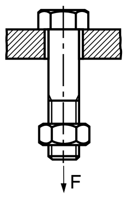
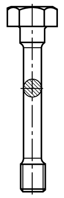
Definitions of mechanical properties for screws

Tensile strength R_m [N/mm²]

Determines how much axial load a screw must withstand without breaking. If full size screws are tested, the yield strength can only be approximately established. Under ISO 898 Part 1, the exact yield strength and elongation after fracture can be determined using machined specimens. Exceptions are stainless steel screws A1 to A4 (ISO 3506).



Tensile test on full size screw



Tensile test on machined screw

Tensile strength at rupture in thread:

$$R_m = \frac{\text{max. tensile force F}}{\text{stress area}} \quad \left[\frac{N}{mm^2}\right]$$

Stress area A_S [mm²] of thread
Pages F.046, F.047

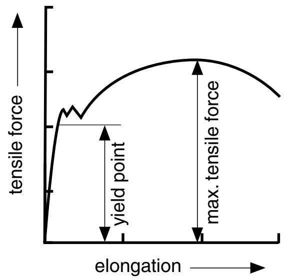
Tensile strength at rupture in cylindrical shank:

$$R_m = \frac{\text{max. tensile force F}}{\text{initial cross section of specimen}} \quad \left[\frac{N}{mm^2}\right]$$

1 N/mm² = 1 MPa = 145.03 psi

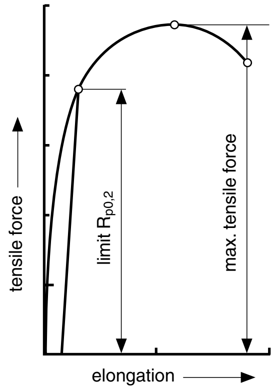
Yield strength R_{eL} [N/mm²]

Yield strength is the amount of resistance of a material to plastic deformation. In general terms, yield strength determines how much stress a screw (specimen) must withstand without being permanently elongated. This applies to relatively soft materials.



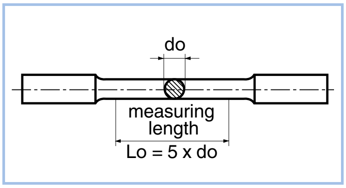
0,2 % limit $R_{p0,2}$ [N/mm²]

The yield point of somewhat harder materials is not sharply pronounced. It is then replaced by the stress at which the permanent elongation is 0.2 %.
In practice, neither the working load of the fastener nor the stress from tightening should exceed the yield strength or the 0.2 % limit.



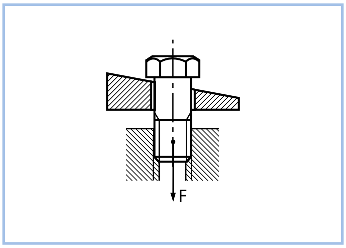
Elongation at fracture A [%]

is the permanent elongation measured on the fractured specimen related to the original measured length. Exceptions: screws A1 to A4, where this is measured on fullsize screws (ISO 3506).



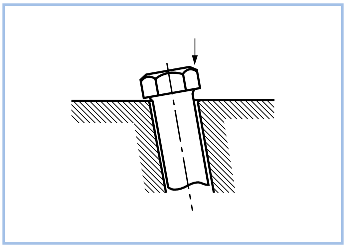
Tensile strength under wedge loading

Is tested by means of having a wedge positioned underneath the screw head. When tensioned, the screw must break in the thread or in the shank. Bolts and screws are subjected to a wedge test to measure the ductility and head integrity.



Head soundness

The head of the screw must withstand several hammer blows. After being bent to a specified angle, the shank head fillet shall not show any signs of cracking. For details see ISO 898, part 1.



Hardness

Hardness is generally the resistance of the material to penetration by a test body. The advantage of the Vickers hardness test is that the entire hardness range encountered in the screw is covered by the method. For details see ISO 898, part 1.

Vickers hardness HV: ISO 6507
Test body-pyramid
(encompasses the complete hardness range usual for screws)

Brinell hardness HB: ISO 6506
Test body ball

Rockwell hardness HRC: ISO 6508
Test body cone

Hardness comparison tables
Page G.006

Notch Impact Strength [Joule] ISO 83

Notch impact energy is the impact energy consumed during notch impact testing. A notched sample is taken from the screw near the surface. This sample is broken in a pendulum impact tester with a single stroke. It gives information on micro-structure, steel making process, inclusion content etc. The values cannot be used for calculations.

Surface Flaws

Surface defects arising in the semi-finished product are slag inclusions, material folds and die marks. **Cracks** on the other hand are crystalline breaks without inclusion of foreign materials. For details see EN 493 and ISO 6157.

Decarburization

Decarburization is a loss of carbon at the surface of ferrous materials (steels). For details see ISO 898, part 1.