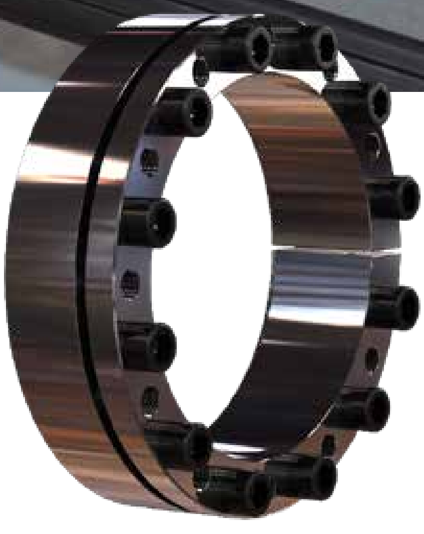
TAS SCHÄFER

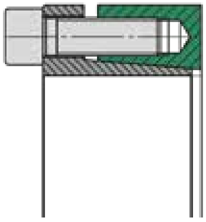
Internal Locking Devices



Shaft-Hub-Connection

Product overview

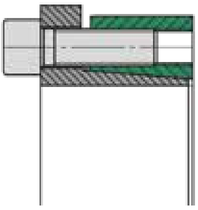
Shaft/ Hub-connections



3003 plus / 3003

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

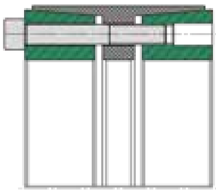
Page 124



3006 plus / 3006

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

Page 128



3012

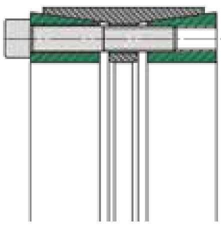
For very high torque transmission.
For high bending moments
Wide installation lenght

Page 132

3014

For high torque transmission
For medium bending moments
Wide installation lenght

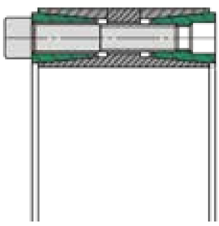
Page 134



RB,3015,3015.1

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

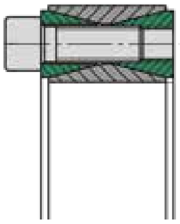
Page 136



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

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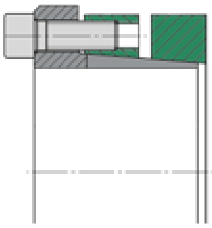
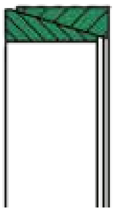


4006

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

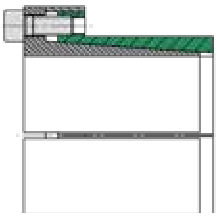
Page 150



8006 (Locking elements)

For low torque transmission
Small installation space

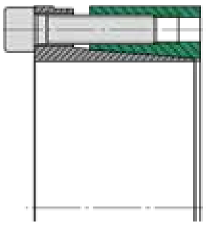
Page 154



TAS 110

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

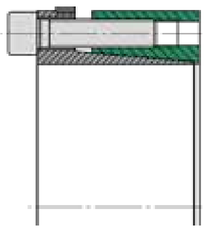
Page 158



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

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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

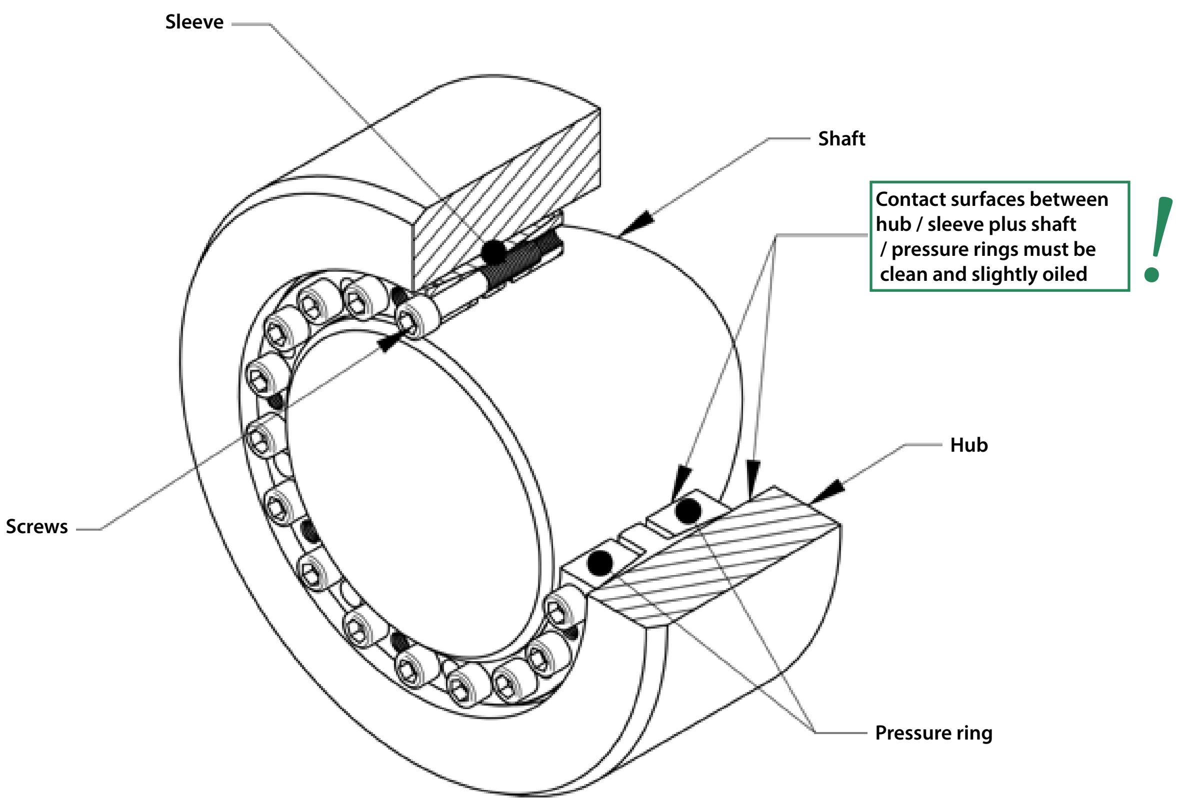
Contact us if a data sheet for an individual product is required.

• 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

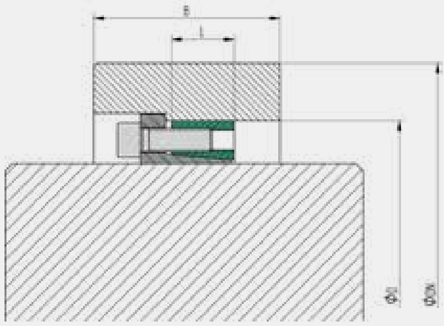
The K-Values can directly be taken from the tables or can be calculated as follows:

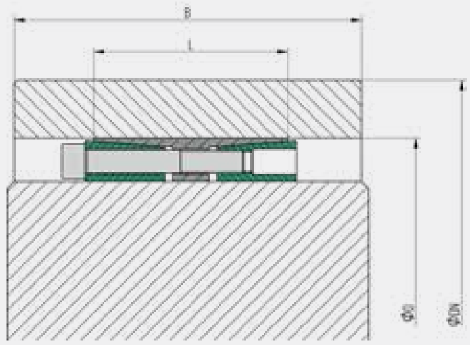
When using TAS Locking assemblies a tension is generated by the surface pressure PN between locking assembly and hub. The required hub diameter is calculated using the same formula, as used for thick-walled hollow cylinder. The real tensions depend on the hub length and shape with respect to the length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

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

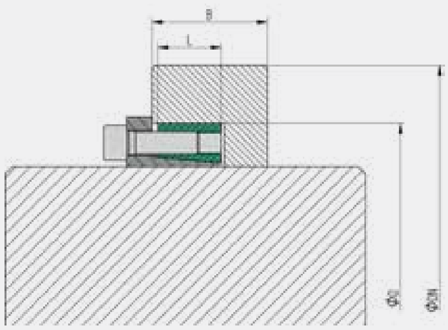
B = ≥ 2 L

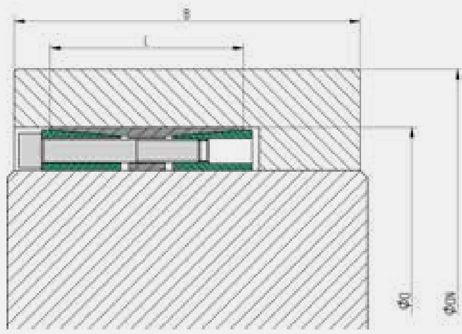
C = 0,6





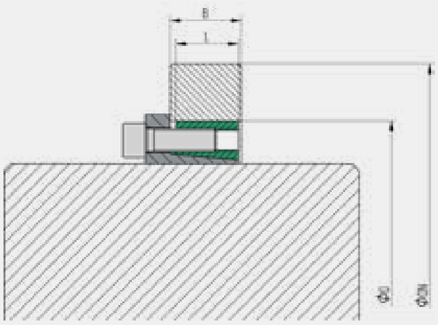
C = 0,8

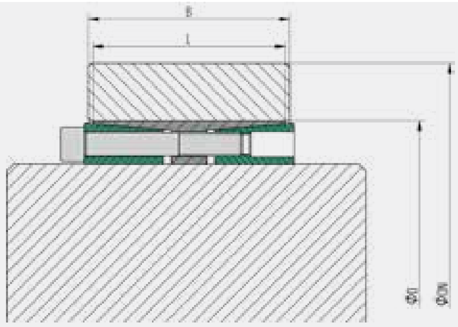




B = ≥ L

C = 1,0





TAS SCHÄFER

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

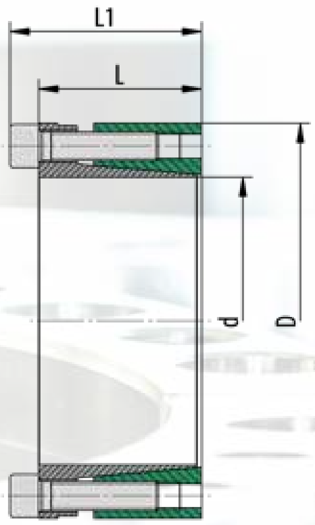
p_N N/mm²	K-Factor for hubtype with C = 0,8 Yield strength hubmaterial (N/mm²)										
	150	180	210	240	270	300	330	360	390	420	450
50	1,315	1,254	1,213	1,184	1,161	1,144	1,130	1,119	1,109	1,101	1,094
55	1,353	1,284	1,237	1,204	1,179	1,160	1,144	1,131	1,120	1,111	1,104
60	1,394	1,315	1,262	1,225	1,197	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

TAS SCHÄFER

Hub Outside Diameter

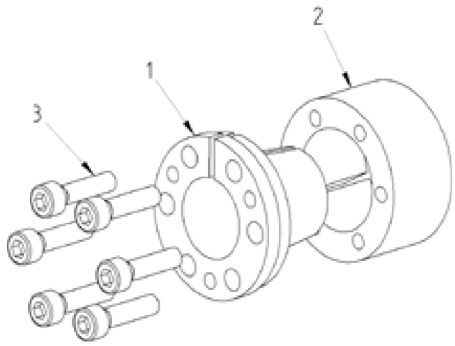
p_N N/mm²	K-Factor for hubtype with C = 1,0 — Yield strength hubmaterial (N/mm²)										
	150	180	210	240	270	300	330	360	390	420	450
50	1,415	1,331	1,275	1,236	1,207	1,184	1,165	1,151	1,138	1,128	1,119
55	1,469	1,372	1,308	1,263	1,230	1,204	1,184	1,167	1,153	1,141	1,131
60	1,528	1,415	1,342	1,291	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

TAS 130



Used symbols

d	[mm]	Shaft diameter
D	[mm]	Hub inside diameter
M_t	[Nm]	Max. transmittable torque $F_{ax} = 0$
F_{ax}	[kN]	Max. transmittable axial force $M_t = 0$
p_W	[N/mm²]	Average pressure on the shaft
p_N	[N/mm²]	Average pressure on the hub
L	[mm]	Width of the locking device without screws
L_1	[mm]	Width of the locking device with screws
Z		Number of clamping screws
S		Size of the clamping screws
M_A	[Nm]	Tightening torque of the clamping screws



Recommended tolerances & surfaces

Shaft	h8 / Rz10
Hub	H8 / Rz10

Pos.	Designation
1	Sleeve
2	Pressure ring
3	Screw

Bending loads

Bending moment (share)	MB max = 0,35 * Mt
Bending angle	max. 5´

More properties

- low axial displacement during assembly
- good self-centering
- high self-locking

Ordering information: TAS 130 /d/D (e.g: TAS 130/20/47 ... further sizes on request)

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TAS 130

d mm		D mm	M_t Nm	F_{ax} kN	p_W N/mm²	p_N N/mm²	Z Pcs.	S	M_A Nm	L mm	L_1 mm	Weight kg
20	**x**	**47**	530	52	264	110	6	M 6 x 25	17	42	48	0,41
22	**x**	**47**	580	52	239	110	6	M 6 x 25	17	42	48	0,38
24	**x**	**50**	630	52	217	100	6	M 6 x 25	17	42	48	0,42
25	**x**	**50**	660	52	208	100	6	M 6 x 25	17	42	48	0,41
28	**x**	**55**	740	52	194	100	6	M 6 x 25	17	42	48	0,50
30	**x**	**55**	790	70	182	100	6	M 6 x 25	17	42	48	0,47
32	**x**	**60**	1150	70	226	120	8	M 6 x 25	17	42	48	0,56
35	**x**	**60**	1300	70	209	120	8	M 6 x 25	17	42	48	0,53
38	**x**	**65**	1300	70	188	110	8	M 6 x 25	17	42	48	0,62
40	**x**	**65**	1400	70	180	110	8	M 6 x 25	17	42	48	0,57
42	**x**	**75**	2000	100	209	120	6	M 8 x 30	41	51	59	1,01
45	**x**	**75**	2200	100	197	120	6	M 8 x 30	41	51	59	0,98
48	**x**	**80**	3200	130	249	150	8	M 8 x 30	41	51	59	1,09
50	**x**	**80**	3300	130	239	150	8	M 8 x 30	41	51	59	1,07
55	**x**	**85**	3600	130	215	140	8	M 8 x 30	41	51	59	1,15
60	**x**	**90**	3900	130	194	130	8	M 8 x 30	41	51	59	1,23
65	**x**	**95**	4300	130	177	120	8	M 8 x 30	41	51	59	1,32
70	**x**	**110**	7500	210	203	130	8	M 10 x 30	83	61	71	2,18
75	**x**	**115**	8000	210	196	130	8	M 10 x 30	83	61	71	2,30
80	**x**	**120**	8500	210	179	120	8	M 10 x 30	83	61	71	2,44
85	**x**	**125**	11400	270	217	150	10	M 10 x 30	83	61	71	2,55
90	**x**	**130**	12000	270	201	140	10	M 10 x 30	83	61	71	2,67
95	**x**	**135**	12600	280	190	135	10	M 10 x 30	83	61	71	2,80
100	**x**	**145**	15000	300	185	130	8	M 12 x 35	145	68	80	3,90
110	**x**	**155**	16500	300	167	120	8	M 12 x 35	145	68	80	4,20
120	**x**	**165**	22500	370	190	140	10	M 12 x 35	145	68	80	4,50
130	**x**	**180**	29000	450	206	150	12	M 12 x 35	145	68	80	5,50
140	**x**	**190**	32000	460	175	130	10	M 14 x 40	210	76	90	6,60
150	**x**	**200**	41000	550	198	150	12	M 14 x 40	210	76	90	6,90
160	**x**	**210**	44000	550	183	140	12	M 14 x 40	210	76	90	7,40
170	**x**	**225**	54500	640	210	160	14	M 14 x 40	210	76	90	8,60
180	**x**	**235**	57500	640	190	150	14	M 14 x 40	210	76	90	9,10
190	**x**	**250**	65000	689	191	146	15	M 14 x 40	210	76	90	10,60
200	**x**	**260**	68000	689	183	141	15	M 14 x 40	210	76	90	11,20
220	**x**	**285**	82000	747	141	109	12	M 16 x 50	325	98	114	17,70