Estimation of screw diameters (according to VDI* 2230)

The following procedure enables an estimation of screw diameter depending on the operating force at temperature of 20°C (15° - 25°C) and on tightening method.

The result has to be double checked by either exact calculation or testing the joint.

Special conditions as mentioned e.g. on page T 10, are not taken into consideration for this estimation.

<table>
<thead>
<tr>
<th>Force in N</th>
<th>Nominal diameter in mm</th>
<th>Property class</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.9</td>
<td>10.9</td>
<td>8.8</td>
</tr>
<tr>
<td>250</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>400</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>630</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>1 000</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1 600</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>2 500</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>4 000</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>6 300</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>10 000</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>16 000</td>
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<td>24</td>
</tr>
<tr>
<td>25 000</td>
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<td>27</td>
</tr>
<tr>
<td>40 000</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>63 000</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

Example:

A joint is dynamically and eccentrically loaded by the axial force \( F_A = 5800 \) N.

A screw with property class 8.8 is to be assembled using a manual torque wrench.

A 6300 N is the next higher force to \( F_A \) in column 1.

B 2 steps for "eccentric and dynamic axial force" add up to \( F_M \) min = 16000 N.

C 1 step for "tightening with manual torque wrench" adds up to \( F_M \) max = 25000 N.

D For the force \( F_M \) max = 25000 N, you will find thread size M 10 in column 4 (property class 8.8).

* VDI = Association of German Engineers

A Choose the next higher force value to operating force \( F_A, Q \) acting on the bolted joint.

B The required minimum preload force \( F_M \) min is found by proceeding from this force with:

- 4 steps for static or dynamic transverse shear force,
  
  \[
  F_M = F_A + 4 \times \text{transverse shear force}.
  \]

- 2 steps for dynamic and eccentric axial force,
  
  \[
  F_M = F_A + 2 \times \text{dynamic and eccentric axial force}.
  \]

- 1 step for either dynamic and concentric or static and eccentric axial force,
  
  \[
  F_M = F_A + \text{dynamic or eccentric axial force}.
  \]

- 0 step for static and concentric axial force.

C The required maximum preload force \( F_M \) max is found by proceeding from force \( F_M \) min with:

- 2 steps for tightening the screw with a simple mechanical, motorized or pneumatic screw driver, which is set for a certain tightening torque,
  
  \[
  F_M = F_M \text{min} + 2 \times \text{torque}.
  \]

- 1 step for tightening with a torque wrench or precision screw driver, which is set and checked by means of the dynamic torque measurement or elongation of the screw.
  
  \[
  F_M = F_M \text{min} + \text{torque}.
  \]

- 0 step for tightening by angle control or by computerized yield point control.

D Once the maximum preload force is estimated, the correct screw size in mm is found next to it in column 2 to 4 underneath the appropriate property class.