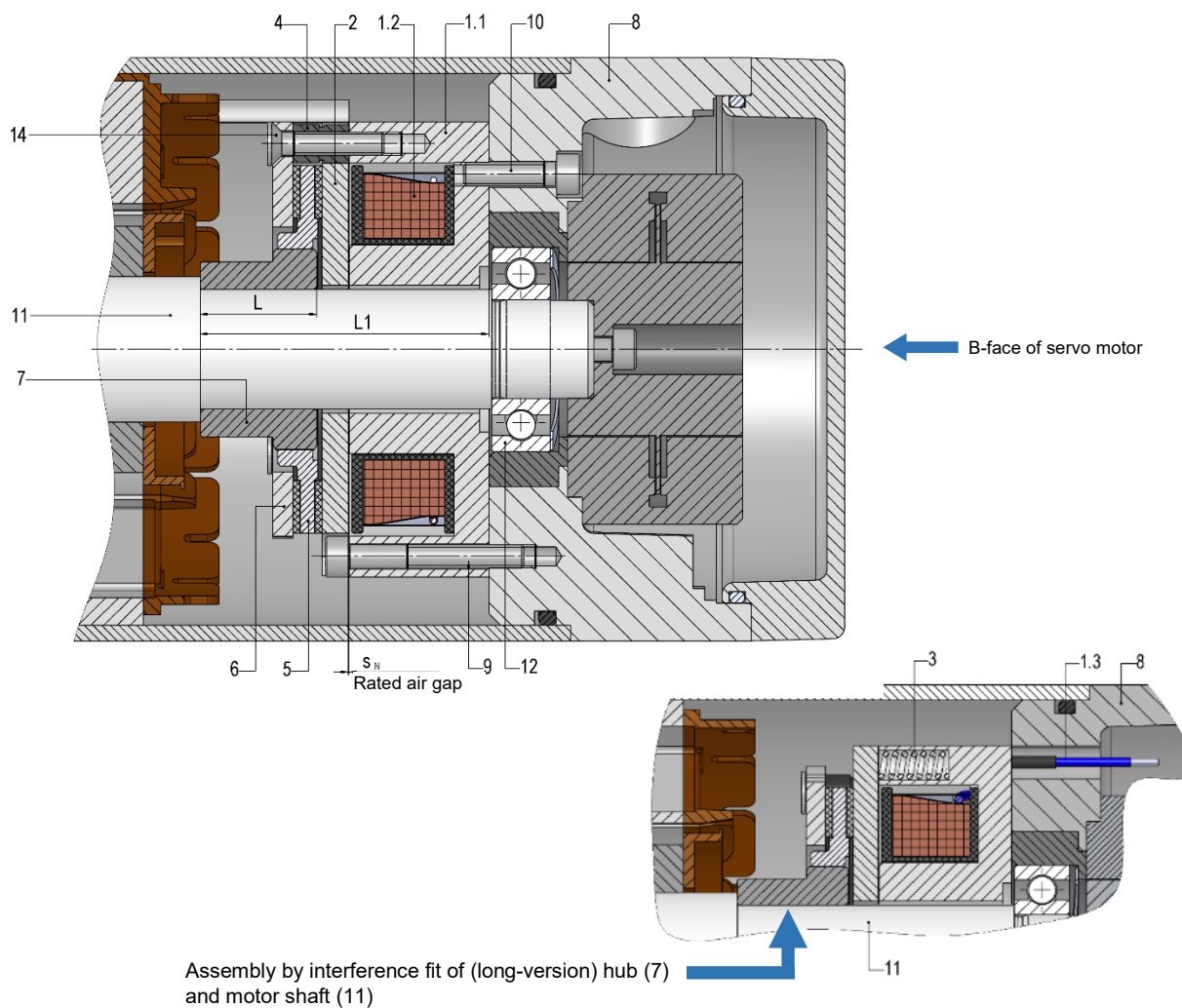


Fig. 7/1: Installation of spring-applied single-disc brake KS 100..A00 in servo motor, e.g. on B-face of motor, contact of (long-version) hub (7) with stop shoulder of motor shaft (11) and assembly of (long-version) hub (7) and motor shaft (11) by interference fit (face mounting: top figure; flange mounting: bottom figure)

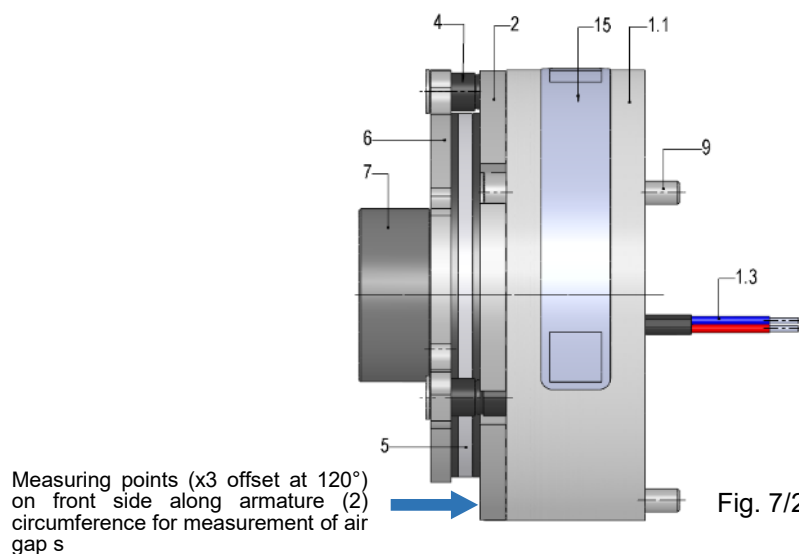


Fig. 7/2: Spring-applied single-disc brake KS 100..A00 and KS 120..A00

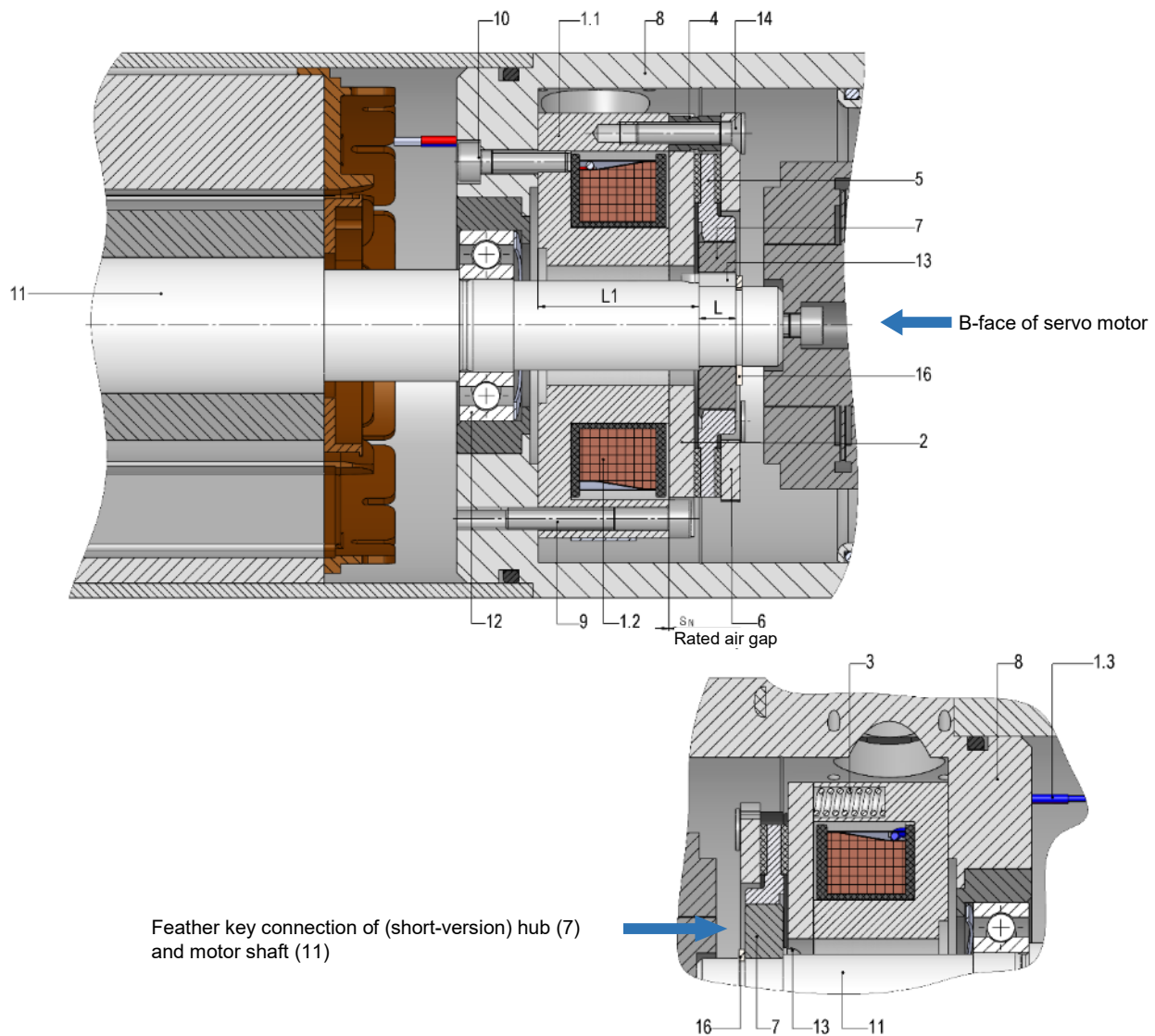


Fig. 8/1: Installation of spring-applied single-disc brake KS 101..A00 in servo motor, e.g. on B-face of motor, connection of (short-version) hub (7) with motor shaft (11) by means of feather key (13) (face mounting: top figure; flange mounting: bottom figure)

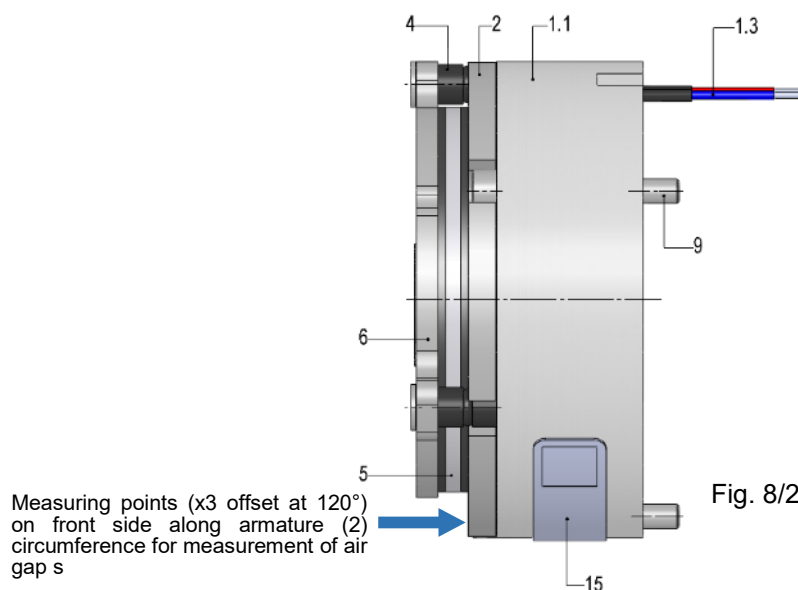


Fig. 8/2: Spring-applied single-disc brake KS 101..A00 and KS 121..A00

3. Installation

3.1 Mechanical installation

3.1.1 Types KS 100..A., KS 110..A. and KS 120..A.

The (long-version) hub (7) and servo motor shaft (11) are firmly assembled by interference fit (shrink fit or force fit). If the (long-version) hub (7) is assembled with the motor shaft (11) by shrink fitting, the (long-version) hub (7) needs to be heated to the required joining temperature. This is done taking account of the component tolerances of the motor shaft (11) and (long-version) hub (7) (hub bore tolerance as specified in brake offer drawing). Once heated, the hub is slipped onto the motor shaft (11) until it stops at the stop shoulder (see Fig. 7/1) of the motor shaft (11). The shrink fit is achieved after the (long-version) hub (7) has cooled down. If the (long-version) hub (7) is assembled with the motor shaft (11) by force fitting, the (long-version) hub (7) needs to be pressed onto the motor shaft (11) in axial direction.

In order to ensure reliable assembly of the motor shaft (11) and (long-version) hub (7), the shaft must meet the requirements specified in Table 9/1 (in accordance with DIN 7190-1:2017-02):

	Size					
	03 ⁶⁾	04 ⁶⁾	05 ⁶⁾	06 ⁶⁾	07 ⁶⁾	08 ⁶⁾
Shaft tolerance	s6	s6	s6	s6	s6	s6
Max. surface roughness R_{zmax} [μm]	3	3	3	3	3	3
Motor shaft diameter [mm]	6.5 .. 7.5	8.5 .. 10.5	10.5 .. 12.5	10.5 15.5	15.5 17.5	15.5 .. 20.5
	Size					
	10	12	14	16	19	
Shaft tolerance	s6	s6	t6	t6	t6	
Max. surface roughness R_{zmax} [μm]	3	3	3	3	3	
Motor shaft diameter [mm]	20.5 .. 25.5	23.5 .. 35.5	30.5 40.5	33.5 45.5	40.5 .. 50.5	
Motor shaft (11) material properties	steel, modulus of elasticity $E = 210000 \text{ N/mm}^2$; min. yield point $R_e = 325 \text{ N/mm}^2$; surface free of oil and grease					

Table 9/1: Motor shaft (11) requirements for assembly of (long-version) hub (7) by interference fit



Warning!

The brake user has to ensure that the tolerance, strength and quality of the motor shaft (11) are suitable to achieve reliable transmission of the generated brake torques from the (long-version) hub (7) to the shaft (11).

Apart from fitting the (long-version) hub (7) to the motor shaft (11), the entire brake must be positioned on the inside of the motor end shield (8) and fixed by means of two ⁷⁾ or three mounting screws (9 or 10) from the flange side or face side (see Fig. 7/1). This is done in a separate mounting procedure. For information on the M_A tightening torques of the mounting screws (9 or 10) for flange or face mounting, please refer to Table 11/1 and/or to the offer drawing. The final third mounting procedure involved in the overall motor assembly process entails coupling the (long-version) hub (7) with the friction disc (5) of the spring-applied brake. This is achieved by inserting the motor shaft (11) with the externally toothed (long-version) hub (7) into the internally toothed friction disc (5) (see Fig. 7/1) and by installing the complete motor assembly as specified by the motor manufacturer. Check that you feel no resistance when sliding the friction disc (5) along the (long-version) hub (7) in axial direction and that the axial position L1 of the (long-version) hub (7) is maintained after the entire brake has been mounted inside the servo motor (see Table 10/1 and Fig. 7/1).

⁶⁾ Preferably force fitting because shrink fitting would require high joining temperature of hub (7).

⁷⁾ Sizes 03 and 04.

	Size					
	03	04	05	06	07	08
Length L of (long-version) hub (7) [mm]	10 _{-0.2}	12 _{-0.2}	12 _{-0.2}	18 _{-0.2}	18 _{-0.2}	20 _{-0.2}
Axial position L1 of (long-version) hub (7) [mm]	34.2±0.2	36.6±0.3	37.8±0.4	43.7±0.4	47.4±0.4	49.5±0.4
	Size					
	10	12	14	16	19	
Length L of (long-version) hub (7) [mm]	25 _{-0.2}	26 _{-0.2}	26 _{-0.2}	34 _{-0.2}	34 _{-0.2}	
Axial position L1 of (long-version) hub (7) [mm]	58.7±0.5	65±0.5	68.5±0.5	81.3±0.5	94.1±0.5	

Table 10/1: Length and axial position of (long-version) hub (7)



Note!

Ensure that the motor bearing (12) is mounted inside the motor end shield (8) before installing the brake.

3.1.2 Types KS 101..A., KS 111..A. and KS 121..A..

The (short-version) hub (7) and servo motor shaft (11) are firmly assembled in a tangentially fixed position by means of a feather key to DIN 6885, sheet 1. In an initial mounting step, the complete brake without (short-version) hub (7) must be positioned on the outside of the motor end shield (8) and fixed by means of two ⁸⁾ or three mounting screws (9 or 10) from the flange side or face side (see Fig. 8/1). For information on the Ma tightening torques of the mounting screws (9 or 10) for flange or face mounting, please refer to Table 11/1 and/or to the offer drawing provided for the brake. Before installing the motor shaft (11) into the servo motor, the feather key (13) must be placed into the keyway machined into the motor shaft (11). After that, the motor end shield (8) and motor shaft (11) can be mounted to the preassembled motor unit following the instructions provided by the motor supplier. In the final third step of the mounting procedure the (short-version) hub (7) is slipped onto the motor shaft (11) provided with the feather key (13) and secured permanently in axial direction by means of a stop shoulder on the motor shaft (11) or by using a circlip (16). Check that you feel no resistance when sliding the friction disc (5) along the (short-version) hub (7) in axial direction and that the axial position L1 of the (short-version) hub (7) is maintained after the entire brake has been mounted inside the servo motor (see Table 10/2 and Fig. 8/1).

	Size					
	03	04	05	06	07	08
Length L of (short-version) hub (7) [mm]	4.1 _{-0.1}	4.7 _{-0.1}	5.3 _{-0.1}	5.7 _{-0.1}	6.4 _{-0.1}	6.8 _{-0.1}
Axial position L1 of (short-version) hub (7) [mm]	24.2±0.2	24.6±0.3	25.8±0.4	25.7±0.4	29.4±0.4	29.5±0.4
	Size					
	10	12	14	16	19	
Length L of (short-version) hub (7) [mm]	8.6 _{-0.1}	10 _{-0.1}	12.5 _{-0.1}	13 _{-0.1}	15.3 _{-0.1}	
Axial position L1 of (short-version) hub (7) [mm]	33.6±0.5	39±0.5	42.5±0.5	47.3±0.5	60±0.5	

Table 10/2: Length and axial position of (short-version) hub (7)



Warning!

The brake user has to ensure that the tolerance, strength and quality of the motor shaft (11) and the type of feather key (13) employed are suitable to achieve reliable transmission of the generated brake torques from the (short-version) hub (7) to the motor shaft (11). In order to avoid any undesired play of the feather key connection during brake operation, which would cause the keyway to wear out, the length of the feather key (13) must be dimensioned in such a way that transmission of the brake torques to the motor shaft (11) takes place along the entire length L of the (short-version) hub (7) (see Table 10/2).

⁸⁾ Sizes 03 and 04

3.1.3 General information on the mechanical brake installation

The brakes can be installed inside the servo motor by mounting them either to the A-face or B-face motor end shield. Brake mounting to the inside of the B-face servo motor end shield is performed as shown in Fig. 7/1 or Fig. 8/1. It is also possible to mount the brake to the outside of the B-face end shield. In this case, flange mounting of the brake is preferred, requiring the solenoid housing (1.1) to be positioned on the outside of the motor end shield (8). Mounting screws (9) are used to secure the brake on the flange side (see Fig. 7/1 or Fig. 8/1, bottom figure). The M_A tightening torques of the mounting screws (9 or 10) for flange or face mounting are specified in Table 11/1. If the M_A tightening torques specified in the offer drawing are different from those listed in Table 11/1, the specifications in the offer drawing shall prevail. To ensure secure fastening of the brake in case of face mounting to the motor end shield (8), the mounting screws (10) (e.g. socket head cap screws to ISO 4767, not supplied) must be tightened to the solenoid housing (1.1) observing both the maximum possible thread reach as well as the required minimum thread reach values specified in Table 11/1.



Note!

Brake mounting to the outside of the B-face servo motor end shield, for example, in which case the flange (6) is in contact with the outside surface of the motor end shield (8), is only possible with specific brakes sizes (12 and over) or with special brake versions. If the brake is mounted in this position, longer mounting screws (9) (see specifications in offer drawing) are used for fastening the brake to the motor end shield (8) from the solenoid housing (1.1) side. Ensure that the mounting screws are tightened evenly in several steps. After the brake has been mounted, the rated air gap s_N (see Table 30/1 "Technical specifications") may be reduced in the section where the mounting screws (9) are located. This is attributable to the specific brake configuration. However, safe and reliable brake operation is ensured if the brake is mounted as specified and provided that the specified M_A tightening torques are applied (see Table 11/1 or offer drawing). Brakes assembled with a feather key should preferably be used for this mounting configuration.

	Size					
	03	04	05	06	07	08
M_A tightening torques [Nm] of mounting screws (9) for flange mounting	0.4	0.7	1.2	3	3	3
M_A tightening torques [Nm] of mounting screws (10) for face mounting	0.7	1.2	1.2	3	3	3
Required minimum thread reach of mounting screws (10) for face mounting [mm]	2.5	3	3	4	4	4
Maximum possible thread reach of mounting screws (10) for face mounting [mm]	3	3.6	3.6	4.8	4.8	5.5
	Size					
	10	12	14	16	19	
M_A tightening torques [Nm] of mounting screws (9) for flange mounting	6	10	24	24	24	
M_A tightening torques [Nm] of mounting screws (10) for face mounting	6	10	24	24	24	
Required minimum thread reach of mounting screws (10) for face mounting [mm]	5	6	8	8	8	
Maximum possible thread reach of mounting screws (10) for face mounting [mm]	6	7.2	9.6	9.6	9.6	

Table 11/1: M_A tightening torques of mounting screws (9 & 10) for flange and face mounting; required minimum thread reach and maximum possible thread reach for face mounting



Attention!

The M_A tightening torques (see Table 11/1) specified for the mounting screws (9 & 10) for flange and face mounting of the brake must be strictly observed. If the M_A tightening torques specified in the offer drawing are different from those listed in Table 11/1, the specifications in the offer drawing shall prevail. Tighten the mounting screws (9 & 10) evenly in several steps. The axial position L1 of the hub (7) specified in Table 10/1 and Table 10/2 must be strictly complied with to ensure reliable torque transmission by the hub (7) and prevent torque loss during brake operation caused by wear.



Note!

The thread reach of the mounting screws (9) used for flange mounting of the brake must be dimensioned by the brake user in such a way that the M_A tightening torques specified for the mounting screws (9) (see Table 11/1 or offer drawing) can be securely applied.



Note!

The friction disc (5) is factory-centred and tightly locked inside the brake to facilitate axial assembly of the hub (7) and friction disc (5). The brake should not be released electromagnetically until installation has been completed (e.g. during brake commissioning and inspection). Install the wire leads (1.3) during overall motor assembly as specified by the motor manufacturer. Avoid any damage to the wire leads (1.3), e.g. by kinking the lead insulation.



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 (12) into the brake. (Sealed bearings can be used to prevent lubricant leaks.) The rated air gap s_N of the brake (see Table 30/1 "Technical specifications") is factory-adjusted by means of the bushes (4). Minor axial bearing play after completion of motor installation will not compromise safe and reliable brake operation.

Check that the motor end shield (8) (mounting surface) meets the following requirements before installing the brake:

- Axial runout relative to the shaft $<0.1\text{mm}$ (measuring radius = pitch circle diameter)
- Surface roughness max. R_z16
- Surface hardness min. 100HB
- Material: steel, cast iron, aluminium – with excellent thermal conductivity
- Absence of oil and grease
- Positional deviations of fastening threads in motor end shield (8) for flange mounting $<0.2\text{ mm}$; reference element: axis of motor shaft (11)



Note!

In case of face-side mounting of the brake, the mounting bores and, if necessary, the bores for the

mounting screws (10) located in the motor end shield (8) (see Fig. 7/1 & Fig. 8/1) must be dimensioned in such a way that the maximum 0.5 mm mismatch of the brake relative to the axis of the motor shaft (11) is not exceeded after completion of brake installation.



Note!

The maximum permissible positional deviation of the fastening threads (flange mounting) or mounting bores (face mounting) in the motor end shield must not be exceeded. This is crucial to prevent the friction disc (5) from rubbing along the bushes (4) during operation and to allow the brake to be mounted to the motor end shield.

3.2 Electrical connection and operation

The spring-applied single-disc brake must be connected directly to a DC power source, connecting the wire leads (1.3) to the power supply. The power supply specifications on the rating plate (15) must be observed. Connection to an AC power source is only possible by means of a bridge or half-wave rectifier. Various Kendrion rectifier types (see Table 13/1 – 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 humming or incorrect operation. Perfect 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 07102B5.	half-wave	100 – 500 ($\pm 10\%$)	$U_1 \cdot 0.445$	-	0.5
32 07103B5.	bridge	100 – 500 ($\pm 10\%$)	$U_1 \cdot 0.890$	-	0.5

The relevant rectifier specification sheets must be observed!

Table 13/1 Recommended rectifiers for single-phase AC voltage supply

3.2.1 DC power supply

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



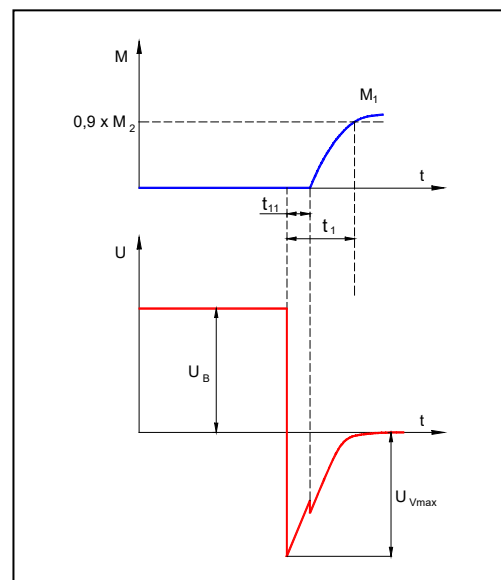
Attention!

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 permissible overvoltage during disconnection is 1500 V. If Kendrion rectifiers are used (see Table 13/1), 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) and mechanical circuitry elements may also be damaged by the lower voltage.



U_B operating voltage (coil voltage)

U_{Vmax} disconnection voltage

3.2.2 DC power supply via PWM control

It is possible to control the power supply to the brake by pulse-width modulation (PWM) in order to enhance brake operation. Pulse-width modulation allows to control the voltage supplied to the brake over an extensive input voltage and temperature range or to keep the voltage level constant. This enables temporary electronic overexcitation of the brake. As a result, the pull-in behaviour of the armature and, consequently, the brake opening performance are significantly improved and the brake service life is extended. After the selected overexcitation time has elapsed, the voltage is reduced to holding voltage by an electronic module. With this solution, the brake operating temperature can be significantly reduced, providing substantial energy savings. Specific PWM control modules are available from Kendrion for this purpose (see Table 14/1). Fast turn-off (see type designation in Table 14/1) is possible as an option to reduce coupling times or closing times (see definitions in Section 9).

PWM type	Mode	Fast turn-off	Rated input voltage U_1 /VDC	Output voltage U_2 /VDC	Frequency f /Hz	L-load I /ADC
34 10125C0.	PWM	no	18 – 50 ($\pm 10\%$)	$U_N^{9)} \cdot 0.5$	500	2.5
34 70125C0.	PWM	yes	18 – 50 ($\pm 10\%$)	$U_N^{9)} \cdot 0.5$	500	2.5

The relevant specification sheets for the specific PWM module type must be observed!

Table 14/1: Recommended PWM module type for brake operation by pulse-width modulation

3.2.3 AC power supply

Direct brake connection to an AC power source is only possible if a rectifier is used. The coupling and closing times (see definitions in Section 9) 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:

If AC side switching is used as shown in Fig. 15/1 a), the easiest wiring method is to connect the rectifier in parallel with the motor connecting cables, e.g. inside the motor terminal box. It must be considered, however, that the motor may act as a generator after AC voltage has been removed and thus extend the coupling and closing times (see definitions in Section 9) significantly (by factor 5 or over). The disconnection and opening times (see definitions in Section 9) remain unchanged. As an alternative, the rectifier can be connected directly to two phases of the supply voltage for AC side switching of the brake as shown in Fig. 15/1 b). This leads to substantially longer coupling or closing times (see definitions in Section 9) compared to DC side switching as shown in Fig. 15/1 c).

DC side switching:

In case of DC side brake switching as shown in Fig. 15/1 c), 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.

⁹⁾ U_N rated voltage of brake.

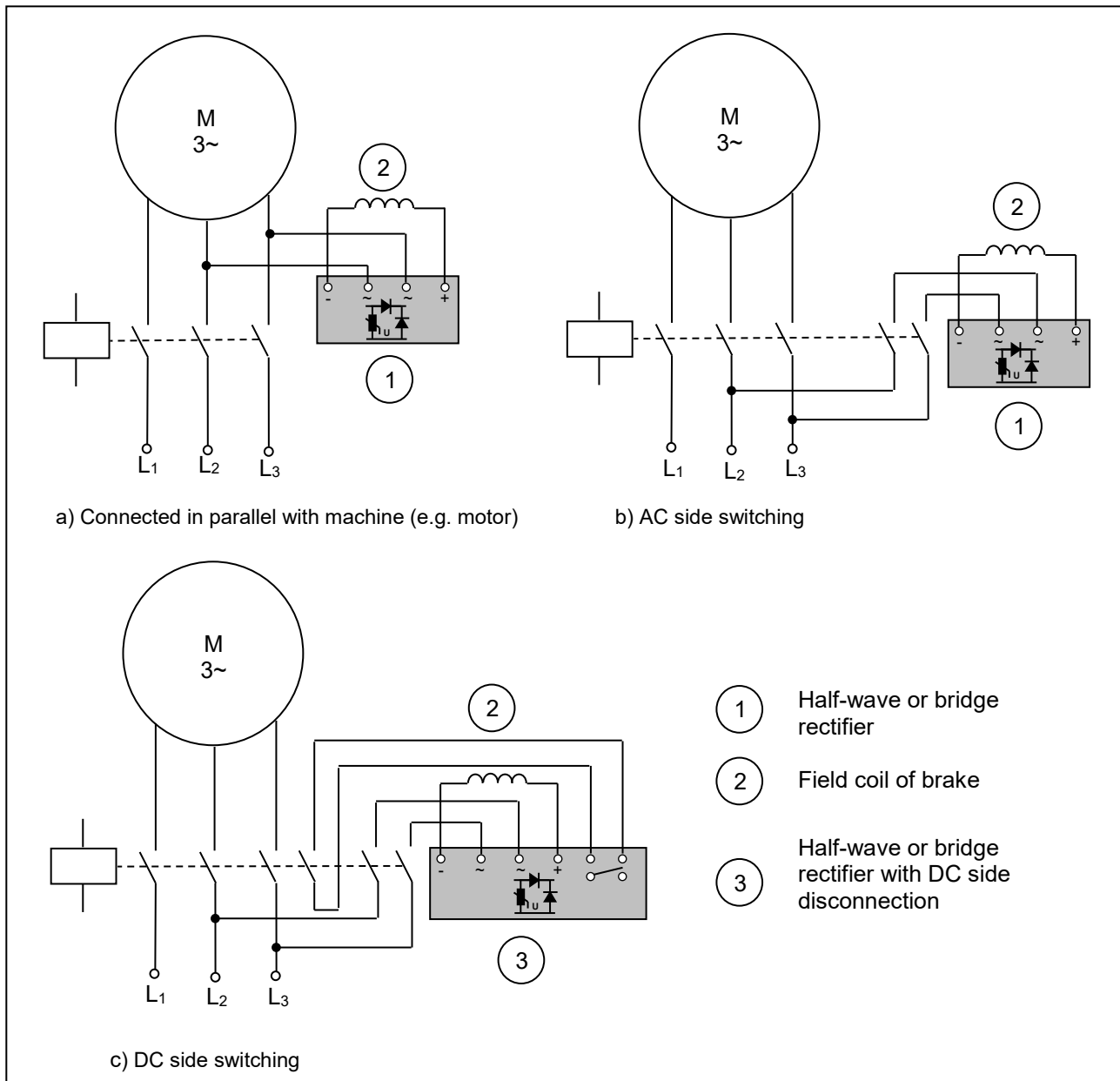


Fig. 15/1: Brake connection options (e.g. in motor terminal box)



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.

3.3 Electromagnetic compatibility

As required by the German Electromagnetic Compatibility Act (EMVG), electromagnetic compatibility is essential to ensure immunity to external electromagnetic fields and conducted interference. Furthermore, the emission of electromagnetic fields and line-conducted interference during brake operation must be minimized. Since the brake features depend on the circuitry and operation, a declaration of conformity with the applicable EMC standard can only be furnished for the wiring type, but not for a specific brake. The spring-applied single-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. Wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial use and other applications. Please refer to the specification sheets for additional information on electromagnetic compatibility, especially with respect to the recommended electronic rectifiers specified in Section 3.2.

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 3.2 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 component and its electronic accessories remains unaffected if the aforementioned consequential damage is avoided.

b) Voltage dips and short supply voltage variations:

Electromagnetically released systems:

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

Electromagnetically engaged systems:

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

Radio interference suppression in accordance with EN 55011:

The 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. 18/1 must be taken to ensure compliance with the limit values applicable to Class A equipment. Interference suppression capacitors should be used which must be dimensioned to suit the connection data of the electromagnetic components and the specific mains conditions. The recommended rectifiers specified in Section 3.2 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.

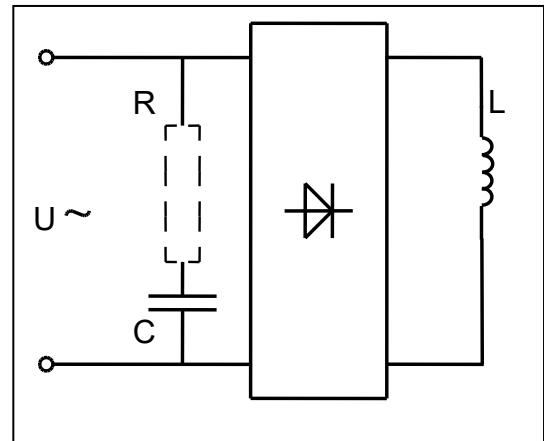


Fig. 18/1

The specifications in Table 19/1 apply if the brakes are used with the recommended rectifiers or with other types of rectifiers. Interference suppression components should be installed as close as possible to the consumer. Interference caused during switching operations of the electromagnetic component is generally attributable to the inductive load.

Where necessary, assemblies designed to limit the disconnection voltage (e.g. anti-parallel diode) or voltage limiting components (e.g. varistors, suppressor diodes, resistance diodes and the like) can be installed. However, such components will inevitably change the switching times of the brake and increase the generated noise level. The rectifiers specified in Section 3.2 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 19/2.

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

Rectifier series	Rated input voltage range U_1/VAC (40 – 60 Hz)	DC at L-load (ADC)	Capacitor nF (VAC)
Half-wave rectifier 32 07102B5.	100 – 500 ($\pm 10\%$)	up to 0.5	no interference suppression measures required
Bridge rectifier 32 07103B5.	100 – 500 ($\pm 10\%$)	up to 0.5	no interference suppression measures required

Table 19/1

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

Table 19/2

3.4 Set-up and start-up



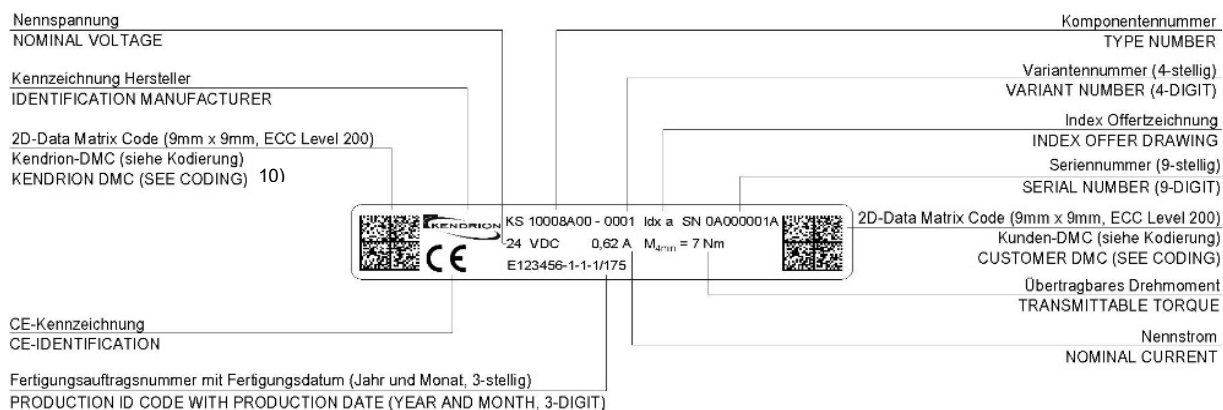
Warning!

Functional testing of the brake must not be performed unless the 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 (15) with respect to the supply voltage, mounting position and protection class. After the brake has been connected to the power source, a functional test must be performed to check that the friction disc (5) is not blocked. For this purpose, turn the motor shaft (11) while the brake is energized and the motor is unpowered. After completion of mounting, all necessary covers and guards must be installed. If necessary (e.g. after a prolonged storage period), a break-in process must be conducted in accordance with the parameters specified in Table 31/1.

Specifications on rating plate (order-specific, example brake type KS 10008A00):



Note: The product number of the brake consists of the type number followed by the version number, e.g. KS 10008A00-0001.



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 motor shaft (11) must not be exposed to load torques. Ensure that the brake is unpowered before restarting the motor.

¹⁰⁾ Coding in accordance with Kendrion drawings KS 10010A00016-0001, KS 10010A00017-0001 and KS 10010A00018-0001.



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 motor shaft (11) needs to be turned during set-up operations while the motor is switched off, the brake must be opened electromagnetically.



Attention!

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



Attention!

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

4. Maintenance

4.1 Checks and service

The spring-applied single-disc brake does not require any maintenance. Replace the spring-applied single-disc brake when the maximum operating air gap s_{Bmax} (see Table 30/1 "Technical specifications" and definition in Section 9) is reached. The hub (7) need not be replaced. Dismantle the motor and remove the brake from the motor end shield (8) by loosening the mounting screws (9). The air gap 's' cannot be adjusted. Install the new brake as described in Section 3.



Note!

The air gap 's' can be checked when the brake is not yet incorporated into the motor. Use a feeler gauge or equivalent instrument to measure the stroke of the armature (2) at three measuring points offset at 120° when the brake is closed and open. The location of the measuring points is shown in Fig. 7/2 and Fig. 8/2. The arithmetic mean of the three measuring values gives the size of the air gap 's'.



Attention!

When the spring-applied single-disc brake is installed, it is crucial that the mounting screws (9) be tightened applying the M_A tightening torque specified in Table 11/1.



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 30/1 "Technical specifications" and definition in Section 9) has been exceeded. In this case, the braking action cannot be neutralized. This may cause thermal overloading 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.



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 motor shaft (11).
- the lock provided to prevent accidental motor start-up is removed after completion of inspection and maintenance work.
- all friction surfaces are free of grease and oil. An oily or greasy friction disc (5) cannot be cleaned.
- no swelling or glazing of the friction linings or friction disc (5) 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

The mounting screws (9) specified in Table 21/1 (optional, not supplied) are required for flange-side brake mounting (see Fig. 7/1 and Fig. 8/1). It is not possible to order individual spare parts (S) for the brake.

Size	S	A	Type	Order number	Quantity
03		X	Socket head cap screw to ISO 4762-M2x20-8.8 A2F	304161	2
04		X	Socket head cap screw to ISO 4762-M2,5x25-8.8 A2F	304163	2
05		X	Socket head cap screw to ISO 4762-M3x30-8.8 A2F	304164	3
06		X	Socket head cap screw to ISO 4762-M4x30-8.8 A2F	304167	3
07		X	Socket head cap screw to ISO 4762-M4x30-8.8 A2F	304167	3
08		X	Socket head cap screw to ISO 4762-M4x30-8.8 A2F	304167	3
10		X	Socket head cap screw to ISO 4762-M5x35-8.8 A2F	304023	3
12		X	Socket head cap screw to ISO 4762-M6x40-8.8 A2F	304177	3
14		X	Socket head cap screw to ISO 4762-M8x45-8.8 A2F	304073	3
16		X	Socket head cap screw to ISO 4762-M8x50-8.8 A2F	304074	3
19		X	Socket head cap screw to ISO 4762-M8x60-8.8 A2F	304076	3

Table 21/1: Accessories (A)

5. Condition at delivery

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 is delivered (7) with the brake as a loose item. Always check the brake for transit damage after receipt of the shipment.



Note!

The environmental conditions specified in Table 22/1 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 und 1Z2	2K12
Biological environmental conditions	1B1	2B1
Mechanically active substances	1S11	2S5
Chemically active substances	1C1	2C1

Table 22/1: 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 from 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 brake, if necessary.
	• No voltage applied to brake	Check the power supply 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 plate (2) blocked mechanically	Eliminate mechanical blocks and install a new brake, if necessary.
	• 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 (5) linings	Install a new brake.
	• Power supply connection defects	Check the power supply connection. Install a new brake, if necessary.
Delayed brake release	• Air gap too large	Check the air gap. Install a new brake, 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 plate (2) blocked mechanically	Eliminate mechanical blocks and install a new brake, if necessary.
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.
	• Defective protective circuit of field coil (1.2)	Check the protective circuit and replace defective components, if necessary.
Brake torque too low	• Air gap too large	Check the air gap. Install a new brake, if necessary.
	• Oily, greasy or dirty friction surfaces	Install a new brake.
	• Thermal damage to friction disc (5) linings	Install a new brake.

Table 23/1: 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 equipment user takes adequate precautions and makes sure that safety instructions are strictly adhered to. It is the duty of the motor owner to plan these measures and to check their implementation.

The machine owner is required to ensure that:

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

8.1 Intended use

The brakes described in these operating instructions are intended to be incorporated into 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

Attached or built-in brakes 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 setting up the machinery into which the brake is to be incorporated. Should any queries arise with respect to torques, torque variations, installation positions, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion and ask for clarification before using the brake. Retrofitting or modification work to be carried out on the brake is subject to the approval from Kendrion (Villingen). Accident prevention regulations applying to the specific field of application of the brake must be strictly observed. The brakes described in this manual are designed for use as holding brakes with emergency stop function. They are **not designed for use as “safety brakes”**. This means that torque reductions caused by factors beyond the user's control (e.g. higher ambient temperatures or humidity, contaminated ambient air and environment, etc.) cannot be excluded.

8.2.1 Set-up

Requirements in terms of the permissible number of switching operations per hour and the maximum switching work per switching operation specified in the technical specifications must be strictly observed during the set-up of machines and plant (jog 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 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. Ensure that the brake is mounted into the motor in such a way that sufficient heat dissipation is ensured. 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 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 connecting cables 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 wear of the spring-applied brake (only when used as dynamic brake or brake with emergency stop function) and the resulting torque reduction must be taken into consideration in the set-up of the machine/equipment. 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 ruled out 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 operating air gap s_{Bmax} (see Table 30/1 "Technical specifications") must not be exceeded throughout the entire brake service life. (Please refer to Section 4 "Maintenance" for details.) For information on the permissible ambient temperature and relative humidity range for brake operation, please refer to the offer drawing and Table 30/2. 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 31/1 is conducted at regular intervals.



Attention!

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 30/1 "Technical specifications"). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 30/2) is not exceeded.

8.2.5 Maintenance and repair

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 and information symbols

Personal injury or equipment damage

Symbol / Signal word	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

Notes and information

Symbol / Signal word	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. Note: In the case of brakes and clutches exposed to purely static loads, the M_4 torque is commonly referred to as rated torque.
Residual torque M_5	torque transmitted by the released brake or clutch
Load torque M_6	torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed
Switching work W	heat generated by friction inside the brake or clutch as a result of the switching operation
Maximum switching work $W_{\max}$	maximum switching work to which the brake or clutch may be exposed
Switching power P	switching work converted into heat per unit of time
Maximum switching power $P_{\max}$	maximum permissible switching work converted into heat per unit of time
Coil ON time t_5	time between power on and power off
Coil OFF time t_6	time between power off and power on
Total cycle time t_7	coil ON time plus coil OFF time
Duty cycle	percentage relationship of coil ON time to total cycle time
Switching operation	one complete switching on and off operation
Switching frequency Z	number of regular switching operations per hour
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 $\Delta\theta_{31}$	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

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

Opening time t_o	time it takes for the brake or clutch to open mechanically (see chart in Fig. 27/1)
Closing time t_{c1}	time it takes for the brake or clutch to close mechanically (see chart in Fig. 27/1)
Activation time t_{c2}	time it takes for the brake or clutch to close mechanically and for the full holding torque to be reached almost completely (see chart in Fig. 27/1)
Power P_{20°	rated power of the brake or clutch at 20°C coil temperature Comments: The rated power P_{20° is equivalent to the rated power P_N defined by DIN VDE 0580.
Transmissible torque $M_{4\ 120^\circ}$	lowest static torque (holding torque) of the brake or clutch at 120°C housing temperature
Transmissible torque $M_{4\ 20^\circ}$	lowest static torque (holding torque) of the brake or clutch at 20°C housing temperature
Transmissible torque M_{4min}	lowest static torque (holding torque) of the brake or clutch at the specified rated operating conditions
Operating air gap s_B	air gap range in closed condition (electromagnetically released system) or open condition (electromagnetically engaged system) in which the brake or clutch can be operated provided that the technical specifications are complied with
Rated air gap s_N	air gap when the brake or clutch is new
Delivery air gap s_A	air gap of the brake or clutch at the time of delivery Comments: In general, the delivery air gap s_A is the same as the rated air gap s_N .
Air gap s_{max}	maximum air gap with which the brake or clutch still closes (electromagnetically engaged system) or opens (electromagnetically released system)
Opening voltage U_1	voltage at which the brake or clutch opens
Coupling voltage U_3	voltage at which the brake or clutch closes
Holding voltage U_4	voltage at which the brake or clutch must remain open

The switching times (disconnection time t_2 and coupling time t_1) are defined in DIN VDE 0580. When using static systems (holding operation), the switching times can also be determined on the basis of the current flow (see Fig. 27/1) instead of using the DIN VDE 0580 definitions.

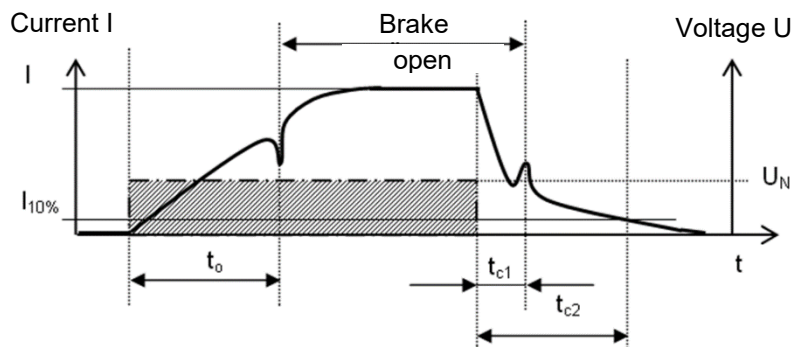


Fig. 29/1: Definition of switching times for (static) holding operation

10. Technical specifications

Product built and tested to DIN VDE 0580

	Size										
	03	04	05	06	07	08	10	12	14	16	19
Transmissible torque M_{4min} [Nm]	see offer drawing										
Transmissible torque $M_{4\ 20^{\circ}C}$ [Nm]	see offer drawing										
Rated power P_N , $P_{20^{\circ}}$ [W]	6.6	8.5	11.4	12.7	14	14.7	20.8	29.5	36.2	37.6	55
Max. limit speed n_G [rpm]	10000			8000	8000	6500	6000	4000	4000	3500	3500
Max. speed n_n [rpm]	see offer drawing										
Max. switching work W_{max} ($Z=20/h$) [J]	see offer drawing										
Max. number of emergency stops Z_{total}	see offer drawing										
Max. total switching work W_{total} [kJ]	see offer drawing										
Rated air gap s_N , s_A [mm]	$0.08^{+0.02}_{-0.02}$		$0.09^{+0.02}_{-0.02}$		$0.11^{+0.02}_{-0.02}$	$0.12^{+0.02}_{-0.02}$	$0.15^{+0.02}_{-0.02}$	$0.18^{+0.06}_{-0.02}$	$0.2^{+0.06}_{-0.02}$	$0.25^{+0.06}_{-0.02}$	$0.3^{+0.06}_{-0.02}$
Max. operating air gap s_{Bmax} [mm]	see offer drawing										
Max. air gap s_{max} (at 65% of rated current) [mm]	0.18	0.19	0.17	0.2	0.27	0.29	0.4	0.41	0.44	0.51	0.58
Max. closing time t_{c1} [ms]	see offer drawing										
Max. opening time t_o [ms]	see offer drawing										
Opening voltage U_1 [VDC]	see offer drawing										
Coupling voltage U_2 [VDC]	see offer drawing										
Holding voltage U_4 [VDC]	see offer drawing										
Mass moment of inertia friction disc & hub J [kgcm ²]	0.05	0.014	0.029	0.062	0.13	0.263	1.0	2.8	4.4	9.8	17
Weight (with hub) m [kg]	0.13	0.25	0.4	0.5	0.76	0.9	1.9	3.2	5	6.9	11.2
Duty cycle [%]	100										
Standard rated voltage [VDC]	24										
Insulation class	F										
Pollution degree	2										
Protection rating	IP00										
Brake type	holding brake with emergency stop function										

Table 30/1: Technical specifications

Required operating conditions	
Rated voltage tolerance	±10%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{13} [°C]	see offer drawing
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 30/2: Required operating conditions for spring-applied single-disc brakes

	03	04	05	06	07	Size 08	10	12	14	16	19
Speed n [rpm]	500	400	380	380	370	320	260	190	180	170	130
Coil ON time t_5 [s]	3	3	3	3	3	3	3	3	3	3	3
Coil OFF time t_6 [s]	1	1	1	1	1	1	1	1	1	1	1
Break-in period t_{total} [s]	approx. 40										

Table 31/1: 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 maximum speed n_n . The maximum number of switching operations (emergency stops) Z per hour and the maximum permissible switching work W_{max} are specified in Table 30/1. The W_{max} values are approximate values. They apply to built-in brakes without any additional cooling and to emergency stops. The opening voltage U_1 applies at a field coil temperature of 20°C and provided the brake air gap is equivalent to the rated air gap s_N . The coupling voltage U_3 and holding voltage U_4 apply at a field coil temperature of 20°C. The closing time t_{c1} and opening time t_o are reached when the brake is operated at the following conditions: 100% of rated voltage, max. rated air gap s_{Nmax} , field coil operating temperature (approx. 155°C), max. ambient temperature ϑ_{13} (see Table 30/1), use of a varistor (type SIOV-S14K30). The specified times are maximum values. In case of AC side brake switching, the closing time t_{c1} is substantially longer. The specified minimum transmissible torque M_{4min} is the lowest static brake torque at the specified operating conditions (see Table 30/2). The transmissible torque $M_{4\ 20^\circ}$ is the lowest static torque (holding torque) of the brake or clutch at 20°C housing temperature. The specified transmissible torque M_4 characterizes the torque level of the brake. Depending on the application the brake is used for, the switching torque M_1 and the effective transmissible torque M_4 may differ from the specified M_4 values. The switching torque M_1 depends on the speed (rpm). If the friction surfaces are contaminated with oil, grease or dirt and the ambient temperatures are below or above the specified range, 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 with the specified break-in parameters (see Table 31/1).



Note!

If there is any conflict between the information provided in the offer drawing and the information given in Section 10 of these operating instructions, the offer drawing shall prevail.

The rated operating conditions specified in Table 30/2 and the technical specifications in Table 30/1 must be observed during operation of the spring-applied single-disc brakes. The information in the relevant offer drawings of the specific brake types must be observed.

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: KS 10008A00

Version number: 0001

Product number: KS 10008A00-0001

12. Specialist repair shops

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13. Revision history

Date of issue	Changes
30/11/2017	New issue.
01/03/2018	Table 8/1: Values of maximum surface roughness (R_{zmax}) modified. Specified shaft tolerances updated.
13/03/2020	Operating instructions revised in content. Updated layout (design) of operating instructions.

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