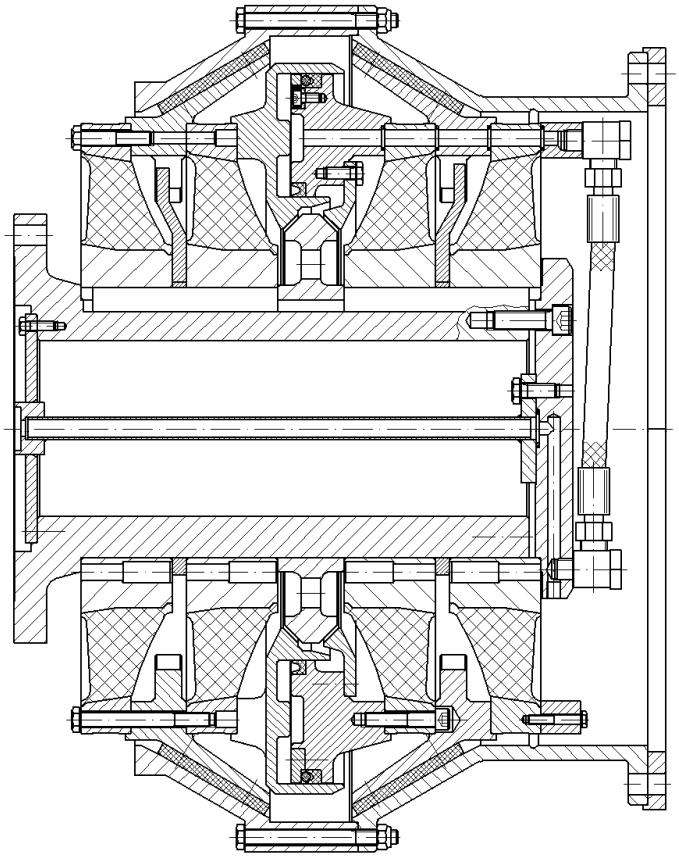
Operation Manual
Highly Elastic Friction Clutch
HESK



TÜV CERT EN ISO 9001

Made by:	Dipl.-Ing. M. Kunert	18/11/05	signed M. Kunert
Checked by:	Dr.-Ing. Ch. Spensberger	18/11/05	signed Ch. Spensberger
	name	date	signature

KWD Kupplungswerk Dresden GmbH
Löbtauer Straße 45 - D – 01159 Dresden
Postfach 270144 – D – 01172 Dresden
Tel.: + 49(0)351 – 4999-0 Fax: + 49(0)351 – 4999-233
kwd@kupplungswerk-dresden.de
http://www.kupplungswerk-dresden.de

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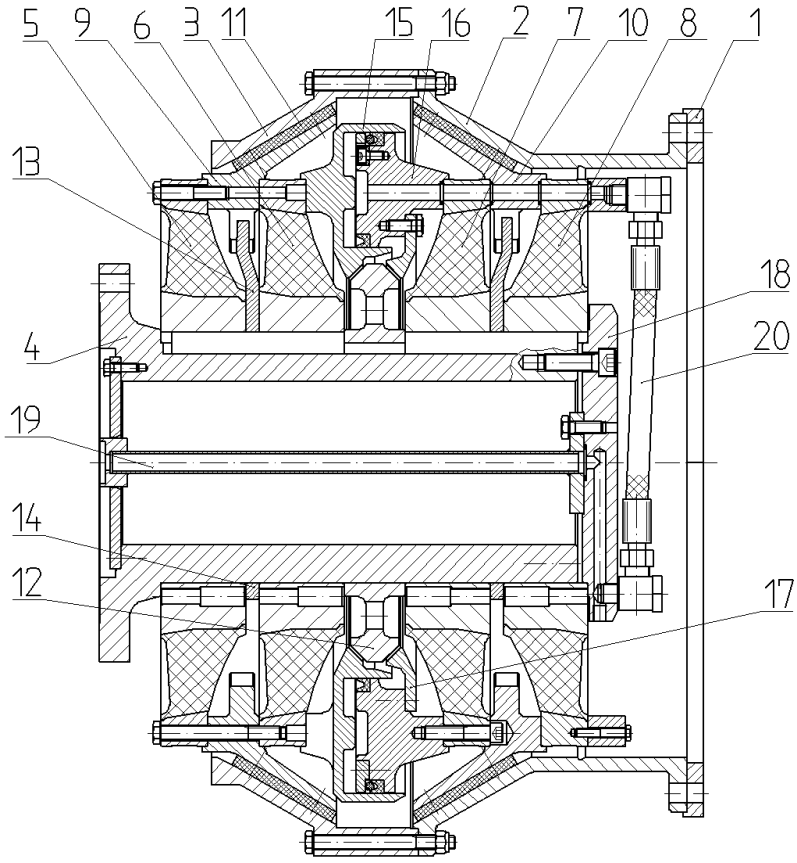
0 Safety and Information Symbols

Danger! **Danger of injury to personnel**

Attention! **Follow instructions**

This operating instruction does not include any information which can be presumed as basic knowledge for trained specialists and engine room staff.

1 Structure



1	Spacing collar, divided	12	Back-up ring
2	Conical casing	13	Stop ring (only for model with torsion limitation)
3	Conical casing		
4	Clutch hub	14	Spacing collar
5	Rubber element	15	Switching cylinder
6	Rubber element	16	Piston
7	Rubber element	17	Back-up disk
8	Rubber element	18	Clamp cover
9	Conical friction disk	19	Compressed-air line
10	Conical friction disk	20	Hose connection
11	Friction covering		

Figure 1 – Structure of Highly Elastic Friction Clutch

The highly elastic friction clutch HESK is a combination of a double-cone friction clutch and a highly flexible shaft-coupling. The circuit part consists of two inner and two outer friction cones, pressed one against the other pneumatically by a switching cylinder, while the elastic part is made of rubber elements connected to one another in pairs.

The outer part of the HESK consists of the conical casings 2 and 3, as well as the divided spacing collar 1.
Among other elements, the coupling's inner part is composed of the clutch hub 5, the rubber elements 5 to 8, the back-up ring 12 and either the stop rings 13 (model with torsion limitation) or the spacing collars 14 (model without torsion limitation).

The rubber elements 5 to 8 are connected

- outside: through the conical friction disks 9 and 10 and the switching piston 16 resp. the switching cylinder 15
- inside: through key with the clutch hub 4.

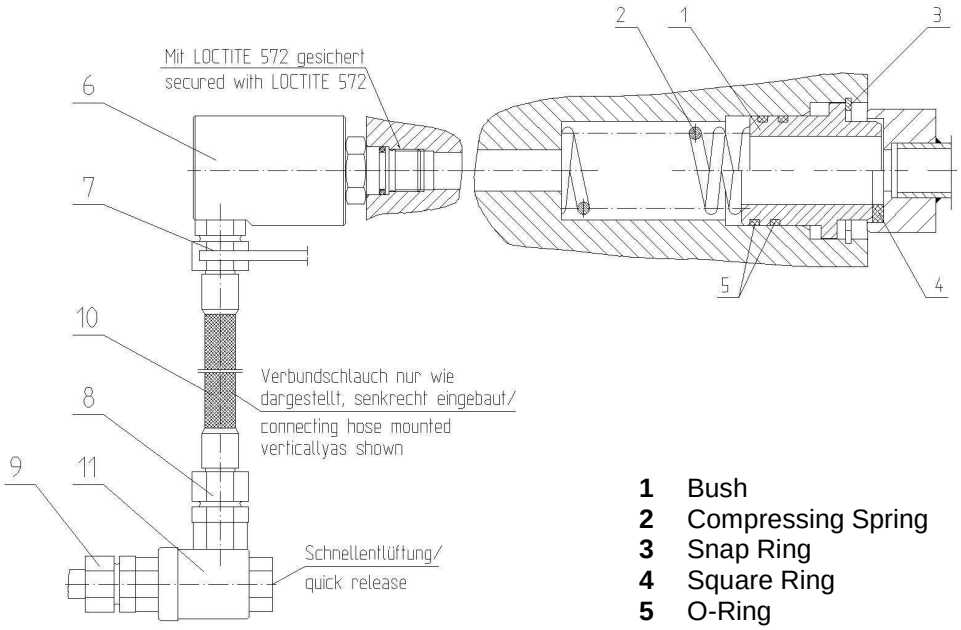
The compressed-air line is conducted through the clutch hub 4 and is connected with the hose connection 20 and the switching cylinder 15/16.

2 Function

2.1 Clutch

To engage the highly elastic friction clutch, compressed air is conducted through line 24 and the hose connection 73 and led to the switching cylinder 17/18 over a rotating air supply.
By rising pressure in the piston chamber, switching cylinder 15 and piston 16 press the friction disks 9 and 10, as well as the friction covering 11 fixed on them, in axial direction against the rubbing surface of the conical cases 2 and 3. The drive end of the coupling is now coupled by traction with the output end. Here, the torque is transmitted from the conical cases 2 and 3 through the friction covering 11, the friction disks 9 and 10 and the rubber elements 5 to 8 to the clutch hub 4. Thereby the axially prestressed rubber elements 5 to 8 are torsional loaded.
As the friction covering 11 are fixed onto the conical friction disks 9 and 10, they isolate the inside from the thermal flow and the frictional heat is well delivered to the ambient air by the conical cases 2 and 3. The large ventilation holes at the cases 2 and 3 bring about an ideal support of the heat dissipation due to the rotation.
To disengage the clutch, the switching cylinder 17/18 has to be vented. The friction disks 9 and 10 are taken back to the starting position without any additional elastic force, only by the restoring force of the rubber elements 5 to 8 axially tensioned before, while the disks are backed up on the one hand, through the switching cylinder 15 and on the other hand, through the back-up disk 17 at the back-up ring 12. The advantage is that though in switched –off condition, the inner parts of the clutch are axially and radially satisfactorily fixed with the clutch hub 4. Owing to that, a contactless running is guaranteed.
Concerning clutches with torsion limitation the angle of torsion is limited by two stops each, lying opposite to each other. The stops are located on the frictional disks 9 and 10 for outer parts and on the stop rings 13 for inner parts.

2.2 Central Air-Supply



1	Bush	**7**	Screwed-in Nozzle
2	Compressing Spring	**8**	Screwed-in Nozzle
3	Snap Ring	**9**	Screwed-in Nozzle
4	Square Ring	**10**	Hose Line
5	O-Ring	**11**	Quick release valve
6	Rotor Sealing		

Figure 2 – Central-Air-Supply

The compressed air is piped through the shaft being connected to the inner parts of the clutch. The helical compression spring presses the bush 1 with the o-rings 5 airtight onto the square ring 4 located in the compressed-air line of the clutch.
The air is supplied by the hose line 10 and the rotor sealing 6.
A quick release valve 11 is positioned between compressed air pipe and hose line to minimize disengage delay.

3 General Information

The clutch is delivered in an outside lacquered condition. Flanges, hub borings and flange surfaces are coated with an anti-corrosive wax.
The connections for the air lines, which are to be installed at the place of action, are closed by plugs.

3.1 Screw Tightening Torques

The following values are valid for dry mounting and turning by help of torque wrench only:

Thread diameter	M8	M10	M12	M14	M16	M20	M24	M30	M36	M42
Turning moment for screws 8.8 [Nm]	21	42	74	118	176	358	618	1216	2129	3394

Table 1

3.2 Liability

The producer is not liable for damages, which are caused **from no vault of his**, by the following reasons:

1. **the general and special information in this operation manual were not observed,**
2. **the service conditions do not match the requested ones,**
3. **there are any overloads;** e.g. by vibrations (work in critical speed range with exceeding of the permissible alternating torques); torque shocks, exceeding the permissible peak torques; or oiling of the frictional surfaces.

Besides the liability is excluded, if the **clutch** has been **opened without our agreement**. In case of the screwed connections between the outer parts of the clutch and the flange hub or the intermediate flange being unscrewed, this is not considered as an opening of the clutch.

4 Advices for Transport and Mounting

4.1 Transport

When transporting the coupling inside and outside the ship, care has to be taken that

- the **transport** principally has to be done **with hemp ropes**, not steel cables
- the clutch is **not fixed at the thin-walled flange of the conical casing** for transport
- the **conical cases 2 and 3** are **not exposed to impact or shock load** at any time
- the clutch is **put down** onto the flange of the conical case 2 **without any shock.**

4.2 General Description

Concerning ships' propelling plants, the alignment can only be done while the ship is in water and has absolutely no contact to the ground at all.

To ease the mounting it is recommended to solidly install a crane rail in the engine room above the clutch.
A main condition for a faultless running of the clutch is an accurate alignment of the propelling plant. The maximal tolerances of this alignment are to be found in **table 2.**

These values are to be observed by all means to keep the additional forces by displacement as low as possible.

4.3 Mounting of Clutch Hubs

In contrast to **image 1** the clutch can be delivered with hubs on the primary and the secondary side. At the beginning these components have to be mounted. Before bringing up, the hubs are to be heated. Hereby the temperature should differ by 40° concerning shafts with conical seatings and 100° concerning shafts with cylindrical ones. This procedure prevents a blowing-on by shocks and hard impacts, furthermore, neighboured bearings and wheels are being saved.

4.4 Alignment of the Clutch

The **alignment of the input to the output end** is done **without the clutch** (⇗ **image 3**).
If possible, the input and the output flange should be turned simultaneously and measured at the same points during the control of the alignment. Owing to this action, the measured values keep unaffected by possible true or plan running errors.

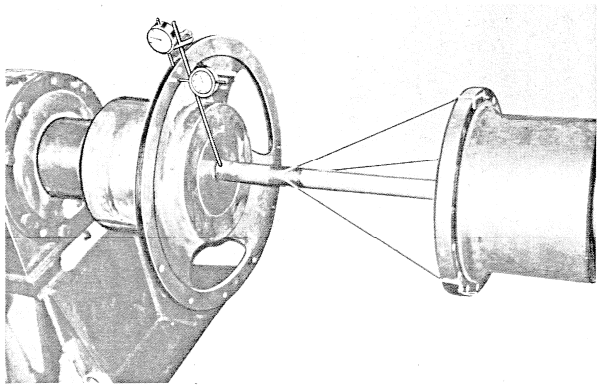


Figure 3 – **Alignment of input- and output flange by means of alignment aid**

Principally the **shafts** are to be **turned only in one direction when** they are **aligned**, since they can be shifted insignificantly on account of the bearing clearance when the direction of the rotation is changed. Thus errors of the determination of the angular displacement are avoided.
Connecting the coupling with shafts having a large overhang is not permitted. Slight overhang has to be equalized by roller blocks during the alignment.
Besides the control of true running and front running errors, the installation length has to be controlled, as well. For the permitted tolerances of the installation length “B” and the alignment deviations see **table 2**.

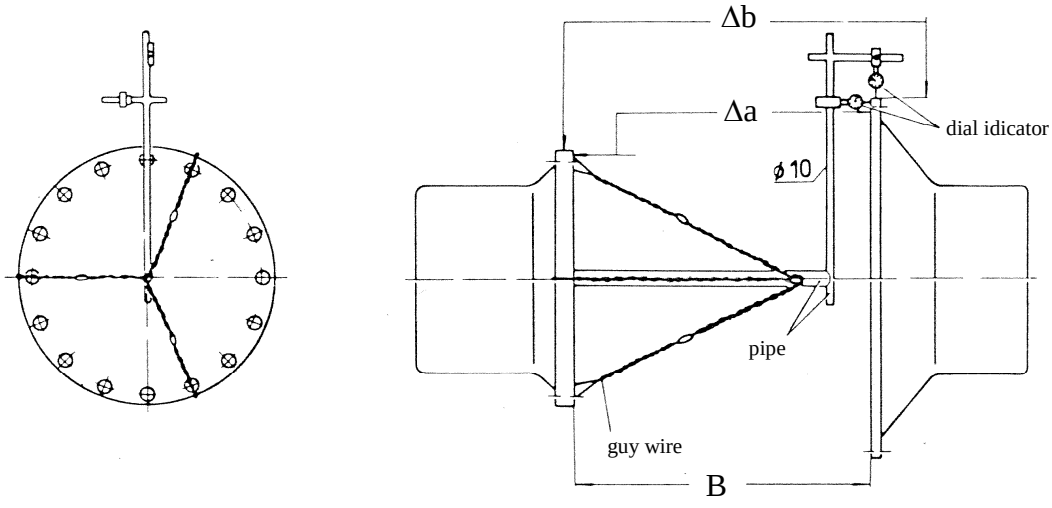


Figure 4 – Scheme of alignment aid

When aligning the installationt **displacements**, which could **develop during the work** have to be taken into consideration (preliminary compensation). A re-alignment is recommended when the double value of the permissible alignment errors Δa and Δb is reached.

Coupling size	HESK 70 to HESK 110	HESK 120 to HESK 180	HESK 200 to HESK 260	HESK 280 to HESK 340	HESK 360 to HESK 380
Alignment error Δa,Δb	0,12	0,15	0,20	0,25	0,30
Tolerance for B	-0,25	-0,3	-0,4	-0,5	-0,6
Perm. Dist. difference γ[1]	1,00	1,20	1,60	2,00	2,40

[1] ⇗ explication **page 11**

Table 2 – permissible alignment errors in mm

4.5 Pre-Assembly of the Central Air-Supply

Before mounting the clutch, the parts of central air-supply on clutch side has to be mounted into the drilled shaft and the faultless seating of the square ring 4 into air-pipe of clutch must be checked.

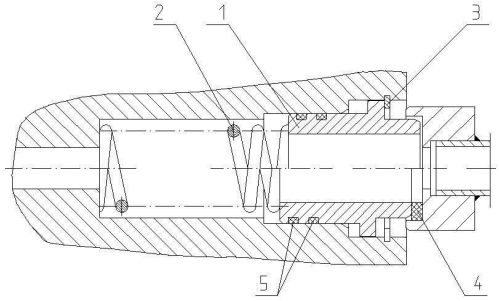


Figure 5 – **Pre-mounted parts of central air-supply**

4.6 Mounting of the Clutch

When the clutch is being installed the **pipe of the compressed-air line 19 is not permitted to overhang.** The mounting of the clutch can be done vertically.

The divided spacing collar is mounted at last (⇗ **Figure 6**).

The two halves of the spacing collar are to be braced that way, that the centring faces of spacing collar contact the centring faces of flanges. If there are no bracing screws included by the collar, the brace have to be done on the outer diameter.

After the screwing of the flange screws the external brace can be unfixed.

If couplings are supplied without flange hub or intermediate flange at the drive end, the dividing of the spacing collar without tensioning screws has to be done by the customer.

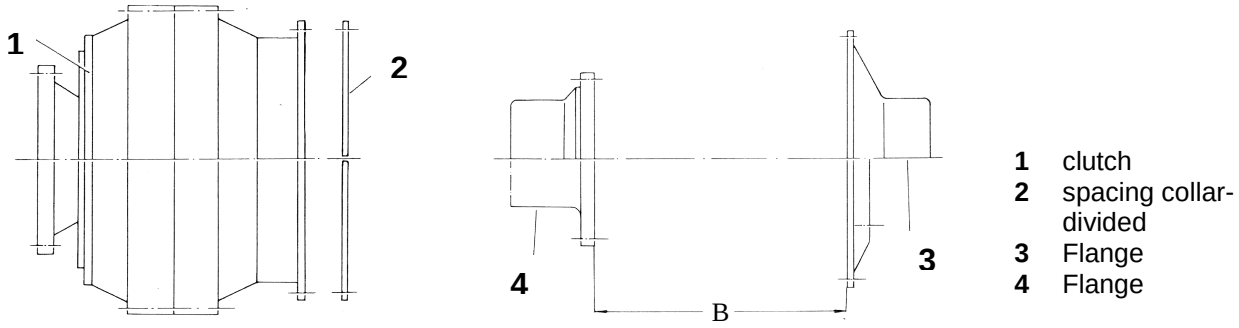


Figure 6 – clutch with spacing collar

After the installation of the bolted flanges at the input and the output end the **clutch** is to be **engaged several times in stillstand**. This switching can **only** be done, **provided that the outside parts of the clutch (conical cases)** have been **completely installed**, as the groove rings could be damaged otherwise. During this process the axial movement of the frictional disks must be watched through the sight holes in the outer part of the clutchg. Little movement arrestings can effect a temporarily different movement. That is insignificant. Nevertheless, the contact travel of both frictional disks is to be nearly equal in order to balance the axial restoring forces of the elastic elements. The measurement of the frictional disks' ways f must be done at three points of the circumference without turning the clutch. A faultless function of the coupling is guaranteed when the way difference of both frictional disks does not exceed the admissible way difference y (deviation of the average values of f_1 and f_2) stated in **table 2**. The differences between the single measurements to determine f_1; f_2 may not surpass the triple divergence of f_1; f_2 (⇗ t**able 3**).
It has to be checked, whether other parts of the plant (e.g. bearings) require less way differences.
If smaller way differences are necessary the position of the outer part of the clutch to the inner one can be changed by regrinding the divided spacing collar. The tolerances for installation and manufacturing are selected thus that a strengthening of the spacing collar is not necessary at all.
Since the mounting length of the clutch is adjusted by the producer with help of the spacing collar deviations of the collar's strength as given in the installation drawing are possible though not important.

4.7 Protective Casing

Having done the final check of the clutch possibly existing floor plates in its area have to be arranged thus that a check of the clutch is possible at any time without further problems.

The clutch is to get a **protective casing** providing that projecting parts (e.g. screw heads) can not be touched while the clutch is working. This casing has to be designed thus that the **heat developing at engaging can be well removed** and the **elastic ring elements are protected against oil contact**.

5 Commissioning

Before the first commissioning the function of the pneumatic remote control device has to be checked. Therefore look at the special operation manual.

Suitably the clutch should be switched several times with partial load and low speed. Afterwards the clutch can be shifted with the allowed maximum speed. After approximately 10 hours of work with full load, all screws have to be controlled and, if necessary, to be retightened.

5.1 Starting Speed

The differential speed between primary and secondary part during the switching process has a substantial effect on the service safety and the operating life of the clutch. **Switching at low speeds should always be aspired.** The maximal permissible starting speed is specially fixed for each service case. It is to be found at the inner door side of the switch cabinet of the pneumatic remote control device.

5.2 Skid Period

The skid period during the commissioning can be adjusted by the choke value of the pneumatic remote control device. The amount of the skid period to be adjusted is stated at the inner part of the door of the switch cabinet of the pneumatic remote control device, just as the maximal permissible starting speed. To simplify the adjustment there is given a time as a reference value how to choose the pressure built-up from 0 to 3 bar. The final period alignment of the pressure to build up should be performed after the end of the first trial switchings thus the procedure results in the prescribed skid period. This prescribed period is always valid for the maximal starting speed mentioned.

6 Maintenance

The maintenance of the clutch is confined to the examination of the wearout of the friction covering.

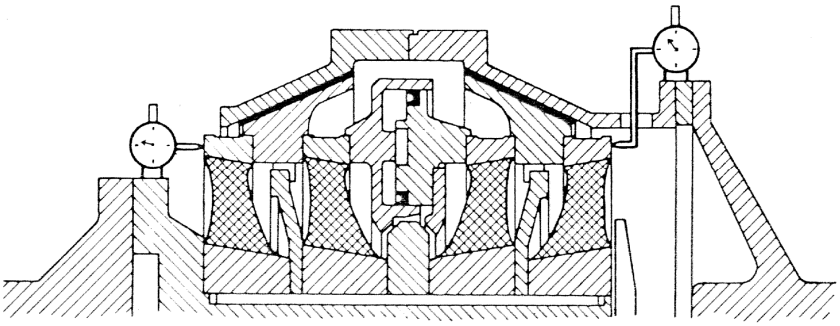


Figure 7 – Checking the thickness of the friction covering (measuring points)

The period between the individual tests depends on the switching frequency and the special service conditions at the different plants. That's why it should be fixed in each case individually.
After the clutch being mounted the **axial ways f_1 and f_2** are **documented** in the measuring list of the producer. **The axial limit of the shaft during operation has to be considered.**
The wearout control of the friction covering is performed at equal final position of the shafts. Hereby the increase of the axial ways f_1 or f_2 with regard to the values taken down after the mounting of the clutch is investigated.

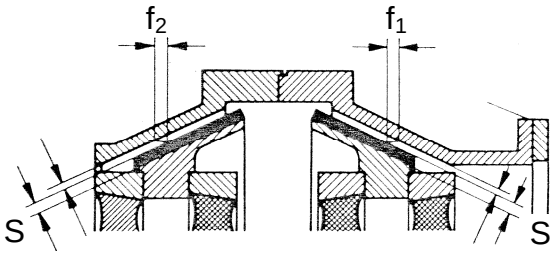


Figure 8 – Scheme of messurement values of axial way and friction covering thickness

The maximal permissible wearout is reached when the values documented after the installation has increased by Δf_1; Δf_2.

Coupling size	Friction covering thickness S	Normal ventilation[2] f_1; f_2 installation condition		Axial way[3] f_1 ; f_2 Production		Max. permissible increase[4] Δf_1; Δf_2
			Permissible deviation		Permissible deviation	
HESK 70	8	1,9	± 0,5	2,0	- 0,2	6
HESK 80		1,9		2,0		
HESK 90		2,1		2,2		
HESK 100		2,1		2,2		
HESK 110		2,3		2,4		
HESK 120		2,5	± 0,6	2,6		
HESK 140		2,7		2,8		
HESK 160	10	2,9		3,0	- 0,3	10
HESK 180		3,1		3,2		
HESK 200		3,5	± 0,8	3,6		
HESK 220		3,9		4,0		
HESK 240		4,3		4,4		
HESK 260		4,7		4,8		
HESK 280		5,1	± 1,0	5,2		
HESK 300	12	5,4		5,6	- 0,4	14
HESK 320		5,8		6,0		
HESK 340		6,4		6,6		
HESK 360		7,0	± 1,2	7,2		
HESK 380		7,6		7,8		

[2] averages of three values, compare **p.11**, considers the permissible way difference y und is obligatory for the installation condition
[3] individual value for the manufacturer
[4] corresponds to the wearout up to the minimal thickness of the friction covering = 5 mm

Table 3

This check-measurement of friction covering thickness have to be taken at three points of the circumference.
If that should not be possible without turning the clutch for mounting reasons the outer and/or the inner parts have to be turned ca. 120° e ach.
To evaluate the wearout of the friction coatings the average of the three values f_1 or f_2 is to be determined.

7 Emergency Screwing (Emergency Switching)

When the compressed air supply breaks down in cases of emergency the clutch can be engaged mechanically in a simple way. Before using the mechanical emergency switching the compressed air is to be switched of in order to avoid faulty switchings by compressed air coming back suddenly. The **safest way** avoiding faulty switchings would be to **separate the hose line from the rotor connection.**

Concerning multi-motor drives with collective gear all couplings are to be disconnected from the compressed air supply.

After having switched off the compressed air the following actions are to be observed:
The four short hexagon-head screws in the outer ring of the elastic ring elements at the output end must be screwed out. These screws posses passing threads up to the screw head and they are staggered on to the other by 90 ° (⇗ **Image 9**). There are four tapped holes at the same hole circle of the elastic ring element, which are specially marked by notches (Z) (⇗ **Image 10**).
The four hexagon-head screws are screwed into these tapped holes (⇗ **Image 11)**. They move the bolts with the packing rings in axial direction and press the switching piston as well as the switching cylinder, having the friction disks fixed on it, onto the conical cases. The frictional resistance transmission between the inner and the outer part is now achieved.

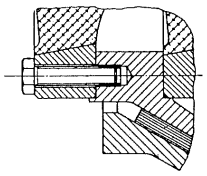


Figure 9

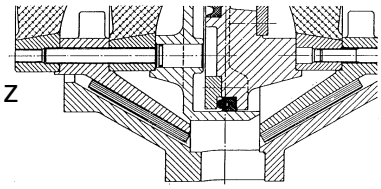


Figure 10

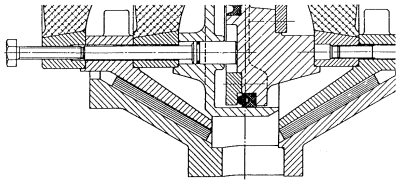


Figure 11

It is to be considered that the **hexagon-head screws are tightened equably crosswise** in order to avoid damages of the hub rings and the switching cylinder at any rate. These could appear by canting of one part against another.

By help of the emergency screwing the nominal torque (including the permissible superposed alternating torque) of the clutch can be transmitted. The required screw turning moments are to be found in **Table 4.**
If the emergency screwing is unscrewed attention is to be paid that the hexagon-head screws are unfastened in the same way as fastened, meaning equably.

Thread diameter	M10	M12	M14	M16	M20	M24	M30	M36
Tightening torque [Nm]	42	74	118	176	358	618	1216	2129

Table 4 – Tightening torque for emergency screwing

KWD Kupplungswerk Dresden GmbH
Löbtauer Straße 45 - D – 01159 Dresden
Postfach 270144 – D – 01172 Dresden
Tel.: + 49(0)351 – 4999-0 Fax: + 49(0)351 – 4999-233
kwd@kupplungswerk-dresden.de
http://www.kupplungswerk-dresden.de