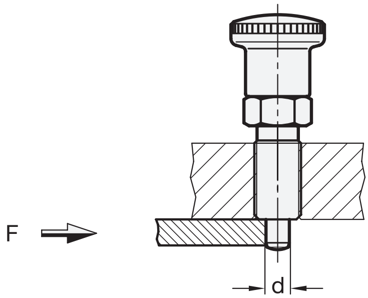
Computing the strength of indexing plungers

for shear loads / flexure loads of the plunger pin



Shear loads

Provided that a miniscule gap remains between the guide of the indexing plunger and the indexing bore hole opposite, the load can be reduced to a clean shear action.

As this is normally not the case, the "flexure" load case should preferably be considered on the following page.

Approximately 80 % of the bolt's tensile strength is assumed for the shear strength. This approach calculates against the tensile strength R_m, i.e. against the indexing pin shearing off. Any pre-existing and remaining deformation may, however, mean that the indexing plunger can be used no longer. To ensure the permanent and proper function of the indexing plunger, the yield limit R_e must be considered in place of the tensile strength R_m.

Formulas for computation

Bolt cross-section	Limit tension	Shear force
$S = \frac{d^2 \times \pi}{4}$	$\tau_a = 0{,}8 \times R_m$	$F = S \times \tau_a = \frac{d^2 \times \pi}{4} \times 0{,}8 \times R_m$

Material characteristics

The tensile strength shown in the table opposite (R_m) and the yield or substitute yield limit (R_e / $R_{p\ 0{,}2}$) have been determine in tension tests involving tension specimen in accordance with DIN 50125- B6-30

These tests constitute the basis for the load bearing details given herein.

Material Description	Material no.	**R_e** in N/mm²	**R_m** in N/mm²
C45Pb	1.0504	560	640
X 10 CrNiS 18 9	AISI 303	580	740

Computing examples, load values

Example:

Indexing plungers with a bolt diameter of 6 mm made of Stainless Steel with a yield limit of R_e = 580 N/mm², computation against permanent deformation, the maximum permissible shear stress is wanted.

$$F_{per} = \frac{(6\ \text{mm})^2 \times \pi}{4} \times 0{,}8 \times 580\ \text{N/mm}^2 = 13120\ \text{N}$$

d Bolt diameter	max. force **F** in N, acc. to material and strength value differs			
	C45Pb / 1.0504		X 10 CrNiS 18 9 / 1.4305	
	at R_e	at R_m	at R_e	at R_m
3	3160	3610	3270	4180
4	5620	6430	5830	7430
5	8790	10050	9110	11620
6	12660	14470	13120	16730
8	22510	25730	23320	29750
10	35180	40210	36440	46490
12	50660	57900	52470	66950

Safety information

On principle, the design also needs an adequate safety coefficient to be taken into account. The usual safety coefficients under static load 1,2 to 1,5; pulsating 1,8 to 2,4 and alternating 3 to 4.

Disclaimer:

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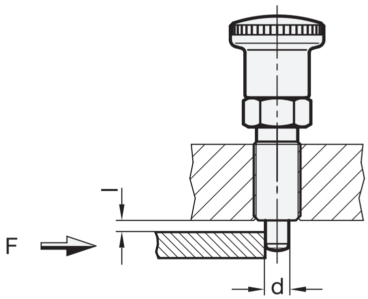

Flexure loads

As soon as a gap l remains between the guide and the indexing bore hole opposite, the load can be reduced to a flexure rod clamped in at one side.

With this approach, the computation is made against the bending of the indexing plunger as a case of failure.

Formulas for computation

Resistance torque	Flexural stress	Flexural strength
$W = \frac{\pi \times d^3}{32}$	$M_b = \sigma_b \times W$	$F = \frac{M_b}{l} = \frac{\sigma_b \times \pi \times d^3}{l \times 32}$

Material characteristics

The yield or substitute yield limit (Re / Rp 0,2) shown in the table opposite has been determine in tension tests involving tension specimen in accordance with DIN 50125-B6-30.

These tests constitute the basis for the load bearing details given herein.

Material		R_e
Description	Material no.	in N/mm² (≈ per. flexural tension σ_b)
C45Pb	1.0504	560
X 10 CrNiS 18 9	AISI 303	580

Computing examples, load values

Example:

Indexing plungers with a bolt diameter of 5 mm made of steel with a yield limit of R_e = 560 N/mm², computation against permanent deformation, the maximum permissible flexural strength is wanted:

$$F_{per} = \frac{560 \text{ N/mm}^2 \times \pi \times (5\text{mm})^3}{2\text{mm} \times 32} = 3430 \text{ N}$$

d Bolt diameter	max. flexural strength **F** in N, acc. to material and gap **l** differentiated C45Pb / 1.0504		X 10 CrNiS 18 9 / 1.4305	
	l = 2 mm	**l** = 3 mm	**l** = 2 mm	**l** = 3 mm
3	740	490	760	510
4	1750	1170	1820	1210
5	3430	2290	3550	2370
6	5930	3950	6140	4100
8	14070	9380	14570	9710
10	27480	18320	28470	18980
12	47490	31660	49190	32790

Safety information

On principle, the design also needs an adequate safety coefficient to be taken into account. The usual safety coefficients under static load 1,2 to 1,5; pulsating 1,8 to 2,4 and alternating 3 to 4.

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