KENDRION

KENDRION INDUSTRIAL BRAKES

Vario Line

Spring-applied single-disc brake

Operating Instructions 76 43108H00

Types: 76 43108H00

PRECISION. SAFETY. MOTION.

Contents

1. General information ... 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) ... 4
1.4 Declaration of Conformity ... 5
1.5 Manufacturer's liability ... 5
2. Product description ... 6
2.1 Operating principle ... 6
2.2 Brake design ... 6
3. Installation ... 8
3.1 Mechanical installation ... 8
3.2 Installation of accessories ... 9
3.3 Electrical connection and operation ... 10
3.3.1 DC power supply ... 10
3.3.2 AC power supply ... 10
3.4 Electromagnetic compatibility ... 13
3.5 Set-up and start-up ... 16
3.6 M_2 rated torque adjustments ... 17
4. Maintenance ... 17
4.1 Checks and service ... 17
4.2 Spare parts and accessories ... 18
5. Condition at delivery, transportation and storage ... 19
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 ... 21
8.2.2 Start-up ... 22
8.2.3 Installation ... 22
8.2.4 Operation ... 22
8.2.5 Maintenance, repair and replacement ... 22
8.3 Safety and warning symbols ... 23
9. Definitions ... 23
10. Technical specifications ... 25
11. Product number / type number / version number ... 27
12. Specialist repair shops ... 27
13. Revision history ... 27

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1. General information

1.1 Introduction

These Operating Instructions describe the operating principle and features of spring-applied single-disc brake type 76 43108H00. 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 single-disc brakes are not ready-to-use devices, but are intended to be incorporated into or assembled with other equipment. Consequently, these brakes will be referred to as **components** in the following sections.

1.2 Standards and directives

The state-of-the-art 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

Type: 76 431108H00

Kendrion (Villingen) GmbH Villingen 13.03.2020 Authorized 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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EN 60529	Enclosure protection ratings
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Type: 76 43108H00

Kendrion (Villingen) GmbH Villingen 13.03.2020 Authorized signatory: ..... D. Hettich .....
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 brake is designed to operate dry. The force generated by an electromagnetic field is utilised 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 form-fit connection between the friction disc and hub and the connection of the hub with the machine shaft (e.g. motor shaft) ensure that the torque generated by the spring-applied single-disc brake (brake torque) is reliably transmitted to the machine (motor).

2.2 Brake design

The solenoid housing (1.1) of the spring-applied single-disc brake accommodates the firmly fitted field coil (1.2) featuring silicone-free connecting cables on the brake circumference. The solenoid housing also comprises the compression springs (4) which press the friction disc (6) over the armature (2) against the friction plate (11) and thus against the mounting surface (8) to generate the braking effect of the spring-applied brake. Spacer bolts (5) are provided to adjust the air gap ‘s’. The friction disc (6) has a spline toothing and can be moved on the hub (12) in axial direction. When DC voltage is applied to the field coil (1.2) of the spring-applied single-disc brake, the spring force is overcome by the electromagnetic field force. This causes the armature (2) to be released and the braking effect to be neutralised. The shaft to be braked is not subjected to any axial force by the brake.

When using brakes with hand release (9), openings must be provided in the part enclosing the brake (e.g. fan cover) so that the hand release lever can be installed. The hand release (9) allows the brake to be released manually (e.g. in case of power failure). The hand release (9) can only be operated by pushing the lever away from the mounting surface (8). The hand release (9) can be removed for brake mounting. The bracket must be removed during brake operation.

List of reference numerals in Fig. 5/1:			
1.1	Solenoid housing	9.1	Lever
1.2	Field coil	9.2	Bolt
2	Armature	9.3	Return spring
3	Adjusting ring	10	Collar
4	Compression spring	11	Friction plate
5	Spacer bolt	12	Hub
6	Friction disc	13	Mounting screws
7	Rating plate	14	Screw plug
8	Mounting surface	15	Sealing ring
9	Hand release		

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

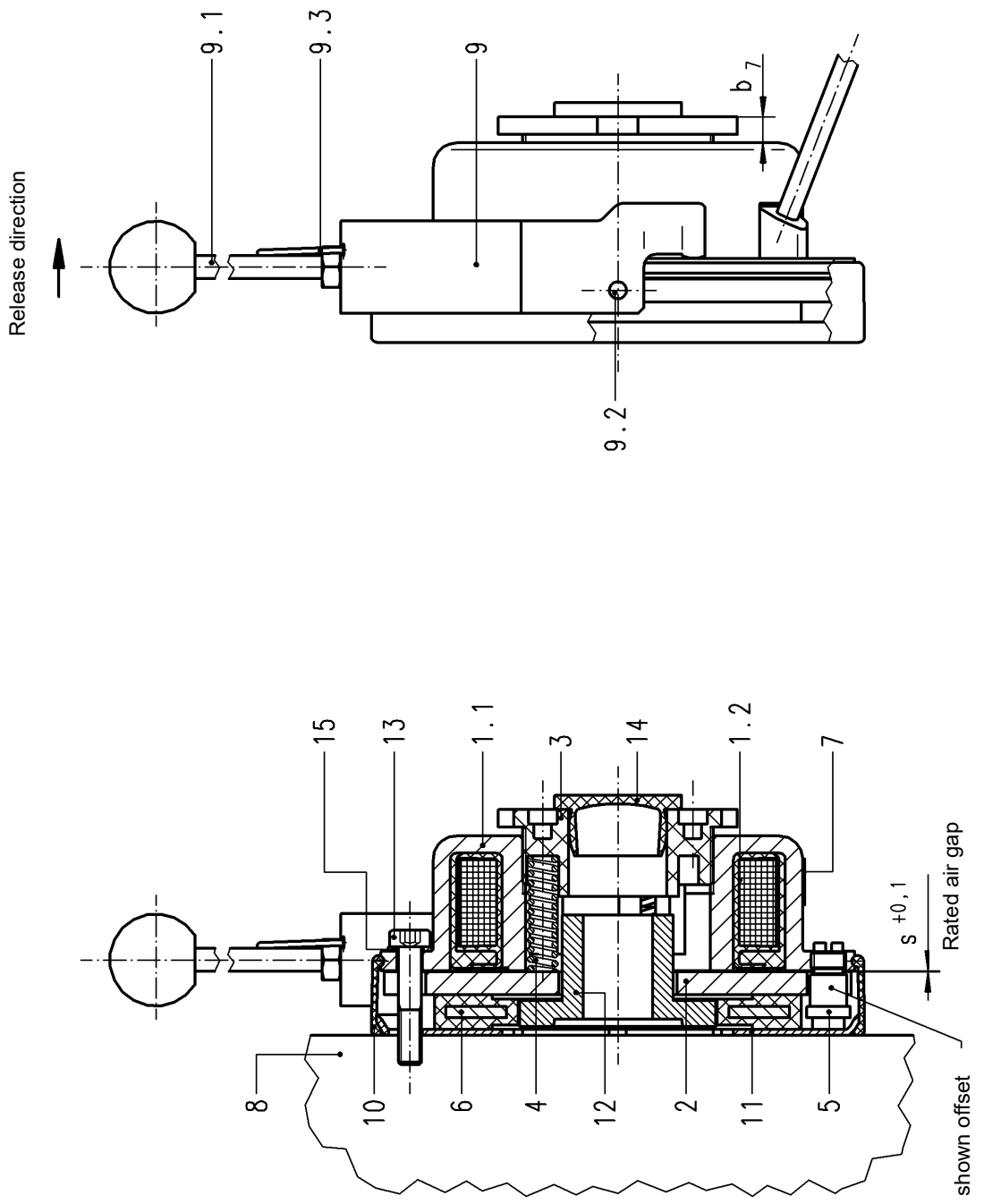


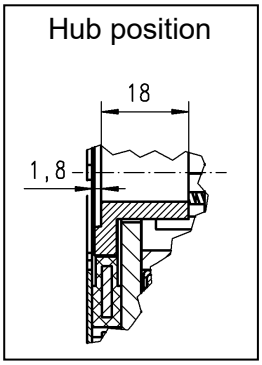
Fig. 7/1: Spring-applied single-disc brake 76 43108H00

3. Installation

3.1 Mechanical installation

The hub (12) must be slipped onto a shaft provided with a feather key to DIN 6885, sheet 1 or 3 [1)], and secured axially (by means of a shaft collar, circlip or the like). Make sure that the hub (12) is set back by 1.8 mm relative to the friction surface of the friction disc (6). If a friction plate (11) (accessories) is used, it must be fitted to the mounting surface (8). The friction disc (6) must then be pushed on the hub (12). Check that the friction disc (6) can be easily moved along the hub (12).

Hub position



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

- Axial runout relative to the shaft <0.1mm (measuring radius = hole circle)
- Surface roughness max. R_Z16
- Surface hardness min. 100HB
- Bright surface
- Material: steel, cast iron – with excellent thermal conductivity
  If other materials are used (e.g. aluminium), the friction plate (11) must be installed
- Absence of oil and grease

If sealing rings (15) (accessories) are used, they must be slipped on the mounting screws (13). The mounting screws (13) are used to screw the core components of the spring-applied single-disc brake, i.e. solenoid housing (1.1) with field coil (1.2), armature (2), adjusting ring (3), compression springs (4), etc., to the mounting surface (8). The mounting screws (13) must be tightened with a tightening torque of M_A=3Nm. Correct tightening of the mounting screws (13) is essential to ensure sufficient centring of the spring-applied single-disc brake. The rated air gap ‘s’ is factory-adjusted.

Note!

If the friction disc (6) and/or hub (12) 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 (6) can be easily moved along the hub (12) by hand. The fitted components (especially the friction surfaces) must be free from grease.

Attention!

The M_A tightening torque specified for the mounting screws (13) must be strictly observed. The screws (13) must be tightened evenly in diametrically opposite sequence.

[1)] Hub bore ∅13-∅15mm.

3.2 Installation of accessories

Hand release (9):

Insert the bolts (9.2) into the cross holes in the armature (2) (holes only provided in brakes with hand release (9) option). Push the hand release bracket into the bolt (9.2). Insert the return spring (9.3) into the hand release bracket and screw the lever (9.1) into the bracket. Apply Loctite, e.g. type 241, to secure the lever. The release force F is about 30N and applies at the maximum rated torque (standard). The maximum permitted release force (actuation force) F_{max} is 50N and must not be exceeded when actuating the hand release (9).

Note!

Machinery-specific regulations and requirements (e.g. for hoists, cranes and elevators) must be observed when using brakes with hand release (9).

Caution!

The brake torque can be neutralised manually by means of the hand release (9). Consequently, the brake must be installed in such a way that any unintentional actuation of the hand release (9) is excluded.

Warning!

Check that the mechanical hand release (9) is in a central position (see Fig. 5/1) 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 (9) and automatic return of the hand release lever in its central position (see Fig. 5/1) has been ensured. The maximum air gap s_{max} (see Table 25/1) must not be exceeded throughout the entire brake service life (see Section 4 Maintenance for further details).

Collar (10):
Pull the collar (10) over the solenoid housing (1.1). Check that the sealing lip of the collar (10) is located precisely between the friction plate (11) and the mounting surface (8) on the mounting surface side. On the brake side, the sealing lip of the collar (10) touches the circumference of the solenoid housing (1.1).

Screw plug (14):
The screw plug (14), if used, must be inserted into the shaft opening on the rear of the brake (see Fig. 5/1).

3.3 Electrical connection and operation

The spring-applied single-disc brake must be supplied with DC voltage. Connection to an AC power source is via a bridge or half-wave rectifier. Various rectifier versions are available (see examples in Table 10/1) 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	Max. output current L-load I/ADC
32 07.22B.0	half-wave	0-500 (±10%)	$U_1 \bullet 0.445$	1.6	2.0
32 07.23B.0	bridge	0-400 (±10%)	$U_1 \bullet 0.890$	1.6	2.0
Specific rectifier specification sheets must be observed!					

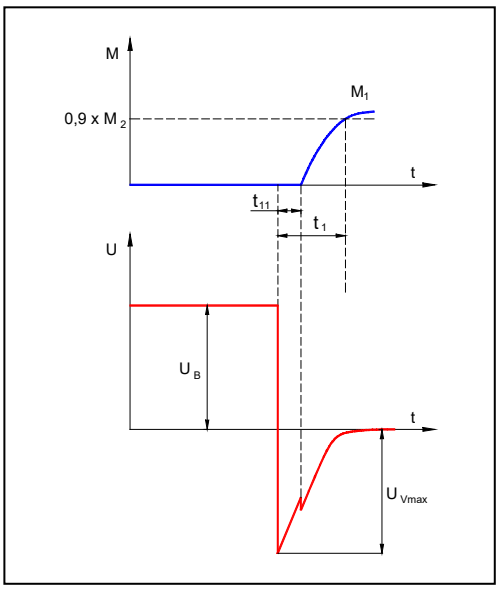
Table 10/1: Recommended rectifiers for single-phase AC voltage supply

3.3.1 DC power supply

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

Attention!

The peak voltage U_{Vmax} during disconnection without protective circuit may reach **several thousand V** in the millisecond region. This may cause irreversible damage to the field coil (1.2), switching contacts and electronic components. Sparking will occur on the switch during disconnection. Consequently, a protective circuit must be provided to reduce the current during disconnection and to limit the voltage. The maximum permitted overvoltage during disconnection is 1500V. If Kendrion rectifiers are used (see Table 10/1), the protective circuit required for the built-in electronic components and field coil (1.2) is included in the rectifier. This does not apply to the external contacts required for DC side switching as there would be no galvanic isolation of the external contact.



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

Attention!

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

3.3.2 AC power supply

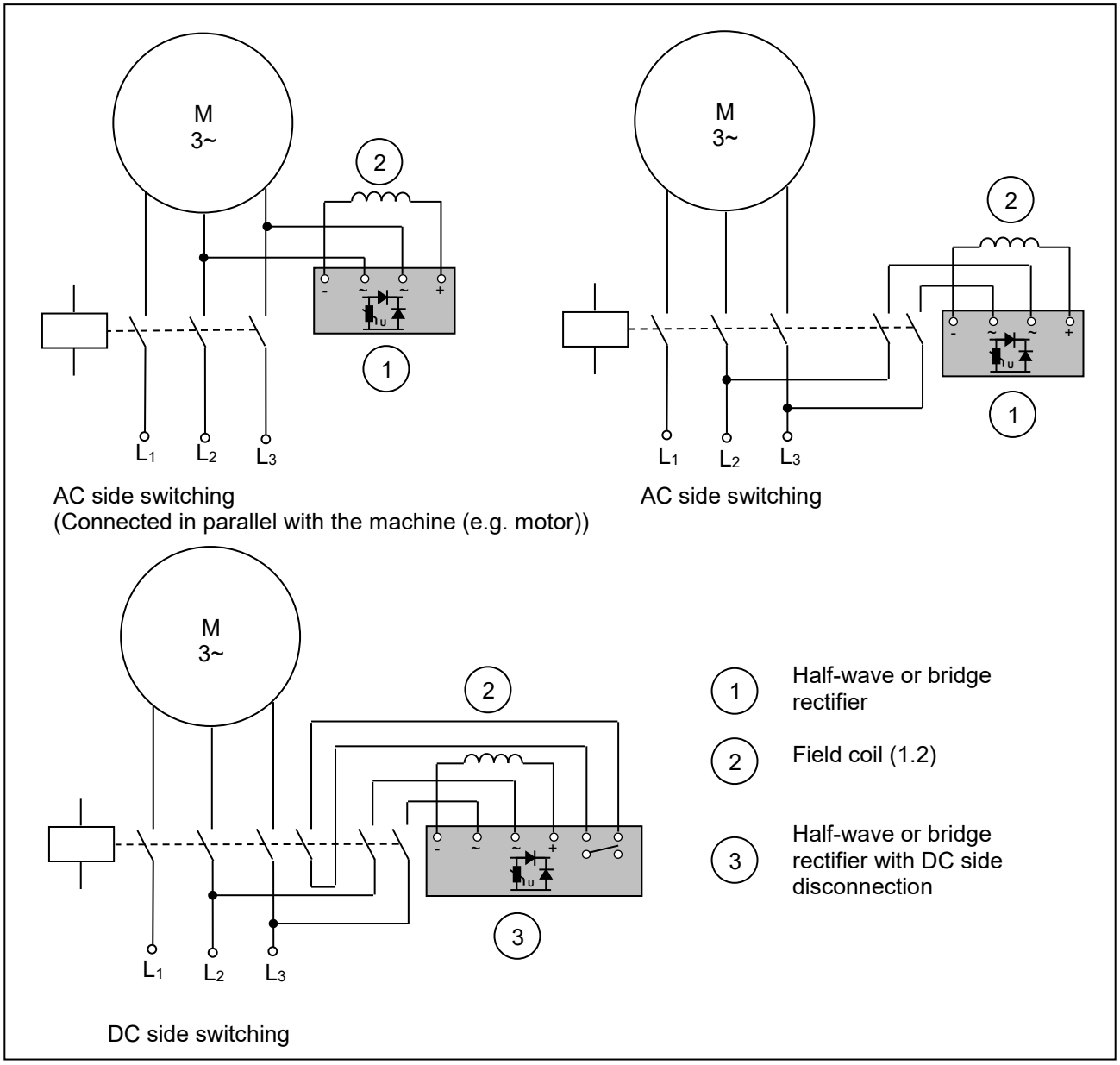
Direct connection of the spring-applied single-disc brake to an AC power source is only possible if a rectifier is used. Wiring of the brake in case of single-phase AC power supply must be performed in the same way as with three-phase voltage. The coupling times vary depending on the switching type (DC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

Half-wave rectification:

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

Bridge rectification:

Bridge rectifiers provide voltage with minimum residual ripple. This allows brake humming to 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 interrupts the power supply to the brake on the DC side.

Attention!

In case of DC side switching, the brake must be operated 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 type 76 43108H00 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-energised 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 energised 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 provided that the aforementioned consequential damage is avoided.

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

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

a) Radiated interference:
When operated with DC voltage or rectified 50/60Hz 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. 5/1 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.

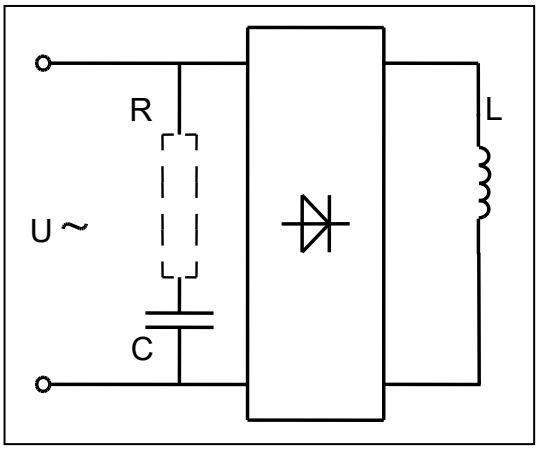


Fig. 14/1

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. As required by the German Electromagnetic Compatibility Act (EMVG), electromagnetic compatibility must be guaranteed 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 minimised. 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.

Rectifier type	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 and start-up

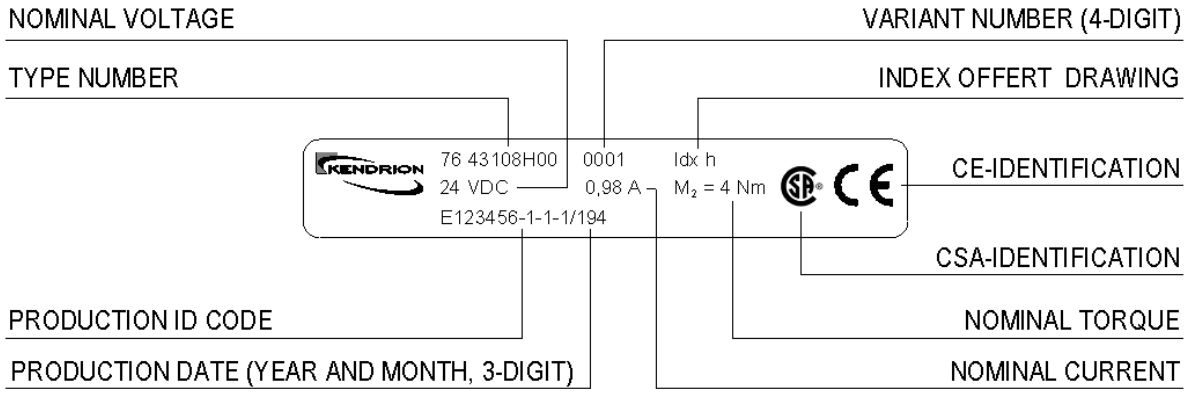
Warning!

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 (6) runs smoothly. For this purpose, turn the shaft while the brake is energised 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 43108H00-0001):



Note: The product number of the brake consists of the type number followed by the version number, e.g. 76 43108H00-0001.

Warning!

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

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 needs to be turned during set-up operations while the machine (e.g. motor) is switched off, the brake must be released electromagnetically or by means of the hand release lever (9).

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 M_2 rated torque adjustments

The brakes are factory-adjusted to the M_2 rated torque (as specified in the purchase order). The factory-adjusted M_2 rated torque is specified on the rating plate (7) of the brake and marked on the adjusting ring (3) by an arrow and by an additional punch mark on the solenoid housing (1.1). The adjusting ring clearance b_7 can be changed by fastening or loosening the adjusting ring (3) by means of a pin spanner or sickle spanner. This results in an approximately 1.5Nm/mm change in the M_2 rated torque (change in M_2 rated torque from 1mm axial adjustment of the adjusting ring (3)). The maximum 6mm adjusting ring clearance b_{7max} must not be exceeded.

4. Maintenance

4.1 Checks and service

The spring-applied single-disc brake does not require any particular maintenance except that the air gap ‘s’ must be measured and adjusted at regular intervals. If the maximum air gap s_{max} (see Table 25/1) between the armature (2) and the solenoid housing (1.1) of the spring-applied single-disc brake has been reached, the air gap needs to be adjusted as follows: Loosen the mounting screws (13) so that the spacer bolts (5) can be adjusted. The spacer bolts (5) are factory-secured in such a way that they can be adjusted by means of a screw driver. Turn the spacer bolts (5) anticlockwise to reduce the air gap ‘s’. After completion of adjustment, tighten the mounting screws (13) with a tightening torque of M_A=3Nm. Check the adjusted air gap ‘s’ (see Table 25/1) with a feeler gauge. The air gap of the spring-applied single-disc brake can be adjusted twice. After the second adjustment and when the maximum air gap s_{max} has been reached (see Table 25/1), the friction disc (6) needs to be replaced. The rated air gap ‘s’ (see Table 25/1) needs to be adjusted after the friction disc replacement.

Attention!

When mounting the spring-applied single-disc brake, it is crucial that the mounting screws (13) be tightened with a tightening torque of M_A=3Nm.

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 25/1) has been exceeded. In this case, the braking effect cannot be neutralised. This may cause thermal overloading of and irreversible damage to the brake if the machine (e.g. motor) is started before the brake has been released. Thermal overloading of the machine (e.g. motor) may occur if the machine (e.g. motor) is not started while the brake is still engaged.

Caution!

If a hand release (9) is fitted to the brake and the maximum air gap s_{max} has been exceeded (see Table 25/1), the hand release (9) will limit the axial movement of the armature (2). This will cause the torque to fall to zero. Whenever carrying out maintenance work, always check the air gap ‘s’ and replace the friction disc (6) well before the maximum air gap s_{max} (see Table 25/1) is reached.

Warning!

Whenever carrying out inspection and maintenance work, ensure that

- the machine (e.g. motor) is secured against accidental or unintentional start-up.
- no load torque acts on the shaft.
- the lock provided to prevent accidental start-up of the machine (e.g. motor) is removed after completion of inspection and maintenance work.
- all friction surfaces are free from grease and oil. An oily or greasy friction disc (6) cannot be cleaned.
- there is no swelling or glazing of the friction lining.

4.2 Spare parts and accessories

S	A	Designation	Type	Order number	Quantity
	X	Hand release (9)	-	76 43108A01940	1
	X	Collar (10)	-	76 43110H00005	1
	X	Collar (10) (when used with hand		76 43108A01005	1
	X	Friction plate (11)		76 43108A00004	1
	X	Mounting screws (13)	DIN 7984-M4x25-8.8	304510	3
	X	Screw plug (14)		412817	1
	X	Sealing ring (15)		326000	3
X		Friction disc (6)	-	76 43108H00200	1

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

5. Condition at delivery, transportation and storage

Upon receipt of the shipment, the spring-applied brake must be checked for transit damage before storage. Ordered accessories (e.g. hand release, sleeve, friction plate, mounting screws, screw plug, sealing rings) are delivered together with the brake. The spring-applied single-disc brake is delivered ready for mounting with factory-adjusted M_2 rated torque and factory-adjusted air gap 's' (air gap adjustment by means of the spacer bolts). The screwed-in spacer bolts limit the armature stroke and keep the armature in its position.

Note!

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

Note!

The environmental conditions specified in Table 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.

	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. If necessary, adjust the air gap or install a new friction disc.
	• No voltage applied to brake	Check the electrical connection and correct faults, if found.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
	• Armature plate blocked mechanically	Eliminate mechanical blocks.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil	Check the field coil resistance. Install a new brake, if necessary.
	• Friction disc thermally overloaded	Install a new friction disc or a new brake, if necessary.
Delayed brake release	• Air gap too large	Check the air gap. If necessary, adjust the air gap or install a new friction disc.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
Brake engagement failure	• Voltage applied to field coil in unpowered condition too high (residual voltage)	Check whether residual voltage is applied to the field coil and correct faults, if found.
	• Armature plate blocked mechanically	Eliminate mechanical blocks.
Delayed brake engagement	• Voltage applied to field coil too high	Check the field coil supply voltage and correct faults, if found.
Brake torque too low	• Air gap too large	Check the air gap. If necessary, adjust the air gap or install a new friction disc.
	• Oily or greasy friction surfaces	Check the friction surfaces. Install a new friction disc, if necessary.
	• Axial armature movement blocked by hand release	Check the air gap. If necessary, adjust the air gap or install a new friction disc.
	• Broken compression spring	Check the spring force. Install a new brake, 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 harmonised 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 the safety instructions are strictly adhered to. It is the duty of the user of the machine to plan these measures and to check their implementation.

The user is required to ensure that:

- the brakes are only used in accordance with their intended use (see Section 2 Product description).
- the brakes are in perfect working order and checked at regular intervals.
- a complete and fully legible copy of these Operating Instructions is kept available at the place of use of the brakes at all times.
- start-up, maintenance and repair work is only done by authorised 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 for attachment to machines, in particular electric motors, and are provided for use in industrial facilities. 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 brakes have hazardous live rotating components 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 authorised 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 (Villingen) 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 (jog mode). Failure to observe these instructions may irreversibly reduce the braking action and cause malfunctions. The normal operating conditions specified in these Operating Instructions are based on DIN VDE 0580. The protection class is based on EN 60529. In case of deviations from these requirements, special precautions may have to be taken after consultation with the brake 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 started up 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 and voltage type specified on the rating plate must be strictly observed when connecting the brakes described in these Operating Instructions. Sufficient heat dissipation must be ensured when the brake is fitted to or incorporated into other equipment. Adequate precautions must be taken to avoid overvoltage during disconnection or voltage peaks. The magnetic field of the products may cause interference outside the brake or even feedback to the brake in case of adverse installation conditions. Should you have queries concerning mounting and fitting conditions, please contact the brake manufacturer and ask for clarification.

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

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

8.2.4 Operation

Make sure that live components such as plug contacts or the field coil are not exposed to water. The brake cable connections must not be crushed, squeezed or exposed to mechanical loads. Make absolutely sure that the friction surfaces of the friction elements are not contaminated with grease, oil or other fluids to avoid substantial 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 (applicable to service brakes only) and the associated 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.

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 25/1). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 26/1) is not exceeded.

Note!

The maximum air gap s_{max} (see Table 25/1) must not be exceeded throughout the entire brake service life. (Please refer to Section 4 Maintenance for details.)

8.2.5 Maintenance, repair and replacement

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

8.3 Safety and warning 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
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.

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 08
Rated torque (standard) M_2 [Nm]	1-4
Max. reachable rated torque with fully screwed-in adjusting ring M_{2max} [Nm]	5
Max. speed n_{max} [rpm]	10000
Max. switching power P_{max} [kJ/h]	200
Max. switching work W_{max} [kJ]	25
Rated power P_N [W]	23.5
Coupling time t_1 (at M_2=4Nm) [ms]	18
Disconnection time t_2 (at M_2=4Nm) [ms]	30
Moment of inertia J – hub and friction disc [kgcm^2]	0.32
Weight m [kg]	0.61
Rated air gap $s^{+0.1}$ [mm]	0.2
Max. air gap s_{max} [2)] (at 70% of rated current) [mm]	0.45
Duty cycle [%]	100
Standard rated voltage [VDC]	24, 102, 178, 205
Insulation class	F
Pollution degree	2
Protection	IP 55 (when installed under motor fan cover) IP 65 (with accessories and when installed under motor fan cover)
Brake type	service brake

Table 25/1: Technical specifications

	Size 08
Speed n [rpm]	800
Coil on time t_5 [s]	2
Coil off time t_6 [s]	1
Break-in period t_{tot} [min]	approx. 2

Table 25/2: Break-in process parameters for the spring-applied single-disc brake

[2)] Maximum air gap s_{max} at maximum rated torque (standard). Maximum air gap s_{max} with rated torque M_{2max} equal to approx. 70% of the values specified in the technical specifications table.

	Rated operating conditions
Rated voltage tolerance	+10%, -15%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{13} [°C]	-5 to +35
Relative humidity	30% to 80% within ambient temperature 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 1000 m a.m.s.l.

Table 26/1: Rated operating conditions for spring-applied single-disc brake

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 >1500rpm substantially reduce the maximum permitted switching work per switching operation. Such operation is only allowed after prior consultation 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. 26/1 (W_{max} as a function of the number of switching operations per hour Z) applies. 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 or attached to the motor. 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 variance. In case of AC side brake switching, the coupling time t_1 is substantially longer. The specified rated torques M_2 characterise 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 oily, greasy or heavily soiled, 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 25/2). Vertical brake operation is only allowed after prior consultation with the manufacturer.

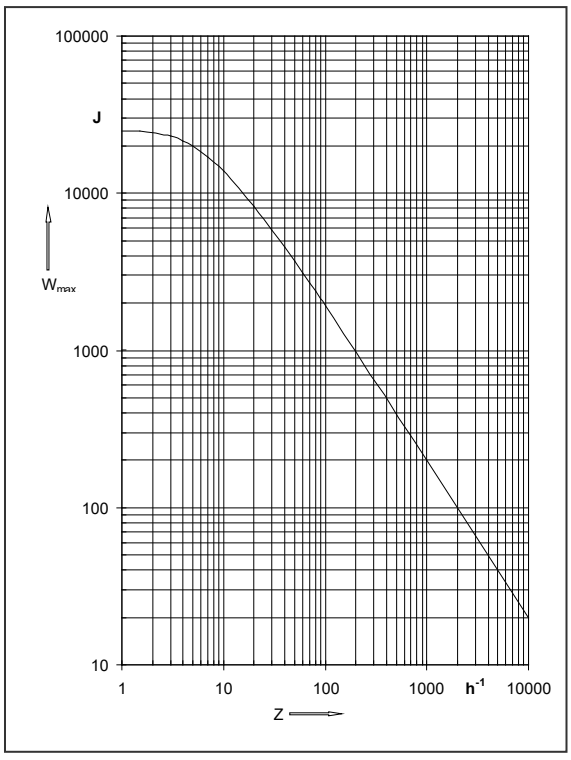


Fig. 26/1: Max. switching work W_{max} per switching operation as a function of the number of switching operations per hour Z (based on n=1500rpm)

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

The required operating conditions specified in Table 26/1 and the information provided in the **VARIO LINE data sheet** and offer drawing 76 43108H00-O 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 43108H00 Version number: 0001

Product number: 76 43108H00-0001

12. Specialist repair shops

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13. Revision history

Date of issue	Changes
26/03/2002	New issue.
24/02/2003	Operating instructions revised in content.
27/07/2004	Operating instructions revised in content.
30/10/2007	Operating instructions revised in content.
30/12/2009	Operating instructions revised in content.
15/04/2019	Added Declaration of Conformity in accordance with Low Voltage Directive 2006/95/EC and RoHS Directive 2011/65/EU. Changed company name. Text revisions. Strandards 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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