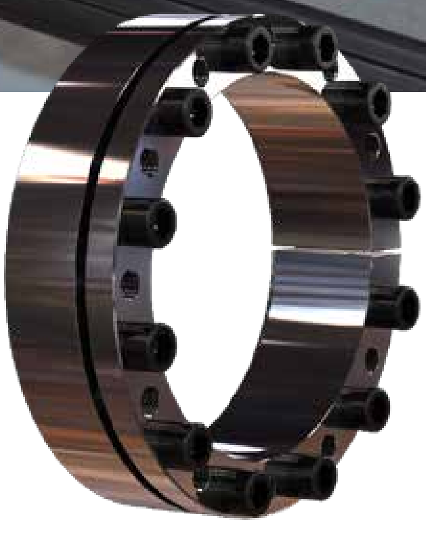
TAS SCHÄFER

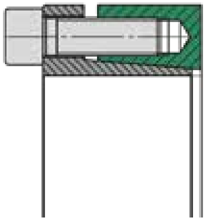


Internal Locking Devices

Shaft-Hub-Connection

Product overview

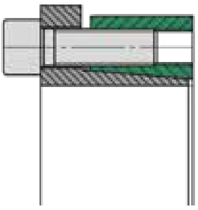
Shaft/ Hub-connections



3003 plus / 3003

For low torque transmission.
For medium bending moments
Short installation lenght

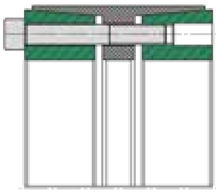
Page 124



3006 plus / 3006

For medium torque transmission.
For medium bending moments
Short installation lenght

Page 128



3012

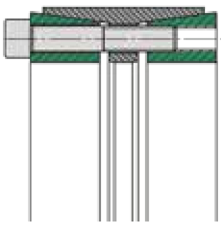
For very high torque transmission.
For high bending moments
Wide installation lenght

Page 132

3014

For high torque transmission
For medium bending moments
Wide installation lenght

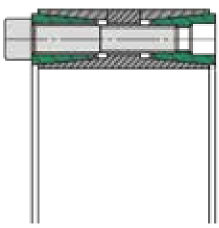
Page 134



RB,3015,3015.1

For medium torque transmission.
For medium bending moments
Average installation lenght

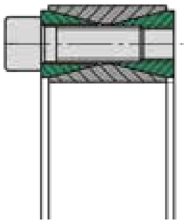
Page 136



3015 DK, 3015.1 DK

For high torque transmission.
For medium bending moments.
Average installation lenght

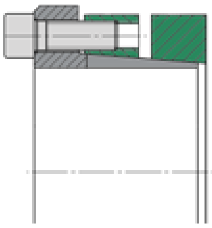
Page 142



3020

For high torque transmission
Low bending moment takes place
via the hub Short installation lenght

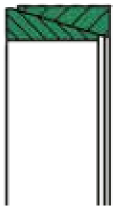
Page 146



4006

For very high torque transmission.
For very high bending moments.
Wide installation lenght (Especial-
ly for pulley)

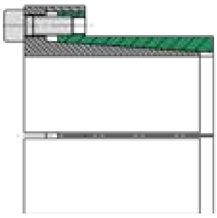
Page 150



8006
(Locking elements)

For low torque transmission
Small installation space

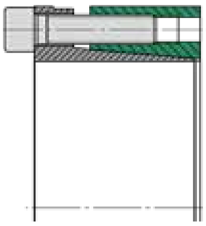
Page 154



TAS 110

For medium torque transmission.
For medium bending moments.
Small hub diameter

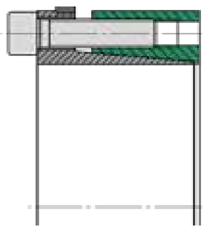
Page 158



TAS 130

For medium torque transmission.
For medium bending moments.
Average installation lenght

Page 160



TAS 131

For medium torque transmission.
For medium bending moments.
Average installation lenght

Page 160

Description of function

Locking devices of the types TAS ...

The main function of a locking assembly is the safe connection of a shaft to a hub by means of friction. For example, between a shaft and a gear hub. The locking assembly creates a play-free connection by expanding between the shaft and the hub. This type of connection is used mainly for transmitting torque.

It is installed by inserting the locking assembly between the components and the subsequent tightening of the screws. By using conical surfaces, the outer diameter increases and the inner diameter reduces. Radial pressure is built up. The clamping forces are provided and controlled by the screws (force-controlled). This allows the direct compensation of the clearance between shaft and hub.

The supplied locking devices are ready for installation.

To achieve proper operation with a sufficiently high coefficient of friction, the contact surfaces between shaft and hub must be clean and slightly oiled. Machine oil must be used as a lubricant. The functional surfaces of the locking assembly, threads and screw heads are prepared at the factory with oil film.

Product data

A detailed installation manual is available on our Homepage.

Data sheets

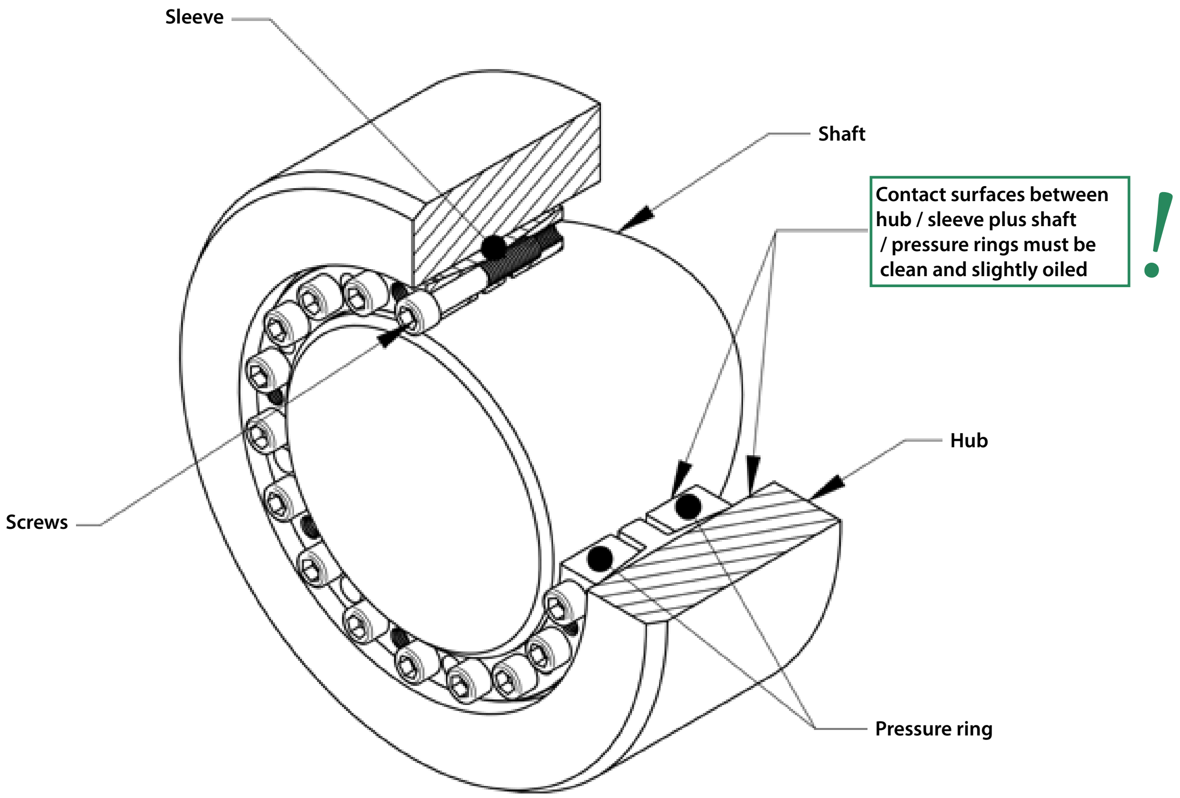
Contact us if a data sheet for an individual product is required.

- For CAD data of couplings, contact us directly, please.

Rolf Gertner
rolf.gertner@tas-schaefer.de

or

Mike Kemper
mike.kemper@tas-schaefer.de



Basic-Design

Clamping length for locking devices

Pressure rings and bush of a locking device must be fully supported on the shaft and in the hub bore.

Tightening torque of the clamping screws

The tightening torque values for screws given in the tables are based on a friction μ_{ges}= 0,14. Basically the specified tightening torque M_A can be reduced to M_{Agew} , to reduce the stresses in the components. When using soft materials, as well as bored shafts, it might become necessary. By reducing M_A , the pressures of P_N and P_W and the transmittable torque M_t are also reduced. The ratio is approximately proportional and can be converted accordingly (approximately):

$$M = \frac{M_{Agew}}{M_A} M_t \quad \text{and} \quad p_{N,W} = \frac{M_{Agew}}{M_A} p_{N,w}$$

The tightening torques can not be reduced arbitrary, therefore apply the following limits:

$$M_{Agew} \geq \left| \begin{array}{l} \text{Class } 8.8 : 0{,}85\, M_A \\ \text{Class } 10.9 : 0{,}70\, M_A \\ \text{Class } 12.9 : 0{,}60\, M_A \end{array} \right| \leq M_A$$

Locking assemblies of type RB, 3015.1 and 3015.1 DK are excluded because they are already provided with reduced values.

Tolerances and surfaces

The values found in the product data, base on surface quality and tolerances according to the tables there. These values are given as recommendations.

Higher surface roughness reduces the transmissible torque and promote unwanted settlings. Larger clearance also reduces the transmissible torque.

In case of significantly diffrent values, please contact us!

The calculation of the values, given in the catalog, are based on the following assumptions and simplification:

Transmissible torque

A connection by locking assembly is capable of transmitting torque, bending moment and axial force. Alternatively, the transmissible torque Mmax is specified in the product data. If such loads occur simultaneously, they must be added vectorially to form a resultant moment Mres. For the resultant moment applies:

$$M_{res} \leq M_{max}$$

At different load cases, these are individually checked against M_{max}!

M_{res} is determined for combined load as follows:

$$M_{res} = \sqrt{M_T{}^2 + 2M_B{}^2 + (F_{AX} \tfrac{dW}{2})^2}$$

*Basically the maximum bending moment corresponds to the maximum transmissible torque. A limitation is due to the change of the surface pressure at the edges of the connection, or by the higher loading of the locking assembly itself. Appropriate limits are found under each product. (See also under „bending moment“)

This results in the following relationships:

Torque only:
The maximum torque is equivalent to M_{max} .

Bending moment only:
The Bending moment coresponds with the indicated portion of M_T , on the product page.

Axial force only:
The maximum axial force is $M_{max} \frac{2}{d_W}$.

Depending on the application, additional safety factors need to be considered for the individual loads!

Basics-Calculation

Radial Force:

Radial forces cause a change in pressure at the contact surface. In the force direction, the pressure increases on one side and is reduced accordingly on the other side. This depends on the amount of radial forceand the rigidity of the parts. The following equation can be used to approximate the pressure change:

$$\Delta p_W = 0{,}75\,\frac{F_{AX}}{d_W\, l_K}$$

The modified pressures $p_{Wmin,\,max}$ results from the following equation:

$$p_{W_{min,\,max}} = p_W \pm \Delta p_W$$

The minimum pressure p_{Wmin} should be at least 30 N/mm² to avoid gap corrosion. In addition, the material must be selected for a maximum pressure p_{Wmax} .

Bending moment

Here the situation is similar to the radial forces. The pressure is greatest at the ends of the connection in this case. Again, the amount and stiffness are important. This leads to the following approximation:

$$\Delta p_{W,N} = 4{,}5\,\frac{M_B}{d_W\, l_K^2}$$

As before, the modified pressures results from:

$$p_{W,N\,min,\,max} = p_{W,N} \pm \Delta p_{W,N}$$

The conditions for minimum and maximum pressure are the same as before. It should be noted that there could be a change in pressure due to radial force!

Shaft and hub calculation

The catalogue contains information about the generated surface pressure of each locking assembly. Due to the generated radial pressure the hub is deformed, whereupon resilience of the shaft and surface smoothing still has to be added. For solid shafts resilience is negligible but has to be considered for hollow shafts. They are showing greater deformation and therefore greater stresses. This should be considered in addition to the other loads.

The equivalent stresses in the hub can be determined according to various hypotheses such as GEH. On the following pages you will find tables showing required hub sizes, taking pressure, shape and yield strength of hub material into consideration. The shown values for hub sizes are only valid for a solid hub cross-section! The calculation is simplified, includes no additional safety and covers the range of static loads only. Various calculation methods for different cases can be found in mechanical-engineering literature. Specialized software allows the same. For complex geometry reliable results can be determined only by verified FEA.

The minimum yield strength of solid shafts should be at least 2 * PW , the yield point of hub material at least 1 * PN. These values are for orientation only, represent minimum requirements and cannot replace calculations for each application! They also do not release from doing so!

Notch effect

Generally there is a notch effect on the components, caused by the radial pressure of the locking device. This depends mainly on the applied pressure. On the shaft the notch effect is usually much higher than at the hub, as the pressure is higher here. The factors are in the range of 1.2 to 1.8 at the shaft. This can, for example, be mitigated by appropriate design details, such as relief notches.

Bore in the shaft (Hollow shaft)

A large bore d_B in the shaft or use of a hollow shaft, reduces the stiffness of this component against radial pressure. Basically, a bore should not be greater than 0,3 d_W.

Hub-Calculation

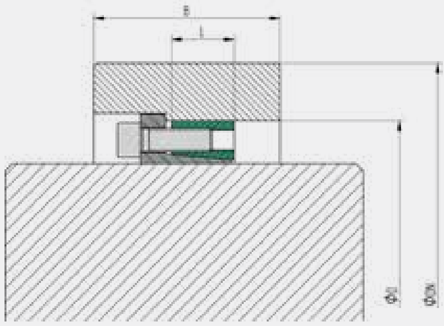
The K-Values can directly be taken from the tables or can be calculated as follows:

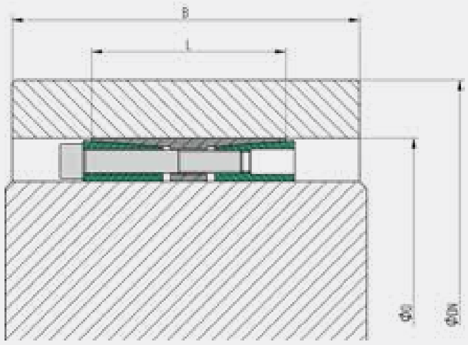
When using TAS Locking assemblies a tension is generated by the surface pressure PN between locking assembly and hub. The required hub diameter is calculated using the same formula, as used for thick-walled hollow cylinder. The real tensions depend on the hub length and shape with respect to the length L of the locking assemblies. Depending on the type of hub, the factor C is taken into account for calculation.

$$D_N \geq D \cdot K \qquad K = \sqrt{\frac{\sigma_{02} + (C \cdot p_n)}{\sigma_{02} - (C \cdot p_n)}}$$

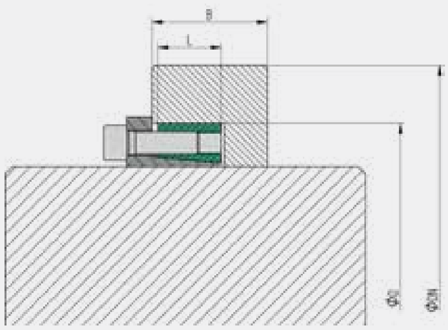
B = ≥ 2 L

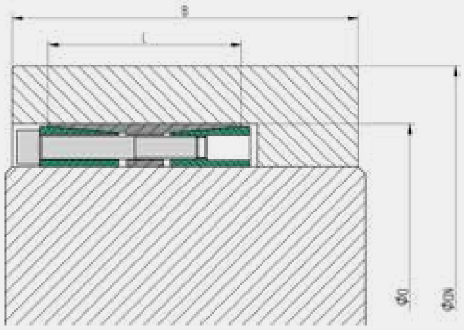
C = 0,6





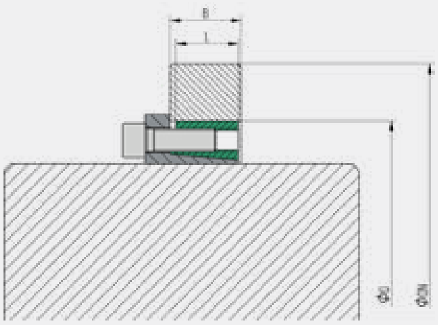
C = 0,8

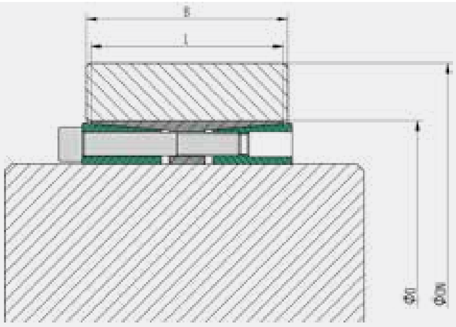




B = ≥ L

C = 1,0





Hub Outside Diameter

p_N N/mm²	K-Factor for hubtype with C = 0,6 Yield strength hubmaterial (N/mm²)										
	150	180	210	240	270	300	330	360	390	420	450
50	1,225	1,184	1,155	1,134	1,119	1,106	1,096	1,088	1,081	1,075	1,070
55	1,251	1,204	1,172	1,149	1,131	1,117	1,106	1,097	1,089	1,082	1,077
60	1,278	1,225	1,190	1,164	1,144	1,129	1,116	1,106	1,097	1,090	1,084
65	1,305	1,247	1,207	1,179	1,157	1,140	1,127	1,115	1,106	1,098	1,091
70	1,334	1,269	1,225	1,194	1,170	1,152	1,137	1,125	1,115	1,106	1,099
75	1,363	1,291	1,244	1,209	1,184	1,164	1,148	1,134	1,123	1,114	1,106
80	1,394	1,315	1,262	1,225	1,197	1,176	1,158	1,144	1,132	1,122	1,114
85	1,425	1,339	1,282	1,241	1,211	1,188	1,169	1,154	1,141	1,130	1,121
90	1,458	1,363	1,301	1,258	1,225	1,200	1,180	1,164	1,150	1,139	1,129
95	1,492	1,389	1,322	1,274	1,240	1,213	1,191	1,174	1,159	1,147	1,136
100	1,528	1,415	1,342	1,291	1,254	1,225	1,202	1,184	1,168	1,155	1,144
105	1,565	1,442	1,363	1,309	1,269	1,238	1,214	1,194	1,177	1,164	1,152
110	1,604	1,469	1,385	1,327	1,284	1,251	1,225	1,204	1,187	1,172	1,160
115	1,645	1,498	1,407	1,345	1,299	1,264	1,237	1,215	1,196	1,181	1,168
120	1,688	1,528	1,430	1,363	1,315	1,278	1,249	1,225	1,206	1,190	1,176
125	1,733	1,559	1,453	1,382	1,331	1,291	1,261	1,236	1,215	1,198	1,184
130	1,780	1,591	1,478	1,402	1,347	1,305	1,273	1,247	1,225	1,207	1,192
135	1,830	1,624	1,502	1,421	1,363	1,319	1,285	1,258	1,235	1,216	1,200
140	1,883	1,659	1,528	1,442	1,380	1,334	1,298	1,269	1,245	1,225	1,208
145	1,940	1,695	1,554	1,462	1,397	1,348	1,310	1,280	1,255	1,234	1,217
150	-	1,733	1,582	1,484	1,415	1,363	1,323	1,291	1,265	1,244	1,225
155	-	1,772	1,610	1,506	1,433	1,378	1,336	1,303	1,276	1,253	1,234
160	-	1,813	1,639	1,528	1,451	1,394	1,350	1,315	1,286	1,262	1,242
165	-	1,856	1,669	1,551	1,469	1,409	1,363	1,327	1,297	1,272	1,251
170	-	1,902	1,700	1,575	1,489	1,425	1,377	1,339	1,308	1,282	1,260
175	-	1,950	1,733	1,599	1,508	1,442	1,391	1,351	1,318	1,291	1,269
180	-	-	1,766	1,624	1,528	1,458	1,405	1,363	1,329	1,301	1,278
185	-	-	1,801	1,650	1,548	1,475	1,420	1,376	1,341	1,311	1,287
190	-	-	1,838	1,677	1,569	1,492	1,434	1,389	1,352	1,322	1,296
195	-	-	1,876	1,704	1,591	1,510	1,449	1,402	1,363	1,332	1,305
200	-	-	1,915	1,733	1,613	1,528	1,464	1,415	1,375	1,342	1,315
205	-	-	1,957	1,762	1,636	1,546	1,480	1,428	1,387	1,353	1,324
210	-	-	-	1,792	1,659	1,565	1,496	1,442	1,399	1,363	1,334
215	-	-	-	1,824	1,683	1,584	1,512	1,455	1,411	1,374	1,344
220	-	-	-	1,856	1,707	1,604	1,528	1,469	1,423	1,385	1,353
225	-	-	-	1,890	1,733	1,624	1,545	1,484	1,435	1,396	1,363
230	-	-	-	1,926	1,759	1,645	1,562	1,498	1,448	1,407	1,373
235	-	-	-	1,962	1,785	1,666	1,579	1,513	1,461	1,419	1,383
240	-	-	-	-	1,813	1,688	1,597	1,528	1,474	1,430	1,394
245	-	-	-	-	1,842	1,710	1,615	1,543	1,487	1,442	1,404
250	-	-	-	-	1,871	1,733	1,633	1,559	1,500	1,453	1,415

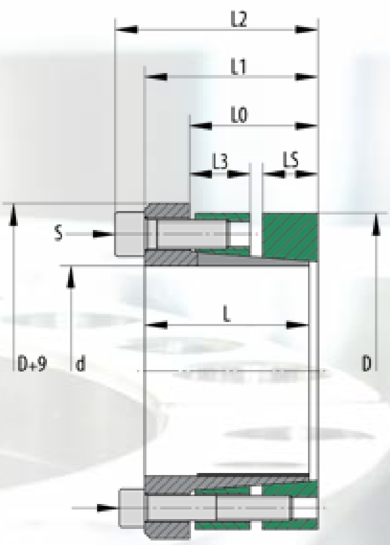
Hub Outside Diameter

	K-Factor for hubtype with C = 0,8										
p_N	Yield strength hubmaterial (N/mm²)										
N/mm²	150	180	210	240	270	300	330	360	390	420	450
50	1,315	1,254	1,213	1,184	1,161	1,144	1,130	1,119	1,109	1,101	1,094
55	1,353	1,284	1,237	1,204	1,179	1,160	1,144	1,131	1,120	1,111	1,104
60	1,394	1,315	1,262	1,225	1,197	1,176	1,158	1,144	1,132	1,122	1,114
65	1,436	1,347	1,288	1,247	1,216	1,192	1,173	1,157	1,144	1,133	1,124
70	1,481	1,380	1,315	1,269	1,235	1,208	1,187	1,170	1,156	1,144	1,134
75	1,528	1,415	1,342	1,291	1,254	1,225	1,202	1,184	1,168	1,155	1,144
80	1,578	1,451	1,370	1,315	1,274	1,242	1,218	1,197	1,181	1,166	1,154
85	1,631	1,489	1,400	1,339	1,294	1,260	1,233	1,211	1,193	1,178	1,165
90	1,688	1,528	1,430	1,363	1,315	1,278	1,249	1,225	1,206	1,190	1,176
95	1,748	1,569	1,461	1,389	1,336	1,296	1,265	1,240	1,219	1,201	1,186
100	1,813	1,613	1,494	1,415	1,358	1,315	1,281	1,254	1,232	1,213	1,197
105	1,883	1,659	1,528	1,442	1,380	1,334	1,298	1,269	1,245	1,225	1,208
110	1,960	1,707	1,563	1,469	1,403	1,353	1,315	1,284	1,259	1,237	1,220
115	2,043	1,759	1,600	1,498	1,427	1,373	1,332	1,299	1,272	1,250	1,231
120	2,135	1,813	1,639	1,528	1,451	1,394	1,350	1,315	1,286	1,262	1,242
125	2,237	1,871	1,679	1,559	1,476	1,415	1,368	1,331	1,300	1,275	1,254
130	2,350	1,934	1,722	1,591	1,502	1,436	1,386	1,347	1,315	1,288	1,266
135	2,479	2,000	1,766	1,624	1,528	1,458	1,405	1,363	1,329	1,301	1,278
140	2,626	2,073	1,813	1,659	1,555	1,481	1,424	1,380	1,344	1,315	1,290
145	2,798	2,151	1,863	1,695	1,584	1,504	1,444	1,397	1,359	1,328	1,302
150	-	2,237	1,915	1,733	1,613	1,528	1,464	1,415	1,375	1,342	1,315
155	-	2,330	1,971	1,772	1,643	1,553	1,485	1,433	1,391	1,356	1,327
160	-	2,434	2,031	1,813	1,675	1,578	1,506	1,451	1,407	1,370	1,340
165	-	2,550	2,094	1,856	1,707	1,604	1,528	1,469	1,423	1,385	1,353
170	-	2,680	2,163	1,902	1,741	1,631	1,550	1,489	1,440	1,400	1,367
175	-	2,829	2,237	1,950	1,776	1,659	1,573	1,508	1,457	1,415	1,380
180	-	-	2,316	2,000	1,813	1,688	1,597	1,528	1,474	1,430	1,394
185	-	-	2,403	2,054	1,852	1,717	1,621	1,548	1,492	1,446	1,408
190	-	-	2,499	2,111	1,892	1,748	1,646	1,569	1,510	1,461	1,422
195	-	-	2,604	2,172	1,934	1,780	1,672	1,591	1,528	1,478	1,436
200	-	-	2,721	2,237	1,978	1,813	1,698	1,613	1,547	1,494	1,451
205	-	-	2,852	2,306	2,024	1,848	1,726	1,636	1,566	1,511	1,466
210	-	-	-	2,381	2,073	1,883	1,754	1,659	1,586	1,528	1,481
215	-	-	-	2,462	2,124	1,921	1,783	1,683	1,606	1,546	1,496
220	-	-	-	2,550	2,179	1,960	1,813	1,707	1,627	1,563	1,512
225	-	-	-	2,646	2,237	2,000	1,844	1,733	1,648	1,582	1,528
230	-	-	-	2,752	2,298	2,043	1,877	1,759	1,670	1,600	1,544
235	-	-	-	2,869	2,364	2,088	1,910	1,785	1,692	1,619	1,561
240	-	-	-	-	2,434	2,135	1,945	1,813	1,715	1,639	1,578
245	-	-	-	-	2,510	2,184	1,982	1,842	1,738	1,659	1,595
250	-	-	-	-	2,592	2,237	2,020	1,871	1,763	1,679	1,613

Hub Outside Diameter

p_N	K-Factor for hubtype with C = 1,0										
	Yield strength hubmaterial (N/mm²)										
N/mm²	150	180	210	240	270	300	330	360	390	420	450
50	1,415	1,331	1,275	1,236	1,207	1,184	1,165	1,151	1,138	1,128	1,119
55	1,469	1,372	1,308	1,263	1,230	1,204	1,184	1,167	1,153	1,141	1,131
60	1,528	1,415	1,342	1,291	1,254	1,225	1,202	1,184	1,168	1,155	1,144
65	1,591	1,460	1,378	1,321	1,279	1,247	1,221	1,201	1,184	1,169	1,157
70	1,659	1,508	1,415	1,351	1,304	1,269	1,241	1,218	1,199	1,184	1,170
75	1,733	1,559	1,453	1,382	1,331	1,291	1,261	1,236	1,215	1,198	1,184
80	1,813	1,613	1,494	1,415	1,358	1,315	1,281	1,254	1,232	1,213	1,197
85	1,902	1,671	1,537	1,449	1,386	1,339	1,302	1,273	1,248	1,228	1,211
90	2,000	1,733	1,582	1,484	1,415	1,363	1,323	1,291	1,265	1,244	1,225
95	2,111	1,799	1,629	1,520	1,445	1,389	1,345	1,311	1,283	1,259	1,240
100	2,237	1,871	1,679	1,559	1,476	1,415	1,368	1,331	1,300	1,275	1,254
105	2,381	1,950	1,733	1,599	1,508	1,442	1,391	1,351	1,318	1,291	1,269
110	2,550	2,036	1,789	1,641	1,542	1,469	1,415	1,372	1,337	1,308	1,284
115	2,752	2,131	1,850	1,686	1,577	1,498	1,439	1,393	1,356	1,325	1,299
120	3,000	2,237	1,915	1,733	1,613	1,528	1,464	1,415	1,375	1,342	1,315
125	3,317	2,355	1,986	1,782	1,651	1,559	1,490	1,437	1,395	1,360	1,331
130	3,742	2,490	2,062	1,835	1,691	1,591	1,517	1,460	1,415	1,378	1,347
135	4,359	2,646	2,145	1,890	1,733	1,624	1,545	1,484	1,435	1,396	1,363
140	5,386	2,829	2,237	1,950	1,776	1,659	1,573	1,508	1,457	1,415	1,380
145	7,682	3,048	2,337	2,014	1,823	1,695	1,603	1,533	1,478	1,434	1,397
150	-	3,317	2,450	2,082	1,871	1,733	1,633	1,559	1,500	1,453	1,415
155	-	3,661	2,577	2,156	1,923	1,772	1,665	1,585	1,523	1,474	1,433
160	-	4,124	2,721	2,237	1,978	1,813	1,698	1,613	1,547	1,494	1,451
165	-	4,796	2,887	2,324	2,036	1,856	1,733	1,641	1,571	1,515	1,469
170	-	5,917	3,083	2,421	2,098	1,902	1,768	1,671	1,596	1,537	1,489
175	-	8,427	3,317	2,527	2,165	1,950	1,806	1,701	1,622	1,559	1,508
180	-	-	3,606	2,646	2,237	2,000	1,844	1,733	1,648	1,582	1,528
185	-	-	3,975	2,780	2,314	2,054	1,885	1,765	1,675	1,605	1,548
190	-	-	4,473	2,933	2,398	2,111	1,928	1,799	1,703	1,629	1,569
195	-	-	5,197	3,110	2,490	2,172	1,973	1,835	1,733	1,654	1,591
200	-	-	6,404	3,317	2,592	2,237	2,020	1,871	1,763	1,679	1,613
205	-	-	9,111	3,566	2,704	2,306	2,069	1,910	1,794	1,705	1,636
210	-	-	-	3,873	2,829	2,381	2,122	1,950	1,826	1,733	1,659
215	-	-	-	4,267	2,970	2,462	2,177	1,992	1,860	1,760	1,683
220	-	-	-	4,796	3,131	2,550	2,237	2,036	1,895	1,789	1,707
225	-	-	-	5,568	3,317	2,646	2,300	2,082	1,931	1,819	1,733
230	-	-	-	6,856	3,536	2,752	2,367	2,131	1,969	1,850	1,759
235	-	-	-	9,747	3,799	2,869	2,439	2,182	2,009	1,882	1,785
240	-	-	-	-	4,124	3,000	2,517	2,237	2,050	1,915	1,813
245	-	-	-	-	4,539	3,148	2,601	2,294	2,093	1,950	1,842
250	-	-	-	-	5,100	3,317	2,693	2,355	2,139	1,986	1,871

4006



Used symbols

d [mm]	Shaft diameter
D [mm]	Hub inside diameter
Mt1 [Nm]	Max. transmittable torque pressure ring 1
Fax1 [kN]	Max. transmittable axial force pressure ring 1
Mt2 [Nm]	Max. transmittable torque pressure ring 2
Fax2 [kN]	Max. transmittable axial force pressue ring 2
Mt1+2	[Nm] Entire transmittable torque Fax = 0
Fax1+2	[kN] Entire transmittable axial force Mt = 0
pW1 [N/mm2]	Average pressure on the shaft
pN1 [N/mm2]	Average pressure on the hub 1
pW2 [N/mm2]	Average pressure on the shaft
pN2 [N/mm2]	Average pressure on the hub 2
L [mm]	Lenght of the sleeve
L0 [mm]	Distance pressure ring 2
L1 [mm]	Width of the locking device without screws
L2 [mm]	Width of the locking device with screws
L3 [mm]	Distance pressure ring 1
LS [mm]	Width of the pressure rings
Z1 & Z2	Number of clamping screws
S1 & S2	Size of the clamping screws
MA1 & MA2	Tightening torque of the clamping screws

Empfohlene Toleranzen & Oberflächen

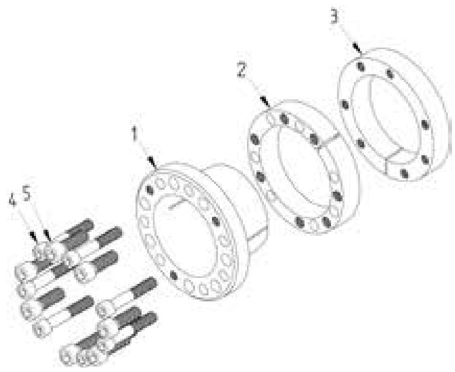
Shaft	h8 / Rz 10
Hub	H8 / Rz 10

Biegebelastung

Bending moment (share)	MB max = 0,6 * Mt
Bending angle	max. 5`

More properties

- no axial displacement during assembly
- very good self-centering
- high self-locking



Pos.	Designation
1	Sleeve
2	Pressure ring 1
3	Pressure ring 2
4	Screw S_2
5	Screw S_1

Ordering information: **TAS 4006/d/D** (e.g: TAS 4006/030/060 ... further sizes on request)

4006

d mm		D mm	M_{t1} Nm	F_{ax1} kN	M_{t2} Nm	F_{ax2} kN	M_{t1+2} Nm	F_{ax1+2} kN	p_{W1} N/mm²	p_{N1} N/mm²	p_{W2} N/mm²	p_{N2} N/mm²	Z_1 Pcs.	S_1	M_{A1} Nm	Z_2 Pcs.	S_2	M_{A2} Nm	L mm	L_0 mm	L_1 mm	L_2 mm	L_3 mm	L_s mm	Weight kg
30	x	**60**	623	42	342	23	**965**	**64**	245	124	134	67	4	M8x25	41	4	M6x40	17	45	36	48	56	18	15	0,95
35	x	**65**	727	42	499	29	**1226**	**70**	210	115	144	78	4	M8x25	41	5	M6x40	17	45	36	48	56	18	15	1,00
40	x	**70**	1039	52	570	29	**1609**	**80**	230	133	126	72	5	M8x25	41	5	M6x40	17	45	36	48	56	18	15	1,12
45	x	**80**	1516	67	1166	52	**2682**	**119**	221	126	170	95	4	M10x25	83	5	M8x50	41	54	42	57	67	21	18	1,47
50	x	**85**	2105	84	1296	52	**3401**	**136**	248	148	153	90	5	M10x25	83	5	M8x50	41	54	42	57	67	21	18	1,58
55	x	**90**	2316	84	1426	52	**3741**	**136**	226	140	139	85	5	M10x25	83	5	M8x50	41	54	42	57	67	21	18	1,70
60	x	**95**	3032	101	1866	62	**4898**	**163**	248	159	153	96	6	M10x25	83	6	M8x50	41	54	42	57	67	21	18	1,81
65	x	**100**	3284	101	2022	62	**5306**	**163**	229	151	141	92	6	M10x25	83	6	M8x50	41	54	42	57	67	21	18	1,93
70	x	**115**	5140	147	3531	101	**8672**	**248**	232	143	159	97	6	M12x35	145	6	M10x60	83	70	56	74	86	27	24	3,60
80	x	**125**	6854	171	4709	118	**11562**	**289**	237	154	163	104	7	M12x35	145	7	M10x60	83	70	56	74	86	27	24	4,00
90	x	**135**	7711	171	5297	118	**13008**	**289**	210	142	145	96	7	M12x35	145	7	M10x60	83	70	56	74	86	27	24	4,38
100	x	**150**	11498	230	8698	174	**20195**	**404**	235	159	177	118	7	M14x40	230	7	M12x70	145	78	61	82	96	29	26	6,00
110	x	**160**	12647	230	9568	174	**22215**	**404**	213	149	161	111	7	M14x40	230	7	M12x70	145	78	61	82	96	29	26	6,50
120	x	**170**	13797	230	10437	174	**24235**	**404**	196	140	148	104	7	M14x40	230	7	M12x70	145	78	61	82	96	29	26	6,97
130	x	**190**	23804	366	17342	267	**41146**	**633**	249	170	181	124	8	M16x50	355	8	M14x80	230	90	71	95	111	35	30	11,0
140	x	**200**	25635	366	18676	267	**44311**	**633**	231	162	169	118	8	M16x50	355	8	M14x80	230	90	71	95	111	35	30	11,6
150	x	**210**	27466	366	20010	267	**47476**	**633**	216	154	157	112	8	M16x50	355	8	M14x80	230	90	71	95	111	35	30	13,0
160	x	**220**	29297	366	21344	267	**50641**	**633**	202	147	147	107	8	M16x50	355	8	M14x80	230	90	71	95	111	35	30	12,3
180	x	**250**	51375	571	32959	366	**84334**	**937**	210	151	135	97	8	M20x70	690	8	M16x100	355	114	92	122	142	45	40	22,1
200	x	**270**	71355	714	45776	458	**117131**	**1171**	237	175	152	112	10	M20x70	690	10	M16x100	355	114	92	122	142	45	40	24,3
220	x	**290**	78490	714	50354	458	**128844**	**1171**	215	163	138	105	10	M20x70	690	10	M16x100	355	114	92	122	142	45	40	26,3
240	x	**310**	102751	856	65918	549	**168669**	**1406**	237	183	152	118	12	M20x70	690	12	M16x100	355	114	92	122	142	45	40	28,6
260	x	**330**	109740	844	70402	542	**180143**	**1386**	215	170	138	109	12	M20x70	690	12	M16x110	355	114	92	122	142	45	40	30,6
280	x	**365**	143639	1026	98485	703	**242124**	**1729**	216	166	148	114	10	M24x80	1200	10	M20x120	690	135	108	144	168	50	45	46,5
300	x	**385**	153899	1026	105520	703	**259419**	**1729**	202	157	138	108	10	M24x80	1200	10	M20x120	690	135	108	144	168	50	45	49,3
320	x	**405**	196991	1231	135065	844	**332056**	**2075**	227	179	155	123	12	M24x80	1200	12	M20x120	690	135	108	144	168	50	45	52
340	x	**425**	244186	1436	167425	985	**411611**	**2421**	249	199	171	137	14	M24x80	1200	14	M20x120	690	135	108	144	168	50	45	54
360	x	**445**	258550	1436	177273	985	**435823**	**2421**	235	190	161	130	14	M24x80	1200	14	M20x120	690	135	108	144	168	50	45	57
380	x	**465**	311902	1642	213853	1126	**525755**	**2767**	255	208	175	143	16	M24x80	1200	16	M20x120	690	135	108	144	168	50	45	60
400	x	**485**	328318	1642	225109	1126	**553426**	**2767**	242	200	166	137	16	M24x80	1200	16	M20x120	690	135	108	144	168	50	45	64
420	x	**505**	344734	1642	236364	1126	**581098**	**2767**	230	192	158	131	16	M24x80	1200	16	M20x120	690	135	108	144	168	50	45	66
440	x	**525**	361150	1642	247619	1126	**608769**	**2767**	168	141	115	96	16	M24x80	1200	16	M20x140	690	167	147	178	202	80	59	70
460	x	**545**	377565	1642	258875	1126	**636440**	**2767**	160	135	110	93	16	M24x80	1200	16	M20x140	690	167	147	178	202	80	59	73
480	x	**565**	393981	1642	270130	1126	**664112**	**2767**	154	131	105	90	16	M24x80	1200	16	M20x140	690	167	147	178	202	80	59	76
500	x	**585**	461697	1847	316559	1266	**778256**	**3113**	166	142	114	97	18	M24x80	1200	18	M20x140	690	167	147	178	202	80	59	79

4006

d mm		D mm	M_{t1} Nm	F_{ax1} kN	M_{t2} Nm	F_{ax2} kN	M_{t1+2} Nm	F_{ax1+2} kN	p_{W1} N/mm²	p_{N1} N/mm²	p_{W2} N/mm²	p_{N2} N/mm²	Z_1 Pcs.	S_1	M_{A1} Nm	Z_2 Pcs.	S_2	M_{A2} Nm	L mm	L_0 mm	L_1 mm	L_2 mm	L_3 mm	L_s mm	Weight kg
520	**x**	**605**	480165	1847	329221	1266	**809386**	**3113**	160	137	109	94	18	M24x80	1200	18	M20x140	690	167	147	178	202	80	59	82
540	**x**	**625**	498633	1847	341884	1266	**840516**	**3113**	154	133	105	91	18	M24x80	1200	18	M20x140	690	167	147	178	202	80	59	85
560	**x**	**645**	517101	1847	354546	1266	**871647**	**3113**	148	129	102	88	18	M24x80	1200	18	M20x140	690	167	147	178	202	80	59	88
580	**x**	**665**	595076	2052	408009	1407	**1003085**	**3459**	159	139	109	95	20	M24x80	1200	20	M20x140	690	167	147	178	202	80	59	91
600	**x**	**685**	615596	2052	422079	1407	**1037675**	**3459**	154	135	105	92	20	M24x80	1200	20	M20x140	690	167	147	178	202	80	59	94
620	**x**	**705**	636116	2052	436148	1407	**1072264**	**3459**	149	131	102	90	20	M24x80	1200	20	M20x140	690	167	147	178	202	80	59	98