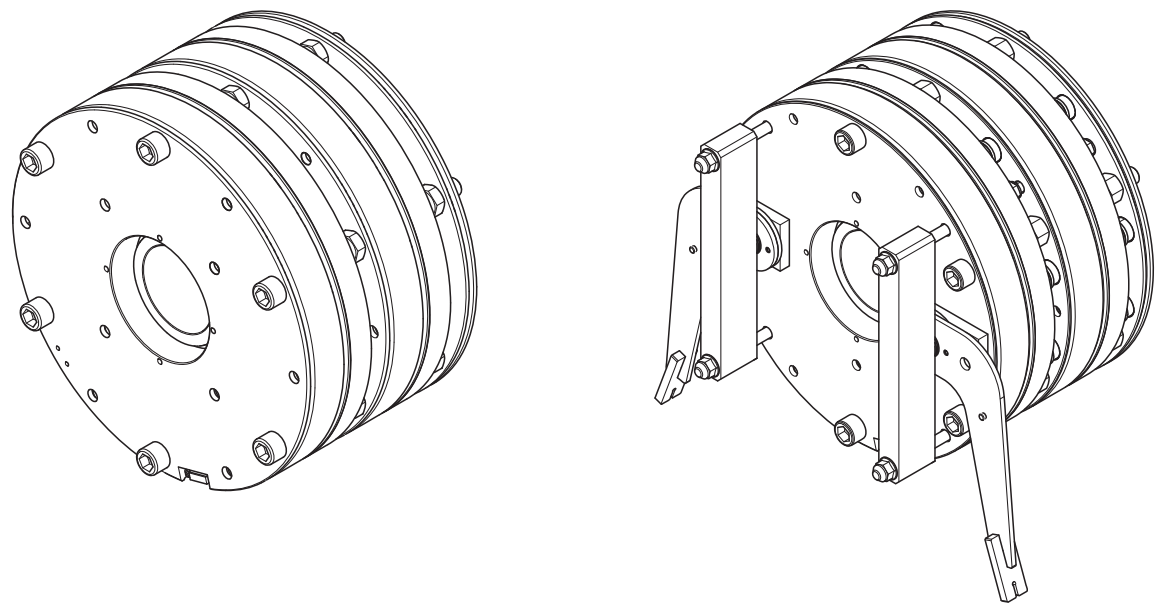


INTORQ BFK455-28

Electromagnetically Released Spring-Applied Brake

Translation of the Original Operating Instructions

This documentation applies to the:



Product key

INTORQ B FK □□□ - □□

A

B

C

D


Legend for the product key

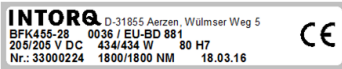
INTORQ BFK455


A	Product group	Brakes
B	Product type	Spring-applied brake
C	Type	455
D	Size	28

Not coded: Supply voltage, hub bore, options

Identification

Packaging label			Example
Manufacturer	Type number		
Type (see product key)	Bar code		
Designation	Qty. per box		
Rated/holding voltage	Rated torque		
Rated/holding power	Hub diameter		
Model identification	CE mark		
Note			

Name plate			Example
Manufacturer	CE mark		
Type (see product key)	EC-type examination identification		
Rated/holding voltage	Rated/holding power		
Type number	Rated torque		
	Hub diameter		
	Date of manufacture		

Label product traceability			Example
Type (see product key)	QR-Code		
Type number			
Serial number			
Manufacturer			

Notes

The brake is marked with the following labels, which have to be observed:

for the holding voltage	for setting the air gap
Lüftspannung Release voltage: 205 V DC Haltespannung: Holding voltage: 103 V DC Nur mit BEG-561-255-130 betreiben! Only use with BEG-561-255-130! Nr./No. 33000224	DE: Den nach der Erstinstallation eingestellten Luftspalt nicht verstellen! EN: Do not re-adjust the air-gap after the first installation! FR: Ne plus régler l'entrefer après la première installation!

Document history

Material number	Version			Description
33000756	1.0	05/2011	TD09	First edition
33000756	1.1	05/2012	TD09	Change in telephone and fax number Front and back page new Addition of the EC type test number Supplemented by chapter "Project planning notes" Supplemented by chapter "Wear of spring-applied brakes"
33002468	2.0	03/2013	TD09	Amended by new chapter on manual release installation Tables of dimensions and switching times were changed Supplement for spare parts list and the spare parts order
33002468	3.0	04/2013	TD09	Limitation of the adjustability Note on the suppressor circuit added to the "Electrical installation" chapter Values for characteristic torque 2x2065 Nm added to "Dimensions" table
33002468	4.0	01/2015	SC	Restructured FM
33002468	4.1	11/2015	SC	Changing the model identification test numbers
33002468	5.0	04/2016	SC	Updates Changing the model identification test numbers

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1 Preface and general information

1.1 About these Operating Instructions




- These Operating Instructions will help you to work safely with the spring-applied brake with electromagnetic release. They contain safety instructions that must be followed.
- All persons working on or with the electromagnetically released spring-applied brakes must have the Operating Instructions available and observe the information and notes relevant for them.
- The Operating Instructions must always be in a complete and perfectly readable condition.

1.2 Terminology used

Term	In the following text used for
Spring-applied brake	Electromagnetically Released Spring-Applied Brake
Drive system	Drive systems with spring-applied brakes and other drive components

1.3 Conventions in use

This document uses the following styles to distinguish between different types of information:

Spelling of numbers	Decimal separator	Point	The decimal point is always used. For example: 1234.56
Symbols	Page reference		Reference to another page with additional information For example:  16 = refer to page 16
	Wildcard	<input type="checkbox"/>	Wildcard for options, selections For example: BFK458- <input type="checkbox"/> <input type="checkbox"/> = BFK458-10
	Note		Important notice about ensuring smooth operations or other key information.

1.4 Abbreviations used

Letter symbol	Unit	Designation
F_R	N	Rated frictional force
I	A	Current
I_H	A	Holding current, at 20 °C and holding voltage
I_L	A	Release current, at 20 °C and release voltage
I_N	A	Rated current, at 20 °C and rated voltage
M_A	Nm	Tightening torque of fixing screws
M_{dyn}	Nm	Braking torque at a constant speed of rotation
M_K	Nm	Rated torque of the brake, rated value at a relative speed of rotation of 100 rpm
n_{max}	rpm	Maximum occurring speed of rotation during the slipping time t_3
P_H	W	Coil power during holding, after voltage change-over and 20 °C
P_L	W	Coil power during release, before voltage change-over and 20 °C
P_N	W	Rated coil power, at rated voltage and 20 °C
Q	J	Quantity of heat/energy
Q_E	J	Maximally permissible friction energy for one-time switching, thermal parameter of the brake
Q_R	J	Braking energy, friction energy
Q_{Smax}	J	Maximally permissible friction energy for cyclic switching, depending on the switching frequency
R_N	Ohms	Rated coil resistance at 20 °C
S_h	1/h	Switching frequency: the number of switching operations evenly spread over the time unit
S_{hue}	1/h	Transition switching frequency, thermal parameter of the brake
S_{hmax}	1/h	Maximum permissible switching frequency, depending on the friction energy per switching operation
s_L	mm	Air gap: the lift of the armature plate while the brake is switched
s_{LN}	mm	Rated air gap
s_{Lmin}	mm	Minimum air gap
s_{Lmax}	mm	Maximum air gap
t_1	ms	Engagement time, sum of the delay time and braking torque - rise time $t_1 = t_{11} + t_{12}$
t_2	ms	Disengagement time, time from switching the stator until reaching 0.1 M_{dyn}
t_3	ms	Slipping time, operation time of the brake (according to t_{11}) until standstill




Letter symbol	Unit	Designation
t_{11}	ms	Delay during engagement (time from switching off the supply voltage to the beginning of the torque rise)
t_{12}	ms	Rise time of the braking torque, time from the start of torque rise until reaching the braking torque
t_{ue}	s	Over-excitation time
U	V	Voltage
U_H	V DC	Holding voltage, after voltage change-over
U_L	V DC	Release voltage, before voltage change-over
U_N	V DC	Rated coil voltage; in the case of brakes requiring a voltage change-over, U_N equals U_L

1.5 Safety instructions and notices








The following icons and signal words are used in this document to indicate dangers and important safety information:

Safety instructions

Structure of safety instructions:

	 SIGNAL WORD
	Icon Indicates the type of danger
	Signal word Characterizes the type and severity of danger
	Note Describes the danger
	Possible consequences ■ List of possible consequences if the safety instructions are disregarded
	Protective measure ■ List of protective measures to avoid the danger

Danger level

	<div data-bbox="432 297 619 353">  DANGER </div> <div data-bbox="432 376 1426 450"> DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury. </div>
	<div data-bbox="432 517 628 573">  WARNING </div> <div data-bbox="432 595 1394 669"> WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. </div>
	<div data-bbox="432 736 622 792">  CAUTION </div> <div data-bbox="432 815 1426 889"> CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. </div>
	<div data-bbox="448 945 547 978"> NOTICE </div> <div data-bbox="432 1001 1426 1075"> Notice about a harmful situation with possible consequences: the product itself or surrounding objects could be damaged. </div>

1.6 Scope of delivery

After receipt of the delivery, check immediately whether the items delivered match the accompanying papers. INTORQ does not accept any liability for deficiencies claimed subsequently.

- Claim visible transport damage immediately to the deliverer.
- Claim visible deficiencies or incomplete deliveries immediately to INTORQ GmbH & Co. KG.

1.7 Disposal

The spring-applied brake consists of different types of material.

- Recycle the metal and plastic parts.
- Ensure professional disposal of assembled circuit boards according to the applicable environmental regulations.

1.8 Drive systems

Labelling

Drive systems and components are unambiguously designated by the indications on the nameplate.

Manufacturer: INTORQ GmbH & Co. KG, Wülmser Weg 5, D-31855 Aerzen, Germany

- The spring-applied INTORQ brake is also delivered in single modules which can then be put together by the customer according to their requirements. The specifications – particularly the packaging label, nameplate and type code – apply to a complete stator.
- The labelling is not included when modules are delivered individually.

1.9 Legal regulations

Liability

- The information, data and notes in these Operating Instructions met the state of the art at the time of printing. Claims referring to drive systems which have already been supplied cannot be derived from this information, illustrations and descriptions.
- We do not accept any liability for damage and operating interference caused by:
 - inappropriate use
 - unauthorised modifications to the product
 - improper work on or with the drive system
 - operating errors
 - disregarding the documentation

Warranty

- Terms of warranty: Refer to the terms of sale and delivery for INTORQ GmbH & Co. KG.
- Warranty claims must be made to INTORQ immediately after the defects or faults are detected.
- The warranty is void in all cases when liability claims cannot be made.

2 Safety instructions

2.1 General safety instructions

- INTORQ components:
 - ... must only be used as directed.
 - ... must not be commissioned if they are noticeably damaged.
 - ... must not be technically modified.
 - ... must not be commissioned if they are incompletely mounted or connected.
 - ... must not be operated without the required covers.
 - ... can include live (current-carrying) as well as moving or rotary parts during operation according to their degree of protection. Surfaces may be hot.
- For INTORQ components:
 - ... the documentation must always be kept at the installation site.
 - ... only permitted accessories are allowed to be used.
 - ... only original spare parts of the manufacturer are allowed to be used.
- Follow all specifications and information found in the corresponding enclosed documentation. These must be followed to maintain safe, trouble-free operations and to achieve the specified product characteristics.
- Only qualified, skilled personnel are permitted to work on and with INTORQ components. According to IEC 60364 or CENELEC HD 384, qualified, skilled personnel are persons:
 - ... who are familiar with the installation, mounting, commissioning, and operation of the product.
 - ... who have the qualifications necessary for their occupation.
 - ... who know and apply all regulations for the prevention of accidents, directives, and laws relevant on site.
- Risk of burns!
 - Surfaces may be hot during operation! Provide for protection against accidental contact.
- Risk of injury due to a rotating shaft!
 - Wait until the motor is at standstill before you start working on the motor.
- The friction lining and the friction surfaces must never contact oil or grease since even small amounts reduce the braking torque considerably.
- The brake is designed for operation under the environmental conditions that apply to IP54 protection. Because of the numerous possibilities of using the brake, it is still necessary to check the functionality of all mechanical components under the corresponding operating conditions.

2.2 Application as directed

- INTORQ components:
 - ... are intended for use in machinery and systems.
 - ... must only be used for the purposes ordered and confirmed.
 - ... must only be operated under the ambient conditions prescribed in these Operating Instructions.
 - ... must not be operated beyond their corresponding power limits.

Any other use or excessive usage is considered improper!

Usage conditions for the INTORQ spring-applied brake

- Humidity: no restrictions
 - In the event of condensation or moisture formation: provide for appropriate ventilation to ensure that all components will dry quickly.
- Ambient temperature:
 - 5 °C to +40 °C
- At high humidity and low temperature:
 - Take measures to protect the armature plate and rotor from freezing.
- Protect the electrical connections against any contact or touching.

3 Technical specifications

3.1 Product description

Versions

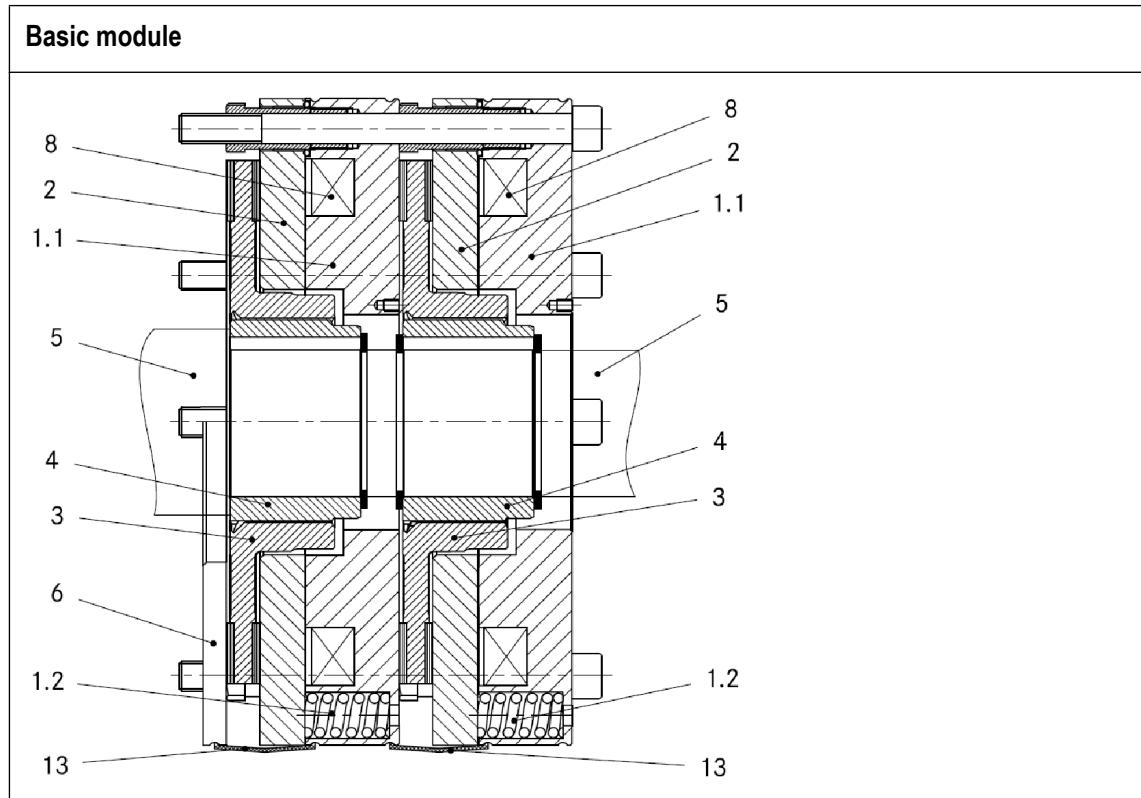




Fig. 1 Design of a BFK455 spring-applied brake

1.1 Stator	3 Complete rotor	6 Flange
1.2 Pressure springs	4 Hub	8 Coil
2 Armature plate	5 Shaft	13 Cover ring

3.1.1 General information

The spring-applied brake is designed for converting mechanical work and kinetic energy into heat energy. Due to the static braking torque, loads can be held at standstill. Emergency braking is possible at high speed of rotation. The wear increases as the switching energy increases (operating speeds  17).

The BFK455 spring-applied brake is a double-disk brake with four friction surfaces. The braking torque is applied through two separate braking circuits, both electrical and mechanical, via several compression springs (1.2) in the form of generated friction. The brake circuits are released electromagnetically. Due to its division into two brake circuits, the brake is particularly suitable for applications such as lift systems and stage/platform technology. The brake can be selected based on the rated torque for one brake circuit. The second brake circuit meets the requirement for redundancy.

The division of the brake circuits is done using two separate armature disks (2) with their corresponding compression springs (1.2) and electromagnetic coils (8). Each brake circuit can be operated individually due to the separate supply lines for each stator and armature plate ( 36).

Each brake circuit has a micro-switch which monitors the switching state of the spring-applied brake. Using the associated switching device, the supply voltage (AC voltage) is rectified and, when the brake is released, lowered after a short period of time. This results in a reduction of the average electrical power of the brake.

The stator (1.1) is supplied in heat class F. The limit temperature of the coils (8) is 155 °C. The BFK455 spring-applied brake is designed for a maximum operating time of 60 % with holding current reduction.

Certificate

Type	Characteristic torque [Nm]	EC-type examination certificate		
		Directive 95/16/EC	UCM	Directive 2014/33 EU
BFK455-28	2 x 1200	ABV 881/2	ESV 881/2	EU-BD 881
	2 x 1700, 2 x 1800			
	2 x 2065			

3.1.2 Brake

During the braking procedure, the pressure springs (1.2) use the armature plate (2) to press the rotor (3) (which can be shifted axially on the hub (4)) against the friction surface. The asbestos-free friction linings ensure high braking torque and low wear. The braking torque is transmitted between the hub (4) and the rotor (3) via gear teeth.

3.1.3 Brake release

When the brakes are applied, an air gap " s_L " is present between the stator (1.1) and the armature plate (2). To release the brake, the coil of the stator (1.1) is energised with the DC voltage provided. The resulting magnetic flux works against the spring force to draw the armature plate (2) to the stator (1.1). This releases the rotor (3) from the spring force and allows it to rotate freely

3.1.4 Release monitoring

The spring-activated brake has a micro-switch for each braking circuit to monitor the switching state. When the brake is released, the micro-switches toggle. This means that it is possible to prevent the drive from being operated when the brake is closed. The micro-switches can be connected as both normally open and also normally closed.

To check that the micro-switches function correctly, we recommend testing the switching status (refer to table 6) in both the released and applied braking states.

3.1.5 Encapsulated design (optional)

This design not only avoids the penetration of spray water and dust, but also the spreading of abrasion particles outside the brake. This is achieved by:

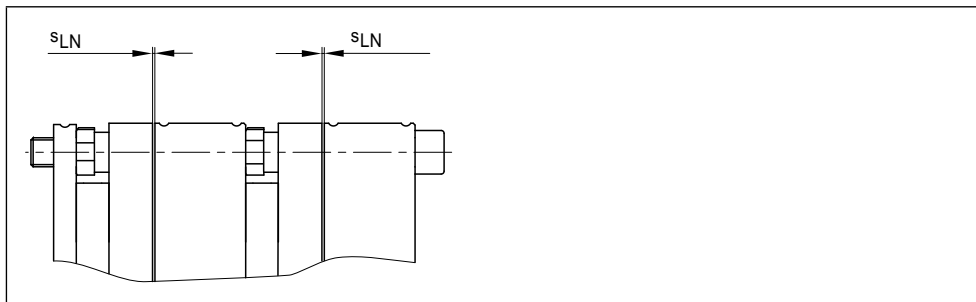
- a cover seal over the armature plate and rotor.

3.1.6 Project planning notes

- The brakes are dimensioned in such a way that the given rated torques are reached safely after a short run-in process.
- However, since the organic friction linings used do not all have identical properties and because environmental conditions can vary, deviations from the specified braking torques are possible. These must be taken into account in the form of appropriate dimensioning tolerances. Increased breakaway torque is common in particular after long downtimes in humid environments where temperatures vary.
- If the brake is used as a pure holding brake without dynamic load, the friction lining must be reactivated regularly.

3.2 Rated data

3.2.1 Dimensions



Type	Rated torque	Air gap		Permitted wear	Rotor thickness		Weight complete stator
	[NM]	$s_{LN}^{+0.05}$ [mm]	s_{Lmax} [mm]	[mm]	min. [mm]	max. [mm]	m [kg]
BFK455-28	2 x 1100	0.4	0.7	0.3	17.7	18	46
	2 x 1200						
	2 x 1700						
	2 x 1800						
	2 x 2065		0.6	0.2	17.8		

Type	Pitch circle		Fixing screws DIN 912		Minimum thread depth		Tightening torque	
	\varnothing [mm]	Thread	without flange [mm]	with flange [mm]	without flange [mm]	with flange [mm]	without flange M_A [Nm]	with flange M_A [Nm]
BFK455-28	314	M16	6 x M16x210	6 x M16x220	25	22.5	206	265

Tab. 1: Dimensions of the BFK455-28

		CAUTION
	<ul style="list-style-type: none"> The minimum thread depth of the end shield must be maintained! Tab. 1. If the required thread depth is not maintained, the fixing screws may run onto the root. This has the effect that the required pre-load force is no longer established – the brake is no longer securely fastened! 	

3.2.2 Electrical data

Type	Voltage		Power		Coil resistance	Current
	Release $\pm 10\%$ U_L [V DC]	Holding $\pm 10\%$ U_H [V DC]	Brake release P_N [W]	Holding P_H [W]		
BFK455-28	103	52	2 x 434	2 x 108.5	2 x 24.5	2 x 4.21
	205	103			2 x 97	2 x 2.12
	360	180			2 x 298.6	2 x 1.21

Tab. 2: Coil power ratings of the BFK455-28

3.3 Rated data (design data)

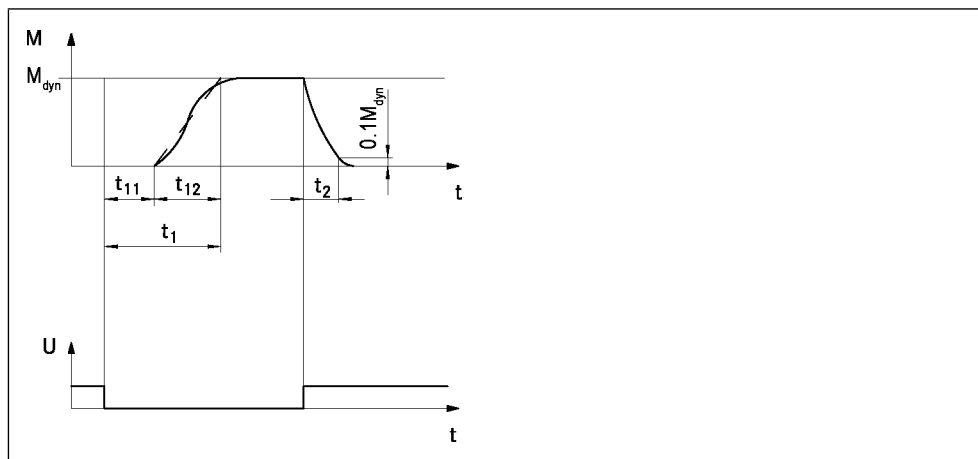


Fig. 2 Operating/switching times of the spring-applied brakes

- | | |
|--|--|
| t_1 Engagement time | t_{11} Reaction delay of engagement |
| t_2 Disengagement time (up to $M = 0.1 M_{dyn}$) | t_{12} Rise time of the braking torque |
| M_{dyn} Braking torque at a constant speed of rotation | U Voltage |

Type	Rated torque ¹⁾	Max. permitted switching energy	Transitional switching frequency	Switching times [ms] ²⁾ at s _{LN} and 0.7 I _N				Max. speed ³⁾
	M _K	Q _E	S _{hue}	Engaging DC side ⁴⁾			Disengaging	n _{max.}
	[Nm]	[J]	[1/h]	t ₁₁	t ₁₂	t ₁	t ₂	[rpm]
BFK455-28	2 x 1100	360000	7	80	220	300	370	455
	60			280		255		
	2 x 1700			20		240	480	455
	2 x 1800			30		250	460	255
	2 x 2065							

Tab. 3: Switching energy - switching frequency - switching times

¹⁾ Minimum brake torque with run-in friction components at $\Delta n=100$ rpm

²⁾ Typical values


³⁾ Max. speed according to EC-type examination certificate (for higher speeds, consultation with the manufacturer is required)

⁴⁾ Measured with induced voltage limitation of -800 V DC

Engagement time


The transition from a brake-torque-free state to a holding-braking torque is not free of time lags.

For emergency braking, short engagement times for the brake are absolutely essential. The DC switching in connection with a suitable spark suppressor must therefore be provided.

- The engagement times apply for **DC switching** with a spark suppressor.
 - Spark suppressors are available for the rated voltages.
 - Connect the spark suppressors in parallel to the contact. If this switching is not admissible for safety reasons (e.g. with hoists and lifts), the spark suppressor can also be connected in parallel to the brake coil.
 - Circuit proposals:  36
- If the drive system is operated with a frequency inverter so that the brake will not be de-energised before the motor is at standstill, AC switching is also possible (not applicable to emergency braking).



NOTICE

If the brake is using AC-side switching, the engagement times increase approximately by a factor of 5 (refer to  35 for connection).

Disengagement time

The disengagement time is the same for DC and AC switching. The specified disengagement times always refer to control using over-excitation.

3.4 Switching energy / switching frequency

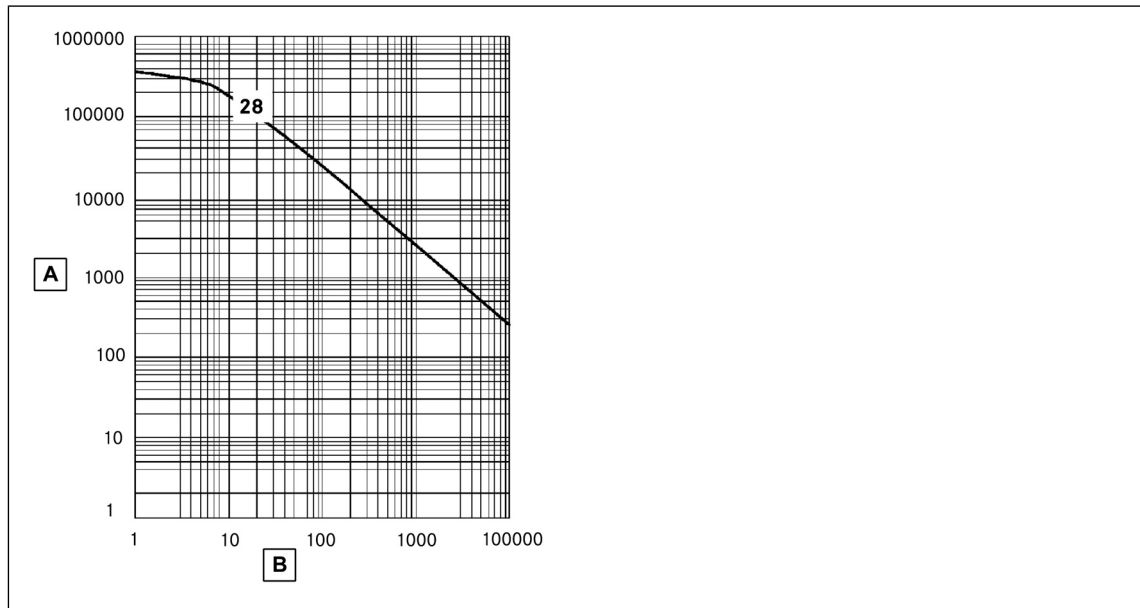


Fig. 3 Switching energy as a function of the switching frequency

[A] Switching energy Q [J]

[B] Switching frequency S_h [1/h]

$$S_{h\max} = \frac{-S_{hue}}{\ln\left(1 - \frac{Q_R}{Q_E}\right)}$$

$$Q_{s\max} = Q_E \left(1 - e^{\frac{-S_{hue}}{S_h}} \right)$$

The permissible switching frequency $S_{h\max}$ depends on the amount of heat Q_R (refer to Figure 3). At a pre-set switching frequency S_h , the permissible amount of heat is $Q_{s\max}$.

With high speeds of rotation and switching energy, the wear increases strongly, because very high temperatures occur at the friction surfaces for a short time.

3.5 Emissions

Electromagnetic compatibility



NOTICE

The user must ensure compliance with EMC Directive 2014/30/EU using appropriate controls and switching devices.

If an INTORQ rectifier is used for the DC switching of the spring-applied brake: If the switching frequency exceeds five switching operations per minute, the use of a mains filter is required.

If the spring-applied brake uses a rectifier from another manufacturer for the switching, it may become necessary to connect a spark suppressor in parallel with the AC voltage. Spark suppressors are available on request, depending on the coil voltage.

Heat

Since the brake converts kinetic energy as well as mechanical and electrical energy into heat, the surface temperature varies considerably, depending on the operating conditions and possible heat dissipation. Under unfavourable conditions, the surface temperature can reach 130 °C.

Noise

The switching noise during engagement and disengagement varies depending on the air gap, braking torque and brake size.


Depending on the natural oscillation after installation, operating conditions and state of the friction surfaces, the brake may squeak during braking.

Miscellaneous




The abrasion of the friction parts produces dust.



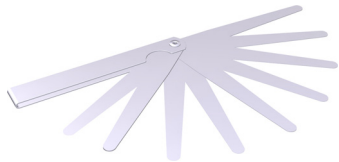
4 Mechanical installation

4.1 Important notes

	NOTICE
	The toothed hub and screws must not be lubricated with grease or oil.


4.2 Necessary tools

Type	Torque wrench Bit for hexagon socket screws		Open-jawed spanner
			
	Measuring range [Nm]	Wrench width [mm]	Adjustment tubes - wrench size [mm]
BFK455-28	40 - 400	14	24

Multi-meter	Caliper gauge	Feeler gauge
		

4.3 Assembly

4.3.1 Important notes

Brake size	Minimum requirements: Use as counter friction surface				
	Material ¹⁾	Evenness [mm]	Axial run-out [mm]	Roughness	Miscellaneous
28	S235 JR C15 EN-GJL-250	< 0.1	0.1	Rz10	<ul style="list-style-type: none"> ■ Threaded holes with minimum thread depth  16 ■ Free of grease and oil

Tab. 4: Counter friction face design of the end shield

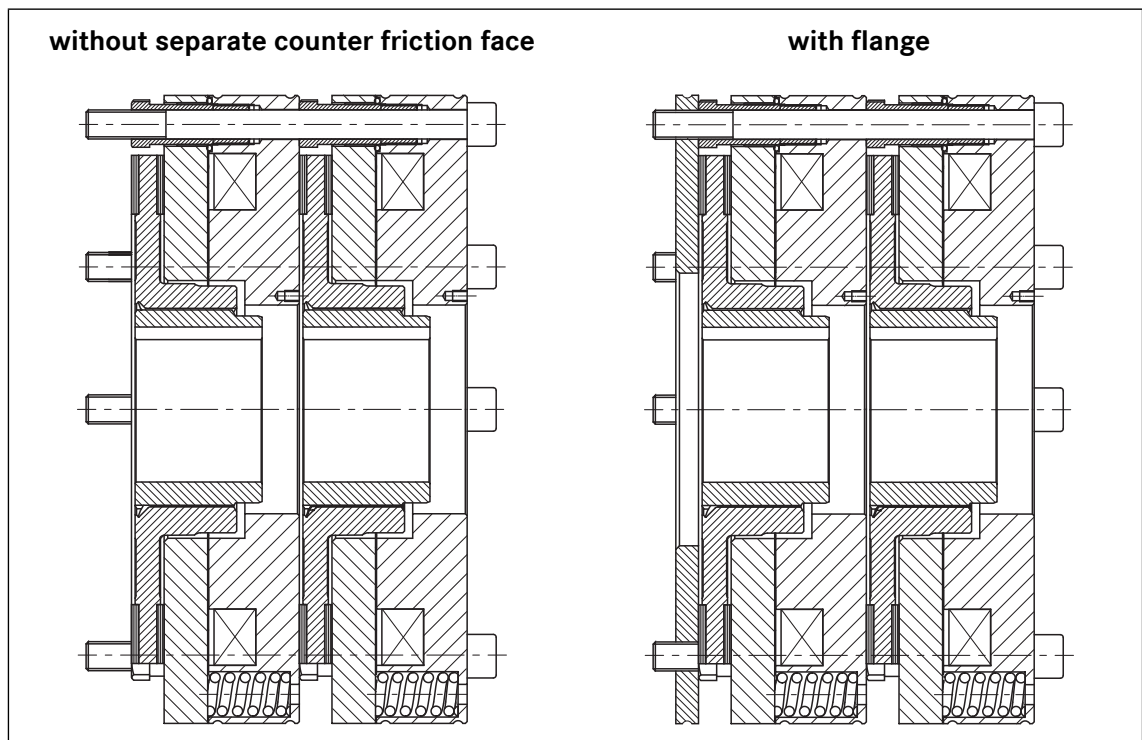
¹⁾ For other materials, please consult with INTORQ.

The diameter of the shaft shoulder must not be greater than the tooth root diameter of the hub.

4.3.2 Preparation

1. Unpack the spring-applied brake.
2. Check for completeness.
3. Check the nameplate data (especially the rated voltage).

4.3.3 Overview



4.4 Installation



NOTICE

The toothed hub and screws must not be lubricated with grease or oil.



NOTICE

When you have ordered a version with flange, attach the hub first (📖 23), then continue with the “Assembly of the counter friction faces”.

4.4.1 Brake assembly

Mounting the first hub onto the shaft

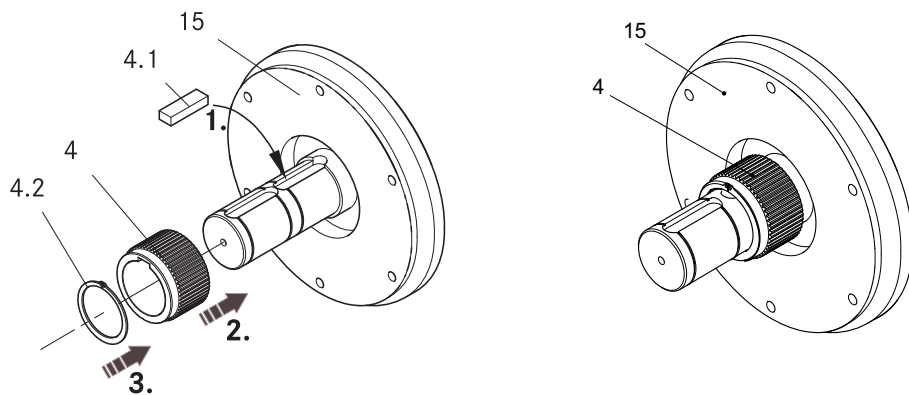


Fig. 4

4 Hub

4.1 Key

15 End shield

1. Insert the key (4.1) into the shaft.
2. Press the first hub (4) onto the shaft.
3. Secure the hub (4) against axial displacement (for example, by using a circlip (4.2)).



NOTICE

For reverse operations, we recommend also glueing the hub to the shaft.

Assembly of the counter friction faces

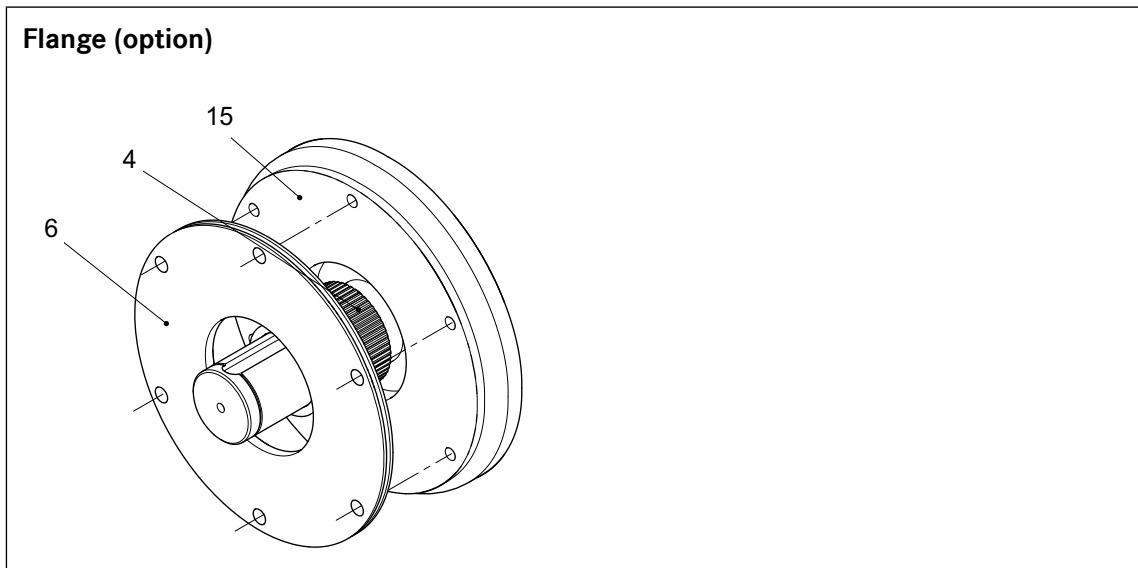


Fig. 5 Assembly of the flange

4	Hub	15	End shield
6	Flange		

4. Hold the flange (6) to the end shield (15).
 5. Align the through holes in the flange to the threads of the fastening bore holes.
- In the following sections, only assembly for the version with flange will be described.**

Assembly of the first rotor

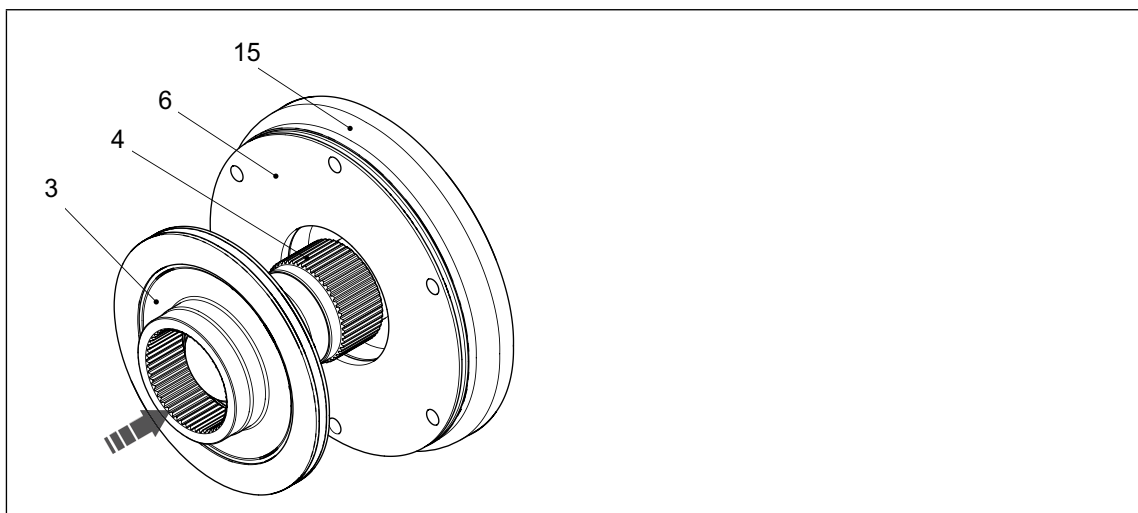



Fig. 6 Mounting of the rotor

3	Rotor	6	Flange	15	End shield
4	Hub				

6. Push the rotor (3) onto the hub (4) and check whether it can be moved by hand.

	NOTICE
	<p>Only in the case of rotors with mounting paste on their gear teeth:</p> <ul style="list-style-type: none"> ■ Remove cover films from both front ends of the rotor. ■ Protect friction surfaces against contact with mounting paste! ■ After the mounting, excessive mounting paste must be removed properly!

Installation of the second hub onto the shaft

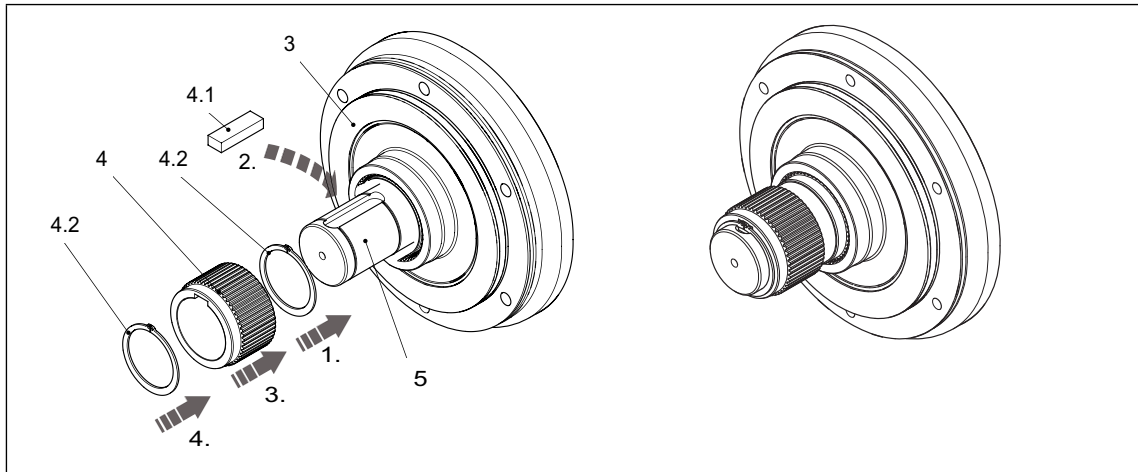


Fig. 7 Mounting of the second hub

4	Hub	3	Complete rotor	4.2	Circlip
5	Shaft	4.1	Key		

7. Insert second key (4.1) into the shaft (5) if required.
8. Press second hub (4) onto the shaft (5).
9. Secure hub (4) against axial displacement, e.g. by using a circlip (4.2).

Assembly of the first stator

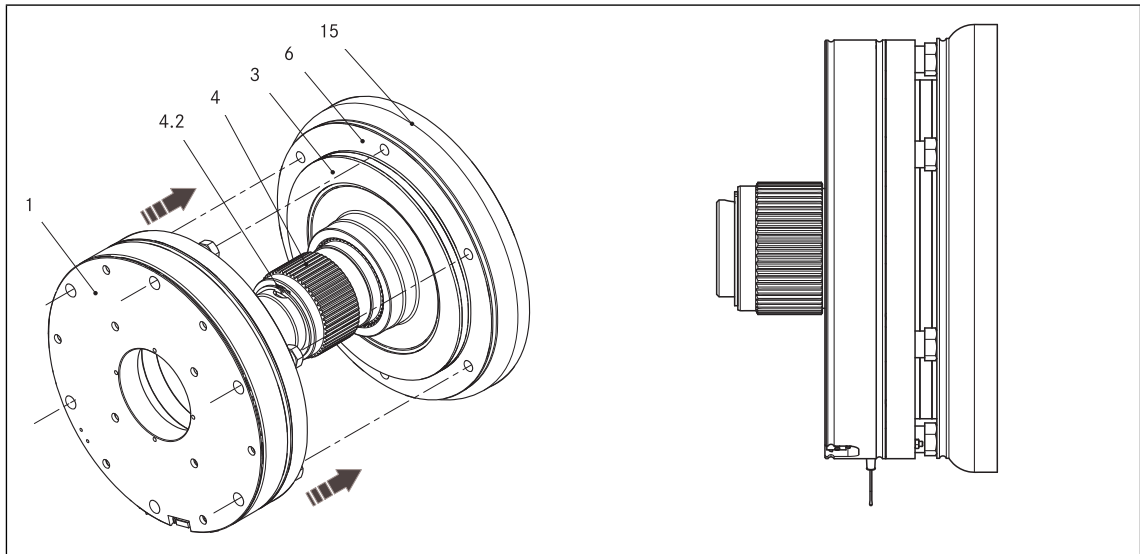


Fig. 8 Assembly of the stator

1 Stator, complete	4 Hub	6 Flange
3 Shaft	4.2 Circlip	15 End shield

10. Push the complete stator onto the shaft.

11. Align the through holes in the complete stator (1) to the threads of the fastening bore holes.

Assembly of the second rotor

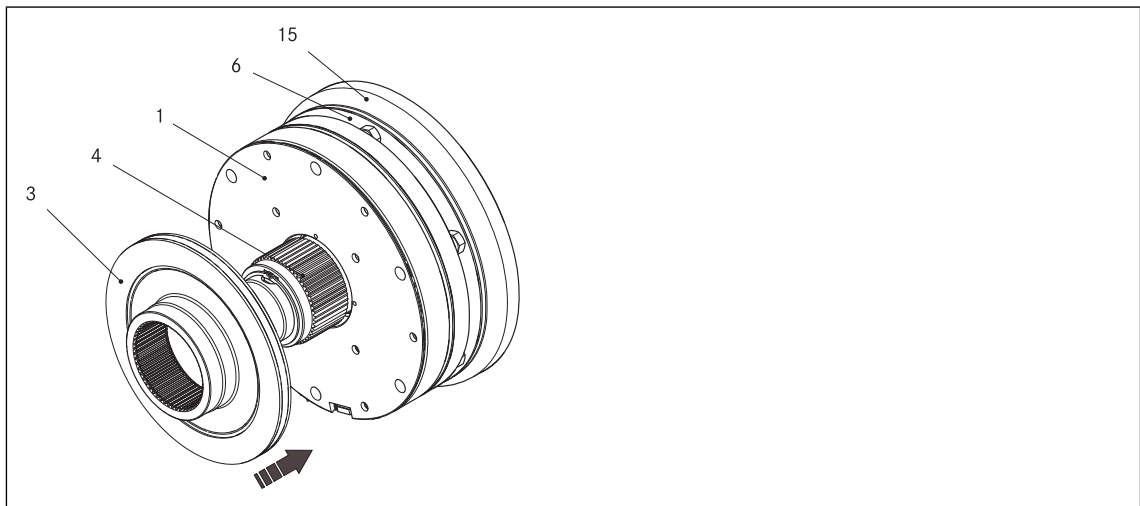



Fig. 9 Mounting of the rotor

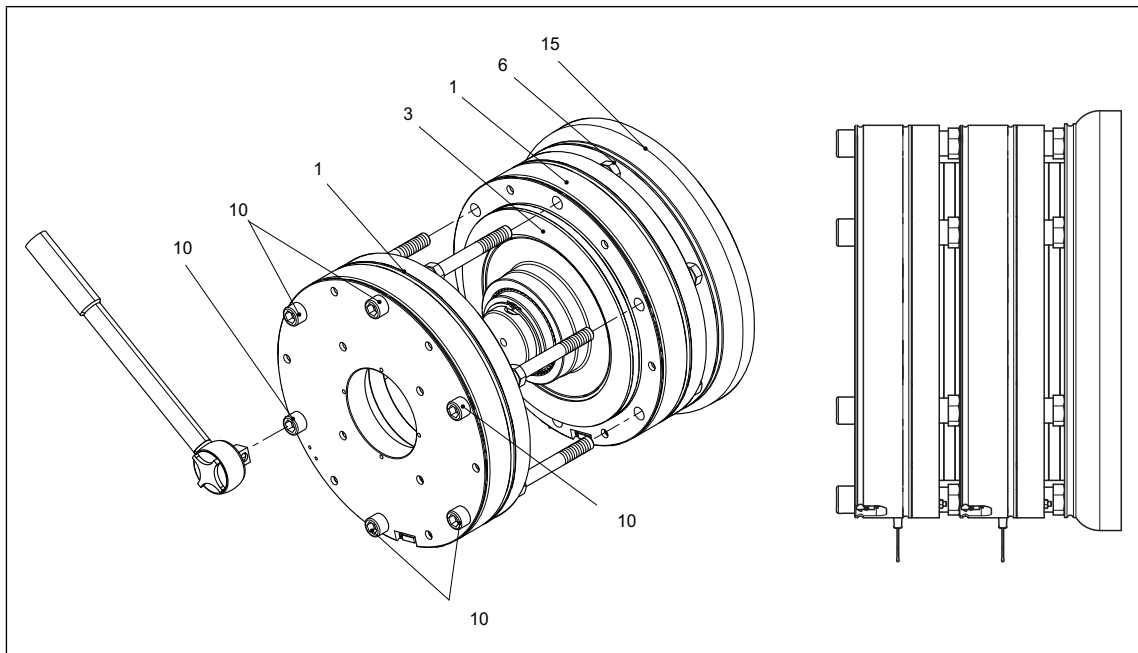
1 Stator, complete	4 Hub	15 End shield
3 Complete rotor	6 Flange	

12. Push the complete rotor (3) onto the hub (4) and check whether it can be moved by hand.



	NOTICE
	<p>Only in the case of rotors with mounting paste on their gear teeth:</p> <ul style="list-style-type: none"> ■ Remove cover films from both front ends of the rotor. ■ Protect friction surfaces against contact with mounting paste! ■ After the mounting, excessive mounting paste must be removed properly!

**NOTICE**



If a manual release is to be installed, the procedure described in section 4.5.2 (Step 2) must be carried out **now!**

Assembly of the second stator**Fig. 10 Assembly of the stator**

1	Stator, complete	6	Flange	15	End shield
3	Complete rotor	10	Fixing screws		

13. Push the complete stator onto the shaft.
14. Align the through holes in the complete stator (1) to the threads of the fastening bore holes in the first stator.
15. Evenly tighten the brake with the six socket head cap screws (10) included in the scope of supply in several runs using a torque key.
16. Establish the electrical connection and energize the brake ( 35).
17. Use a torque key to re-tighten the supplied fixing screws (10) with the required tightening torque ( 16).
18. Switch off the power.

4.4.2 Check the air gap

	 DANGER
	<p>Danger: rotating parts! Switch off the voltage. The brake must be free of residual torque.</p>

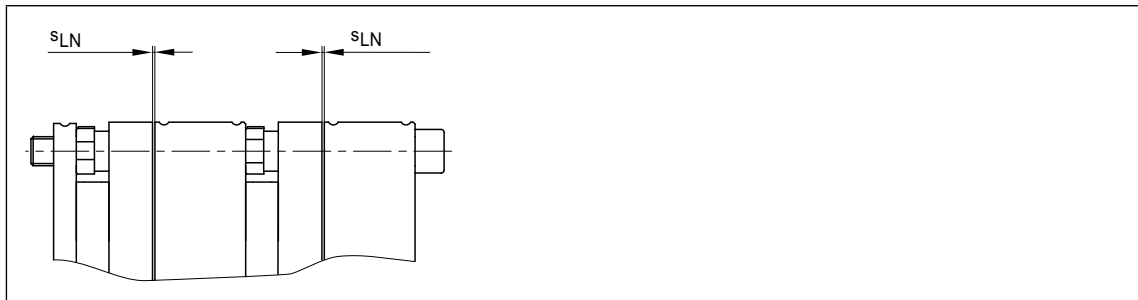


Fig. 11 Check the air gap

1. Check the air gap near the screws (10) by means of a feeler gauge. Compare the measured values to the values for " s_{LN} " in the table (📖 16).

**NOTICE**

Do not insert feeler gauge more than 10 mm between armature plate (2) and stator (1.1)!

If the measured value " s_L " is outside the tolerance of " s_{LN} ", set the dimension:

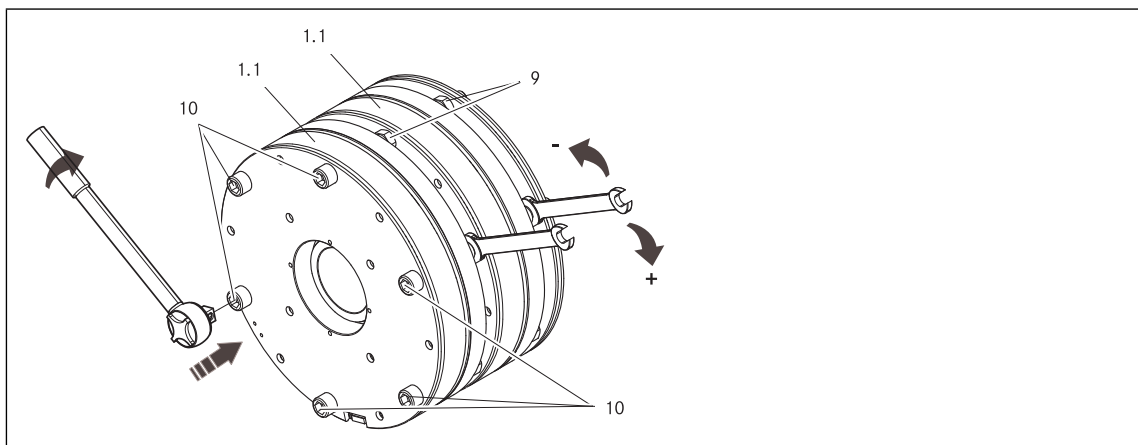


Fig. 12 Adjusting the air gap during the initial installation

2. Loosen the bolts (10).

**NOTICE**

First correctly adjust the air gap with every 2nd bolt (10) / sleeve bolt (9)! The other three sleeve bolts should be screwed into the stator so that they do not touch the flange or the bearing shield. Then repeat the process with the other three bolts (10).

3. Slightly turn the sleeve bolts (9) using an open end spanner.
 - If the air gap is too large, screw into the stator (1.1).
 - If the air gap is too small, screw them out of the stator (1.1).
 - A 1/6 turn will change the air gap by approximately 0.15 mm.
4. Tighten the screws (10) (for torques, see table 16).
5. Check the air gap " s_L " near the screws (10) using a feeler gauge, (" s_{LN} " 16).
6. Repeat the adjustment procedure if the deviation of " s_{LN} " is too large.

4.5 Manual release



NOTICE

- The manual release is designed for activation via a Bowden cable.
- For activation without a Bowden cable, the lever has to be extended.
- An individual brake circuit can only be released electrically.

The manual release is mounted when the double-spring-applied brake is installed. No power is applied to the brake.

1. Mount the first rotor (3), the first complete stator (1), and the second rotor (3A) according to section 4.4.1, steps 1 through 12 (23 and 26).

4.5.1 Components of the manual release

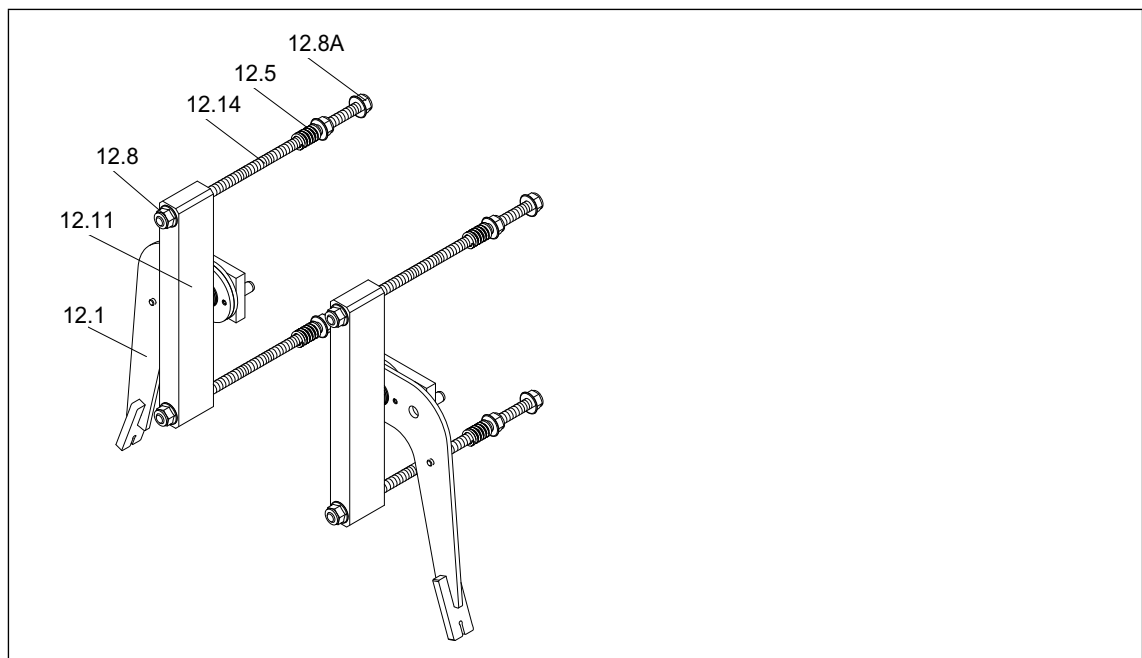


Fig. 13 Manual release

12.1 Manual release lever

12.5 Pressure spring

12.8 Lock nut

12.11 Clip

12.14 Tension rod

4.5.2 Installing the manual release

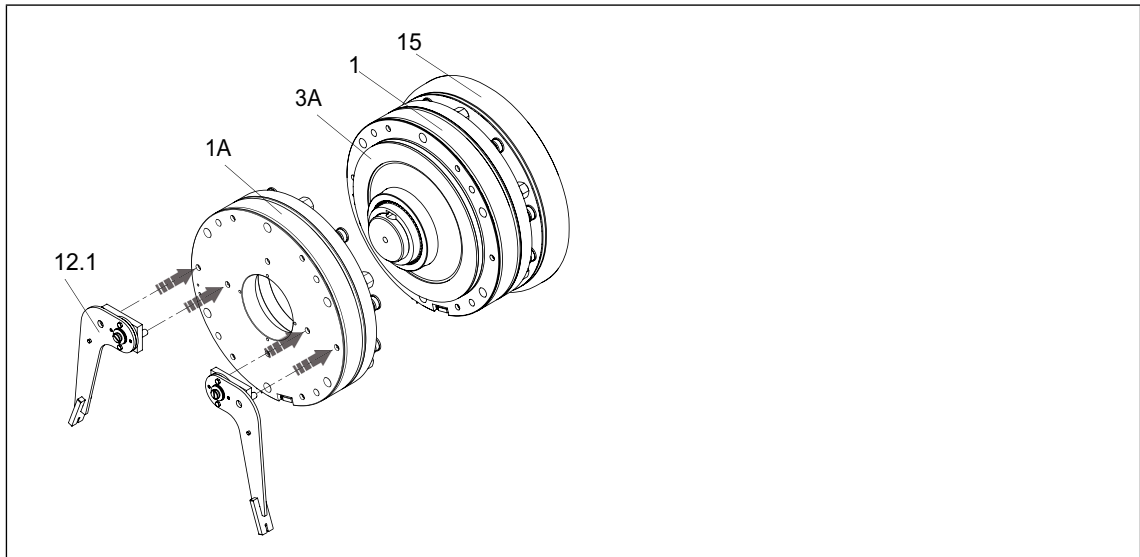


Fig. 14 Applying the manual release lever

- Put both levers completely (12.1) onto the second stator (1A). To do this, push in the plates' pins into the corresponding holes of the stator (using a suitable tool).



NOTICE

The plates are not symmetric. The pin with the greater distance from the axis of rotation must be oriented towards the outside. The lever must also face outwards.

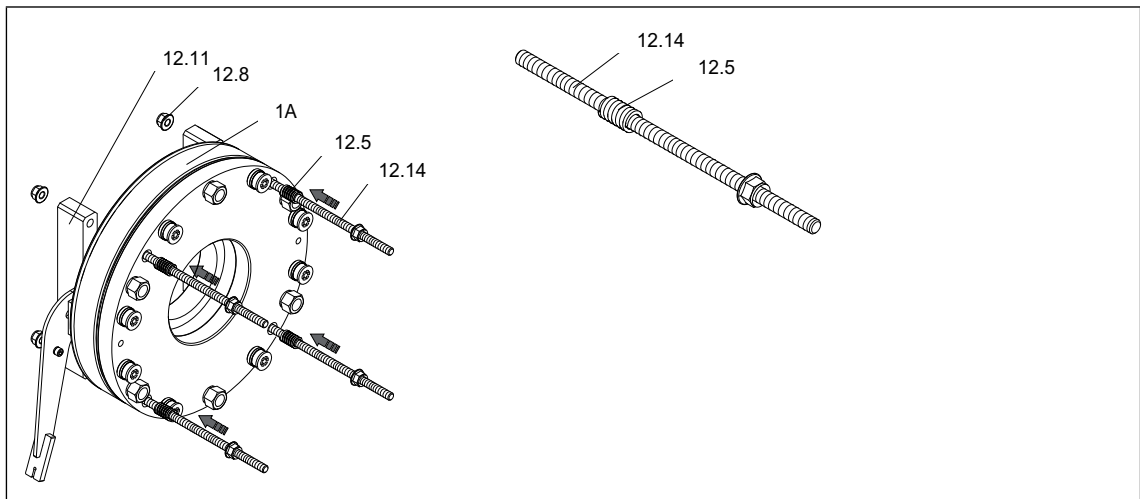


Fig. 15 Installation of the tension rods

- Assemble four pre-assembled tension rods (12.14) with one spring (12.5) each. Carry out steps 4 and 5 separately for each side of every lever.

4. From the armature plate end, plug one pair of pre-assembled tension rods (12.14) each into the provided bore holes ($\varnothing 11$ mm) of the complete stator (1A). Insert the springs (12.5) of the tension rod into the clearing hole of the armature plate ($\varnothing 16.5$ mm) in the process.

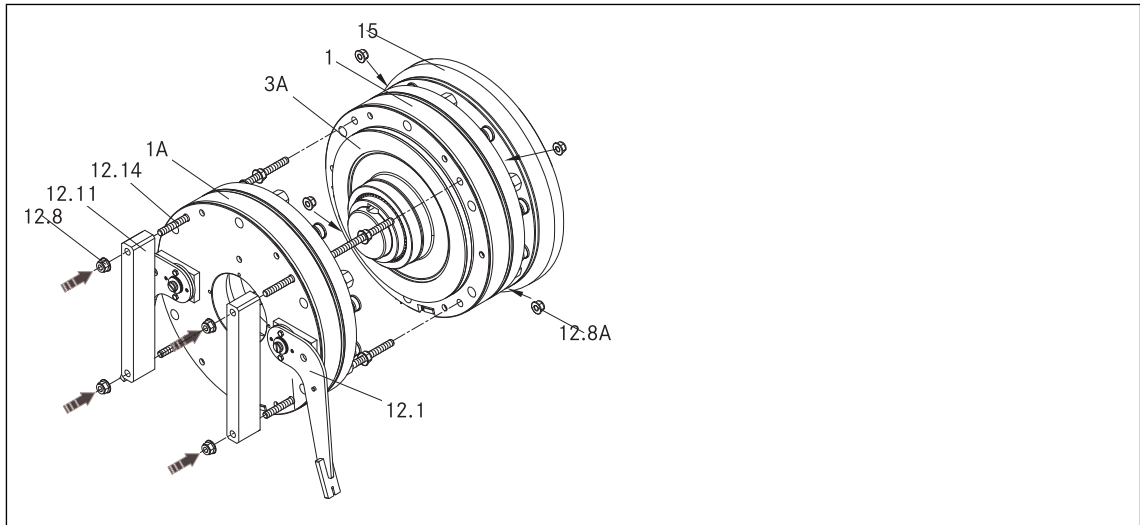


Fig. 16 Assembly parts

5. Attach the clips (12.11) with the bore holes ($\varnothing 12$ mm) to the tension rods (12.14) and tighten them with the lock nuts (12.8). The blind holes ($\varnothing 17$ mm) are now pointing in the direction of the stator and the screw heads of the manual release levers are completely sunk into the clips (12.11).
6. Position the second complete stator (1A) in front of the complete stator (1). Insert the pre-assembled tension rods (12.14) into the through holes ($\varnothing 12$ mm) of the first complete stator (1) in the process.

	NOTICE
	Tension rods must not be bent!

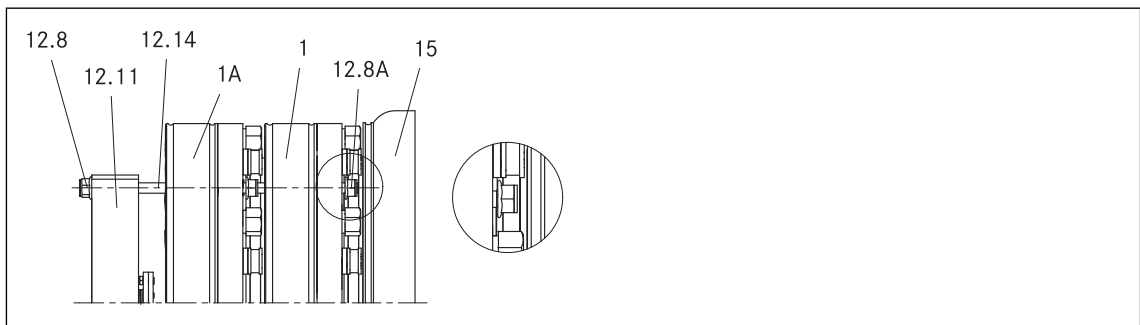




Fig. 17 Pre-assembly of the brake with manual release on the motor

7. Screw four lock nuts (12.8A) between the motor end shield and the complete stator (Pos.1) onto the tension rods (12.14) up to the point where the back side of the lock nut aligns with the top of the tension rod.
8. Evenly tighten the brake with the six socket head cap screws (10) included in the scope of supply in several runs using a torque key (as shown in Figure 17).

9. Establish the electrical connection and energize the brake ( 35).
10. Use a torque key to re-tighten the supplied fixing screws (10) with the required tightening torque ( 16).
11. Switch off the power.

4.5.3 Checking the air gap

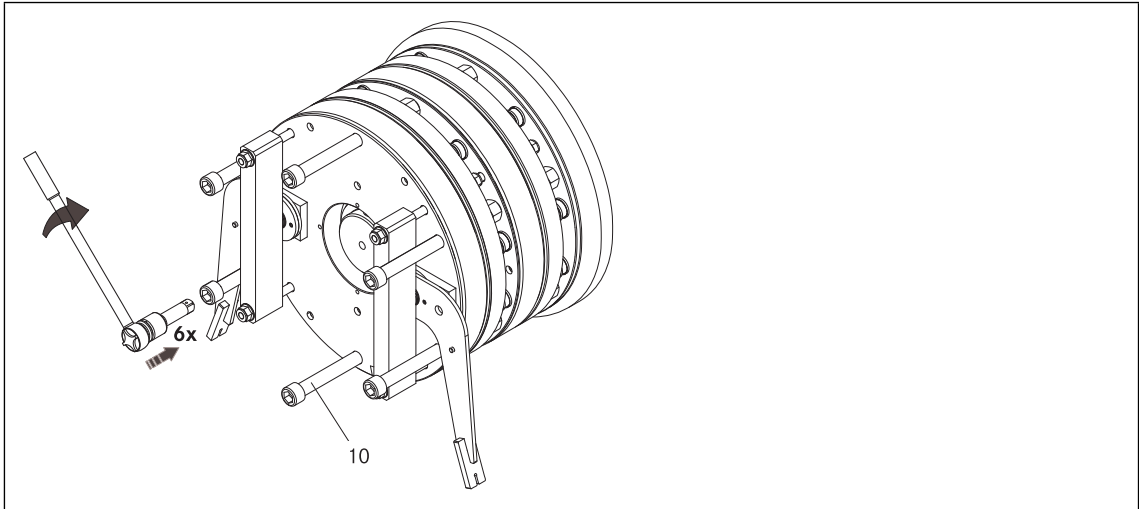



Fig. 18 Checking the air gap

12. Check the air gap using a feeler gauge and correct it if necessary ($s_{LN} = 0.4 \pm 0.05 \text{ mm}$) according to Figures 11 and 12.

4.5.4 Setting the manual release

	NOTICE
	For setting the manual release, always lock the pre-assembled hexagon nut of the tension rod (12.14) against rotation and rotate the lock nuts at the ends of the tension rod only.

Carry out steps 13 and 14 separately for each side of every lever

13. Tighten the lock nuts (pos. 12.8) on the clips (12.11) evenly until the nuts of the tension rod are in contact with the armature plate of the second stator (1A) (there should be noticeable resistance). While tightening, make sure that the clips (12.11) are parallel to the rear of the stator (1A). (Check using a caliper gauge.) If there are dimensional differences where $X > 0.1 \text{ mm}$ (see Figure 19), this should be corrected by loosening the lock nut (12.8) at the smaller dimension and tightening the lock nut (12.8) at the larger dimension until the clips (12.11) are adjusted in parallel to the back of the brakes (as shown in Figure 19).
14. Evenly tighten the lock nuts on the motor end shield side up to the point where the nuts of the tension rod are in contact with the armature plate of the first stator (1) (tangible resistance).
15. Loosen the lock nuts (12.8) at the clips (12.11) by a $\frac{3}{4}$ revolution (270°).

Carry out steps 16 and 17 separately for each side of every lever.

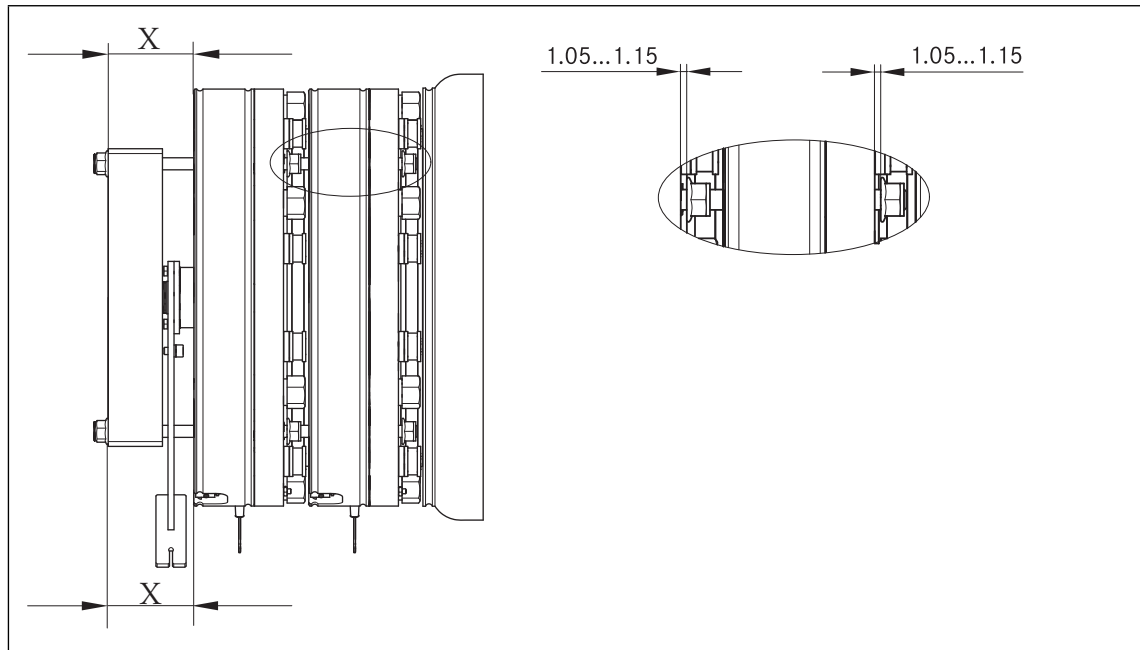


Fig. 19 Test dimensions and reference dimensions

16. Check of the correct setting (nominal dimension 1.05 ... 1.15 mm):

- For this purpose, position two feeler gauges of the same thickness (e.g. 1.1 mm) for each tension rod between the hexagon nuts and the complete stator and ensure that the feeler gauges can be easily moved.

17. Correct the setting if necessary until both feeler gauges can be moved by the same force.

18. Check that the manual release functions properly. Attach pipe sections onto the levers and press them together to check whether the motor shaft can rotate freely.

19. Connect the Bowden cable (not included in this delivery) and pull until the motor shaft can be freely rotated.



NOTICE

The actuation force between the Bowden cable's hanging points is approximately 900 N. The actual pull force required may be higher depending on the characteristics and position of the cable.

4.6 Cover ring assembly

**NOTICE**

Brakes without flange require a groove at the end shield for the lip of the cover seal.

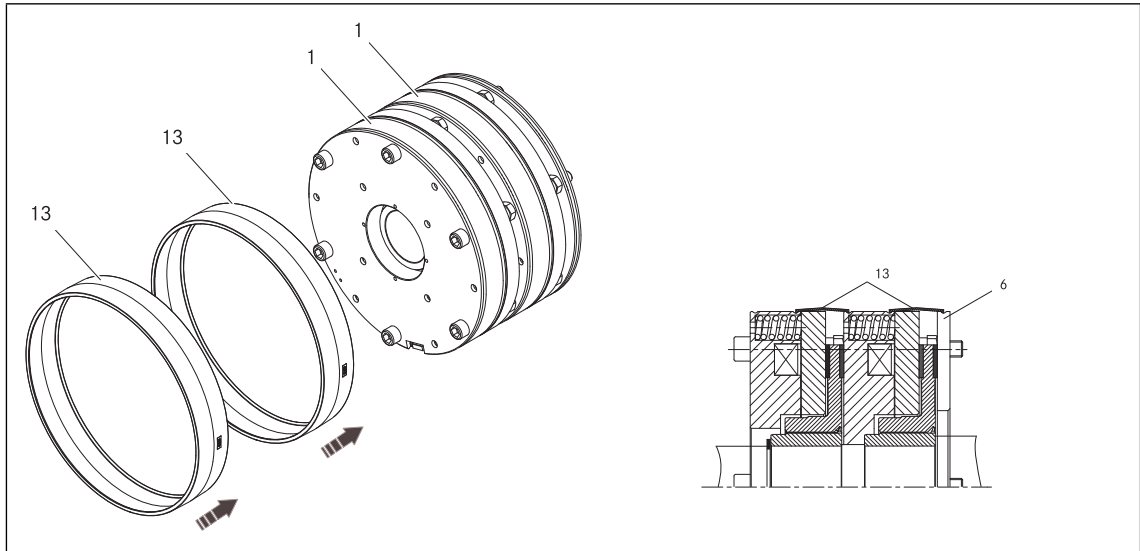


Fig. 20 **Cover ring assembly**

1 Stator, complete

6 Flange

13 Cover ring








1. Disconnect electrical connection.
2. Pull cables through the cover rings (13).
3. Push cover rings (13) over the complete stators (1).
4. Press the lips of the first cover ring (13) into the groove of the complete stator (1) and flange (6) / end shield.
5. Press the lips of the second cover ring into the groove of the first and second complete stator (1).
6. Re-establish the electrical connection.

**NOTICE**

Cover ring with condensation drain hole:
Attach the cover ring so that condensation can drain through the hole.

5 Electrical installation

5.1 Important notes

	 DANGER
	<p>There is a risk of injury by electrical shock!</p> <ul style="list-style-type: none"> ■ The electrical connections must only be made by skilled personnel! ■ Only carry out connection work when no voltage is applied (no live parts)! There is a risk of unintended start-ups or electric shock.
	NOTICE
	<ul style="list-style-type: none"> ■ Make sure that the supply voltage corresponds to the data on the nameplate. ■ Voltages must be adjusted to the local environment!
	NOTICE
	<ul style="list-style-type: none"> ■ If an emergency stop is carried out without the required suppressor circuit, the control unit may be destroyed. ■ Observe the correct polarity of the suppressor circuit!
	NOTICE
	<ul style="list-style-type: none"> ■ To functionally test the individual brake circuits, the power supply must be able to be switched off individually. For a new over-energizing during switch-on, it is also necessary to open switches K1/K3. ■ The protective circuitry contained in the INTORQ switching device BEG-561-□□□-□□□ (terminals 3 and 4) is not permitted for use in the lift system. The protective circuitry must be connected parallel to the brake coil ( 36).
	NOTICE
	<ul style="list-style-type: none"> ■ Only operate the brake with a holding current reduced to 25 % of P_{max} ! ■ You can use the INTORQ switching device BEG-561-□□□-□□□ for this purpose.

5.1.1 Switching suggestions

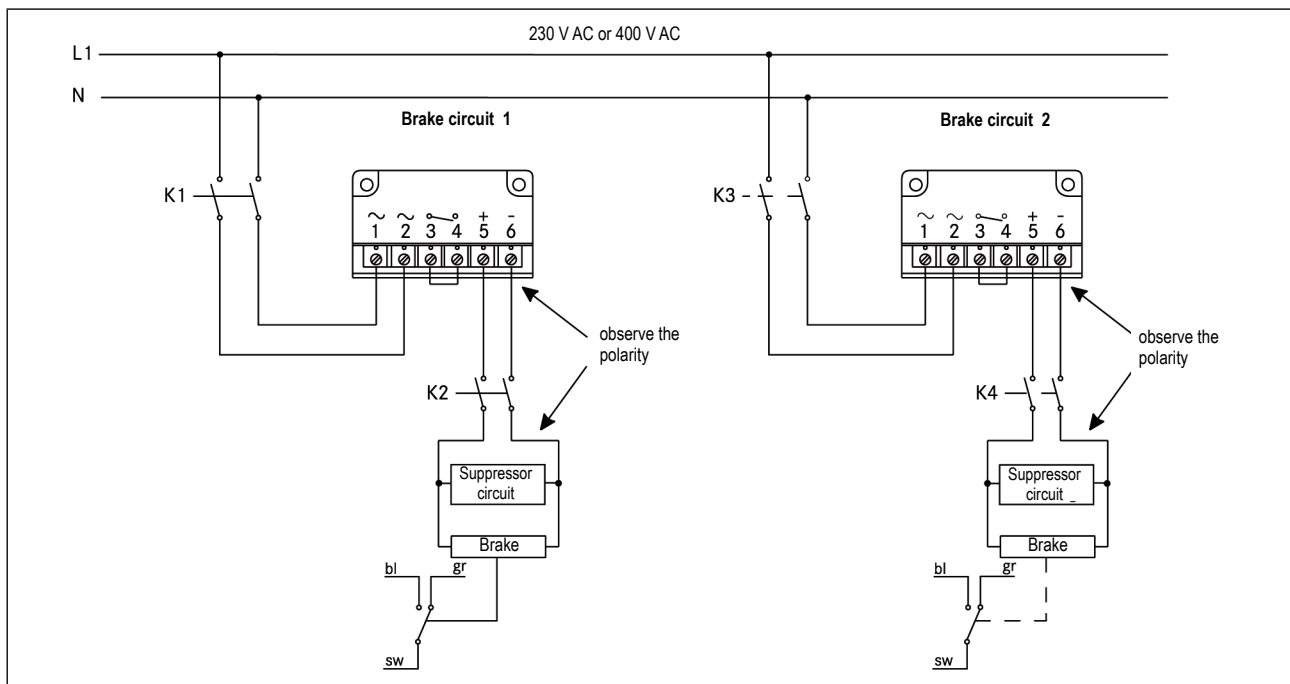


Fig. 21 INTORQ BFK455 connection diagram

Switching on

- K2/K4 must be switched on **before or at the same time** as K1/K3!

Switching off

- Normal - AC switching
 - K2/K4 remain closed
 - K1/K3 open
- Emergency stop - DC switching
 - K1/K3 and K2/K4 are opened at the same time

**NOTICE**

Recommended current load for the micro-switches

- DC current: 10 mA ... 100 mA at 12 V
- AC current: 10 mA ... 5 A at 12 V / max. 250 V
- Suppressor circuit: the limit voltage impacts the switching times (17).

5.2 Bridge/half-wave rectifier (optional)

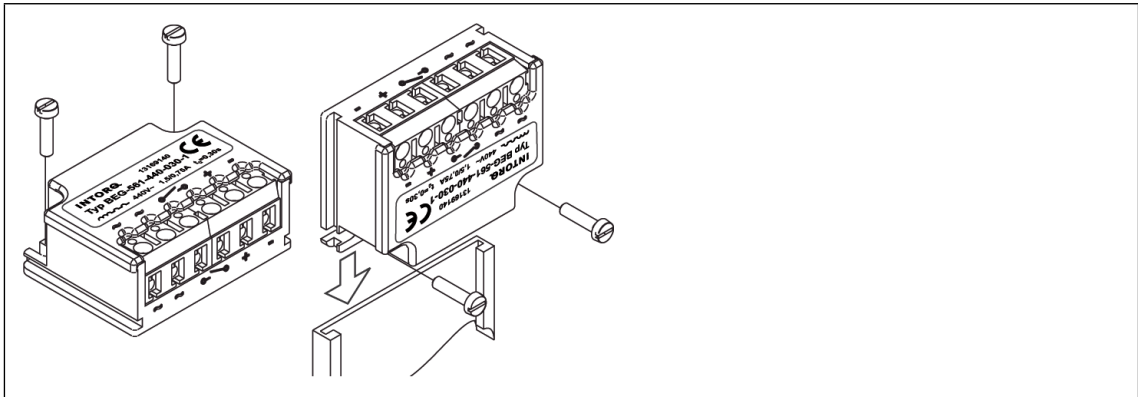
BEG-561-□□□-□□□

The bridge/half-wave rectifiers are used to supply electromagnetic DC spring-applied brakes which are approved for the use with such rectifiers. Other use is only permitted with the approval of INTORQ.

Once a set over-excitation time has elapsed, the bridge/half-wave rectifiers switch over from bridge rectification to half-wave rectification.

5.2.1 Assignment: Bridge/half-wave rectifier - brake size

Rectifier type	Supply voltage [V AC]	Coil voltage Release / holding [V DC]	Assigned brake
BEG-561-255-130	230 $\pm 10\%$	205 / 103	BFK455-28 (205 V)
BEG-561-440-130	400 $\pm 10\%$	360 / 180	BFK455-28 (360 V)



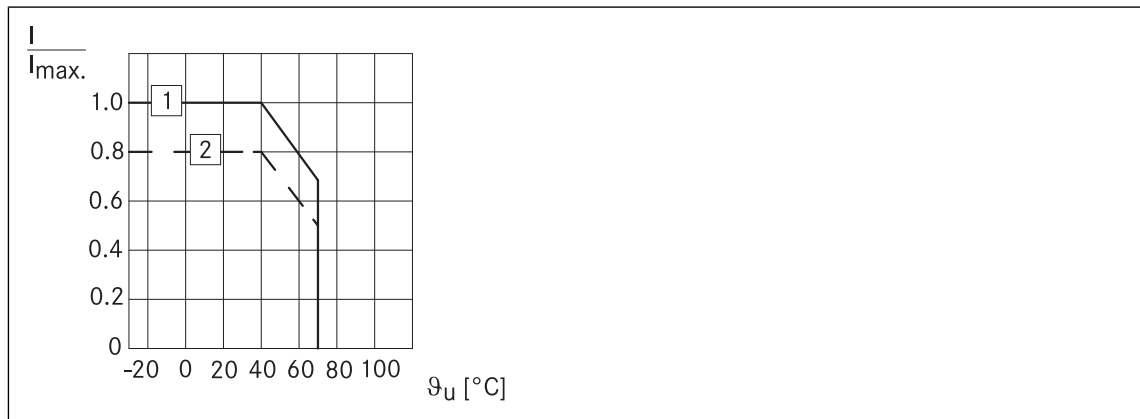
5.2.2 Technical specifications

Rectifier type	Bridge / half-wave rectifier
Output voltage for bridge rectification	$0.9 \times U_1$
Output voltage for half-wave rectification	$0.45 \times U_1$
Ambient temperature (storage/operation) [°C]	-25 – +70

Type	Input voltage U_1 (40 Hz ... 60 Hz)			Max. current I_{\max}		Over-excitation time t_{ue} ($\pm 20\%$)		
	Min. [V ~]	Rated [V ~]	max. [V ~]	Bridge [A]	half-wave [A]	at $U_{1 \min}$ [s]	at $U_{1 \text{ Nom}}$ [s]	at $U_{1 \max}$ [s]
BEG-561-255-130	160	230	255	3.0	1.5	1.870	1.300	1.170
BEG-561-440-130	230	400	440	3.0	1.5	2.300	1.300	1.200



Tab. 5: Data for bridge/half-wave rectifier type BEG-561


5.2.3 Permissible current load at ambient temperature



- 1 For screw assembly with metal surface (good heat dissipation)
- 2 For other assembly (e.g. adhesive)



5.3 Electrical connection

	 DANGER
	<p>There is a risk of injury by electrical shock!</p> <p>The brake must only be electrically connected when no voltage is applied!</p>

	<p>NOTICE</p> <p>Compare the coil voltage of the stator to the DC voltage of the installed rectifier.</p>
---	--

6 Commissioning and operation



6.1 Important notes



	 DANGER
	<ul style="list-style-type: none"> ■ The live connections and the rotating rotor must not be touched. ■ The drive must not be running when checking the brake.

6.2 Function checks before commissioning


6.2.1 Functional checks

Brake with micro-switch


	 DANGER
	Danger: rotating parts! The brake must be free of residual torque. The motor must not run!

	 DANGER
	There is a risk of injury by electrical shock! Live connections must not be touched.

1. The switching contact for the brake must be open.
2. Remove two bridges from the motor terminals to de-energise the motor.
 - Do not switch off the voltage supply to the brake.

	NOTICE
	If the brake is connected to the neutral point of the motor, the PE conductor must also be connected to this point.

3. Apply DC voltage to the brake.
4. Measure the AC voltage at the motor terminals. The measured level must be zero.
5. Close the switching contact for the brake.
 - The brake is released.

6. Measure the DC voltage at the brake:
 - The measured DC voltage after the over-excitation time (see bridge/half-wave rectifier,  36) must correspond to the holding voltage (see table 5). A deviation of $\pm 10\%$ is permissible.
7. Check the air gap "s_L".
 - It must be zero and the rotor must rotate freely.
8. Check the switching status of the micro-switch (see table 6).
9. Open the switching contact for the brake.
 - The brake is applied.
10. Check the switching status of the micro-switch (see table 6).
11. Switch off DC voltage for the brake.
12. Screw the bridges onto the motor terminals.
13. If necessary, remove the neutral conductor from the neutral point (step 2).

Contact type	Connection	Brake released	Micro-switch closed
NC contact	black / grey	yes	no
		no	yes
NO contact	black / blue	yes	yes
		no	no





Tab. 6: Switching status of the micro-switch


The preparations for commissioning are completed.

6.3 Commissioning

1. Switch on the drive system.
2. Carry out a braking test.


6.4 During operation


	 DANGER
	Danger: rotating parts! The running rotor must not be touched.
	 DANGER
	There is a risk of injury by electrical shock! Live connections must not be touched.

- Checks must be carried out regularly. Pay special attention to:
 - unusual noises or temperatures
 - loose attachment elements
 - the condition of the electrical cables
- The armature plate must be tightened and the rotor must move without residual torque.
- Measure the DC voltage at the brake.
 - The measured DC voltage after the over-excitation time (see bridge/half-wave rectifier,  36) must correspond to the holding voltage (see table 5). A deviation of $\pm 10\%$ is permissible.
- If faults occur once, go through the troubleshooting table in chapter 8. If the fault cannot be fixed or eliminated, please contact your customer service.

7 Maintenance and repair

7.1 Wear of spring-applied brakes

INTORQ spring-applied brakes are wear-resistant and designed for long maintenance intervals. The friction lining and braking mechanism are subject to operational wear. For safe and trouble-free operation, the brake must be checked at regular intervals or replaced, if necessary  43.

	NOTICE
	The air gap must not be re-adjusted after it has been correctly adjusted during the initial installation of the brake on the motor! This could result in a loss of braking torque.


The table below shows the different causes of wear and their impact on the components of the spring-applied brake. The influential factors must be quantified so that the service life of the rotor and brake can be calculated and so the prescribed maintenance intervals can be specified accurately. The most important factors in this context are the applied friction energy, the initial speed of rotation of braking and the switching frequency. If several of the causes of friction lining wear occur in an application at the same time, the influencing factors should be added together when the amount of wear is calculated.

Component	Cause	Effect	Influencing factors
Friction lining	Braking during operation	Wear of friction lining	Friction work
	Emergency stops		
	Overlapping wear during start and stop of drive		
	Active braking via the drive motor with support of brake (quick stop)		
	Starting wear in case of motor mounting position with vertical shaft, even when the brake is not applied		Number of start-stop cycles
Armature plate and flange	Rubbing of brake lining	Armature plate and flange are run in	Friction work
Gear teeth of brake rotor	Relative movements and shocks between brake rotor and brake shaft	Wear of gear teeth (primarily on the rotor side)	Number of start-stop cycles
Brake support	Load reversals and jerks in the backlash between the armature plate and guide pins	Breaking of armature plate and guide pins	Number of start/stop cycles, braking torque
Springs	Axial load cycle and shear stress of springs through radial backlash on reversal of armature plate	Reduced spring force or fatigue failure	Number of switching operations of brake

Tab. 7: Causes for wear





7.2 Inspections

To ensure safe and trouble-free operations, the spring-applied brakes must be checked at regular intervals and, if necessary, replaced. Servicing will be easier at the plant if the brakes are made accessible. This must be considered when installing the drives in the plant.

Primarily, the required maintenance intervals for industrial brakes result from their load during operation. When calculating the maintenance interval, all causes for wear must be taken into account,  42. For brakes with low loads (such as holding brakes with emergency stop function), we recommend a regular inspection at a fixed time interval. To reduce costs, the inspection can be carried out along with other regular maintenance work in the plant.



Failures, production losses or damage to the system may occur when the brakes are not serviced. Therefore, a maintenance strategy that is adapted to the particular operating conditions and brake loads must be defined for every application. For the spring-applied brakes, the maintenance intervals and maintenance operations listed in the table below must be followed. The maintenance operations must be carried out as described in the detailed descriptions.



7.2.1 Maintenance intervals



Type	Time interval			
	for service brakes:		for holding brakes with emergency stop:	
BFK455-28	<ul style="list-style-type: none">■ according to service life calculation■ or else every six months■ after 4000 operating hours at the latest		<ul style="list-style-type: none">■ at least every two years■ after 1 million cycles at the latest	
	Maintenance			
	Inspections with assembled brake:		Inspections after the brake has been removed:	
	<ul style="list-style-type: none">■ Check release function and control	 44	<ul style="list-style-type: none">■ Check the play of the rotor gear teeth (replace worn-out rotors)	 45
<ul style="list-style-type: none">■ Measure the air gap	 45	<ul style="list-style-type: none">■ Check for breaking out of the torque support at the sleeve bolts and the armature plate		
<ul style="list-style-type: none">■ Measure the rotor thickness (replace rotor if required)	 45	<ul style="list-style-type: none">■ Check the springs for damage		
<ul style="list-style-type: none">■ Check for thermal damage of the armature plates or flange (dark-blue tarnishing)		<ul style="list-style-type: none">■ Check the armature plate and flange or bearing shield<ul style="list-style-type: none">- Levelness < 0.1 mm- Max. run-in depth = rated air gap for the size		

7.2.2 Release / voltage

1. Start motor and control system!

	 DANGER
	Danger: rotating parts! The running rotor must not be touched.

	 DANGER
	There is a risk of injury by electrical shock! Live connections must not be touched.

2. Observe the air gap "s_L" when the drive is running. It should be zero.
3. Measure the DC voltage at the brake.
 - After the over-excitation time (see bridge/half-wave rectifier,  36), the measured DC voltage must correspond to the holding voltage ( 37). A deviation of $\pm 10\%$ is permissible.

7.3 Maintenance







NOTICE

Brakes with defective armature plates, socket head cap screws, springs or counter friction faces must always be replaced completely. Observe the following for inspections and maintenance works:



- Contamination by oils and greases should be removed using brake cleaner, or the brake should be replaced after determining the cause. Dirt and particles in the air gap between the stator and the armature plate endanger the function and should be removed.
- After replacing the rotor, the original braking torque will not be reached until the run-in operation for the friction surfaces has been completed. After replacing the rotor, the run-in armature plates and counter friction faces have an increased initial rate of wear.


7.3.1 Check the rotor thickness

	 DANGER
	Danger: rotating parts! The motor must not run during the check.



1. Stop the motor and control system!
2. Remove the motor cover and remove the cover ring, if present.
3. Measure the rotor thickness using a caliper gauge.
4. Compare the measured rotor thickness with the minimally permissible rotor thickness,  16.
5. If required, replace the rotor completely ( 45).



7.3.2 Check the air gap

	 DANGER
	Danger: rotating parts! The motor must not run during the check.

1. Stop the motor and control system!
2. Measure the air gap " s_L " near the fixing screws between the armature plate and the stator using a feeler gauge.
3. Compare the measured air gap with the maximum permitted air gap " s_{Lmax} " ( 16).
4. If required, replace both rotors completely.

7.3.3 Replacing the rotor

	 DANGER
	Danger: rotating parts! The brake must be free of residual torque.

1. Switch off voltage!
2. Disconnect the connection cable.
3. Loosen the screws evenly and remove them completely.
4. Remove the complete stator from the bearing shield. Pay attention to the connection cable.
5. Pull the complete rotor from the hub.
6. Check the gear teeth of the hub.
7. Replace the hub if it is worn.
8. Check the friction surface on the bearing shield. In case of strong scoring at the flange, replace the flange. In case of strong scoring on the bearing shield, rework the friction surface.
9. Measure the rotor thickness (new rotor) and head height of the sleeve bolts with a caliper gauge.
10. Calculate the distance between the stator and the armature plate as follows:
Distance = rotor thickness + s_{LN} - head height
 (" s_{LN} "  16)
11. Unscrew the sleeve bolts evenly until the calculated distance between the stator and armature plate is reached.
12. Install and adjust the new complete rotor and stator ( 23).
13. Reconnect the connection cable.

7.4 Spare-parts list

- Only parts with item numbers are available.
 - The item numbers are only valid for the standard design.
- Please include the following information with the order:
 - Order number of the brake
 - Position number of the spare part

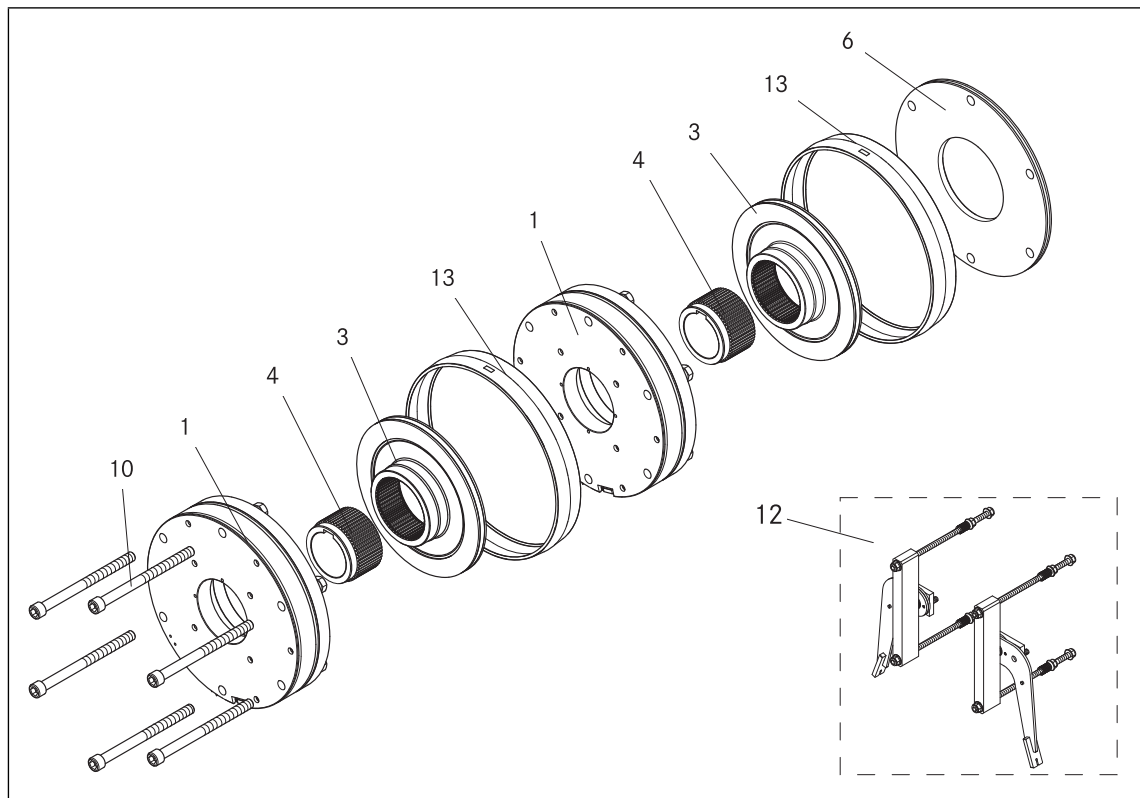


Fig. 22 BFK455-28 spring-applied brake

Item	Designation	Variant
1	Stator, complete	Voltage
3	Complete rotor Rotor, complete noise-reduced	
4	Hub	Bore diameter
6	Flange	
10	Fixing screws Socket head cap screw set, DIN912	for mounting to the motor for flange with through hole
12	Complete manual release	
13	Cover ring	

7.5 Ordering spare parts

Stator, complete

- Size ☐ 28
- Voltage ☐ 103 V / 52 V ☐ 205 V / 103 V ☐ 360 V / 180 V
- Braking torque _____ Nm (see torque gradation)
- Cable length ☐ Standard (1000 mm)
- Armature plate ☐ Standard
- Micro-switch ☐ Monitoring the switching function

Components

- Rotor ☐ Aluminium ☐ Noise-reduced (rotor with sleeve)
- Hub _____ mm (for hole diameter, see dimensions)
- Fixing screw set ☐ For mounting
☐ For mounting with flange
- Counter friction face ☐ Flange
- Seal ☐ Cover ring
- Complete manual release ☐


Electrical accessories



Rectifier type: Selection see chapter 5.2.1

- Rectifier ☐ BEG-561-255-130
☐ BEG-561-440-130

8 Troubleshooting and fault elimination

If any malfunctions should occur during operations, please check for possible causes based on the following table. If the fault cannot be fixed or eliminated by one of the listed measures, please contact customer service.

Fault	Cause	Remedy
Brake cannot be released, air gap is not zero	Coil interruption	<ul style="list-style-type: none"> ■ Measure the coil resistance using a multimeter: <ul style="list-style-type: none"> - If resistance is too high, replace the complete stator.
	Coil has contact to earth or between windings	<ul style="list-style-type: none"> ■ Measure coil resistance with multimeter: <ul style="list-style-type: none"> - Compare measured value with rated resistance. - Values:  17 - If resistance is too low, replace the complete stator. ■ Check coil for short circuit to ground using a multimeter: <ul style="list-style-type: none"> - Replace the complete stator if short circuit to ground is detected. ■ Check brake voltage (see "defective rectifier, voltage too low").
	Wiring defective or incorrect	<ul style="list-style-type: none"> ■ Check and correct. <ul style="list-style-type: none"> - Check cable for continuity using a multimeter: ■ Replace the complete stator if a cable is defective.
	Defective or incorrect rectifier	<ul style="list-style-type: none"> ■ Measure rectifier DC voltage using a multimeter. <p>If DC voltage is zero:</p> <ul style="list-style-type: none"> ■ Check AC rectifier voltage. If AC voltage is zero: <ul style="list-style-type: none"> - Switch on power supply. - Check fuse. - Check wiring. <p>If AC voltage is OK:</p> <ul style="list-style-type: none"> - Check rectifier. - Replace the defective rectifier. <p>If DC voltage is too low:</p> <ul style="list-style-type: none"> - Check rectifier. - If diode is defective, use a suitable new rectifier. <ul style="list-style-type: none"> ■ Check coil for inter-turn fault or short circuit to ground. ■ If the rectifier defect occurs again, replace the entire stator, even if you cannot find any fault between turns or short circuit to ground. The fault may occur later during heating-up.
	Incorrect micro-switch wiring	Check the wiring of the micro-switch and correct it.
	Micro-switch incorrectly set	Replace the complete stator and make a complaint about the setting of the micro-switch to the manufacturer.
Brake cannot be released, air gap is not zero	Air gap "s _L " is too large	<ul style="list-style-type: none"> ■ For adjustable brakes: <ul style="list-style-type: none"> - Readjust air gap. ■ For non-adjustable brakes: <ul style="list-style-type: none"> - Replace all rotors.

Fault	Cause	Remedy
Rotor cannot rotate freely	Air gap "s _L " too small	Readjust the air gap "s _L " ( 28).
Rotor thickness too small	Rotor has not been replaced in time	Replace the rotor ( 45).
Voltage is not zero during functional test (6.2.2 or 6.2.3)	Incorrect micro-switch wiring	Check and correct the wiring of the micro-switch.
	Micro-switch defective or incorrectly set	Replace the complete stator and return the defective complete stator to the manufacturer.
Voltage too high	Brake voltage does not match the rectifier	Adjust rectifier and brake voltage to each other.
Voltage too low	Brake voltage does not match the rectifier	Adjust rectifier and brake voltage to each other.
	Defective rectifier diode	Replace defective rectifier with a suitable undamaged one.
AC voltage is not mains voltage	Fuse is missing or defective	Select a connection with proper fusing.
	Incorrect micro-switch wiring	Check and correct the wiring of the micro-switch.
	Micro-switch defective or incorrectly set	Replace the complete stator and return the defective complete stator to the manufacturer.

Notes



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