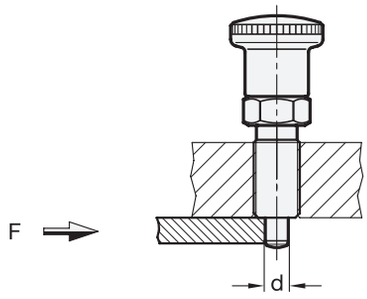
Strength Calculation of (Cam Action) Indexing Plungers

for Shear Load / Bending Load of the Plunger Pin



Shear load

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

As this is normally not the case, the “bending” load should preferably be considered on the next page.

Approximately 80 % of the pin‘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. However, any pre-existing and remaining deformation may mean that the indexing plunger can be used no longer. To ensure the permanent and proper function of the indexing plunger, the yield strength R_e must be considered instead of the tensile strength R_m.

Formulas for calculation

Pin 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 (R_m) and the yield strength (R_e) shown in the table opposite have been determined by tension tests on tension specimen in accordance with DIN 50125-B6-30.

These tests constitute the basis for the load bearing capacities given below.

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

Calculation example, load values

Example:

Indexing plungers with a 6 mm pin diameter made of stainless steel with a yield strength of R_e = 580 N/mm², calculation against permanent deformation, the maximum permissible shear stress is wanted.

$$F_{per} = \frac{(6\ mm)^2 \times \pi}{4} \times 0.8 \times 580\ N/mm^2 = 13120\ N\ (2949\ lbf)$$

Dimensions in: millimeters - *inches*

d Pin diameter	Max. force **F** differentiated acc. material and strength value			
	C45Pb (1.0504)		X 10 CrNiS 18 9 (AISI 303)	
	at R_e	at R_m	at R_e	at R_m
3 *0.12*	3160 N *710 lbf*	3610 N *812 lbf*	3270 N *735 lbf*	4180 N *940 lbf*
4 *0.16*	5620 N *1263 lbf*	6430 N *1446 lbf*	5830 N *1311 lbf*	7430 N *1670 lbf*
5 *0.20*	8790 N *1976 lbf*	10050 N *2259 lbf*	9110 N *2048 lbf*	11620 N *2612 lbf*
6 *0.24*	12660 N *2846 lbf*	14470 N *3253 lbf*	13120 N *2949 lbf*	16730 N *3761 lbf*

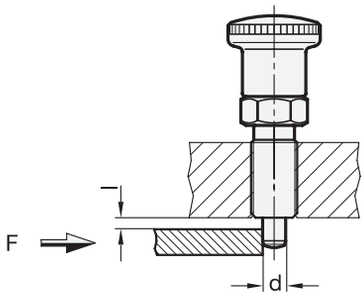
d Pin diameter	Max. force **F** differentiated acc. material and strength value			
	C45Pb (1.0504)		X 10 CrNiS 18 9 (AISI 303)	
	at R_e	at R_m	at R_e	at R_m
8 *0.31*	22510 N *5060 lbf*	25730 N *5784 lbf*	23320 N *5243 lbf*	29750 N *6688 lbf*
10 *0.39*	35180 N *7909 lbf*	40210 N *9040 lbf*	36440 N *8192 lbf*	46490 N *10451 lbf*
12 *0.47*	50660 N *11389 lbf*	57900 N *13016 lbf*	52470 N *11796 lbf*	66950 N *15051 lbf*
16 *0.63*	90070 N *20249 lbf*	102940 N *23142 lbf*	93290 N *20972 lbf*	119020 N *26757 lbf*

Safety information

The design also requires an adequate safety factor to be taken into account. Usual safety factors under static load 1.2 to 1.5; pulsating 1.8 to 2.4 and alternating 3 to 4.

Disclaimer:

Our information and recommendations are given with non-binding effect and ruling out any liability, unless we have expressly committed ourselves in writing to provide information and recommendations. All products are standard parts for versatile uses and as such are subjected to extensive standard tests. You should carry out your own test series to verify whether a certain product is suitable for your specific applications. We cannot be held responsible for this.



Bending load

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

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

Formulas for calculation

Resistance torque	Bending stress	Bending 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 tensile strength (R_m) and the yield strength (R_e) shown in the table opposite have been determined by tension tests on tension specimen in accordance with DIN 50125-B6-30.

These tests constitute the basis for the load bearing capacities given below.

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

Calculation examples, load values

Example:

Indexing plungers with a 5 mm pin diameter made of steel with a yield strength of R_e = 560 N/mm², calculation against permanent bending, the maximum permissible bending force is wanted:

$$F_{per} = \frac{560\ N/mm^2 \times \pi \times (5mm)^3}{2mm \times 32} = 3430\ N\ (771\ lbf)$$

Dimensions in: millimeters - *inches*

d Pin diameter	Max. bending force **F** differentiated acc. material and gap **"l"**			
	C45Pb (1.0504)		X 10 CrNiS 18 9 (AISI 303)	
	l = 2 mm	**l** = 3 mm	**l** = 2 mm	**l** = 3 mm
3 *0.12*	740 N *166 lbf*	490 N *110 lbf*	760 N *171 lbf*	510 N *115 lbf*
4 *0.16*	1750 N *393 lbf*	1170 N *263 lbf*	1820 N *409 lbf*	1210 N *272 lbf*
5 *0.20*	3430 N *771 lbf*	2290 N *515 lbf*	3550 N *798 lbf*	2370 N *533 lbf*
6 *0.24*	5930 N *1333 lbf*	3950 N *888 lbf*	6140 N *1380 lbf*	4100 N *922 lbf*

d Pin diameter	Max. bending force **F** differentiated acc. material and gap **"l"**			
	C45Pb (1.0504)		X 10 CrNiS 18 9 (AISI 303)	
	l = 2 mm	**l** = 3 mm	**l** = 2 mm	**l** = 3 mm
8 *0.31*	14070 N *3163 lbf*	9380 N *2109 lbf*	14570 N *3275 lbf*	9710 N *2183 lbf*
10 *0.39*	27480 N *6178 lbf*	18320 N *4118 lbf*	28470 N *6400 lbf*	18980 N *4267 lbf*
12 *0.47*	47490 N *10676 lbf*	31660 N *7117 lbf*	49190 N *11058 lbf*	32790 N *7371 lbf*
16 *0.63*	112590 N *25311 lbf*	75063 N *16875 lbf*	116610 N *26215 lbf*	77740 N *17477 lbf*

Safety information

The design also requires an adequate safety factor to be taken into account. Usual safety factors under static load 1.2 to 1.5; pulsating 1.8 to 2.4 and alternating 3 to 4.

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