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

<table>
<thead>
<tr>
<th>Pin cross-section</th>
<th>Limit tension</th>
<th>Shear force</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S = \frac{d^2 \times \tau}{4}$</td>
<td>$\tau_s = 0.8 \times R_m$</td>
<td>$F = S \times \tau_s = \frac{d^2 \times \tau}{4} \times 0.8 \times R_m$</td>
</tr>
</tbody>
</table>

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.

Calculation example, load values

Example:
Indexing plungers with a 6 mm pin diameter made of stainless steel with a yield strength of $R_e = 580 \text{ N/mm}^2$, calculation against permanent deformation, the maximum permissible shear stress is wanted.

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

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 “I” 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

<table>
<thead>
<tr>
<th>Resistance torque</th>
<th>Bending stress</th>
<th>Bending strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ W = \frac{n \times d^3}{32} ]</td>
<td>[ M_b = \sigma_b \times W ]</td>
<td>[ F = \frac{M_b \times l}{I \times 32} ]</td>
</tr>
</tbody>
</table>

### 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.

### Calculation examples, load values

Example:

Indexing plungers with a 5 mm pin diameter made of steel with a yield strength of \( R_e = 560 \text{ N/mm}^2 \), calculation against permanent bending, the maximum permissible bending force is wanted:

\[ F_{\text{per}} = \frac{560 \text{ N/mm}^2 \times n \times (5 \text{mm})^3}{2 \text{mm} \times 32} = 3430 \text{ N (771 lbf)} \]

### 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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