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Gearless Lift Machines

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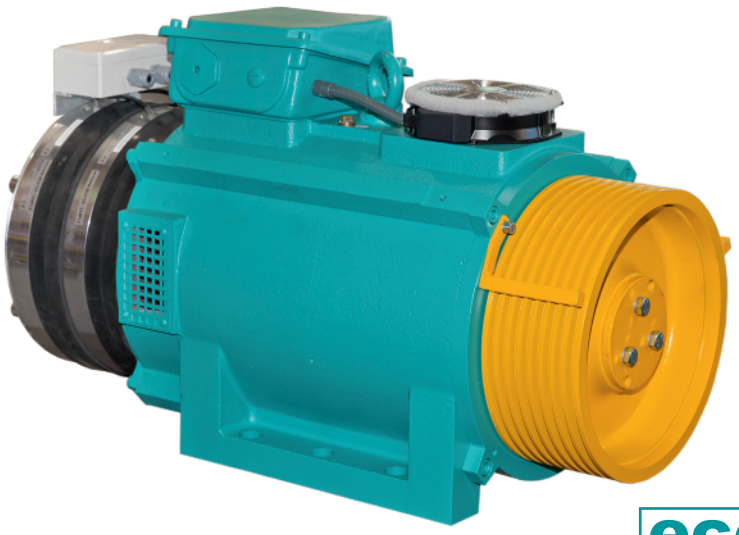
WSG-S2.4



eco

English

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These operating instructions are applicable to lift machines:

WSG - S2.4....

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Contents

1. General information

1.1. About this operating manual

The purpose of this operating manual is to ensure that any work on WSG-S2 lift machines is carried out safely. Please regard it as part of the product and keep it within easy reach.

All persons working on or with WSG-S2 lift machines must have read and understood this operating manual.

1.2. Intended use

WSG-S2 lift machines are intended for use as gearless drives for rope lifts. They may only be used for their intended purpose and with all safety devices in proper working order.

They may only be operated under the conditions described in this manual and with due regard to their performance limits.

1.3. Scope of delivery

The WSG-S21 lift machines are customised to meet individual requirements. The exact scope of delivery can be found in the accompanying documentation.

1.4. Warranty and liability

Our "Conditions of Sale and Delivery" shall apply for all our supplies and services.

Any warranty claims must be made immediately upon discovery of the deficiency or defect.

We do not accept any warranty or liability claims for personal injury or property damage resulting from one or more of the following causes:

- Improper use of the WSG-S2 lift machine
- Improper installation, commissioning, operation or maintenance
- Operation of the WSG-S2 with defective and/or inoperative safety or protective devices
- Non-compliance with the instructions contained in the operating manual or other documentation supplied
- Unauthorised construction modifications to the WSG-S2
- Insufficient monitoring of parts subject to wear
- Repairs carried out improperly
- Emergencies caused by external forces or force majeure

2. Safety instructions

2.1. General

WSG-S2 lift machines are not ready-to-use products; they may only be operated after they have been installed in lift systems and their safe operation has been ensured by taking the appropriate measures.

WSG-S2 lift machines are intended for use in an enclosed, lockable machine room to which only qualified personnel and personnel authorised by the customer have access.

Qualified personnel

Only qualified personnel are authorised to perform any planning, installation or maintenance work, and this must be done in accordance with the relevant instructions. The personnel must be trained for the job and must be familiar with the installation, assembly, commissioning and operation of the product.

2.2. Format of the safety instructions

The safety instructions contained in this operating manual are presented in a standardised format.

They comprise a **danger symbol + signal word + instruction text**. The danger symbol indicates the type of danger, the signal word specifies the severity of the danger, and the instruction text describes the danger and explains how to avoid it.

Danger symbols

	Risk of electric shock		Property damage
	General danger		Information

Signalworte

- **DANGER** Serious injuries or death will result
- **WARNING** Serious injuries or death may result.
- **CAUTION** Minor to moderate injuries may result.
- **NOTICE** Property damage may result.
- **Information** Points out useful information.

2.3. Safety precautions

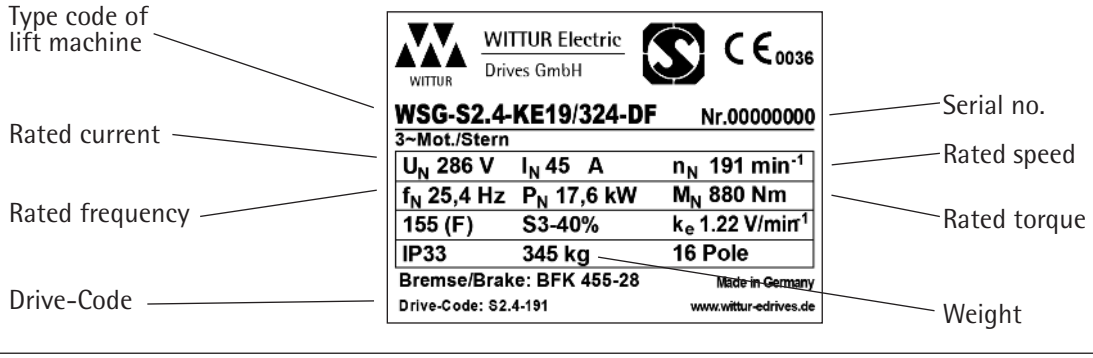
- Check the proper functioning of the motor and the brake after installing the machine.
- Repairs may only be carried out by the manufacturer or an authorised repair agency. Unauthorised opening and tampering may result in injuries to persons and property.
- The machines are not designed for direct connection to the three-phase system but are to be operated via an electronic frequency converter. Direct connection to the mains may damage the motor beyond repair.
- High surface temperatures may occur on the external parts of the machine. Therefore, no temperature-sensitive parts may be in contact with these parts or attached to them. Protection against accidental contact should be provided, if required.
- The EC type-examined fail-safe brakes provided are designed only for a limited number of emergency braking operations. They must not be used as working brakes.
- If the motor is not energised, no torque is produced. This may result in uncontrolled acceleration of the lift, if the brakes are released. Therefore, the motor winding should be short-circuited to produce a speed-dependent braking torque while the motor is not supplied with current. (Use the main contacts for short-circuiting as rated motor current may be flowing.) The motor must never be short-circuited while it is energised.
- High voltages are present at the terminal connections during the operation of synchronous motors.

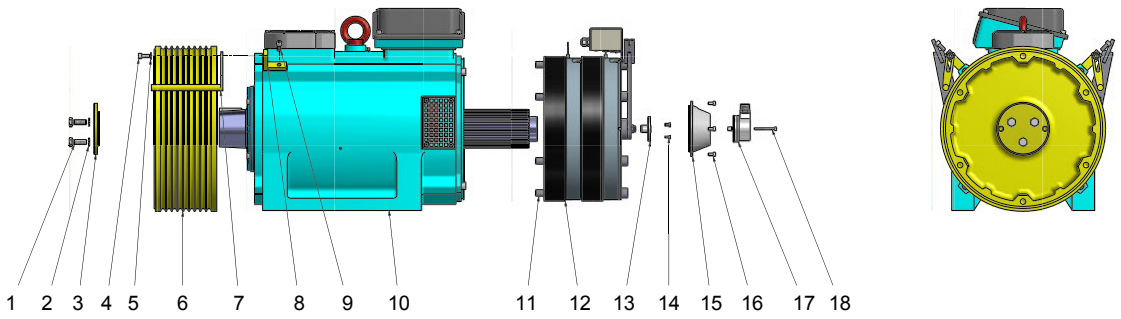
3. Product description

The compact gearless WSG-S2 synchronous lift machines are designed for traction sheave lifts. They are distinguished by their high efficiency, extremely low noise and excellent operating characteristics.

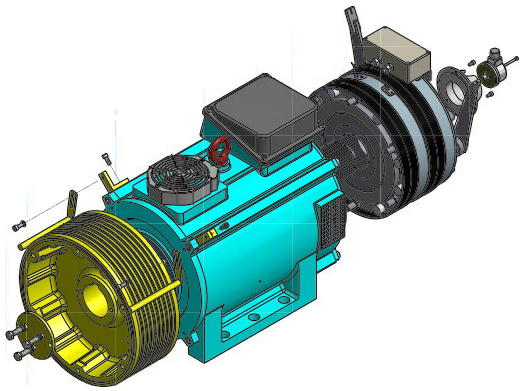
The machines can be supplied for several rated speeds, which can be further adapted to meet individual customer requirements. The machine comprises a frame, the synchronous motor, the traction sheave, and the type-tested safety brake, which can be used to prevent uncontrolled upward movement of the car.

The nameplate of the lift machine is on the motor frame.





Item	Part	WSG-S2.4
1	Bolts (3x)	DIN 933 - M12x35-8.8
2	Lock washers (3x)	NL 12-DIN 25201
3	Pressure disc	
4	Bolts (2x)	DIN 912 - M8x20
5	Washers (2x)	DIN 125 - A 8,4
6	Traction sheave	
7	Rope slip-off guard (2x)	
8	Elbows (2x)	
9	Bolts (2x)	DIN 912 - M8x20
10	Frame	
11	Bolts (6x)	DIN 912 M16x210
12	Brake	BFK 455-28
13	Plug-in shaft	
14	Screws (3x)	DIN 912 - M4x10
15	Clamping sleeve	
16	Screws (4x)	DIN 912 - M6x12
17	Measuring system	
18	Screw	DIN 912 M5x50



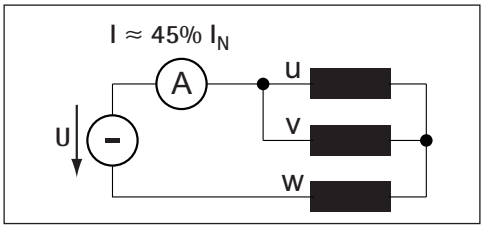
4. Transport and storage

- The lift machines leave the factory in perfect condition after being tested.
- Make a visual check for any external damage immediately upon their arrival on site. If any damage is found to have occurred in transit, make a notice of claim in the presence of the carrier. If appropriate, do not put these machines into operation.
- Observe the relevant safety regulations and take the centre of gravity into account when handling the lift machines.
- Check that the eyebolts are tightly fitted before using them.
- Do not expose the motor to any shocks or impact.

⚠ WARNING The eyebolts are designed for the specified machine weight, i.e. additional loads must not be applied. Danger of breakage!

Storage

- Store the motors only in closed, dry, dust-free, well-ventilated and vibration-free rooms (storage temperature: -20°C to 60°C). Do not store lift machines in the open air. Bright parts are not sufficiently preserved to withstand extended periods of exposure.
- Avoid excessive storage periods (recommendation: max. one year).
- After prolonged storage (>3 months), rotate the motor in both directions at a low speed (< 20 min^{-1}) to allow the grease to distribute evenly in the bearings.
- Measure the insulation resistance before initial operation of the machine. If the value has dropped below 1 kΩ per volt of rated voltage, the winding needs to be dried (insulation meter voltage: 1,000 VDC).
- This can be done, for instance, with hot air, in a drying oven, or by applying a DC voltage to the motor connections. Make sure that the voltage selected does not exceed the values shown in the figure "Drying the winding". Let the temperature rise to about 70 – 80°C and maintain it for several hours.



Drying the winding

Unpacking

- Dispose of the packaging material in an environmentally friendly manner or reuse it.
- Any special transport aids or shipping braces are left with the customer.

5. Installation

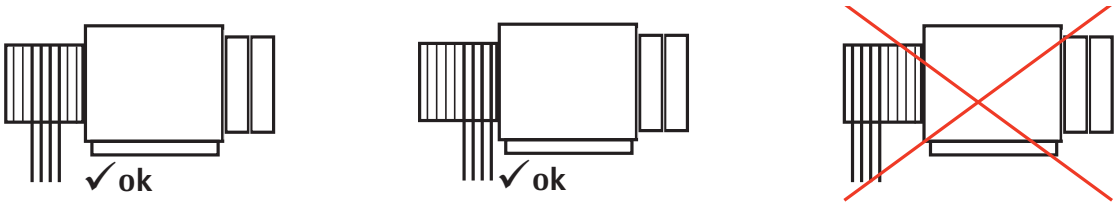
5.1. Setting up

DANGER Be sure to use calculations to check the base frame or foundation loads before installing the lift machine.

- The machines can be used in lift systems with or without a machine room.
- No welding work may be performed on the lift machine, nor is it permissible to use the machine as a mass point for welding work. This might cause irreparable damage to the bearings and magnets.

When using the machine in a shaft, please take into account the patent situation.

- If there are more grooves on the traction sheave than the number of ropes used, position the ropes either in the centre of the traction sheave or towards the motor end.



- The measuring system is only accessible from the rear side. Therefore, leave enough space between the wall and the rear side of the machine or ensure that the machine can be moved away from the wall.

WARNING Cover the machine and especially the brakes when doing any machining or dust-producing work in the shaft or machine room.

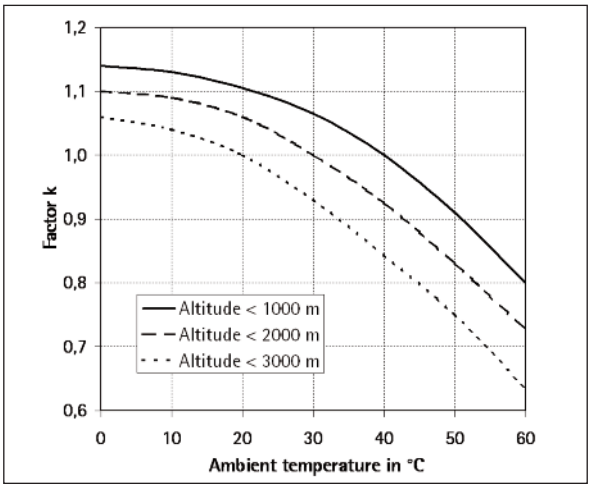
Ambient conditions

- The following ambient conditions must be ensured on site:

  Altitud: max. 1,000 m a.s.l.
  Ambient temperature: -5°C – 40 °C
  Max. rel. humidity: 85% at 20°C (no moisture condensation)

- Install the machine so that ventilation is not obstructed, i.e. sufficient heat dissipation by convection and radiation must be ensured.
- The torque and power values indicated in the Technical Data apply to the above ambient temperatures and altitudes. In the case of a deviating altitude and/or temperature, the reduction factors k shown in the diagram "Ambient conditions" must be used.

$$M_{permiss} = k * M_N$$
$$P_{permiss} = k * P_N$$



Securing the machine

- The rope force can be applied to the lift machine in any direction.
- The machine should be mounted on rubber pads for vibration damping.
- Fasten the machine using bolts
  - 4 x **M 24** bolts (**strength class 8.8; tightening torque: 680 Nm**) in case of using the threaded holes or
  - 6 x **M 24** bolts (**strength class 8.8; tightening torque: 680 Nm**) in case of using the mounting holes
- After completing the adjusting work or after a breakdown, tighten all the fastening bolts of the machine, using the specified torque.
- The permissible uneveness of the mounting surface is 0.1mm. The mounting surface must be sufficiently distortion-resistant and stable to accommodate the forces occurring in the system.
- Lift machines are generally equipped with rope slip-off guards. After putting the ropes in place, adjust them so that the distance between the rope and the rope slip-off guard does not exceed 1.5 mm.
- If the lift machine is not installed at the head of the machine room as is usually the case, it may be necessary to modify the fitting of the rope slip-off guard. Optional rope slip-off guards installed in the foot area of the machine are available for this purpose.

5.2. Electrical connection

5.2.1. General

WARNING The electrical connection may only be made by a qualified electrician.

- Before starting any work on the machines, ensure that the lift machine or system is properly isolated.

Before making any electrical connections check that

- the connecting cables are suitable for their specific application and for the relevant voltages and currents.
- sufficiently dimensioned connecting cables, torsion, strain and shear relief, as well as anti-kink protection are provided
- the protective conductor is connected to the earthing terminal
- there are no foreign bodies, dirt or moisture in the terminal box
- cable entries not in use and the terminal box itself are tightly sealed to prevent the ingress of dust or splashing water.

CAUTION

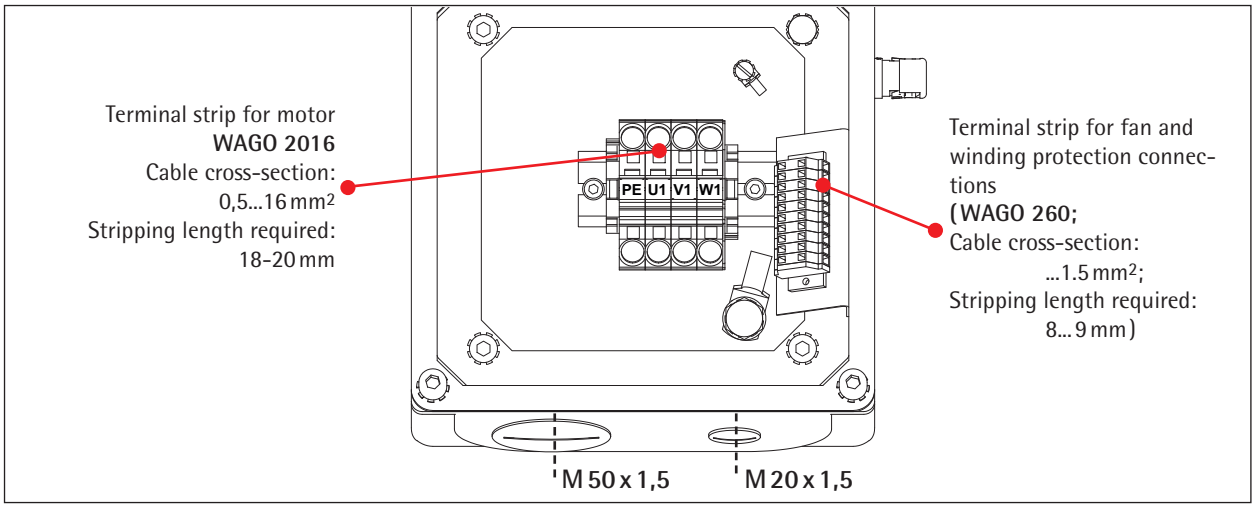
The insulation system of the motors is designed such that they can be connected to a converter with a maximum DC link voltage $U_{link\ max}$ up to max. 700 V DC.

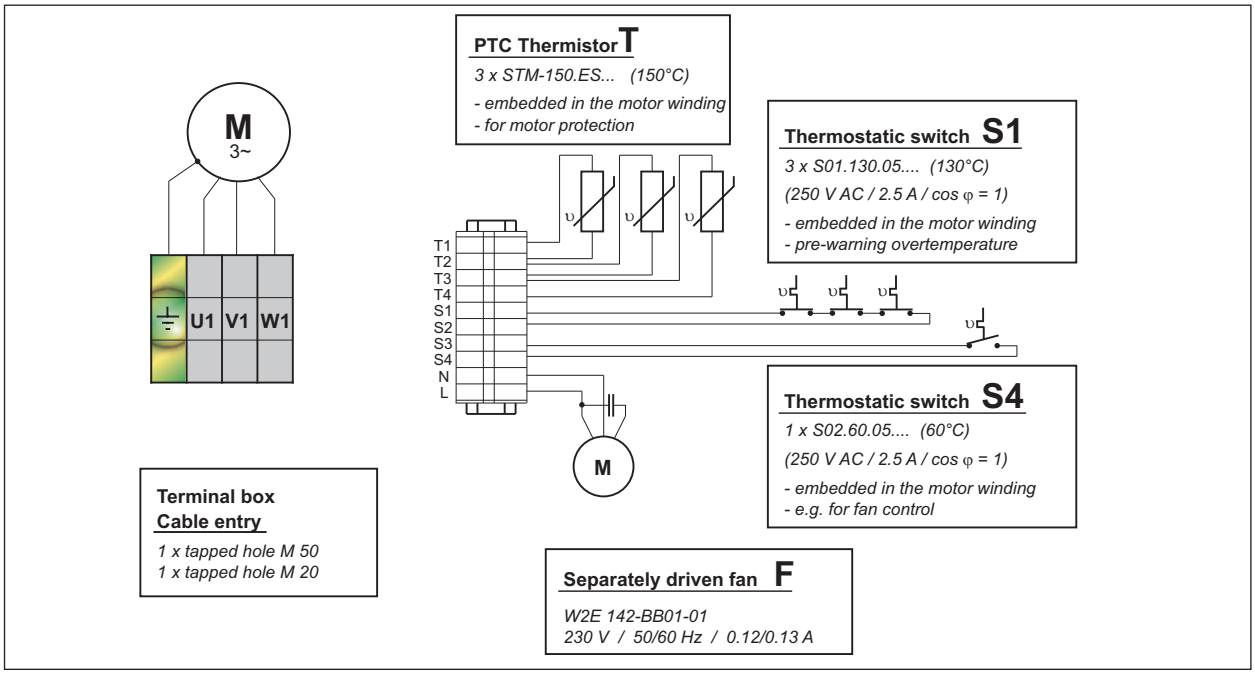
$U_{link\ max}$ is the maximum value of the DC link voltage which is only transient and approximately equivalent to the inception voltage of the braking chopper or of the energy recovery unit.

The maximum permissible rate of voltage rise (dU/dt) at the motor terminals is 4 kV/µs. The overvoltage at the motor terminals must not exceed 1.56 kV. It may be necessary to use motor current filters or reactors to achieve these values.

5.2.2. Motor connection / Winding protection

- The electrical connection of the motor, the brake, the fan and the winding sensors is made in the terminal box located on the motor.
- The motor cable must be shielded. Ensure that the cable shield contacts the frame over a large area at both ends.
- The motor phases U1, V1 and W1 must be connected correctly to the corresponding phases of the converter; they must not be interchanged.
- We recommend using a converter with a minimum switching frequency of 12 kHz.
- The PTC resistor embedded in the winding must be evaluated in an appropriate manner in the control system or the frequency converter to protect the motor from overheating.
- The separately driven fan must be properly connected and operated. If required, it can be switched in dependence of the temperature by means of thermal switch S4 (relay must be used).





Cable cross-section required:

The currents specified under the machine data refer to duty type S3-40%. This must be taken into account when selecting the cable cross-section required. The continuous r.m.s. value required for the selected cable is approximated

from:

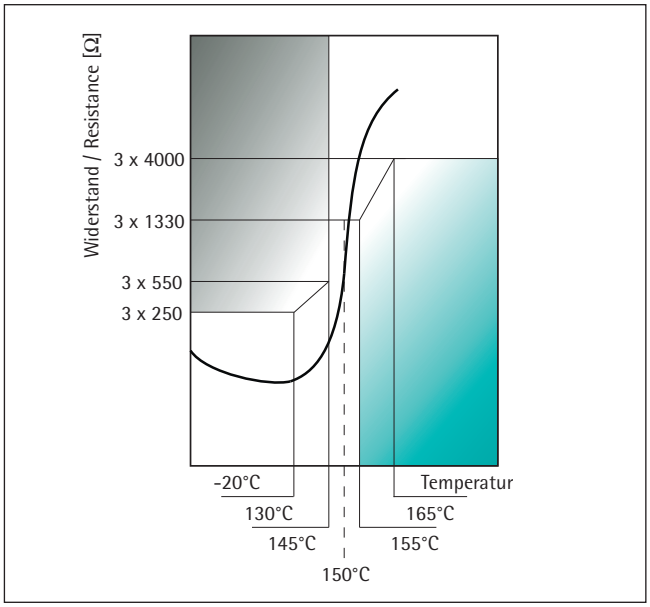
$$I_{\text{r.m.s. (cable)}} \approx I_{\text{N (motor, S3-40\%)}} / 1{,}58$$

The table on the right gives the **standard values** for the current-carrying capacity of PVC cables at a maximum ambient temperature of 40 °C:

Cable cross-section	Permissible max. current (r.m.s. value)	Permissible max. motor current IN (S3 - 40%)
1,0 mm²	13,1 A	20,7 A
1,5 mm²	15,7 A	24,8 A
2,5 mm²	22,6 A	35,7 A
4,0 mm²	29,6 A	46,7 A

PTC thermistors

The maximum operating voltage of the PTC thermistors is not allowed to exceed 2.5 VDC



Short-circuiting the motor terminals

- The motor terminals of the synchronous lift machines, type WSG, can be short-circuited, if required, to brake the lift machine faster.
- However, this is only permissible at speeds less than or equal to the rated speed of the respective motor.

5.2.3. Speed/Position measuring system

- The basic version of the lift machines is equipped with an ECN 413 SineCosine encoder from Heidenhain GmbH. The encoder is connected via a 17-pole signal plug connector fitted to the measuring system housing.
- Alternatively, the machines can be equipped with ERN 487 encoders (also from Heidenhain GmbH). We can also provide other measuring systems on request.
- Use a shielded cable to connect the measuring system to the inverter system. We recommend the use of our cable sets, which can be supplied as an accessory.

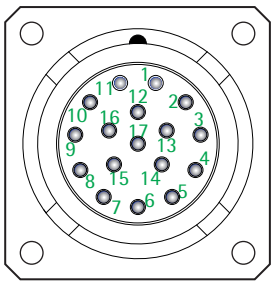
STOP CAUTION

The measuring system of WSG lift machines with a synchronous motor (WSG) is matched to the associated converter. Do not change the adjustment, as this may make it impossible to use the motor. On the measuring system housing there is a label showing the "offset angle" determined at the factory.
This value depends on the converter used.

Measuring system ECN 413 / ECN 1313

Number of sine-cosine periods per rotation: 2048
Operating voltage: 5 V
Data interface: SSI oder ENDAT

Pin	Signal
1	U_p Sensor
4	0 V Sensor
7	U_p
8	Clock +
9	Clock -
10	0 V (U_p)
11	inner shield
12	B +
13	B -
14	DATA +
15	A +
16	A -
17	DATA -

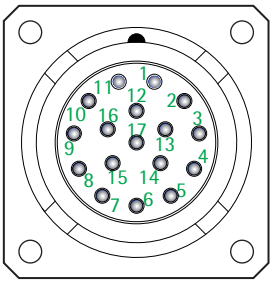


Pin contacts of flanged connector socket (exterior)

Measuring system ERN 487

Number of sine-cosine periods per rotation:: 2048
Operating voltage: 5 V
Commutation signals: 1 sine and cosine signal with 1 per/rotation (Z1 track)

Pin	Signal
1	U_p Sensor
2	R -
3	R +
4	0 V Sensor
7	U_p
8	D -
9	D +
10	0 V (U_p)
11	inner shield
12	B +
13	B -
14	C +
15	A +
16	A -
17	C -



Pin contacts of flanged connector socket (exterior)

5.2.4. Brake

- Please refer also to the operating instructions for the brake.
- The brakes are supplied with DC voltage by the overexcitation rectifiers, which are supplied separately or in the terminal box.
- Only the overexcitation rectifiers which are included in our scope of supply are to be used for the brake activation.
- The terminals for the brake coils and the monitoring contacts are provided in a terminal box
- Repeated switching of the brake magnets during the overexcitation period must be avoided as this will result in overloading of the brake control unit. Therefore, a minimum brake operating time of approx. 1.5 – 2 s should be maintained, especially during an inspection or commissioning drive.
- To reduce the switch-off time, switching can be effected from the DC side. However, switching must also be performed from the AC side at the same time)! (Wiring with a varistor as shown in the circuitry suggestion on page 15!)

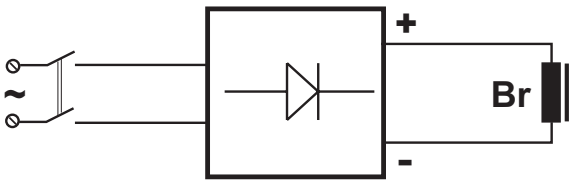
Note on the use of DC/AC side switching:

AC side switching is recommended for normal operation, since the lift machine is then decelerated in a controlled manner to zero speed and the switching noise of the brake is negligible.

When braking in the event of a breakdown (emergency stop) or during an inspection drive, the switching should be performed from the DC side, since this ensures a faster braking effect with the car being stopped earlier. We therefore recommend the use of 2 separate contactors for the brake control circuitry, one of which switches at the DC side, the other at the AC side.

AC side switching

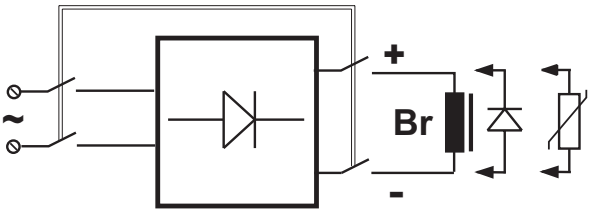
- Low-noise switching of the brake
- No protective measures required for switching contact
- Slow application of the brake.



Attention: schematic diagram!

DC side switching

- Noisy switching
- Burn-up protection for switching contact required (e.g. varistor, free-wheeling diode)
- Fast application of the brake.



Attention: schematic diagram!

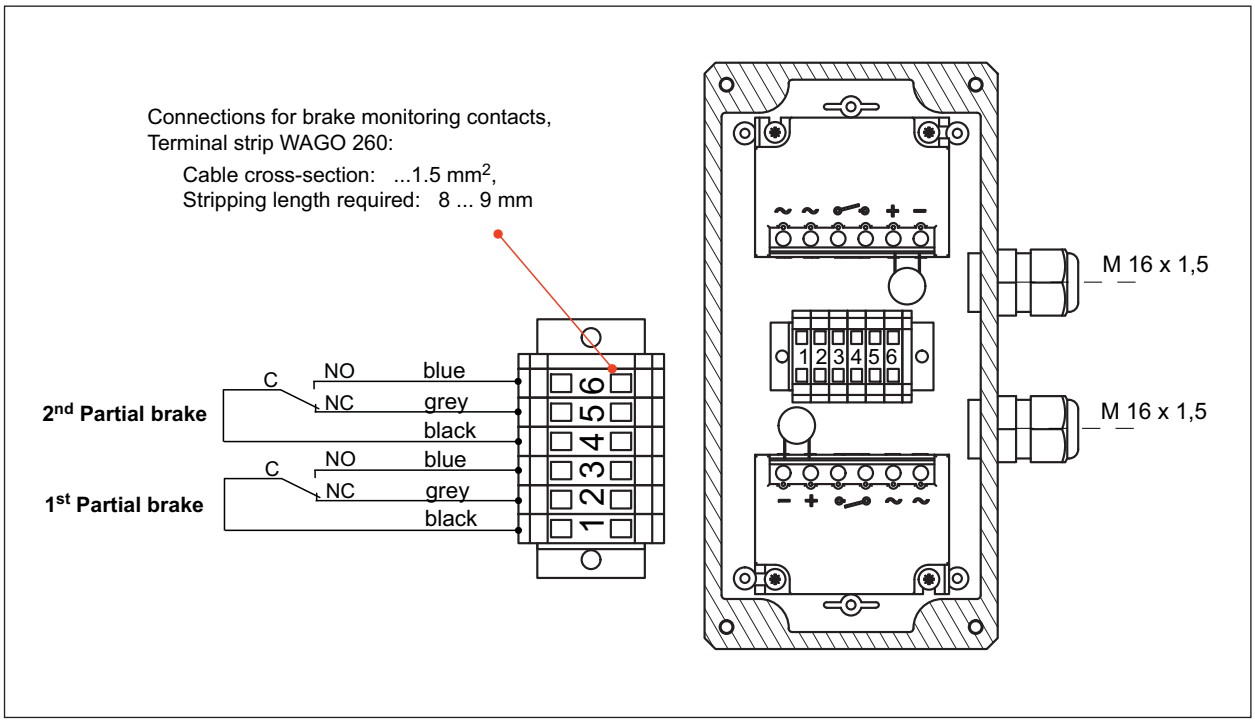
Monitoring the brakes

- The switching states of the brakes are monitored by means of dust-proof microswitches with gold contacts. Both the n.c. and the n.o. contact connections are available.

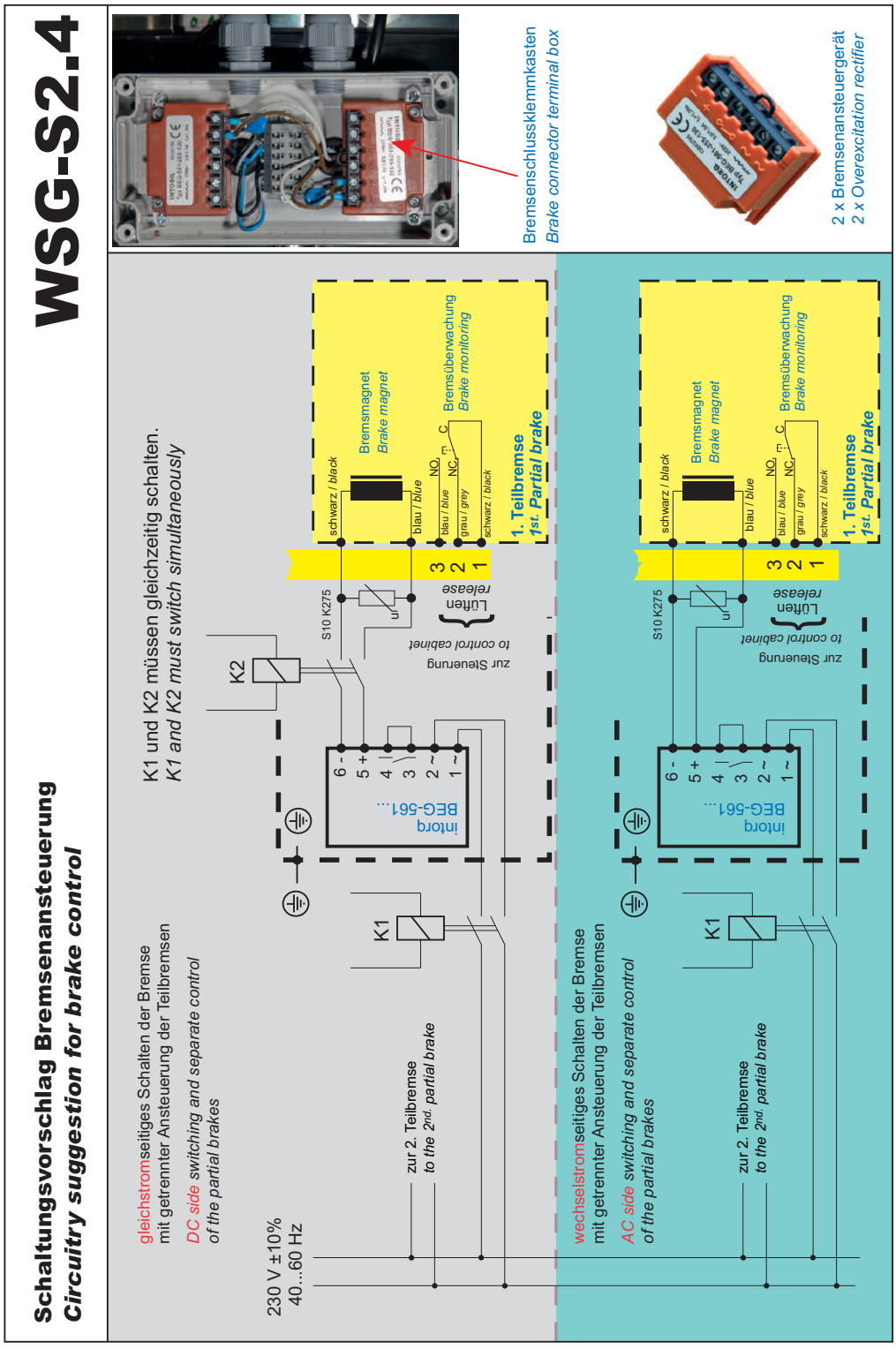
WARNING The microswitches must be evaluated separately for each partial brake to ensure compliance with the requirements of the type examination.

Connection of the brakes

The terminals for the brake magnet, brake control unit and the monitoring contacts are available in the terminal box.



Circuitry suggestion for brake control WSG-S2.4



6. Commissioning

The following points should be checked or completed:

- Remove all securing, auxiliary and installation tools from the danger area.
- Check that the lift machine is used for its intended purpose and that the permissible ambient conditions are met.
- Check that the lift machine is properly fastened.
- Are all bolts tightened with the specified torque and secured?
- Check the motor connection, especially the earthing.
- Check that the temperature monitoring devices are properly connected and functioning.
- Check that the brakes are properly connected and that the brake monitoring switches are functioning properly.
- Is the measuring system properly connected?
- Check that the offset value indicated on the measuring system agrees with the value set on the converter.
- Check the proper functioning of the brake; perform a braking test using one partial brake.
- Is the rope slip-off guard properly tightened and adjusted?

An initial function test of the motor and the brake, together with the converter, should be performed before the ropes are put in place.

If the motors are being operated at no shaft load (no ropes put in place) for an extended period of time, abnormal noise may occur resulting from the bearing type used.

Half-load test

If the motor winding is short-circuited with the control system deactivated, a speed-dependent braking torque will be produced, even at low speeds. Therefore, the short-circuiting should be deactivated during the half-load test. It is imperative for it to be reactivated after the test.

7. Operation and maintenance

7.1. General

- The regulations concerning operation, maintenance and inspection pursuant to the applicable safety regulations for lift construction such as DIN EN 81 "Safety rules for the construction and installation of lifts", Part 1: "Electric lifts", and other relevant regulations are to be strictly observed.
- The operator is responsible for ensuring that the motor is installed properly and in accordance with the safety requirements, as well as for its inspection and maintenance as specified in the applicable regulations.
- The proper maintenance of gearless lift machines requires adequately trained specialist personnel and special devices and tools.
- Repairs other than those described in these operating instructions are not to be carried out by the lift fitter/maintenance technician for liability reasons.

Bolt/screw tightening torques

- When performing any work on the machine or replacing parts, make sure that the specified bolt/screw strength class and the tightening torques are observed (see table).
- Secure the bolts/screws with "omnifit 100" or a similar product against accidental loosening.

Dimension	Tightening torque [Nm]		
Strength class	8.8	10.9	12.9
M4	2,8	4,1	4,8
M5	5,5	8,1	9,5
M6	9,6	14	16
M8	23	34	40
M10	46	67	79
M12	79	115	135
M16	195	290	340
M20	395	560	660
M24	680	970	1150

7.2. Maintenance intervals

Check the brake air gap	every six months	see the brake operating instructions
Check the proper functioning of the brakes and the brake monitoring switches	every six months	see the brake operating instructions
Check the bearing noise	every six months	
Regrease the bearings	see section 7.3.	
Check the traction sheave for wear	every six months	
Make a visual check of the fasteningbolts/screws on the frame, brake and traction sheave	every six months	see section 7.1.
Check the electrical cables	every six months	see section 5.2.
Check the rope slip-off guard	every six months	
Check the guards and safety devices for their condition and safe functioning	every six months	
Clean the external machine surfaces	as required	

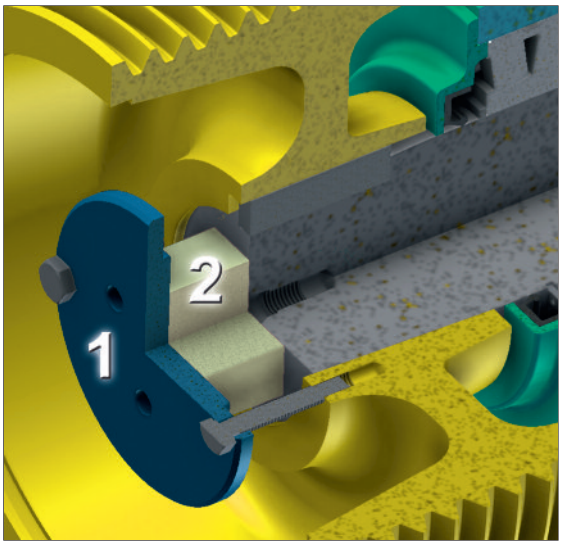
7.3. Regreasing the bearings

The anti-friction bearings have been provided with a grease filling at the factory that is sufficient for the planned service life of the machine. Under normal operating conditions, regreasing is not required or recommended.

7.4. Replacing the traction sheave

⚠ WARNING The traction sheave can work loose if it is not properly installed.

Disassembly



- Disconnect the system and safeguard against accidental restarting.
- Secure the car and the counter-weight.
- Remove the rope slip-off guards and the rope guards, if provided.
- Relieve the load on the traction sheave; remove the ropes.
- Support the traction sheave by means of a hoisting gear.
- Remove the three M12 bolts at the pressure disc and the pressure disc itself.
- Insert two fastening bolts into the outer hole circle of the pressure disc (1) and into the traction sheave.
- Insert a 4-7 mm spacer (2) between the pressure disc and the shaft journal.
- Pull off the traction sheave from the tapered shaft seats by tightening the bolts evenly.

Assembly

- Clean the traction sheave and the motor shaft.
- Support the traction sheave by means of a hoisting gear.
- Insert the feather key into the shaft end.
- Slide the traction sheave onto the motor shaft.
- Fit the pressure disc to the traction sheave and fasten it using three pairs of NORD-LOCK washers and M12 bolts. Tighten the bolts alternately around the circle in three torque steps (30, 60 and 85 Nm) as far as they will go. **Tightening torque: 85 Nm**
- Replace the ropes and reinstall the rope slip-off guard.

7.5. Filter mats

Remove the two screws from the protective screen. Then remove the screen and filter to clean or replace the filter mats.

⚠ WARNING Do this work only with the fan switched off as the rotating fan wheel could be dangerous.

7.6. Emergency evacuation

- The lift design engineer must always provide an electric return motion control or a manual rewinder (please note EN 81-1 / 12.5.2).
- Should a failure occur with the car at rest, the car can be moved with the drive connected to the mains or, in the case of mains failure, to an uninterruptible power supply (UPS), or mechanically under its own load with the emergency brakes temporarily released.
- The brakes are released electrically either from the mains or using a UPS.
- If the brakes are released with the motor deenergised, the motor windings should be short-circuited. This prevents the lift from accelerating in an uncontrolled manner, since the short-circuiting produces a speed-dependent braking torque.
- In the special case of the car being caught by the safety device, it can be released by powering the drive from the mains or a UPS.
- A remote manual releasing device ia available as an option.

7.7. Testing the brake system to EN81-1

The brake system should be tested with the car about halfway down the shaft. If any motor short-circuit connections have been made, these should be deactivated so that the brake effect can be tested independently.

Overload

- The brake system should be tested by interrupting the power supply to the motor and brake system with the car moving downward at rated speed and 1.25 times the rated load. The brake system must be capable of decelerating the car.

Failure of a brake

- If one brake fails, the brake system must still be capable of decelerating the car sufficiently during its downward travel at rated load and rated speed.
- When simulating the failure of one brake, the other brakes must be kept open separately, even if the safety circuit is open. This should be done using suitable electric circuitry or by hand.
- This state must not be maintained in the long term!
- Observe the lift during this test. If it does not decelerate, close the open brake circuit immediately.

Separate operation of the individual brakes

- The only method by which the partial brakes can be released separately is through electrical control. The brakes can be activated/deactivated quickly using individual control buttons. (The connections for the individual coils are accessible in the box.)

Monitoring the brakes

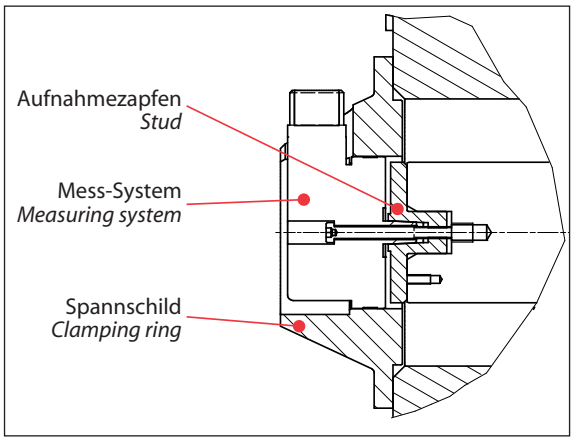
- Check the brake monitoring switches individually. No car travel must be permitted if a microswitch signal is missing or a wrong signal operates.

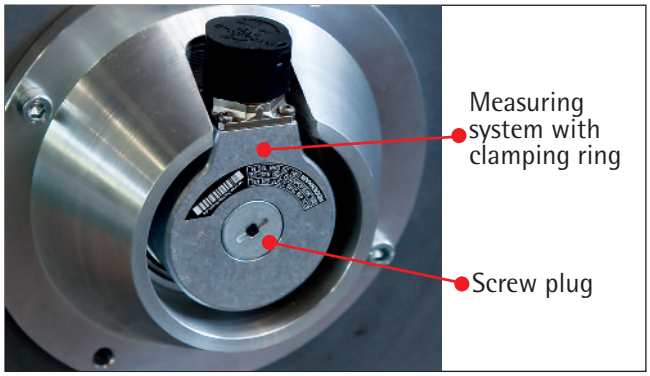
7.8. Replacing the measuring system

The measuring system is only accessible from the rear side of the motor.

See the mounting instructions for the Heidenhain encoder.

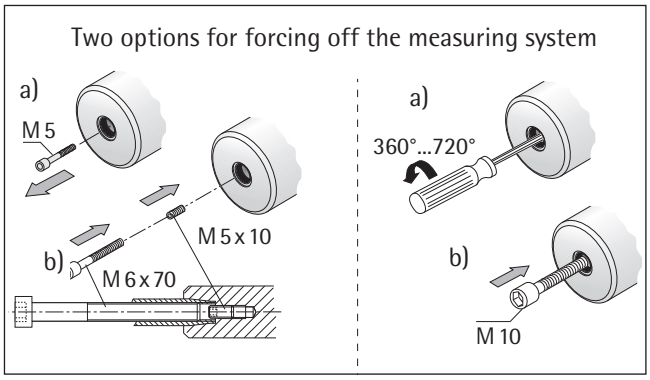
Disassemble the measuring system only if this is necessary because of a defect. Remember to readjust the offset value after reassembly (see the converter operating instructions).





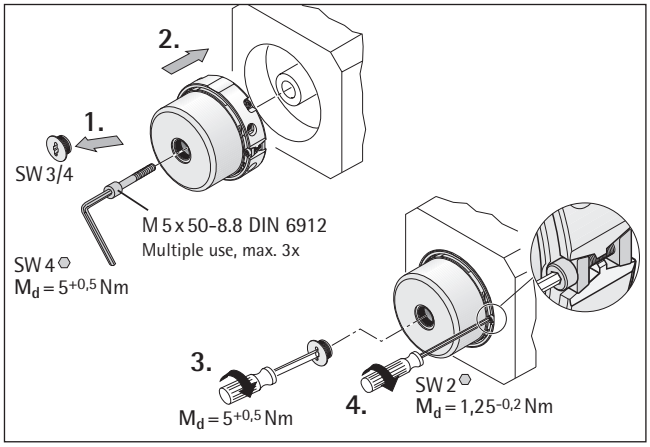
Disassembly

- Remove the screw plug.
- Loosen the clamping ring on the measuring system (2 mm Allen screw, shown in figure "Assembly").
- Force off the measuring system.



Assembly

- Check for true running on the plug-in shaft. (Permissible runout max. 0.02 mm).
- Clean the stud and the measuring system shaft end; do not grease them.



7.9. Trouble shooting

Fault	Possible cause	Remedy
Motor does not start, operates out of control or develops no torque	• Motor not connected in proper phase sequence	• Connect motor correctly
	• Measuring system not properly connected	• Connect measuring system correctly
	• Converter parametrisation incorrect	• Check converter parametrisation
	• EMC disturbance	• Carry out shielding and earthing measures as described by the converter manufacturer
	• Measuring system offset angle incorrectly set	• Check measuring system offset angle
	• Measuring system defective	• Replace measuring system
Motor noise	• Bearing defective	• Notify customer service
	• Converter parametrisation incorrect	• Check converter parametrisation
Braking system does not release	• Braking system is not supplied with voltage	• Check electrical connection
	• Brake magnet voltage too low	• Check braking voltage supply voltage
	• Brake shoes mechanically blocked	• Remove mechanical blocking
	• Overexcitation rectifier defective	• Replace overexcitation rectifier
Delay in braking system release	• Overexcitation rectifier defective	• Replace overexcitation rectifier
Braking system does not engage	• Brake shoe mechanically blocked	• Remove mechanical blocking
Delay in engaging of braking system	• Switch-off time too short with AC side switching	• Brake control using DC side switching of the overexcitation rectifier
Brake makes loud switching noise	• DC side switching of the brake in "normal operation"	• Change over to brake control by AC side switching in "normal operation"
	• Brake air gap too large	• Adjust brake air gap
Braking torque too low	• Brake friction surface or brake linings dirty.	• Clean friction surface / brake linings
	• Foreign bodies between friction surface and brake lining	• Remove foreign bodies
	• Brake friction surface or brake lining have come into contact with oily or greasy materials	• Replace brake lining, clean brake drum thoroughly
	• Load torque too high	• Reduce load torque

8. Type code

Example:	W	S	G-	S2	.	4	-	0		E		19	/	324	-	DF
	W	**S**	**G-**	**S2**	**.**	**4**	**-**	**X1**		**X2**		**X3 X4**	**/**	**X5 X6 X7**	**-**	**X8 X9**

Customer specific identifier

S = Synchronous motor

G = gearless

Frame size

Overall length

X1: Customer specific identifier

X2: Motor voltage:
E: serie „ECO", suitable for converter supply using a link voltage of 500 .... 620 V

X3 X4: Rated speed:
e.g. 07: 75 min^{-1} (with D_T = 320 mm v = 0.63 m/s; suspension 2:1)
11: 119 min^{-1} (with D_T = 320 mm v = 1.0 m/s; suspension 2:1)
19: 191 min^{-1} (with D_T = 320 mm v = 1.6 m/s; suspension 2:1)

X5 X6 X7: Traction sheave design
(Traction sheave diameter; width, groove design, groove geometry)

X8 X9: Variant code (brake, measuring system, modifications)
DE: dual-curcuit brake; measuring system ECN 413-2048 incr. - SSI-interface
DF: dual-curcuit brake; measuring system ECN 413-2048 incr. - ENDAT-interface
DG: dual-curcuit brake; measuring system ERN 487-2048 incr.

9. Technical data

Duty type:	S3 - 40 % ED
Traction sheave:	dia. 320 mm or dia. 400 mm
Traction sheave hardnesse:	mind. 220 HB 30 formbeständige Keilrille HRC 55
Typical number of carrying ropes and dia.:	8 x dia. 8 mm; 9 x dia. 10 mm;
DE bearing:	self-aligning roller bearing
NDE bearing:	ball bearing
Permissible shaft load:	up to 45 kN
Drive motor:	synchronous motor
Number of pole pairs:	8
Thermal class:	155 (F)
Degree of protection:	IP 33
Overload capability:	1.9-fold (I_{max}/I_N)
Winding protection:	triple PTC 150°C triple therm. switch (NC contact)130°C therm. switch (NO contact) 60°C

Site conditions

Max. altitude:	max. 1,000 m (derating required at higher altitudes)
Ambient temperature:	-5°C ... +40°C
Max. rel. humidity:	85 % at 20°C (no moisture cendensation)

Dual-circuit fail-safe brake

Type:	BFK 455-28
Max. braking torque:	2 x 1200 Nm
Air gap s_B:	$0{,}4^{\pm 0{,}05}$ mm (new air gap)
Max. air gap $s_{B\ max}$:	0,7 mm
Holding voltage:	103 V DC
Holding current:	2 x 1.06 A
Overexcitation voltage:	205 V DC
Overexcitation current:	2 x 2.12 A

Brake control units

Type:	BEG-561-255-130 from Intorq GmbH (accessories)
Operating voltage	U_N = 230 V AC (± 10 %), 40... 60 Hz
Dimensions:	52 x 22 x 38 (w x h x l)

Brake monitoring contacts

Contact rating	12 - 30 V DC / 0,01 - 0,1 A
Min. contact current	10 mA
Mechanical life of contacts:	2 x 10^6 switching operations

Separately driven fan

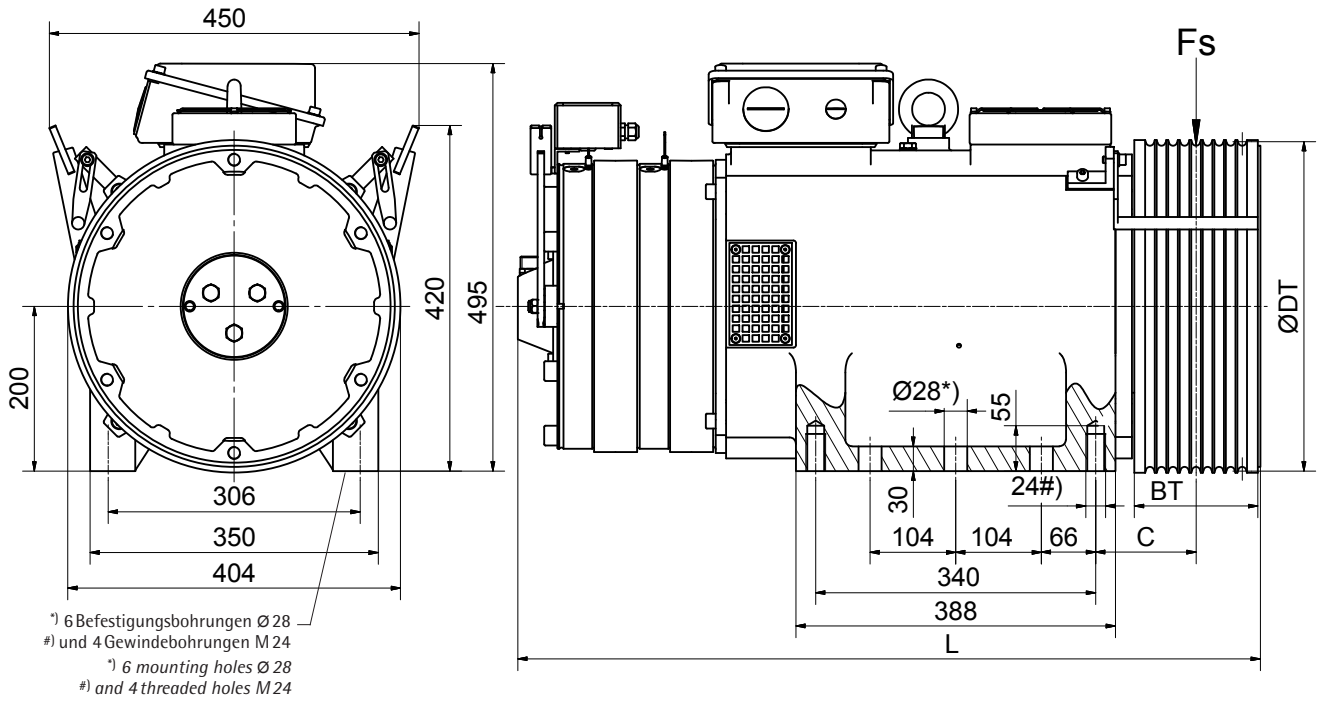
Type:	W2E 142-BB01-01
Operating voltage:	230 V / 50/60 Hz
Current consumption:	0,12/0,13 A

*) Reference values. Achievable nominal load depends on specific lift system data.

The table is applicable to an overall shaft efficiency of approx. 73..85 % (counterweight: 50 %). It lists a standard selection of machines. The lift and project data will be adapted to actual site conditions and may deviate from the above values.

Motor / *motor*		WSG-S2.4					
Drehmoment / *torque* S3-40%, 240 S/h	M_N [Nm]	900					
max. Drehmoment / *max. torque*	M_{max} [Nm]	1700					
Treibscheibe / *traction sheave*	$\varnothing D_T$ [mm]	320			400		
für Nennlasten / *for loads* *)	Q [kg]	bis / *up to* 1600			bis / *up to* 1275		
Aufhängung / *suspension*		Tabelle gilt für / *table applies for* 2:1					
Motorströme gelten für 500 ... 620 V Zwischenkreisspannung („ECO"-Reihe) *Motor currents applicable to 500 ... 620 V DC link voltage (serie „ECO")*	v [m/s]	n_N [rpm]	P_N [kW]	I_N [A]	n_N [rpm]	P_N [kW]	I_N [A]
	0,5	60	5,7	18,0	48	4,5	18,0
	0,63	75	7,1	21,0	60	5,7	18,0
	1,0	119	11,2	29,5	95	9,0	24,5
	1,6	191	18,0	46,0	153	14,4	38,0
	1,75	209	19,7	46,0	167	15,7	38,0
	2,0				191	18,0	46,0

10. Dimension drawing

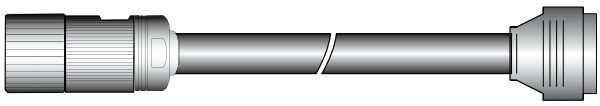
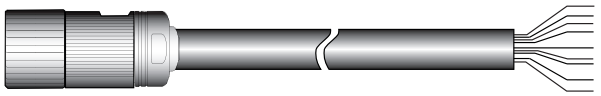
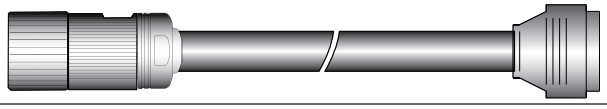
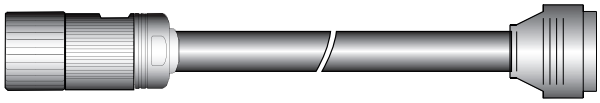
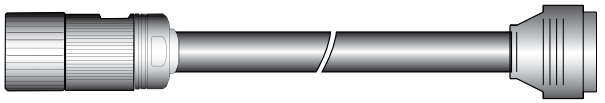
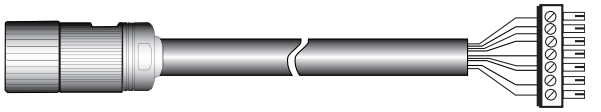
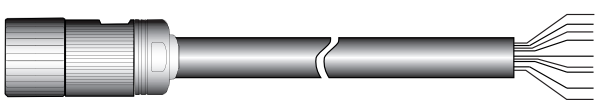
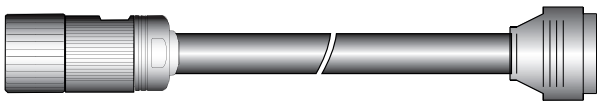


*) 6 Befestigungsbohrungen Ø 28
#) und 4 Gewindebohrungen M 24
*) *6 mounting holes Ø 28*
#) *and 4 threaded holes M 24*

Motor / *motor*	WSG-	S2.4			
	Ø D_T	320		400	
	B_T	105	120	105	150
	L	854	869	857	902
	C	100	107	100	122
Masse / *weight*	m_G [kg]	445	447	460	474
Trägheitsmoment *inertia*	J_G [kgm²]	1,03	1,06	1,62	2,06
Achskraft bis zu *shaft loads up to*	F_S [kN]	45			

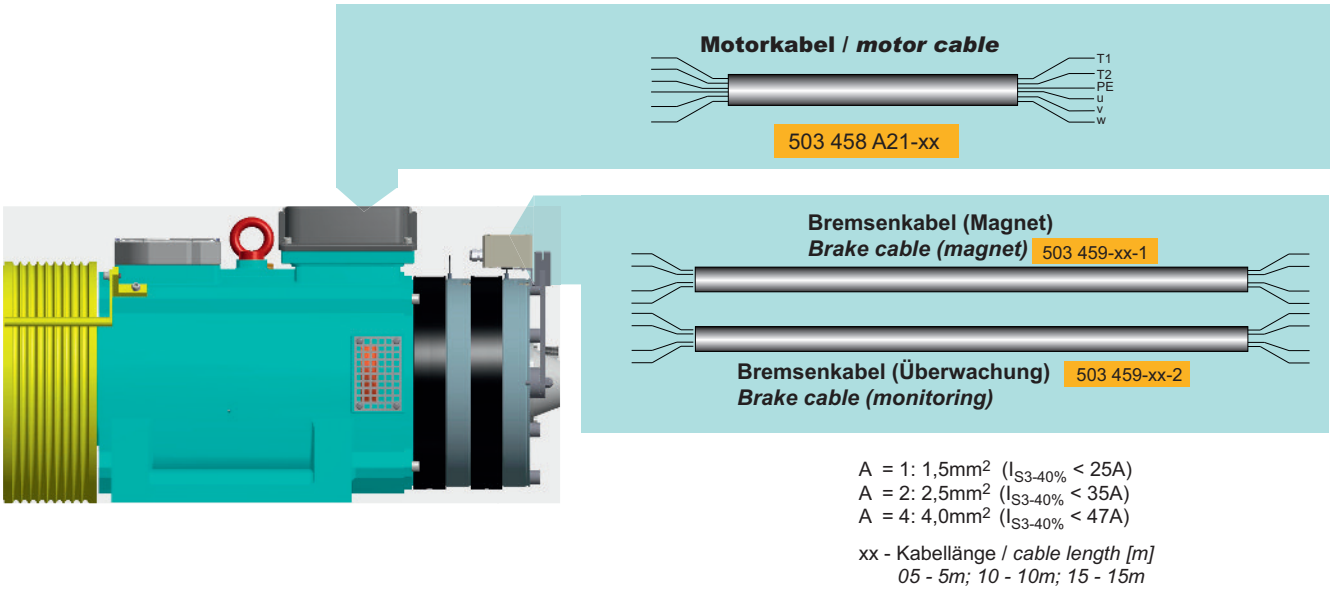
11. Accessories

11.1. Connecting cable for measuring systems

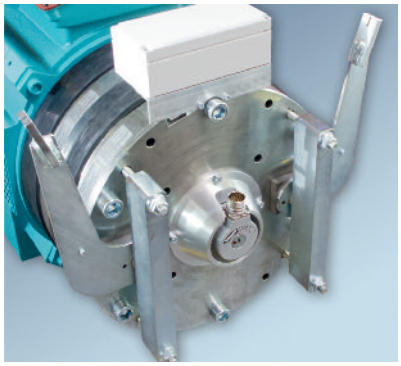
	Inverter type	recom. encoder system	recommended measurement system cable
	ARKEL *ADrive* CT *unidrive SP*	ECN 413 (EnDat or SSI)	502 452 021 xx
	emotron/ Dietz DSV 5445	ECN 413 (EnDat or SSI)	501 112 022 xx
	Flender/Loher L05	ERN 487	503 500 022 xx
	Fuji Frenic	ECN 413 (EnDat)	502 679 022 xx
	KEB F5	ECN 413 (EnDat)	502 363 022 xx
	LTi DRiVes Lust CDD 3000	ECN 413 (SSI)	505 677 022 xx
	RST Elektronik FRC	ECN 413 (EnDat)	508 752 022 xx
	GEFRAN (SIEI) AVY-L-M	ERN 487	503 499 022 xx
	Vacon NXP	ECN 413 (EnDat)	503 289 021 xx
	Yaskawa/ Omron L7 Telemecanique/ Schneieder Altivar 71	ECN 413 (EnDat)	503 715 022 xx
	Ziehl-Abegg 2SY/3BF	ECN 413 (EnDat or SSI)	508 749 022 xx

xx... cable length [m]

11.2. Cable set for motor and brake



11.3. Brake manual release



As an option the brake is available with a manual release. Brake with or without manual release as specified with the order. No possibility for retrofit.

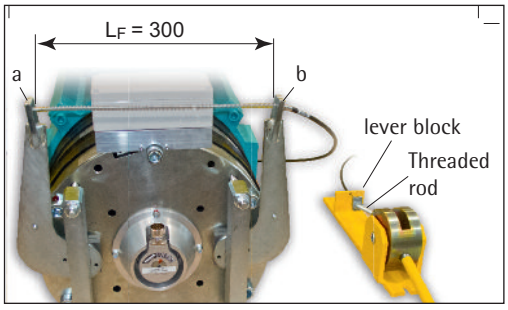
The for releasing necessary manual release lever including Bowden cable can be delivered, if required.

The standard length of the Bowden cable is **3 m**. Other lengths on request.

Installation:

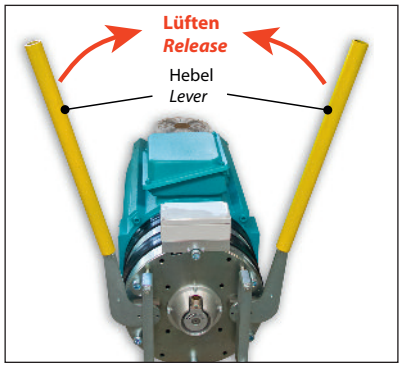
Install the manual brake releasing device while the brake is disconnected from the power supply.

- Lock the car and the counterweight. Ensure that the required safety measures are observed for the lift system.
- Install the lever block.
- Insert the Bowden cable into the brake lever (a and b) and the lever block . Adjusting of the Bowden cable on the lever block. Set L_F = **300 mm** on the lever block with the assistance of threaded rod. (Do not actuate the lever block !)
- Perform a functional test (at least three times).



The Bowden cable has to be installed in wide arcs only (bending radius > 0.5 m, if possible). **Put no loops !**

Alternatively, another simple version of the manual releasing device is available for lifts with a machine room.



12. Spare parts

Item	Teil	Bezeichnung
Motor		
01	traction sheave	acc. machine nameplate type code X5X6X7
02	Measuring system (depending on spec.)	ECN 413 / SSI / 2048 incr. / clamping ring ECN 413 / ENDAT / 2048 Inkr. / clamping ring ERN 487 / 2048 Inkr. / clamping ring
Brake system		
04	Overexcitation rectifier	BEG-561-255-130
05	Micro switch (brake monitoring)	ET 37 74 210 0807
06		

WITTUR Electric
Drives GmbH

EG-Konformitätserklärung
EC Declaration of Conformity

im Sinne der EG-Richtlinie Niederspannung (2006/95/EG)
as defined by the EC Low Voltage Directive (2006/95/EC)

Der Hersteller
The manufacturer

WITTUR Electric Drives GmbH
Offenburger Straße 3
D-01189 Dresden

erklärt hiermit, dass die folgenden Produkte
certifies that the following products

Produktbezeichnung:
Product designation:

Asynchronmotoren *Asynchronous motors*	DS☐ 1, DS☐ 3, 2S☐ 3, 6S☐ 3, WLG
Synchronmotoren *Synchronous motors*	DS☐ 2, DS☐ 4, DG☐ 4, DU☐ 4, DG☐ 6, DU☐ 6, TMS 0, WSG
Sondermotoren *Custom-made motors*	EPX, 6PX, 4HX, APX, MMX, NPX, OPX, QPX

den Bestimmungen der EG-Richtlinie 2006/95/EG entsprechen.
are in conformity with the specification of the EC Directive 2006/95/EC.

Erklärung zur EMV-Richtlinie (2004/108/EG)
Bei Netzbetrieb an sinusförmiger Wechselspannung erfüllen die Motoren die Anforderungen der EG-Richtlinie „Elektromagnetische Verträglichkeit" 2004/108/EG unter Berücksichtigung der Normen EN 61000-6-1..4.

Statement relating to EMC Directive (2004/108/EC)
When connected to a sinus-shaped a.c. voltage system, the motors conform to the requirements of the EC Directive "Electromagnetic compatibility" 2004/108/EC, including those specified in standards EN 61000-6-1...4.

Folgende Normen sind angewandt:
The following standards are in use:

EN / IEC 60 204-1:	Sicherheit von Maschinen; Elektrische Ausrüstung von Maschinen; Teil 1: Allg. Anforderungen *Safety of machinery - Electrical equipment of machines. Part 1: General requirements*
EN / IEC 60 034:	Drehende elektrische Maschinen *Rotating electrical machines*
EN ISO 12 100-1: **EN ISO 12 100-2**	Sicherheit von Maschinen - Allgemeine Gestaltungsleitsätze, Risikobeurteilung und Risikominimierung *Safety of machinery - General principles for design, risk assessment and risk reduction*

Dresden, 2012-09-17
(Ort, Datum)
(Place, date)

Dr. Michael Bork
Geschäftsführer
General Manager

Steffen Mann
Leiter Entwicklung/Konstruktion
Head of Development/Construction

EC_09_2012

Industrie Service

Mehr Sicherheit.
Mehr Wert.

Report
on the review of calculation documents

Customer: WITTUR Electric Drives GmbH
Offenburger Strasse 3
01189 Dresden

Subject of inspection: Traction sheave shaft for lift machines,
types xSG-S2.4

Inspection order: Review of the traction sheave shaft calculation

Specification: DIN 743
Shafts and axles; calculation of load capacity

Scope:
- Review of the calculations to ensure compliance with the specification
- Review of the calculation results
- Review of the calculation documents to ensure compliance with the data in the drawings

Inspector: Dipl.-Ing. Thoralf Mührel
Technical Expert

Datum: 01.11.2012

Unsere Zeichen:
IS-FT1-DRE/Dmü

Dokument:
xSG-S2.4_en.docx

Das Dokument besteht aus
2 Seiten.

Sitz: München
Amtsgericht München HRB 96 869
USt-IdNr. DE129484218
Informationen gemäß § 2 Abs. 1 DL-InfoV
unter www.tuev-sued.de/impressum

Aufsichtsrat:
Karsten Xander (Vorsitzender)
Geschäftsführer:
Ferdinand Neuwieser (Sprecher),
Dr. Ulrich Klotz, Thomas Kainz

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Drescherhäuser 5d
01159 Dresden
Deutschland

Industrie Service

1. Calculation documents

The following technical documents were to be reviewed:

- Calculation documents S2_4FE12012.DOC pages 1 to 5 dated 06/0/2012, incl. Annexes 1.
- Drawing no. 512 719 (Revision Äm 150/12, 05/06/2012).

2. Technical data

The data which are of relevance to the calculation are specified as follows in the calculation document S2_4FE12012.DOC :

– max. shaft load (center traction sheave):	45.0 kN
– max. magnetic pull:	0.8 kN
– load torque:	1800.0 Nm
– emergency brake torque:	2200.0 Nm
– traction sheave weight:	52.0 kg
– rotor weight:	101.3 kg
– brake weight:	10.0 kg

3. Results of the review

The calculations submitted were drawn up in compliance with the specification.

The values determined in the safety verification calculation were confirmed by performing a control calculation.

The data in drawing no. 512 719 comply with the values relevant for the calculation.

4. Comments

The review did not cover verification of the rotor hub/shaft, traction sheave/shaft and key shrink fits, or of the bearing life.

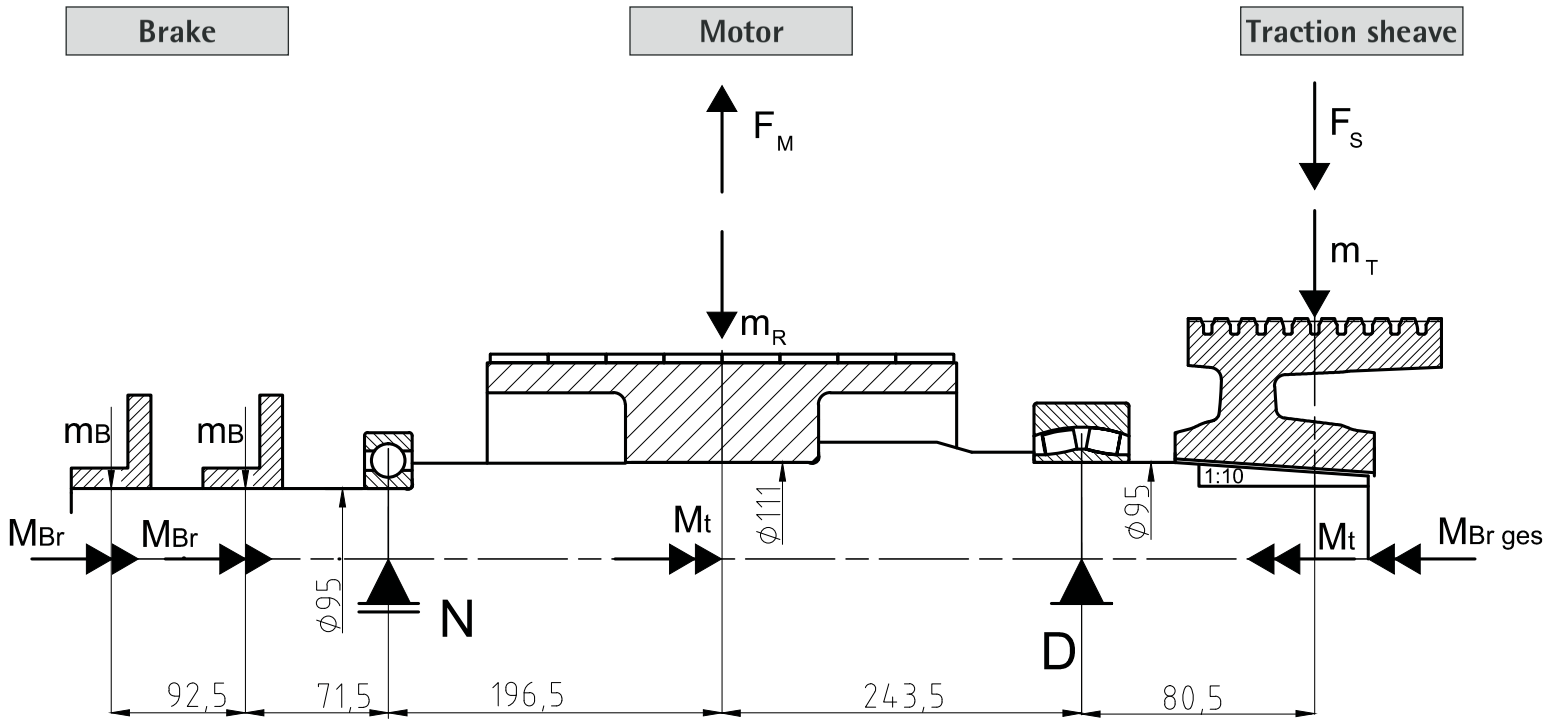
The Inspector

Thoralf Mühre l

TÜV SÜD Industrie Service GmbH Fördertechnik

Traction sheave shaft (Annex - calculation of the shaft)

Re:
WSG-S2.4



Werkstoff: Stahl DIN EN 10083-1 - 42CrMo4
Denticulation: steel DIN EN 10083-1 - 42CrMo4

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Fax: +49 (0) 351 40 44-111

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Industrie Service

EC type-examination certificate

Certificate no.:	ABV 881
Notified body:	TÜV SÜD Industrie Service GmbH Westendstr. 199 80686 München – Germany
Applicant/ Certificate holder:	INTORQ GmbH & Co. KG Wülmser Weg 5 31855 Aerzen – Germany
Date of application:	2011-08-11
Manufacturer of the test sample:	INTORQ GmbH & Co. KG Wülmser Weg 5 31855 Aerzen – Germany
Product:	Braking device acting on the shaft of the traction sheave, as part of the protection device against overspeed for the car moving in upwards direction
Type:	BFK455-28
Test laboratory:	TÜV SÜD Industrie Service GmbH Prüflaboratorium für Produkte der Fördertechnik Prüfbereich Aufzüge und Sicherheitsbauteile Westendstr. 199 80686 München – Germany
Date and number of the test report:	2012-02-28 ABV 881
EC-Directive:	95 / 16 / EC
Result:	The safety component conforms to the essential safety requirements of the Directive for the respective scope of application stated on page 1 - 2 of the annex to this EC type-examination certificate.
Date of issue:	2012-03-01

Certification body for lifts and safety components
Identification number: 0036

Christian Rührmeyer

TÜV SÜD Industrie Service GmbH 00 36 Benannte Stelle

TÜV®

Industrie Service

Annex to the EC type-examination certificate no. ABV 881 dated 2012-03-01

1 Scope of Application

1.1 Permissible brake moment when the braking device acts on the shaft of the traction sheave while the car is moving upward — 3400 and 3600 Nm

1.2 Maximum tripping speed of the overspeed governor and maximum rated speed

The maximum tripping speed and the maximum rated speed must be calculated on the basis of the traction sheaves maximum tripping rotary speed and maximum rated rotary speed as outlined in sections 1.2.1 and 1.2.2 taking into account traction sheave diameter and car suspension.

$$v = \frac{D \times \Pi \times n}{60 \times i}$$

v = speed (m/s)
D= Diameter of the traction sheave from rope's centre to rope's centre (m)
Π= 3.14
n = Rotary speed (min^{-1})
i = Ratio of the car suspension

1.2.1 Maximum tripping rotary speed of the traction sheave — 455 min^{-1}

1.2.2 Maximum rated rotary speed of the traction sheave — 396 min^{-1}

2 Conditions

2.1 Since the brake device represents only a part of the protection device against overspeed for the car moving in upwards direction an overspeed governor as per EN 81-1, paragraph 9.9 must be used to monitor the upward speed and the brake device must be triggered (engaged) via the overspeed governor's electric safety device.

Alternatively, the speed may also be monitored and the brake device engaged by a device other than an overspeed governor as per paragraph 9.9 if the device shows the same safety characteristics and has been type tested.

2.2 In order to recognise the loss of redundancy the movement of each brake circuit (each anchors) is to be monitored separately and directly (e.g. by micro switches). If a brake circuit fails to engage (close) while the lift machine is at standstill, next movement of the lift must be prevented.

2.3 In cases where the lift machine moves despite the brake being engaged (closed), the lift machine must be stopped at the next operating sequence at the latest and the next movement of the lift must be prevented. (The car may, for example, be prevented from travelling by querying the position of the micro switch which is used to monitor the mechanical movement of the brake circuits, should both brake circuits fail to open).

2.4 According to EN 81-1, paragraph 9.10.4 d) a braking device must act directly on the traction sheave or on the same shaft on which the traction sheave is situated in the immediate vicinity thereof.

If the braking device does not act in the immediate vicinity of the traction sheave on the same shaft on which the traction sheave is situated, the standard is not complied with. In cases involving shaft failure in the extended area between the traction sheave and the braking device, safety would no longer be ensured by the latter if the lift car made an uncontrolled upward movement.

Shaft failure in the extended area must therefore be ruled out by appropriate design and sufficient dimensioning. In order to eliminate or reduce influencing factors which may lead to failure wherever possible, the following requirements must be satisfied:

- Minimization of bending length between traction sheave and braking device or traction sheave and the next bearing (the next bearing must form part of the drive unit)
- Static defined bearing (e. g. 2-fold borne shaft) otherwise measures are required to obtain a defined loading
- As far as possible, prevention of a reduction in load-bearing capacity in the area of reversed bending stress (reduction in load-bearing capacity caused, for example, by stress concentration and cross-sectional reductions)
- Between traction sheave and braking device the shaft must be continuous (made from one piece)
- Cross-sectional influences on the shaft are only permitted if they act on the following connections: traction sheave – shaft, braking device – shaft, torque of the transmitting component – shaft (situated between traction sheave and braking device).

2.5 The manufacturer of the drive unit must provide calculation evidence that the connection braking device – shaft, traction sheave - shaft and the shaft itself is sufficiently safe. The calculation evidence must be enclosed with the technical documentation of the lift.

3 Remarks

3.1 The braking device exists of two brake circuits. Redundancy requirements necessitate that a sufficient braking effect as outlined in section 12.4.2.1 of EN 81.1 is still maintained if one of the brake circuit fails. It is not assumed that two brake circuits will fail simultaneously.

3.2 The permissible brake moment must be applied to the lift system in such a manner that they do not decelerate more than 1 g_n, if the empty car is moving upwards.

3.3 In the scope of this type-examination it was found out, that the brake device also functions as a brake for normal operation, is designed as a redundant system and therefore meets the requirements to be used also as a part of the protection device against overspeed for the car moving in upwards direction.

This type examination only refers to the requirements pertaining to brake devices as per EN 81-1, paragraph 9.10.

Checking whether the requirements as per paragraph 12.4 have been complied with is not part of this type examination.

3.4 In order to provide identification, information about the basic design and it's functioning and to show which parts have been tested pertaining to the tested and approved type, drawing no. BFK45528-001 (page 3 of 3) or Nr. BFK45528-003 (page 3 of 3) each with certification stamp dated 01 March 2012 is to be enclosed with the EC type-examination certificate and the Annex thereto. The installation conditions and connection requirements are presented or described in separate documents (e.g. assembly and operating instructions).

3.5 The EC type-examination certificate may only be used in connection with the pertinent annex and the list of the authorized manufacturers (according to enclosure). This enclosure shall be updated and re-edited following information of the certificate holder.

Industrie Service

Enclosure of EC type-examination certificate no. ABV 881 dated 2012-03-01

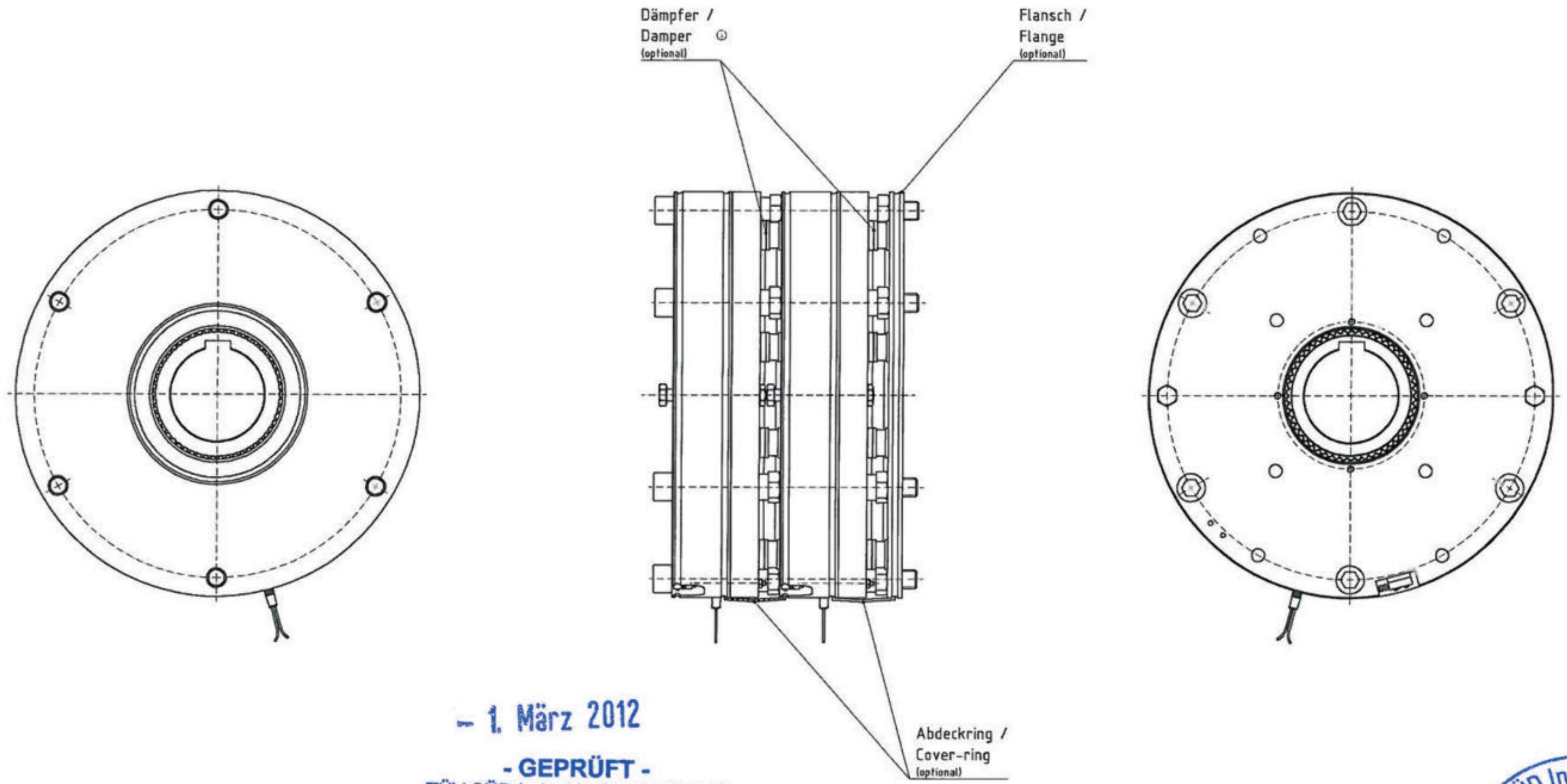
Authorised manufacturers – production sites (stated: 2012-03-01):

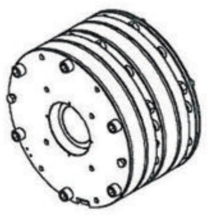
INTORQ GmbH & Co. KG
Wülmser Weg 5
31855 Aerzen - Germany

INTORQ (Shanghai) Co., LTD
No. 600, Xiu Yuan Road
Building No. 6 / Zone B
Nan Hui District, Lingang
Shanghai 201306 - V. R. China

- END OF DOCUMENT -

Base: letter of INTORQ GmbH & Co. KG dated 2011-08-11





– 1. März 2012

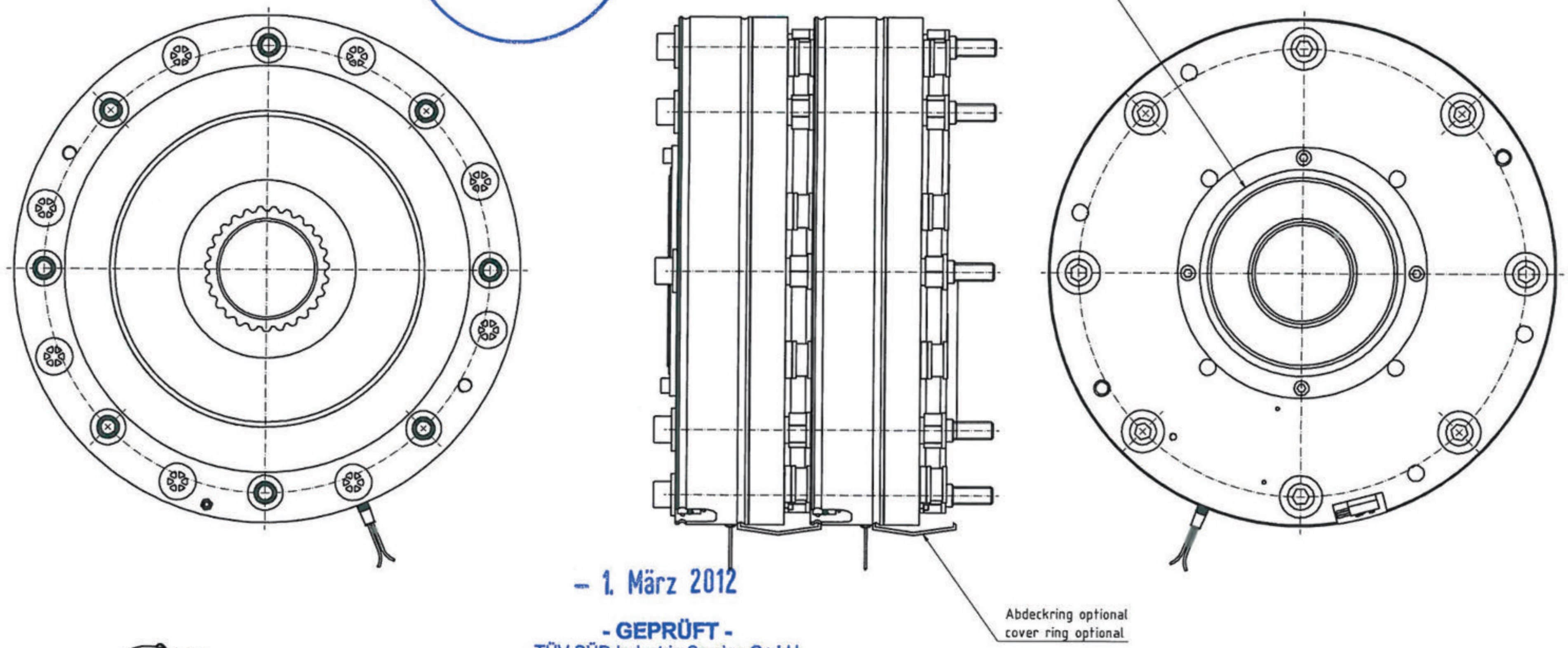
- GEPRÜFT -
TÜV SÜD Industrie Service GmbH
Zentralbereich Fördertechnik-Sonderbauten
Abteilung Aufzüge und Sicherheitsbauteile
Westendstr. 199, D-80686 München
Der Sachverständige

TÜV SÜD Industrie Service GmbH

Doppelbremse / dubble-brake

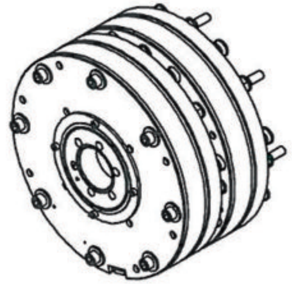
INTORQ

BFK45528-001



– 1. März 2012

- GEPRÜFT -
TÜV SÜD Industrie Service GmbH
Zentralbereich Fördertechnik-Sonderbauten
Abteilung Aufzüge und Sicherheitsbauteile
Westendstr. 199, D-80686 München
Der Sachverständige



Maßstab/scale 1:2

Benennung/name of drawing: Doppelbremse / double brake
Typ BFK455-28

Ind./ind.	Anz./quan.	Änder-Nr./revision no.	Datum/date	Name/name
1	-	600364	08.02.2012	Ge

	Datum/date	Name/name
Bearb.	22.11.2011	Gauger
Geprüft	22.11.2011	Quadlasel

CAD
INTORQ

Zeichnungsnummer/drawing no: BFK45528-003
Blatt/sheet: 3 / 3
Dateifile: BFK45528-003.iam

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Industrie Service

Type-examination certificate

Certificate no.:	ESV 881
Certification office:	TÜV SÜD Industrie Service GmbH Westendstr. 199 80686 München - Germany
Applicant/ certificate holder:	INTORQ GmbH & Co. KG Wülmser Weg 5 31855 Aerzen - Germany
Date of application:	2012-11-30
Manufacturer of the test sample:	INTORQ GmbH & Co. KG Wülmser Weg 5 31855 Aerzen - Germany
Product:	Braking element acting on the shaft of the traction sheave, as a part of the protection device against unintended car movement
Type:	BFK455-28
Test laboratory:	TÜV SÜD Industrie Service GmbH Prüflaboratorium für Produkte der Fördertechnik Prüfbereich Aufzüge und Sicherheitsbauteile Westendstr. 199 80686 München - Germany
Date and number of the test report:	2013-01-30 ESV 881
Examination basis:	EN 81-1:1998 + A3:2009 (D)
Result:	The safety component conforms to the requirements of examination basis for the respective scope of application stated on page 1 - 2 of the annex to this type-examination certificate.
Date of issue:	2013-01-31

Certification office for products of conveyor systems
Lifts and safety components

Christian Rührmeyer

TÜV SÜD Industrie Service GmbH

TÜV®

Industrie Service

Annex to the type-examination certificate no. ESV 881 dated 2013-01-31

1 Scope of application

1.1 Nominal brake torques and response times with relation to a brand-new brake element

Nominal brake torque* [Nm]	Maximum tripping rotary speed [rpm]	Maximum response times** [ms] without Overexcitation / at double Overexcitation		
		t_{10}	t_{50}	t_{90}
2 x 1200 = 2400	255	117 / 153	159 / 195	200 / 236
2 x 1700 = 3400	455	36 / 52	72 / 88	108 / 124
2 x 1800 = 3600	455	36 / 52	72 / 88	108 / 124
2 x 2065 = 4130	255	56 / 77	100 / 121	144 / 165

Explanations:

* **Nominal brake torque:** Brake torque assured for installation operation by the safety component manufacturer.

** **Response times:** t_X time difference between the drop of the braking power until establishing X% of the nominal brake torque, t_{50} optionally calculated $t_{50}= (t_{10}+ t_{90})/2$ or value taken from the examination recording

1.2 Assigned execution features

Type of powering / deactivation	Continuous current / continuous current end
Brake control	Parallel
Maximum air gap	0.45 mm
Damping elements	YES
Overexcitation	at double non-release voltage

2 Conditions

2.1 The above mentioned safety component represents only part of a protective equipment against unintended movement of the elevator car. Only in combination with a detecting and triggering component (two separate components also possible), which must be subjected to an own type examination, can the system created fulfil the requirements for a safety component in accordance with Annex F.8, EN 81-1:1998 + A3:2009 (D).

2.2 The safety component is used in combination with the brake device as part of the ascending car overspeed protection means and as a drive brake.

2.3 The installer of a lift must create an examination instruction in accordance with D.2 p) of EN 81-1:1998 + A3:2009 (D) for lift(s) to fulfil the overall concept, add it to the lift documentation and provide any necessary tools or measuring devices, which allow a safe examination (e. g., with closed shaft doors).

2.4 The dimension configuration of the lift system must be designed as regards the brake torques in such a way that the permissible value of deceleration does not exceed 1 g_n in either direction. Excluded are decelerations, which are caused by an instantaneous roller safety gear up to a rated speed of the lift system of 0.63 m/s for instance.

2.5 The traction and its variance must be taken into account as regards its braking distance (transferable power / torque) and included in the calculation.

2.6 For installer of a lift, the compliance of the component with the type examined component and the assured nominal brake torques and response times must be confirmed in writing (e. g., type plate and/or supplement in the declaration of conformity).

2.7 The information evaluation for self-monitoring must prevent an operational starting of the lift in the event of a fault.

2.8 According to the norm requirements, the brake element of the protective device must impact directly on the traction sheave or on the same shaft in the immediate vicinity of the traction sheave.

If the brake element does not impact in the immediate vicinity of the traction sheave on the same shaft, on which the traction sheave is also arranged, a deviation from the norm exists. A failure of the shaft in the area between the traction sheave and the brake element must be ruled out using corresponding construction designs and sufficient measurements. The manufacturer of the entire drive must prove the sufficient safety of the connection brake element – shaft and traction sheave – shaft as well as the shaft itself in calculations. This proof must be added to the technical documentation of the lift.

3 Remarks

3.1 As part of the type examination, it was detected that the brake element has a redundant design and that the correct function is monitored by sensors.

The examination of compliance with all requirements under Section 12.4 (EN 81-1:1998 + A3:2009 (D)), deterioration of the brake torques/breaking forces due to wear and tear and the operation-related change of the drive capability are not part of this type-examination.

This type-examination refers to the partial requirements for the protection device against unintended car movement only according to EN 81-1:1998 + A3:2009 (D), Section 9.11.

3.2 In order to provide identification, information about the basic design and functioning and to show the environmental conditions and connection requirements, drawing with the relevant latest identification from the associated EC type-examination certification no. ABV 881/X is to be enclosed with the type-examination certificate and the annex thereto.

3.3 The EC type-examination certificate may only be used in connection with the pertinent annex and the list of the authorized manufacturers (according to enclosure of the corresponding EC type-examination certification no. ABV 881/X).

Industrie Service

Enclosure of EC type-examination certificate no. ABV 881/1 dated 2013-01-30

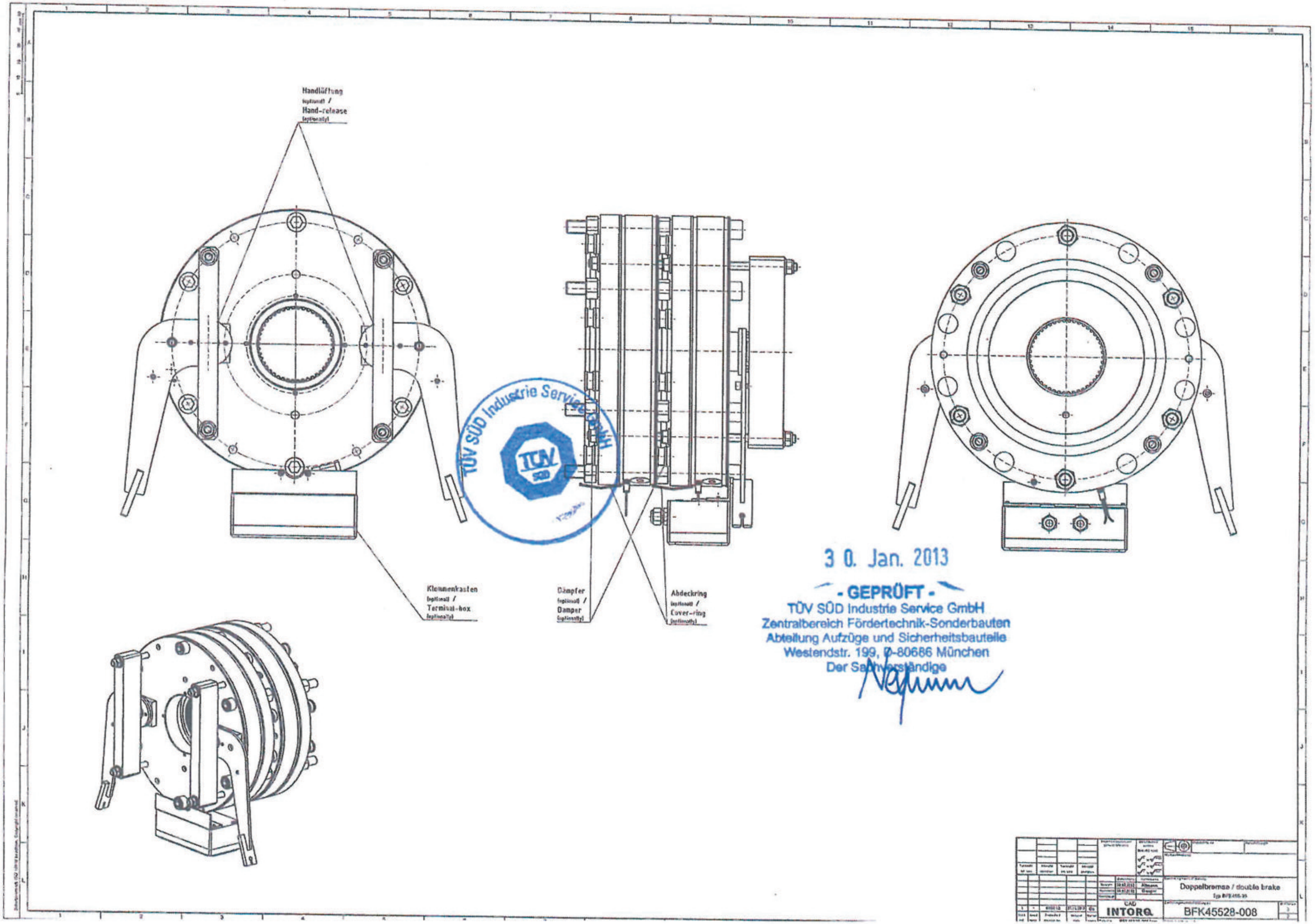
Authorised manufacturers – production sites (stated: 2013-01-30):

INTORQ GmbH & Co. KG
Wülmser Weg 5
31855 Aerzen - Germany

INTORQ (Shanghai) Co., LTD
No. 600, Xiu Yuan Road
Building No. 6 / Zone B
Nan Hui District, Lingang
Shanghai 201306 - P. R. China

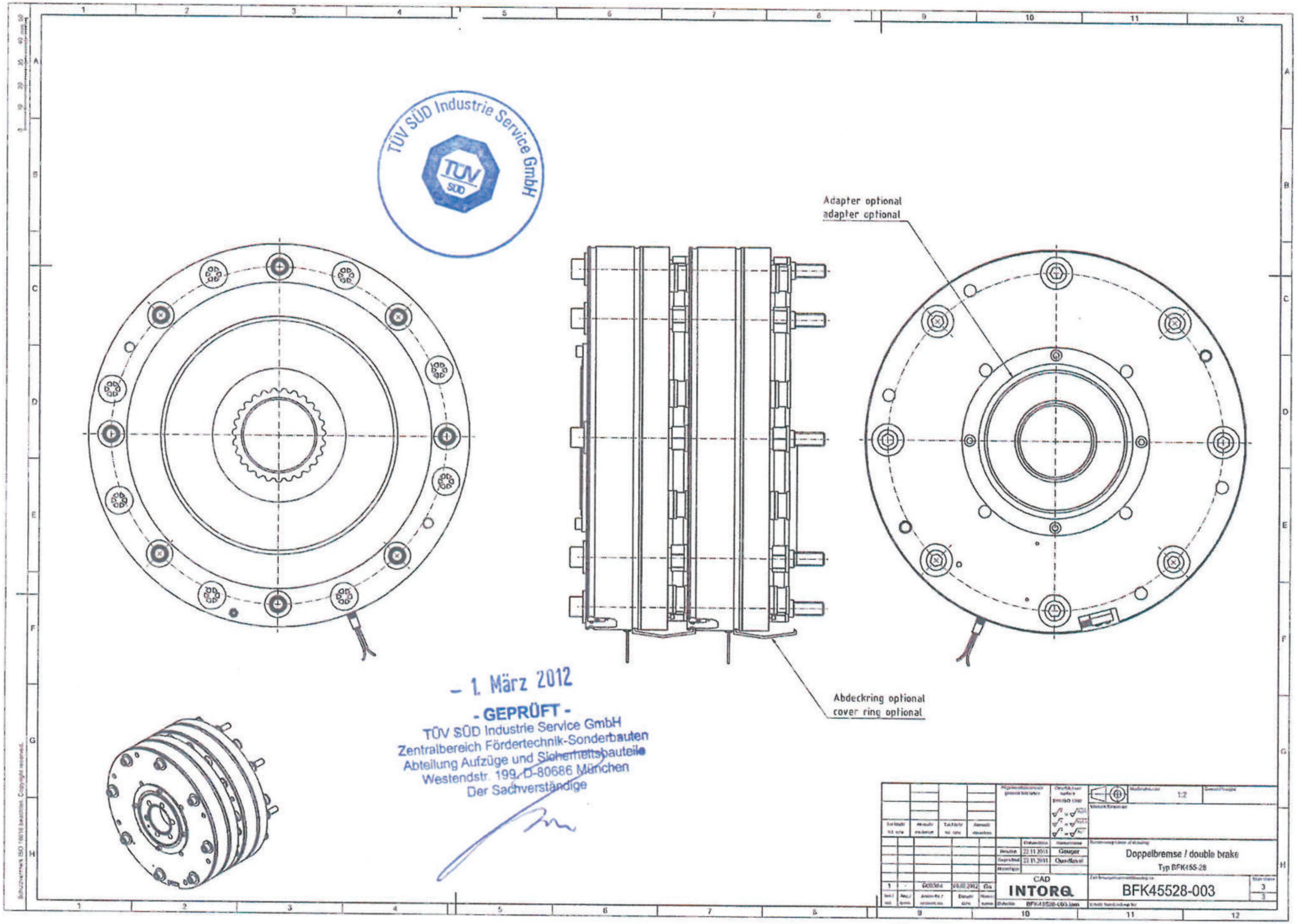
- END OF DOCUMENT -

Base: letter of INTORQ GmbH & Co. KG dated 2012-11-30



3 0. Jan. 2013

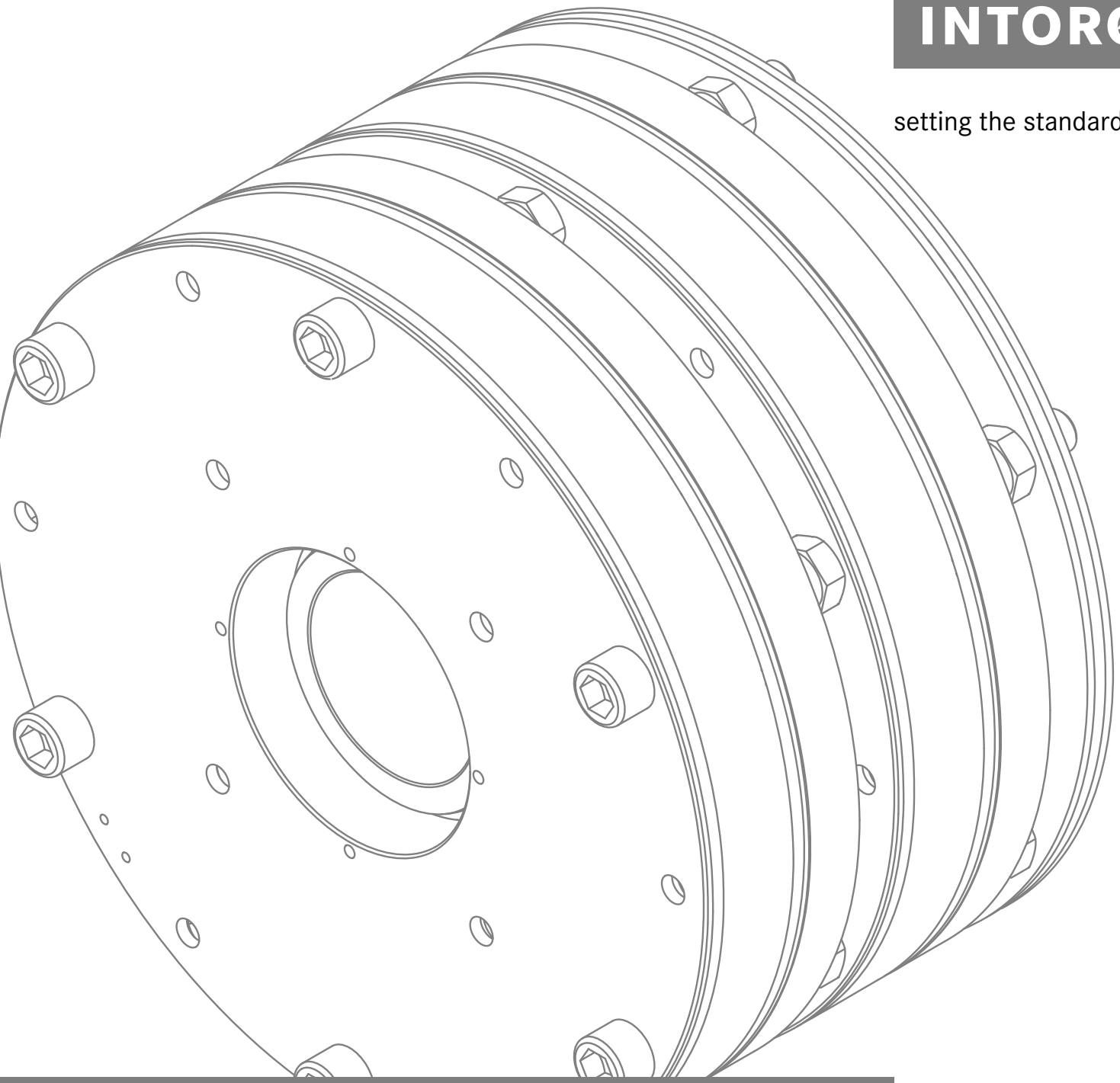
- GEPRÜFT -
TÜV SÜD Industrie Service GmbH
Zentralbereich Fördertechnik-Sonderbauten
Abteilung Aufzüge und Sicherheitsbauteile
Westendstr. 199, D-80686 München
Der Sachverständige



Adapter optional
adapter optional
Abdeckring optional
cover ring optional
TÜV SÜD Industrie Service GmbH
– 1. März 2012
- GEPRÜFT -
TÜV SÜD Industrie Service GmbH
Zentralbereich Fördertechnik-Sonderbauten
Abteilung Aufzüge und Sicherheitsbauteile
Westendstr. 199, D-80686 München
Der Sachverständige
1:2
Doppelbremse / double brake
Typ BFK455-28
22.11.2011 Gauger
22.11.2011 Quedfeld
CAD
INTORQ
BFK45528-003

INTORQ

setting the standard



INTORQ BFK455

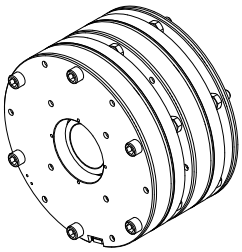
Electromagnetically released spring-applied brake

Operating Instructions

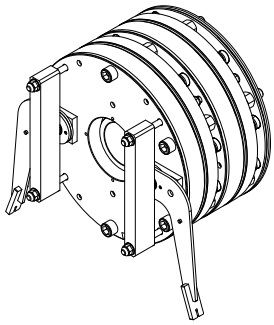
www.intorq.com

This documentation applies to ...

BFK455-28 - double-disk version



BFK455-001.iso/dms



BFK455-020.iso/dms

Product key

Product key **INTORQ** **B** **FK** **□□□** - **□□**

A

B

C

D

Legend for the INTORQ BFK455 product key

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

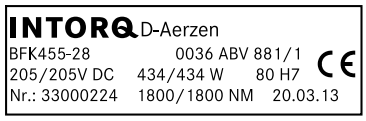
Not coded: supply voltage, hub bore, options

Identification

Package label			Example
Manufacturer		Bar code	
Type (see product key)		Type No.	
Name		Quantity per box	
Rated voltage	Rated torque	Packing date	
Rated power	Hub diameter		
Additional information		CE designation	

BFK455-101.iso/dms

Nameplate			Example
Manufacturer			
Type (see product key)		CE designation	
Rated voltage	Rated power	Hub diameter	
Type No.	Rated torque	Production date	



BFK455-002.iso/dms

Notes

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

for holding voltage	for air gap setting
Lüftspannung: Release voltage: 205 V DC Haltespannung: Holding voltage: 103 V DC Nur mit BEG-561-255-030 betreiben! Only use with BEG-561-255-030! Nr./No.: 13346411	DE: Den nach der Erstinstallation eingestellten Luftspalt nicht verstellen! EN: Do not re-adjust air-gap after first installation! FR: Ne plus regler l'entrefer après la première instàllation!

Document history

Material number	Version			Description
33000803	1.0	05/2011	TD09	First edition
33000803	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 hand-release installation Tables of dimensions and operating times were changed Amendment of the spare parts list and the spare parts order
33002468	3.0	05/2013	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

i Contents

i Contents

1 Preface and general information

1.1 About these Operating Instructions

- These Operating Instructions will help you to work safely on and 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	Spring-applied brake with electromagnetic release
Drive system	Drive systems with spring-applied brakes and other drive components

1.3 Conventions used

This documentation uses the following conventions to distinguish 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 = see page 16
	Document reference	🕮	Reference to another documentation with additional information For example: 🕮 Operating instructions
	Wildcard	☐	Wildcard for options, selections For example: BFK458-☐☐ = BFK458-10

1 Preface and general information

1.4 Abbreviations used

Abbreviation	Unit	Name
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 the fixing screws
M_K	Nm	Rated torque of brake, rated value at a relative speed of 100 rpm
n_{max}	rpm	Maximum speed during the slipping time t3
P_H	W	Coil power during holding, through normal excitation and 20 °C
P_L	W	Coil power during release, through normal excitation and 20 °C
P_N	W	Rated coil power at rated voltage and 20 °C
Q	J	Heat/energy
Q_E	J	Max. permissible friction work per switching cycle, thermal rating of the brake
Q_R	J	Braking energy, friction work
Q_{Smax}	J	Max. permissible friction work during cyclic switching, depending on the operating frequency
R_N	Ohm	Rated coil resistance at 20 °C
S_h	1/h	Operating frequency, the number of repeated operations per unit time
S_{hue}	1/h	Transitional operating frequency, thermal rating of the brake
S_{hmax}	1/h	Maximum permissible operating frequency, depending on the friction work per operation
s_L	mm	Air gap, movement of armature plate by switching the brake
s_{LN}	mm	Rated air gap
s_{Lmin}	mm	Minimum air gap
s_{Lmax}	mm	Maximum air gap
t_1	ms	Engagement time, the total of the reaction delay and torque rise time $t_1 = t_{11} + t_{12}$
t_2	ms	Disengagement time, time from switching the stator until the torque has reduced to 0.1 M_K
t_{11}	ms	Slipping time to standstill (after t_{11})
t_{11}	ms	Delay time when connecting, time from disconnecting the voltage until the torque begins to rise
t_{12}	ms	Rise time of braking torque, time from beginning of rise of torque until braking torque is reached
t_{ue}	S	Overexcitation time
U	V	Voltage
U_H	V DC	Holding voltage by change of voltage
U_L	V DC	Release voltage by change of voltage
U_N	V DC	Rated coil voltage for brakes which require automatic voltage changing, the rated coil voltage U_{rated} is the same as the release voltage U_L

1 Preface and general information

1.5 Notes used

The following pictographs and signal words are used in this documentation to indicate dangers and important information:

Safety instructions

Structure of safety instructions:

Danger!

Characterises 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.

Pictograph and signal word	Meaning
 **Danger!**	**Danger of personal injury through dangerous electrical voltage** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Danger!**	**Danger of personal injury through a general source of danger** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
 **Stop!**	**Danger of property damage** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

Application notes

Pictograph and signal word	Meaning
 **Note!**	Important note to ensure troublefree operation
 **Tip!**	Useful tip for simple handling
	Reference to another documentation

1 Preface and general information

1.6 Scope of supply

After receipt of the delivery, check immediately whether it corresponds to the accompanying papers. INTORQ does not grant any warranty for deficiencies claimed subsequently.

- Claim visible transport damage immediately to the forwarder.
- Claim visible deficiencies / incompleteness immediately to INTORQ GmbH & Co.KG.

1.7 Disposal

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

- Recycle metals and plastics.
- Ensure professional disposal of assembled PCBs according to 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

- The spring-applied INTORQ brake is also delivered in single modules and individually combined to its modular design. The data - package labels, nameplate, and type code in particular - apply to one complete stator.
- If single modules are delivered, the labelling is missing.

1 Preface and general information

1.9 Legal regulations

Liability

- The information, data and notes in this documentation met the state of the art at the time of printing. Claims referring to products which have already been supplied cannot be derived from the 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 working on and with the product
  - operating faults
  - disregarding the documentation

Warranty

- Terms of warranty: see terms of sale and delivery of INTORQ GmbH & Co. KG.
- Warranty claims must be made to INTORQ immediately after detecting defects or faults.
- The warranty is void in all cases where liability claims cannot be made.

2 Safety instructions

2.1 General safety information

- INTORQ components ...
  - ... must only be applied as directed.
  - ... must not be commissioned if they are noticeably damaged.
  - ... must not be technically modified.
  - ... must not be commissioned if they are mounted and connected incompletely.
  - ... must not be operated without the required covers.
  - ... can hold live 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.
- All specifications of the corresponding enclosed documentation must be observed.

  This is vital for a safe and trouble-free operation and for achieving the specified product features.
- Only qualified, skilled personnel are permitted to work on and with INTORQ components.

  In accordance with 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 by no means have contact to oil or grease since even small amounts reduce the brake torque considerably.
- The brake is designed for operation under the environmental conditions that apply to IP54. Because of the numerous possibilities of using the brake, it is however necessary to check the functionality of all mechanical components under the corresponding operating conditions.

2 Safety instructions

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 shall be deemed inappropriate!

Possible applications of the INTORQ spring-applied brake

- Humidity: no restrictions
  - In case of formation of condensed water and moisture: 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 armature plate and rotor from freezing.
- Protect electrical connections against contact.

3 Technical data

3.1 Product description

Versions

Basic module

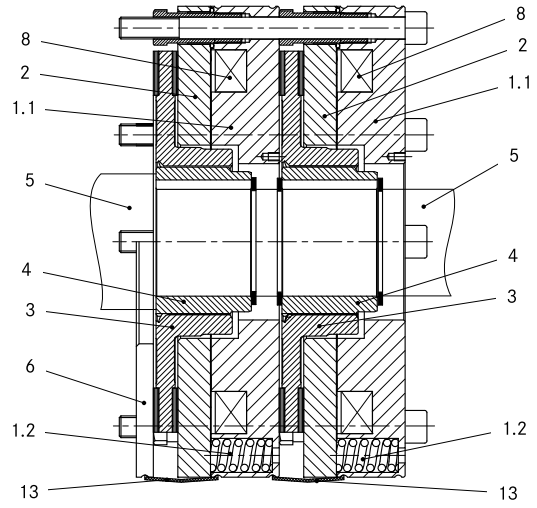


Fig. 1 Design of a BFK455 spring-applied brake

1.1	Stator	3	Complete rotor	6	Flange
1.2	Compression 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 the conversion of mechanical work and kinetic energy into heat. Due to the static brake torque, the brake can hold loads without speed difference. Emergency braking is possible at high speed. The more friction work, the higher the wear, (operating speeds 🕮 16).

The BFK455 spring-applied brake is a double disc brake with four friction surfaces. The braking torque is generated within two electrically and mechanically separated braking circuits by means of several compression springs (1.2) with friction locking. The braking circuits are released electromagnetically. Due to its division into two braking circuits, the brake is especially suitable for applications in the fields of lift technology and stage machinery. The brake is selected on the basis of the characteristic torque for one braking circuit. The second braking circuit meets the requirement for redundancy.

The braking circuits are divided by two separate armature plates (2) with the respective compression springs (1.2) assigned and electromagnetic coils (8). The separate connecting cables for each stator and armature plate render it possible to switch each braking circuit individually, 🕮 36.

3 Technical data

The switching status of the spring-applied brake is monitored by one microswitch (16) for each braking circuit. The associated switchgear rectifies the supply voltage (AC voltage) which is reduced after a short time while the brake is in the released state. Thus the mean electrical power of the brake is reduced.

The stator (1) is designed in temperature class F. The temperature limit of the coils (8) is 155 °C. The BFK455 spring-applied brake is designed for a maximum operating time of 60 % with a reduction of the holding current.

Certificate

Type	Characteristic torque [Nm]	EC type-examination certificate
BFK455-28	2 x 1100, 2 x 1200	ABV 881/1
	2 x 1700, 2 x 1800	
	2 x 2065	

3.1.2 Braking

During braking, the rotor (3), which is axially movable on the hub (4), is pressed against the friction surface - via the armature plates (2) - by means of the springs (1.2). The asbestos-free friction linings ensure a high braking torque with low wear. The braking torque is transmitted between hub (4) and rotor (3) via the splines.

3.1.3 Brake release

In braked state, there is an air gap "s_L" between the stator (1) and the armature plate (2). To release the brake, the coil of the stator (1) is excited with the DC voltage provided. The magnetic force generated attracts the armature plate (2) towards the stator (1) against the spring force. The rotor (3) is then released and can rotate freely.

3.1.4 Release monitoring

The spring-applied brake is equipped with one microswitch (16) each per braking circuit for monitoring the switching status. When the braking circuits are released, the microswitches (16) change over. This means that the operation of the drive against the applied brake can be excluded. The microswitches can be connected both as NO and NC contacts.

For checking the correct functioning of the microswitches, we recommend to check the switching status (see Tab. 6) both when the brake is released and when the brake is applied.

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 Technical data

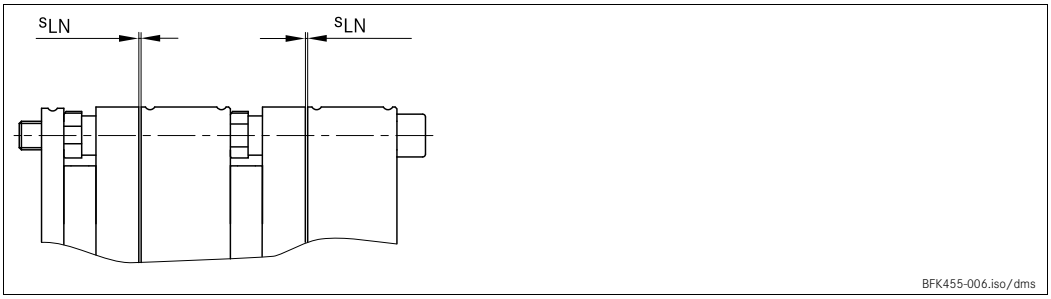
3.1.6 Project planning notes

- The brakes are dimensioned in such a way that the given characteristic torques are reached safely after a short run-in process.
- Due to the fluctuating properties of the organic friction linings used and the alternating environmental conditions, deviations of the given braking torques may occur. These must be considered by corresponding safety measures in the dimensioning process. Especially with humidity and alternating temperatures, an increased breakaway torque may occur after a long downtime.
- If the brake is used as a pure holding brake without dynamic load, the friction lining must be reactivated regularly.

3 Technical data

3.2 Rated data

3.2.1 Dimensions



Type	Characteristic torque	Air gap		Perm. wear	Rotor thickness		Mass of complete stator
	[Nm]	s_{Lrated} +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 +1.0 mm		Tightening torque	
			without flange	with flange	without flange	with flange	without flange	with flange
	Ø[mm]	Thread	[mm]	[mm]	[mm]	[mm]	M_A [Nm]	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

Stop!

- The minimum thread depth of the end shield must be observed in any case, 🕮 Tab. 1
- If the required thread depth is not observed, the fixing screws may run into the thread root. As a result, the required preload force will no longer be built up and the brake will no longer be fixed securely!

3 Technical data

3.2.2 Electrical data

Type	Voltage		Power		Coil resistance	Current
	Release ±10%	Holding ±10%	Release	Holding		
	U_L [V] DC	U_H[V] DC	P_N [W]	P_H [W]	R_N±5% [Ω]	I_L [A]
BFK455-28	103	52	2 x 434	2 x 108.5	2 x 24.5	2 x 4.21
	205	103	2 x 434	2 x 108.5	2 x 97	2 x 2.12
	360	180	2 x 434	2 x 108.5	2 x 298.6	2 x 1.21

Tab. 2 Coil power ratings of the BFK455-28

3.3 Rated data (selection data)

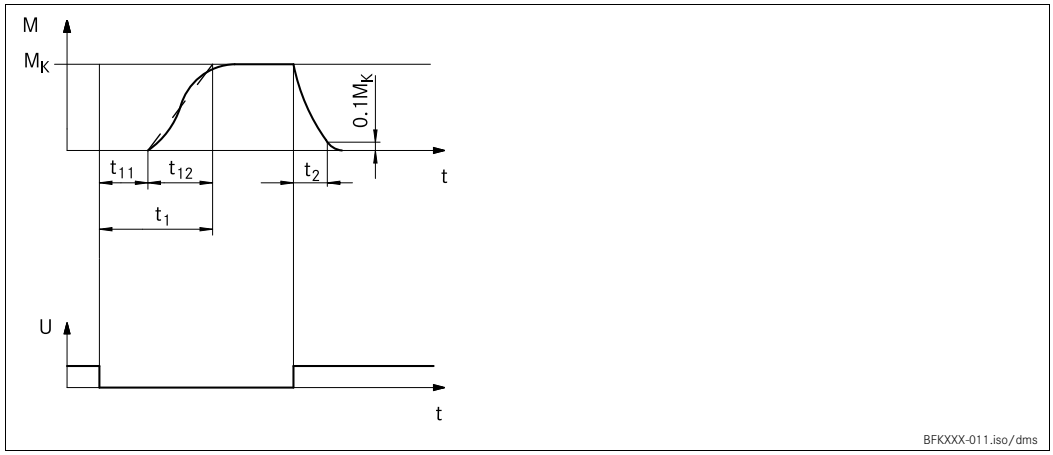


Fig. 2 Operating times of the spring-applied brakes

t_1	Engagement time	t_{11}	Reaction delay during engagement
t_2	Disengagement time (up to M = 0.1 M_r)	t_{12}	Rise time of the brake torque
M_K	Characteristic torque	U	Voltage

Type	Rated torque [1]	Max. perm. switching energy	Transition operating frequency	Operating times [ms] [2] at s_{LN} and 0.7 I_N				Max. speed [3]
	M_K	QE	S_{hue}	DC engagement [4]			Disengage	
				t_{11}	t_{12}	t_1	t_2	$n_{max.}$
	[Nm]	[J]	[h^{-1}]					[rpm]
BFK455-28	2 x 1100	360000	7	80	220	300	370	455
	2 x 1200			60		280		
	2 x 1700			20		240	480	
	2 x 1800							
	2 x 2065			30		250	460	

1) Minimum brake torque when all components are run in with Δn=100 rpm
2) Typical values
3) Max. speed according to EC type-examination certificate (for higher speeds contact the manufacturer)
4) Measured with induced voltage limitation -800 V DC

Tab. 3 Switching energy - operating frequency - operating times

3 Technical data

Engagement time

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

Short brake engagement times are vital for emergency braking. DC switching together with a suitable spark suppressor must therefore be provided.

- The engagement times are valid 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 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 deenergised before the motor is at standstill, AC switching is also possible (not applicable to emergency braking).

Note!

When the brake is switched on the AC side, the engagement times are extended approximately by the factor 5, connection 🕮 35.

Disengagement time

The disengagement time is the same for DC and AC switching. The disengagement times specified always refer to the control with overexcitation.

3 Technical data

3.4 Friction work / operating frequency

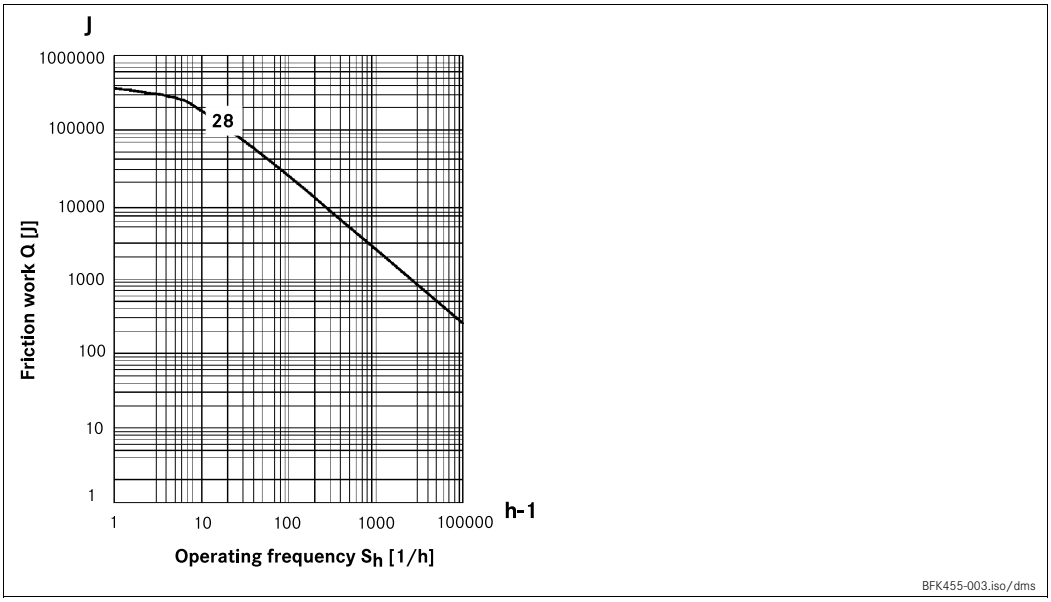


Fig. 3 Switching energy as a function of the operating frequency

$$S_{hmax} = \frac{-S_{hue}}{\ln\left(1 - \frac{Q_R}{Q_E}\right)} \qquad Q_{smax} = Q_E\left(1 - e^{\frac{-S_{hue}}{S_h}}\right)$$

The permissible operating frequency S_{hmax} depends on the quantity of heat Q_R (see Fig. 3). If the operating frequency S_h is specified, the permissible quantity of heat Q_{smax} will result.

With high speed and friction work, the wear increases strongly, because very high temperatures occur at the friction faces for a short time.

3 Technical data

3.5 Emission

Electromagnetic compatibility

Note!

The user must ensure compliance with EMC Directive 2004/108/EC using appropriate controls and switching devices.

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

If the spring-applied brake uses a rectifier of 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 "s_L" and the brake size.

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

Others

The abrasion of the friction parts produces dust.

4 Mechanical installation

4.1 Important notes

Stop!

Toothed hub and screws must not be lubricated with grease or oil!

4.2 Necessary tools

Type	Torque key Insert for hexagon socket screws		Open-jawed spanner
			
	Measuring range [Nm]	**Wrench size [mm]**	**Adjustment tubes - wrench size [mm]**
BFK455-28	40 - 250	14	24

	Feeler gauge	Caliper gauge	Multimeter
			

4.3 Mounting

4.3.1 Important notes

Brake size	Minimum requirements for the counter friction face				
	Material [1)]	**Evenness [mm]**	**Axial runout [mm]**	**Roughness**	**Others**
28	S235 JR C15 EN-GJL-250	< 0.1	0.1	Rz10	▮ Threaded holes with minimum thread depth 📖 16 ▮ Free of grease and oil

[1)] **In case of other materials please consult INTORQ.**

Tab. 4 Counter friction face design of the end shield

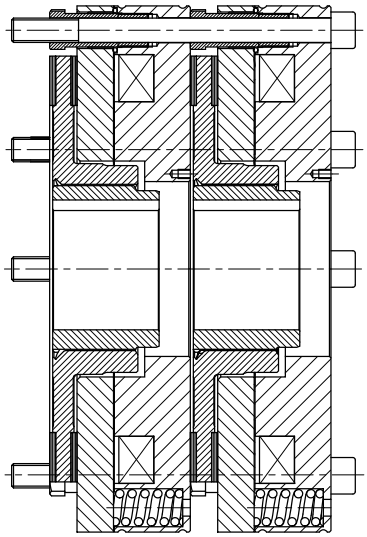
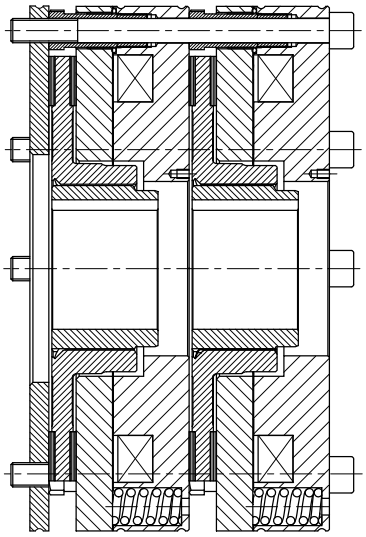
The diameter of the shaft shoulder must not be bigger than the tooth root diameter of the hub.

4 Mechanical installation

4.3.2 Preparation

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

4.3.3 Overview

without separate counter friction face	with flange
 BFK455-007.iso/dms	 BFK455-008.iso/dms

4.4 Installation

Stop!

Toothed hub and screws must not be lubricated with grease or oil!

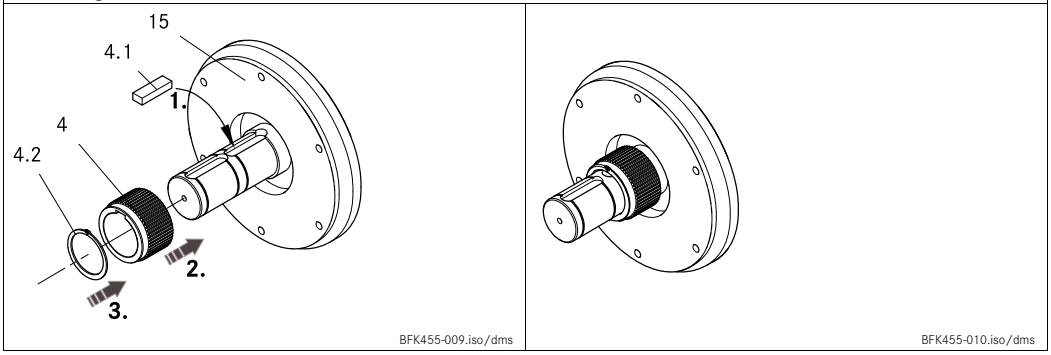
Note!

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

4 Mechanical installation

4.4.1 Brake assembly

Mounting the first hub onto the shaft



4 Hub 4.1 Keyway 15 End shield

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

Stop!

In reverse operation, it is recommended to additionally glue the hub to the shaft!

Assembly of the counter friction faces

Flange (option)

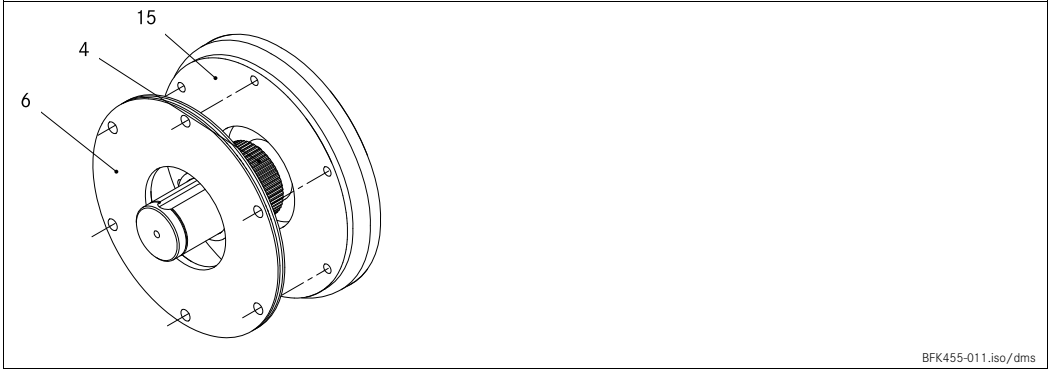


Fig. 4 Assembly of the flange

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.

4 Mechanical installation

Assembly of the first rotor

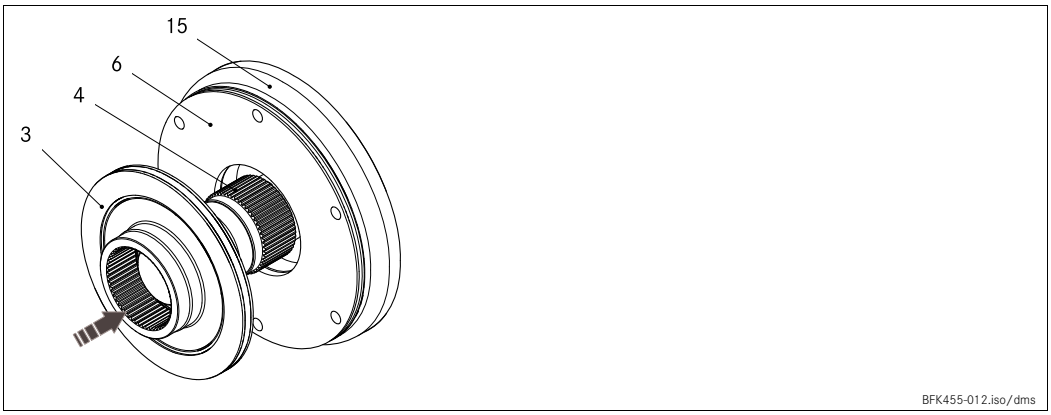


Fig. 5 Mounting of the rotor

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.

Stop!

Only in the case of rotors with mounting paste on their gear teeth:

- 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

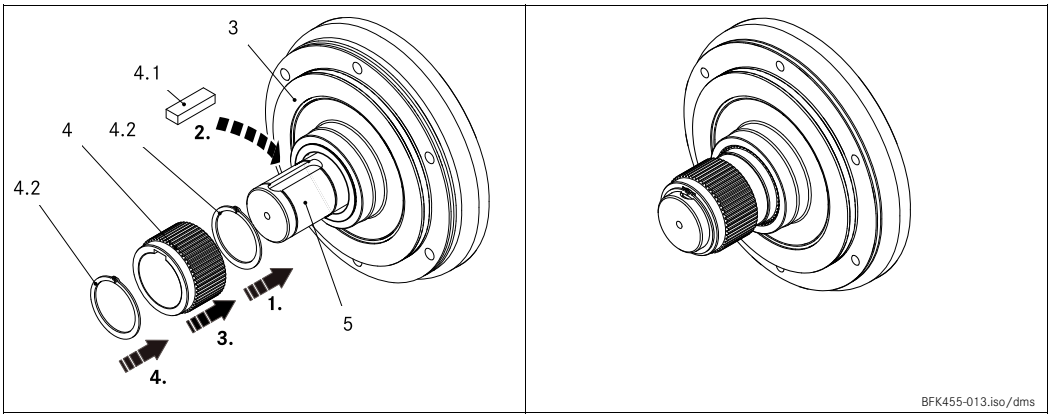


Fig. 6 Mounting of the second hub

4	Hub	3	Complete rotor	4.2	Circlip
5	Shaft	4.1	Keyway		

7. Insert second keyway (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).

4 Mechanical installation

Assembly of the first stator

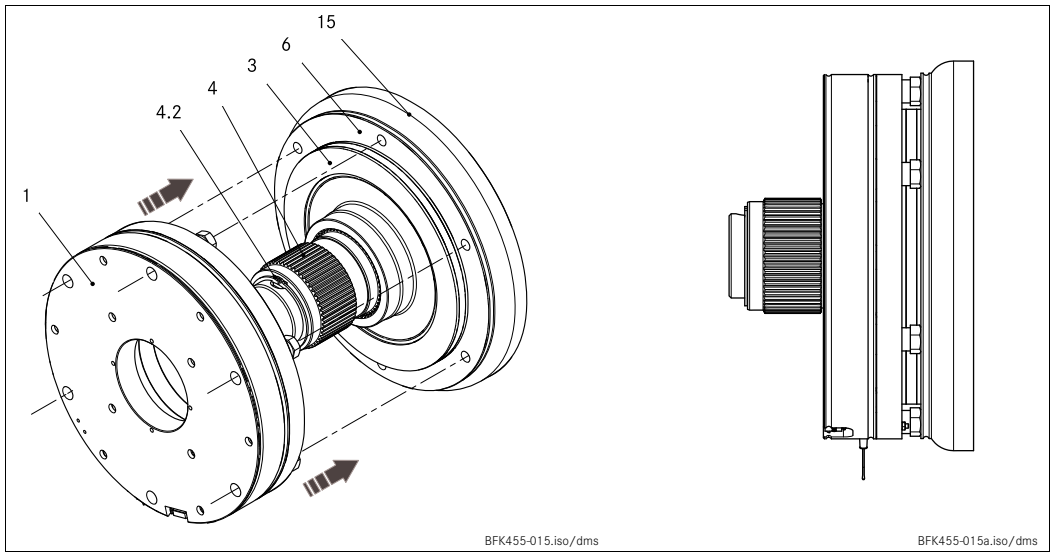


Fig. 7 Assembly of the stator

1	Complete stator	4	Hub	6	Flange
3	Complete rotor	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

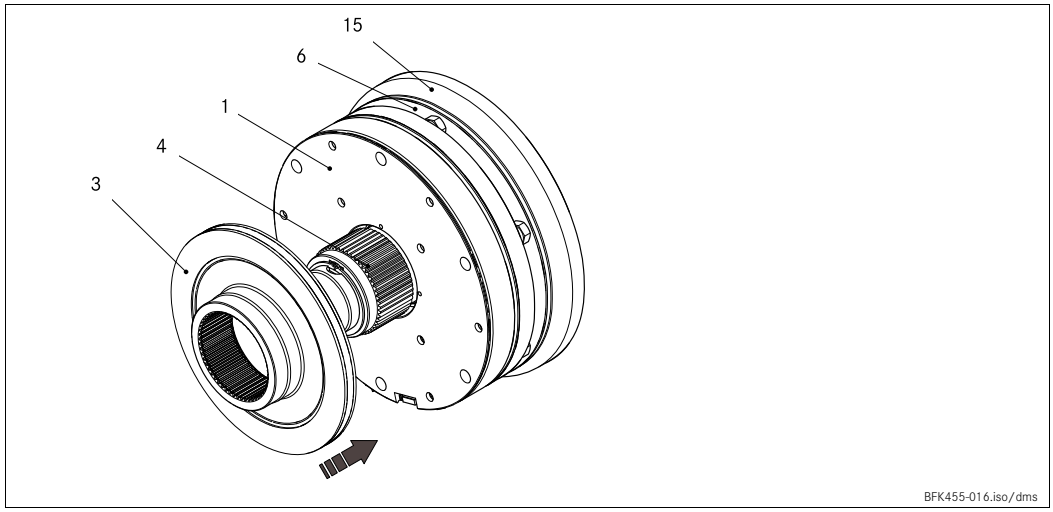


Fig. 8 Mounting of the rotor

1	Complete stator	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.

4 Mechanical installation

Stop!

Only in the case of rotors with mounting paste on their gear teeth:

- 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!

Note!

If a manual release is to be installed, the required worksteps in chapter 4.5.2 Step 2 must be carried out **now**!

Assembly of the second stator

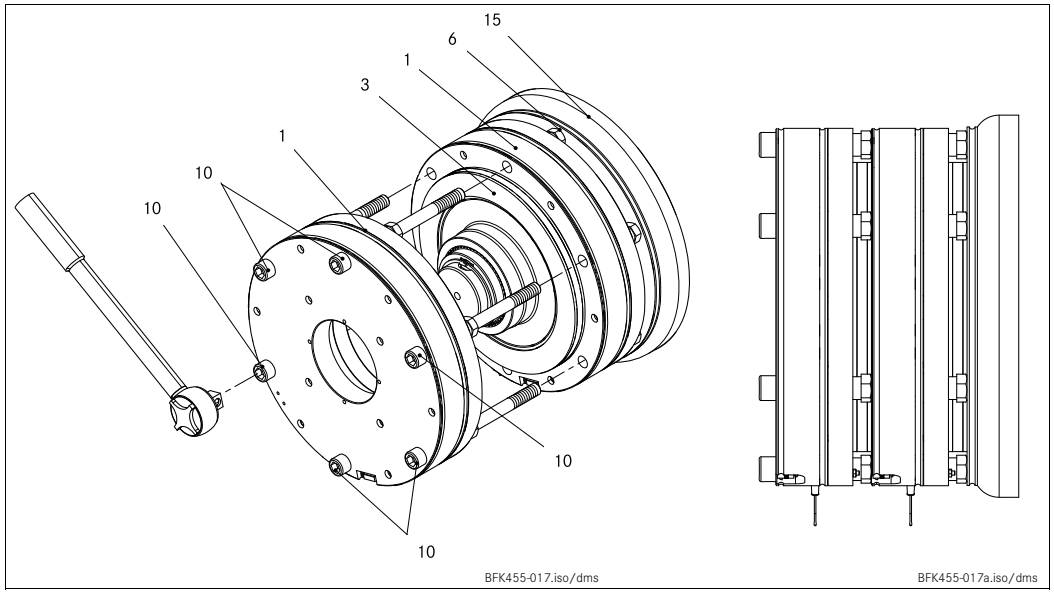


Fig. 9 Assembly of the stator

1	Complete stator	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 cheese-head screws (10) included in the scope of supply in several runs using a torque key.
16. Establish electrical connection and energise brake (🕮 35).
17. Use a torque key to retighten the fixing screws (10) with the required tightening torque, 🕮 16.
18. Switch off power.

4 Mechanical installation

4.4.2 Checking the air gap

Danger!

Disconnect voltage. The brake must be free of residual torque.

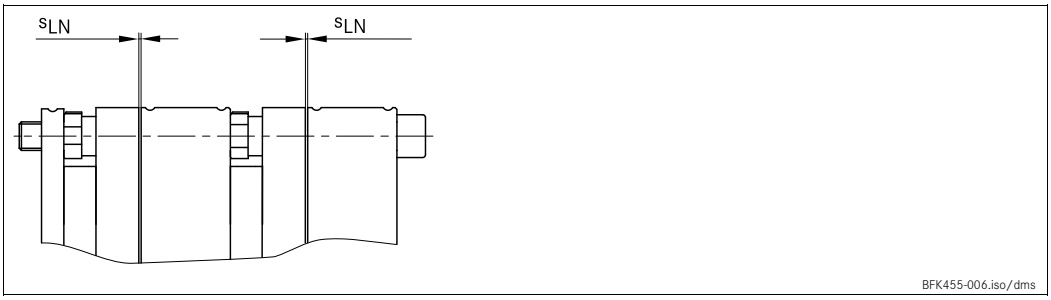


Fig. 10 Checking the air gap

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

Note!

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:

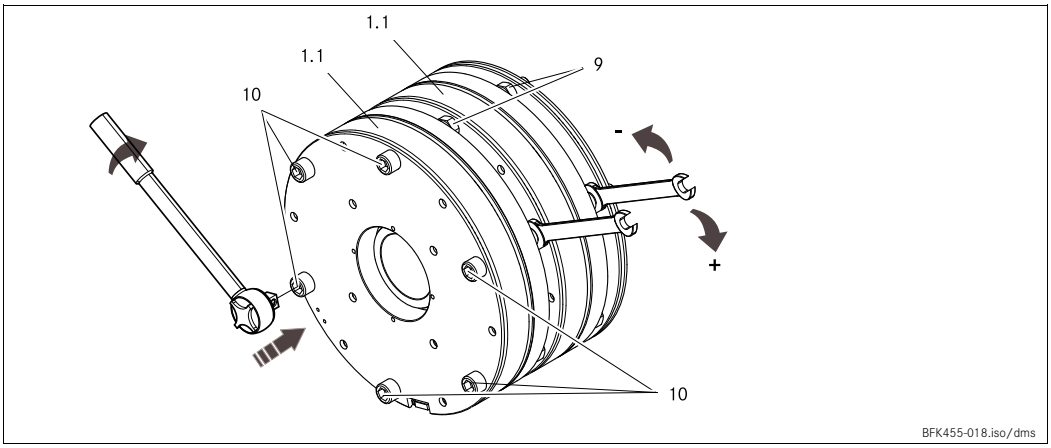


Fig. 11 Adjusting the air gap during the initial installation

1. Unbolt screws (10).

Note!

Correctly adjust the air gap using every 2nd screw (10) / sleeve bolt (9)! Turn the remaining three sleeve bolts just far enough into the stator to make sure that they do not touch the flange or the end shield. Repeat this process with the other three screws (10).

2. Slightly turn the sleeve bolts (9) using a spanner.

4 Mechanical installation

- If the air gap is too large, screw them into the stator (1.1).
- If the air gap is too small, screw them out of the stator (1.1).
- $^1/_6$ turn changes the width of the air gap by approx. 0.15 mm.

3. Tighten the screws (10), (for torques, see table 📖 16).
4. Check the air gap "s_L" near the screws (10) using a feeler gauge, ("s_{LN}" see table 📖 16).
5. If the difference between the measured air gap and "s_{LN}" is too large, repeat the readjustment.

4.5 Manual release

Note!

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

Manual release is installed along with the double spring-applied brake. The brake is deenergised during the process.

1. Mount first rotor (3), first complete stator (1), and second rotor (3A) according to chapter 4.4.1 steps 1. to 12., 📖 24 and 25.

4.5.1 Components of the hand-release

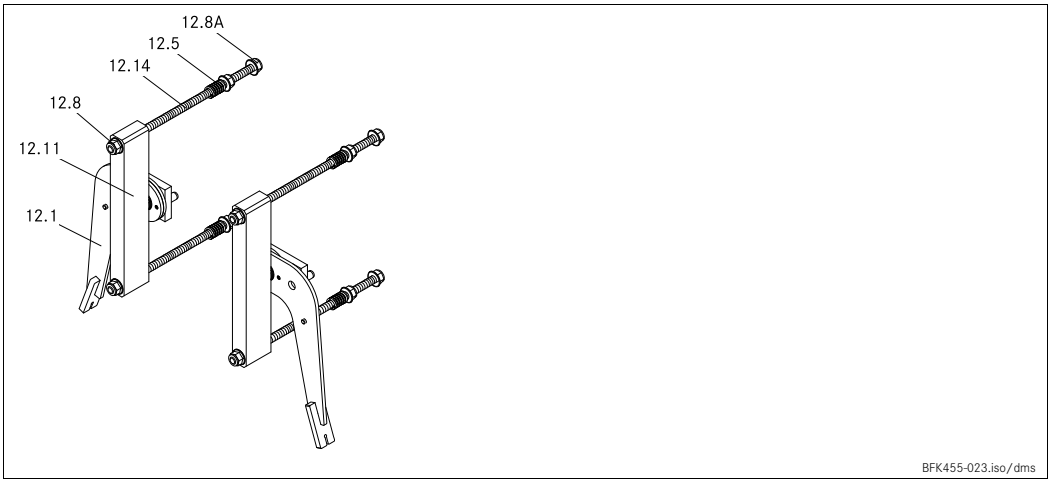


Fig. 12 Manual release

12.1	Manual release lever	12.8	Self-locking nut	12.14	Tension rod
12.5	Compression spring	12.11	Clip		

4 Mechanical installation

4.5.2 Assembly of the hand-release

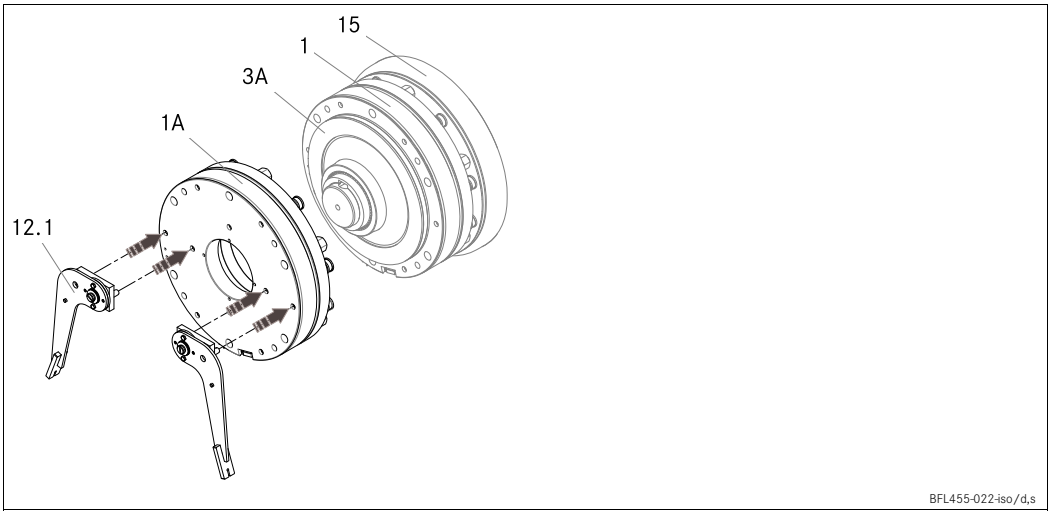


Fig. 13 Applying the manual release lever

2. Mount the two complete levers (12.1) to the second complete stator (1A). For this purpose, press the pins of the boards into the provided bore holes of the stator, use a tool if necessary.

Note!

The boards are not symmetrical. The pin with the greater distance to the axis of rotation must point to the outside. The levers also point to the outside.

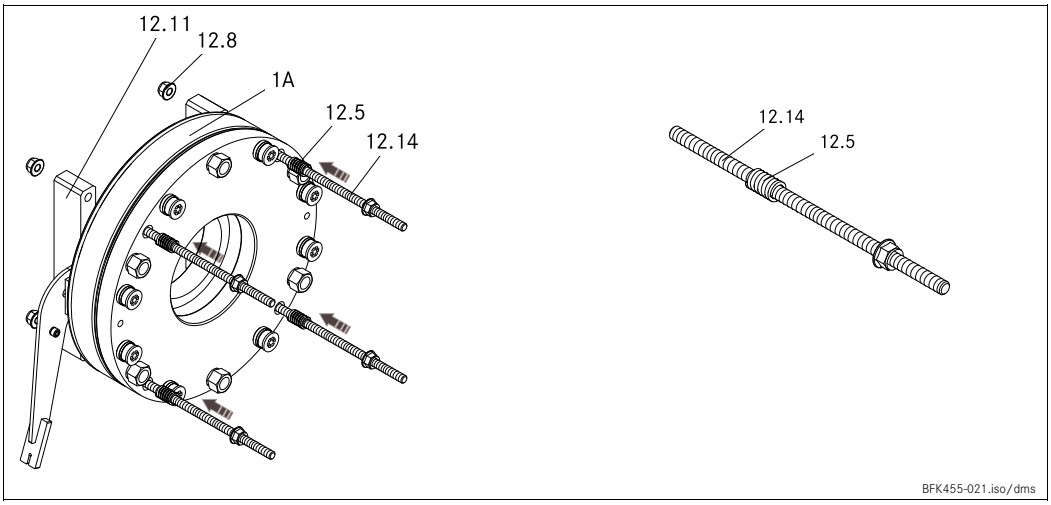


Fig. 14 Installation of the tension rods

3. 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 (Ø11 mm) of the complete stator (1A). Insert the springs (12.5) of the tension rod into the clearing hole of the armature plate (Ø16.5 mm) in the process.

4 Mechanical installation

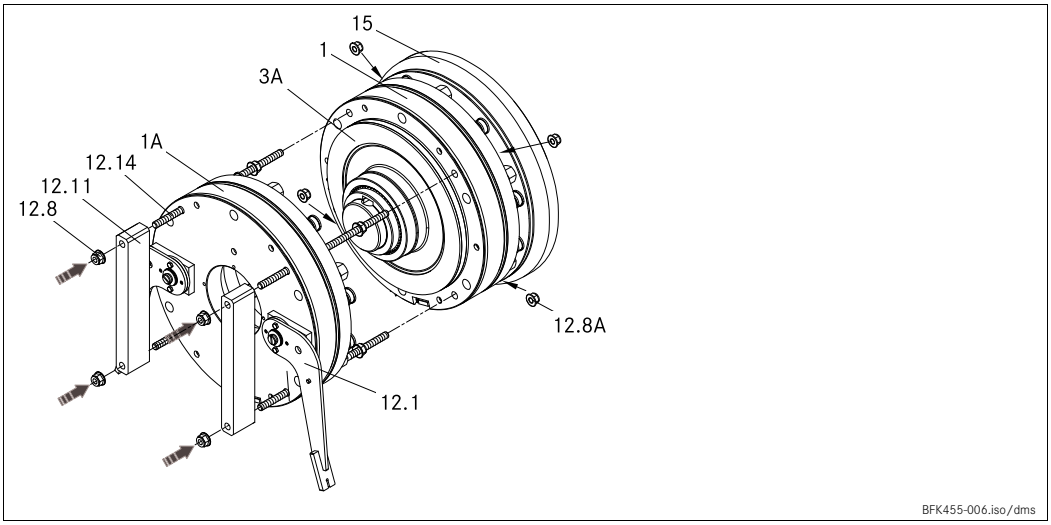


Fig. 15 Assembly parts

5. Attach the clips (12.11) with the bore holes (Ø12 mm) to the tension rods (12.14) and tighten them with the self-locking nuts (12.8), the blind holes (Ø17 mm) pointing in the direction of the stator and the screw heads of the complete manual release levers sinking 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 (Ø12 mm) of the first complete stator (1) in the process.

Stop!

Tension rods must not be bent!

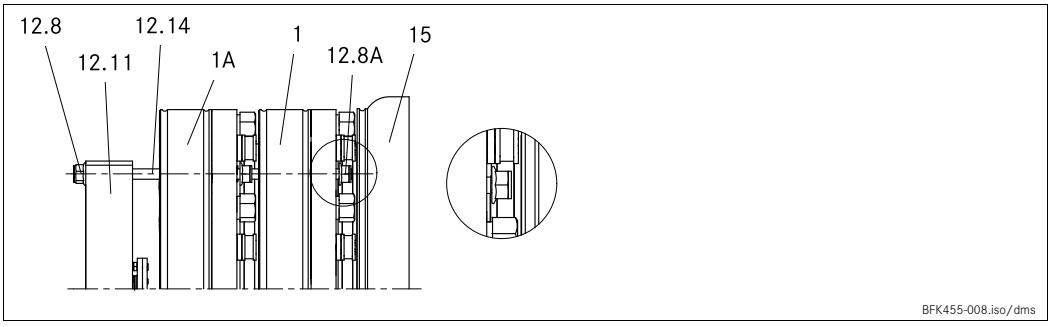


Fig. 16 Preassembly of the brake with manual release on the motor

7. Screw four self-locking 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 self-locking nut aligns with the top of the tension rod.
8. Evenly tighten the brake with the six cheese-head screws (10) included in the scope of supply in several runs using a torque key, Fig. 17.
9. Establish electrical connection and energise brake, 📖 35.

4 Mechanical installation

10. Use a torque key to retighten the supplied fixing screws (10) with the required tightening torque, 🕮 16.
11. Switch off power.

4.5.3 Checking the air gap

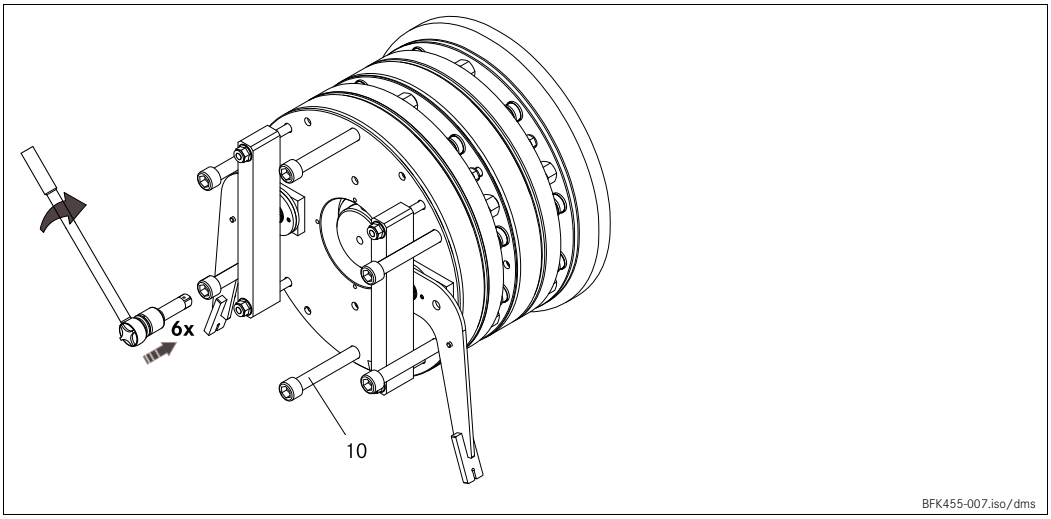


Fig. 17 Checking the air gap

12. Check the air gap by means of a feeler gauge and correct it if necessary (s_{LN} = 0.4 +0.05mm), according to Fig. 10 and Fig. 11.

4 Mechanical installation

4.5.4 Setting the hand-release

Stop!

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

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

13. Evenly tighten the self-locking nuts (Pos. 12.8) at the clips (12.11) up to the point where the nuts of the tension rod are in contact with the armature plate of the second stator (1A) (tangible resistance). Observe the parallel alignment of the clips (12.11) with the back side of the complete stator (1A) (check by means of a caliper gauge). In the case of deviations X > 0.1mm (Fig. 18), correct the setting by loosening the self-locking nut (12.8) with the smaller measured value and by tightening the self-locking nut (12.8) with the greater measured value until the clips (12.11) are aligned in parallel with the back side of the brake, Fig. 18.
14. Evenly tighten the self-locking 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 self-locking nuts (12.8) at the clips (12.11) by one revolution (360°).

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

4 Mechanical installation

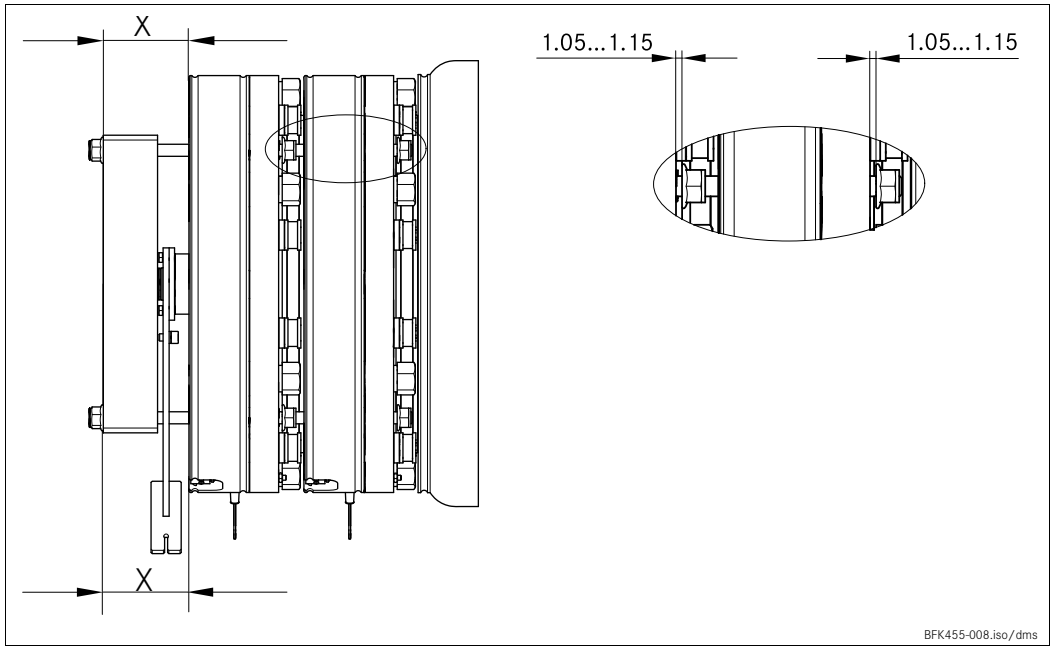


Fig. 18 Test dimensions and reference dimensions

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 the function of the manual release. For this purpose, attach pipe sections onto the levers and press them together to check whether the motor shaft can rotate freely.
19. Connect Bowden cable (not included in the scope of supply) and pull with approx. 420 N until the motor shaft can be freely rotated.

4 Mechanical installation

4.6 Assembly of the cover ring

Stop!

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

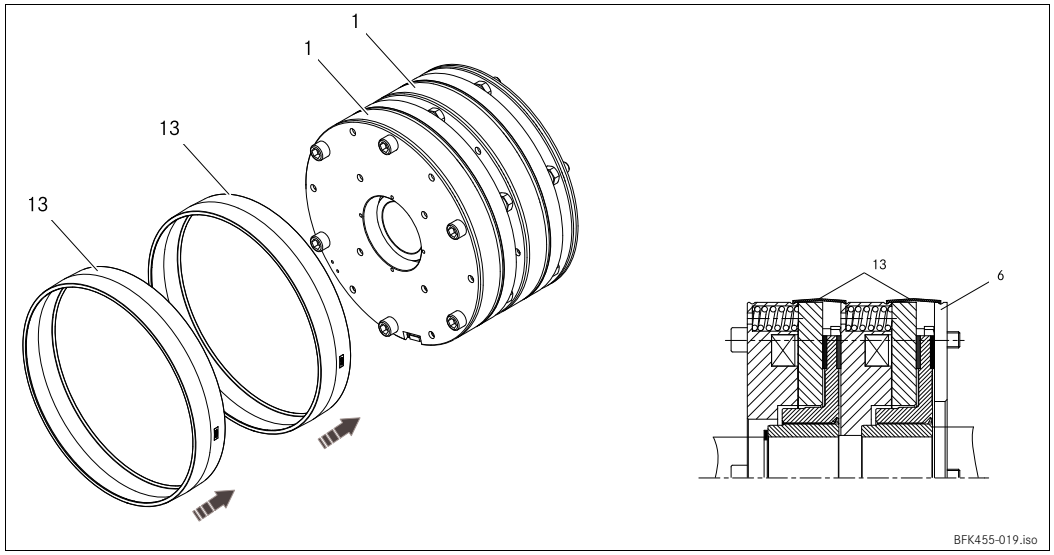


Fig. 19 Assembly of the cover ring

1 Complete stator 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. Establish electrical connection again.

Stop!

Cover seal with condensation drain hole:

Attach cover seal such that condensate can run off through hole.

5 Electrical installation

5.1 Electrical connection

5.1.1 Important notes

Danger!

- Electrical connection must only be carried out by skilled personnel!
- Connections must only be made when the equipment is de-energised! Danger through unintended starts or electric shocks.

Stop!

- It must be ensured that the supply voltage corresponds to the nameplate data.
- Voltages must be adapted to the local environment!

Stop!

- If emergency switching off is carried out without the required suppressor circuit, the control unit may be destroyed.
- Observe the correct polarity of the suppressor circuit!

Stop!

- For checking the individual braking circuits, it must be possible to switch off the power supply separately for each braking circuit. For a new overexcitation during switch-on, switches K1/K3 must be opened, too.
- The suppressor circuit included in INTORQ switchgear BEG-561-☐☐☐-☐☐☐ (terminals 3 and 4) must not be used in lift or hoist applications. In this case, the suppressor circuit must be connected in parallel to the brake coil, 🕮 36.

Stop!

- Only operate the brake with holding current reduction to 25 % P_{max}!
- For this purpose, use e.g. INTORQ switching device BEG-561-☐☐☐-☐☐☐.

5 Electrical installation

5.1.2 Circuit proposals

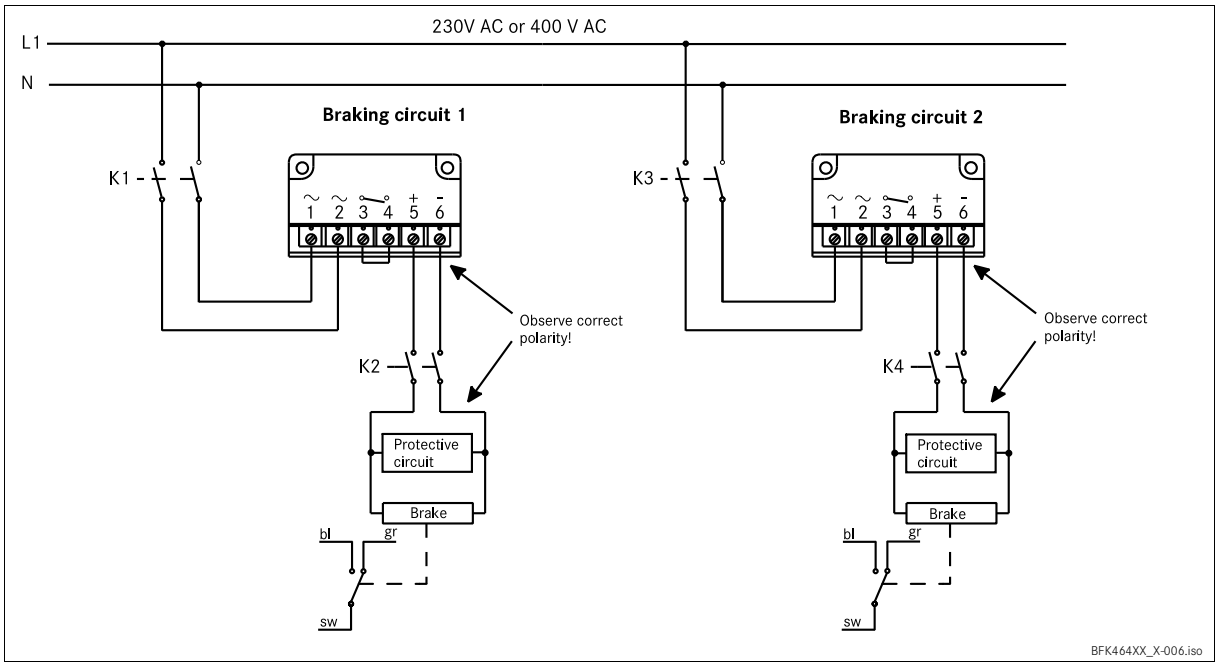


Fig. 20 INTORQ BFK455connection diagram

Switch-on

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

Switch-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

Note!

Recommended current load of the microswitches

- 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 operating times, 📖 17.

5.2 Bridge/half-wave rectifiers (option)

BEG-561-□□□-□□□

Bridge/half-wave rectifiers are used for the supply of electromagnetic spring-applied DC brakes which have been released for operation with such rectifiers. Any other use is only permitted with the explicit written approval of INTORQ.

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

5 Electrical installation

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

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

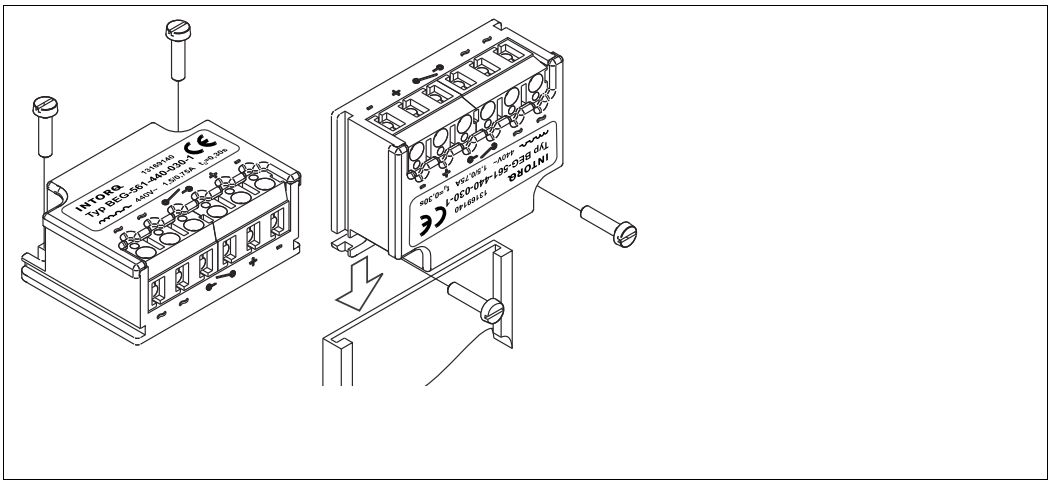


Fig. 21 BEG-561 attachment features

5.2.2 Technical data

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

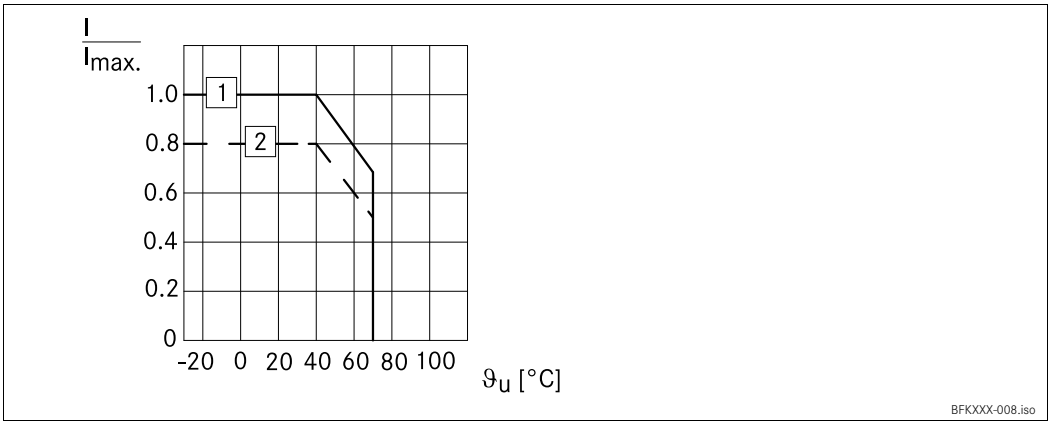
Type	Input voltage U_1 (40 Hz ... 60 Hz)			Max. current $I_{max.}$		Overexcitation time t_{ov} (±20%)		
	min. [V ~]	rated [V ~]	max. [V ~]	bridge [A]	half-wave [A]	with $U_{1\ min}$ [s]	with $U_{1\ rated}$ [s]	with $U_{1\ max}$ [s]
BEG-561-255-130	160	230	255	3.0	1.5	1.870	1.300	1.170
BEG-561-440-130	230	400	440	3.0	1.5	2.300	1.300	1.200

Input voltage U_1 (40 ... 60 Hz)

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

5 Electrical installation

5.2.3 Permissible current load - ambient temperature



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

5.3 Electrical connection

Danger!

The brake must only be electrically connected when no voltage is applied!

Tip!

Compare the coil voltage of the stator to the DC voltage of the installed rectifier.

6 Commissioning and operation

6.1 Important notes

Danger!

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 Operational check

Brake with microswitch

Danger!

The brake must be free of residual torque. The motor must not rotate.

Danger!

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 deenergise the motor.
   - Do not switch off the DC brake supply.

Stop!

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

3. Apply DC voltage to the brake.
4. Measure the AC voltage at the motor terminals. It must be zero.
5. Close the switching contact for the brake.
   - The brake is released.
6. Measure the DC voltage at the brake:
   - The DC voltage measured after the overexcitation time (see bridge/half-wave rectifier, 📖 36) must correspond to the holding voltage (see Tab. 5). A ±10 % deviation is permissible.
7. Check air gap "s_L".
   - It must be zero and the rotor must rotate freely.
8. Check the switch position of the microswitch (see Tab. 6).

6 Commissioning and operation

9. Open the switching contact for the brake.
   – The brake is applied.
10. Check the switch position of the microswitch (see Tab. 6).
11. Switch off DC voltage for the brake.
12. Bolt bridges to the motor terminals.
13. If necessary, remove neutral conductor from star point (step 2).

Contact type	Connection	Brake released	Microswitch closed
NC contact	black / grey	yes	no
		no	yes
NO contact	black / blue	yes	yes
		no	no

Tab. 6 Switching status of microswitch

The preparations for commissioning are completed.

6.3 Commissioning

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

6 Commissioning and operation

6.4 During operation

Danger!
The running rotor must not be touched.

Danger!
Live connections must not be touched.

- Check the brake regularly during operation. Take special care of:
  - unusual noises or temperatures
  - loose fixing elements
  - the condition of the electrical cables.
- The armature plate must be attracted and the rotor must move without residual torque.
- Measure the DC voltage at the brake.
  - The DC voltage measured after the overexcitation time (see bridge/half-wave rectifier, 📖 36) must correspond to the holding voltage (see Tab. 5). A ±10 % deviation is permissible.
- In the event of failures, refer to the troubleshooting table in chapter 8. If the fault cannot be eliminated, please contact the aftersales service.

7 Maintenance/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 the mechanical brake components are subject to function-related wear. For safe and trouble-free operation, the brake must be checked at regular intervals or, if necessary, be replaced, 🕮 43.

Stop!

Braking torque reduction

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 reduction of the braking torque.

The following table describes the different causes of wear and their effects on the components of the spring-applied brake. The important influencing factors must be quantified so that the service life of the rotor and brake can be calculated and that the maintenance intervals to be prescribed can be specified precisely. The most important factors in this context are the applied friction energy, the initial speed of braking and the operating frequency. If several of the causes of friction lining wear occur in an application at the same time, the influencing factors are to 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 counter friction face	Rubbing of brake lining	Run-in of armature plate and counter friction face	Friction work
Splining of brake rotor	Relative movements and shocks between brake rotor and brake shaft	Wear of splining (primarily on the rotor side)	Number of start/stop cycles
Brake support	Load alternation and jerks in the backlash between armature plate, sleeve bolts and guide bolt	Breaking of armature plate, sleeve bolts and guide bolt	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 Maintenance/repair

7.2 Inspections

To ensure safe and trouble-free operation, spring-applied brakes must be checked and maintained at regular intervals. Servicing can be made easier if good accessibility of the brakes is provided in the plant. This must be considered when installing the drives in the plant.

Primarily, the necessary maintenance intervals for industrial brakes result from the 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, we recommend a regular inspection at a fixed time interval. To reduce the cost, the inspection can be carried out along with other regular maintenance work in the plant if necessary.

If the brakes are not maintained, failures, production losses or damage to the system may occur. Therefore, a maintenance concept 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 below table must be provided. The maintenance operations must be carried out as described in the detailed descriptions.

7.2.1 Maintenance intervals

Type	Time interval			
BFK455-28	for service brakes:		for holding brakes with emergency stop:	
	▮ according to service life calculation ▮ or else every six months ▮ after 4000 operating hours at the latest		▮ at least every two years ▮ after 1 million cycles at the latest	
	Maintenance			
	Inspections if brake is built-on:		Inspections after brake has been removed:	
	▮ Check release function and control ▮ Measure air gap ▮ Measure rotor thickness (replace rotor, if necessary ▮ Thermal damage of armature plate or flange (dark-blue tarnishing)	📖 44 📖 45 📖 45	▮ Check clearance of the rotor gearing (replace worn-out rotors ▮ Play of torque plate at sleeve bolts and armature plate ▮ Check springs for damage ▮ Check armature plate and flange/end shield – Levelness < 0.1 mm – Max. run-in depth = rated air gap of brake size	📖 45

7 Maintenance/repair

7.2.2 Release / voltage

1. Start motor and control system!

Danger!
The running rotor must not be touched.

Danger!
Live connections must not be touched.

2. Observe air gap "s_L" during operation of the drive. The air gap must be zero.
3. Measure the DC voltage at the brake.
   - The DC voltage measured after the overexcitation time (see bridge/half-wave rectifier, 📖 36) must correspond to the holding voltage, 📖 37. A ±10 % deviation is permissible.

7.3 Maintenance operations

Note!
Brakes with defective armature plates, cheese head screws, springs or counter friction faces must always be replaced completely.
Generally observe the following for inspections and maintenance works:
- Remove oil and grease linked impurities using brake cleaning agents, if necessary, replace brake after identifying the cause of the contamination. Dirt deposits in the air gap between stator and armature plate impair the function of the brake and must be removed.
- After replacing the rotor, the original braking torque will not be reached until the run-in operation of the friction surfaces has been completed. After replacing the rotor, run-in armature plates and counter friction faces have an increased initial rate of wear.

7.3.1 Checking the rotor thickness

Danger!
The motor must not run during the check.

1. Stop motor and control system!
2. Remove the motor cover and seal ring, if mounted.
3. Measure the rotor thickness using a caliper gauge.
4. Compare the measured rotor thickness with the minimally permissible rotor thickness, 📖 16.
5. If necessary, replace the complete rotor. See 📖 45 for description.

7 Maintenance/repair

7.3.2 Checking the air gap

Danger!
The motor must not run during the check.

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

7.3.3 Rotor replacement

Danger!
The brake must be free of residual torque.

1. Switch off voltage!
2. Disconnect the supply cable.
3. Loosen the screws evenly and remove them completely.
4. Remove the complete stator from the end shield. Observe the supply cable.
5. Pull the complete rotor off the hub.
6. Check hub teeth.
7. Replace the hub as well if worn.
8. Check the friction surface at the end shield. In case of strong scoring at the flange, replace the flange. If scoring occurs at the end shield, re-finish end shield.
9. Measure rotor thickness (new rotor) and sleeve bolt head with a caliper gauge.
10. Calculate the gap between the stator and the armature plate as follows:

    Gap = rotor thickness + s_{LN} - head height

    "s_{LN}" 📖 16

11. Unscrew the sleeve bolts evenly until the calculated gap between stator and armature plate is reached.
12. Install and adjust new rotor and stator, 📖 23.
13. Reconnect the supply cable.

7 Maintenance/repair

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

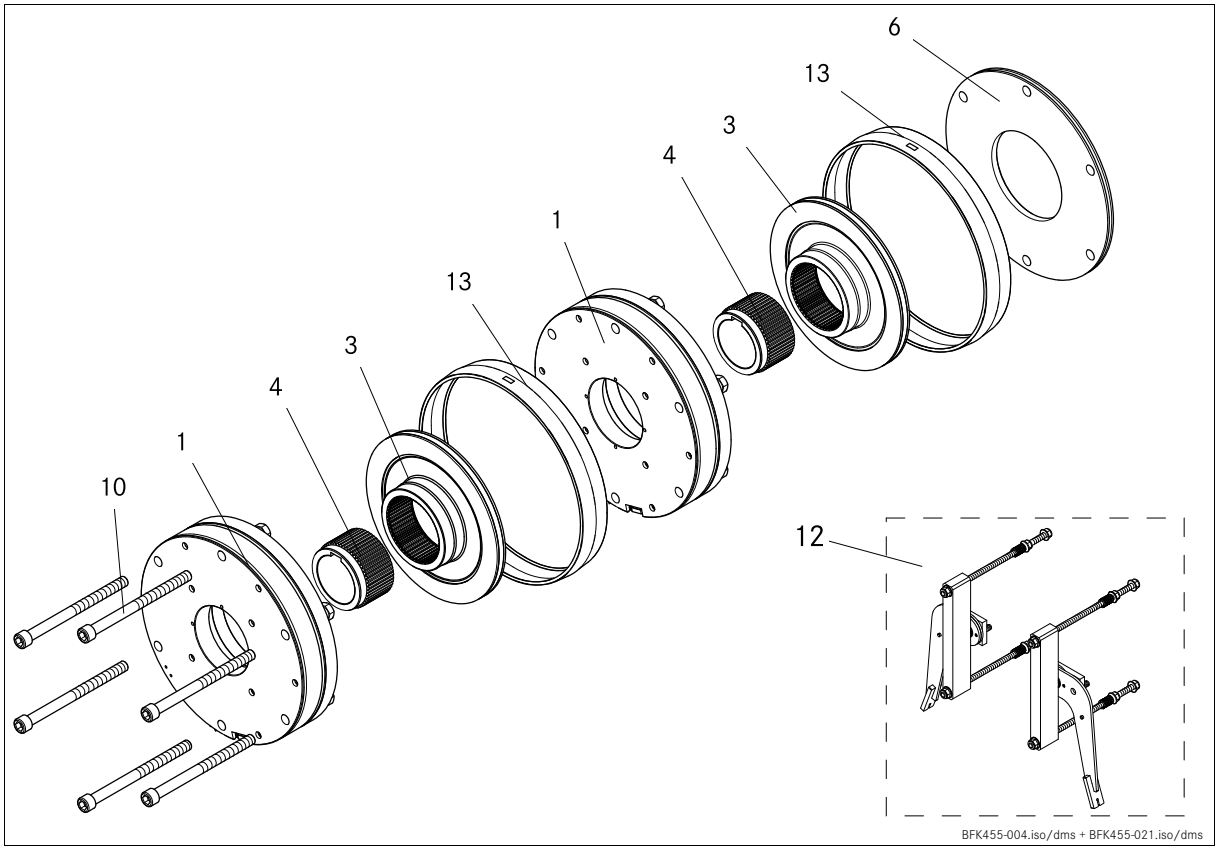


Fig. 22 BFK455-28 spring-applied brake

Pos.	Name	Variant
1	Complete stator	Voltage
3	Complete rotor Complete rotor, noise-reduced	
4	Hub	Bore diameter
6	Flange	
10	Fixing screws Cheese head screw set DIN912	for mounting to the motor for flange with through hole
12	Complete manual release	
13	Cover ring	

7 Maintenance/repair

7.5 Spare parts order

Complete stator

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

Component parts

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
Sealing	☐ Cover ring
Complete manual release	☐

Electrical accessories

Rectifier type: For 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 operation, please check the possible causes using the following table. If the fault cannot be eliminated by one of the listed measures, please contact the aftersales service.

Fault	Cause	Remedy
Brake cannot be released, air gap is not zero	Coil interruption	▮ Measure coil resistance using multimeter: – If resistance is too high, replace the complete stator.
	Coil has interturn fault or short circuit to ground	▮ Measure coil resistance using multimeter: – Compare measured resistance to rated resistance. For values, see 🕮 16. If the resistance is too low, replace the complete stator. ▮ Check coil for short circuit to ground using a multimeter: – Replace the complete stator if short circuit to ground is detected. ▮ Check brake voltage (see ”defective rectifier, voltage too low”).
	Wiring incorrect or defective	▮ Check and correct wiring. ▮ Check cable continuity using a multimeter: – Replace defective cable.
	Rectifier defective or wrong	▮ Measure rectifier DC voltage using a multimeter. If DC voltage is zero: ▮ Check AC rectifier voltage. If AC voltage is zero: – Apply voltage, – check fuse, – check wiring If AC voltage is ok: – Check rectifier – replace defective rectifier If DC voltage is too low: – Check rectifier – If diode is defective, use suitable new rectifier ▮ Check coil for fault between turns and 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 microswitch wiring	Check microswitch wiring and correct it.
	Incorrect microswitch setting	Replace the complete stator and complain about the incorrect microswitch setting to the manufacturer.
	Air gap too big	▮ For adjustable brakes: – Readjust air gap. ▮ For non-adjustable brakes: – Replace all rotors.
Rotor cannot rotate freely	Air gap s_L too small	Readjust air gap s_L 🕮 27.

8 Troubleshooting and fault elimination

Fault	Cause	Remedy
Rotor not thick enough	Rotor has not been replaced in time	Replace rotor (📖 45)
Voltage is not zero during functional test (6.2.2 or 6.2.3)	Incorrect microswitch wiring	Check microswitch wiring and correct it
	Defective microswitch or incorrect setting	Replace the complete stator and return complete defective unit to the manufacturer
Voltage too high	Brake voltage does not match the rectifier	Adapt rectifier and brake voltage to each other.
Voltage too low	Brake voltage does not match the rectifier	Adapt rectifier and brake voltage to each other.
	Defective rectifier diode	Replace rectifier by a suitable new one.
AC voltage is not mains voltage	Fuse is missing or defective	Select a connection with proper fusing.
	Incorrect microswitch wiring	Check microswitch wiring and correct it
	Defective microswitch or incorrect setting	Replace the complete stator and return complete defective unit to the manufacturer

Notes

Notes

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