

Bolt Preload

Mechanical Engineering

Why a bolted joint works by clamping, and how torque relates to clamp force.

A bolted joint carries load by clamping the parts together; preload, not bolt shear, is the design variable.

$$F_i \approx 0.75 S_p A_t \cdot T \approx K F_i d \cdot K \approx 0.2 \text{ dry}$$

M10 class 8.8

$A_t = 58 \text{ mm}^2$.

Preload about 26 kN

$K = 0.2$, $d = 10 \text{ mm}$

Dry, plain thread.

Torque about 52 N·m

Lubricated thread

Less torque, same F_i .

K falls to about 0.15

THE COMMON MISTAKE

✗ **Sizing the bolt for the external shear load**

✓ **Size it for the clamp force**

A preloaded joint carries shear by friction between the plates. Once it slips, the bolt sees bearing and shear it was never sized for.

Torque control scatters preload by roughly a quarter either way. Angle or direct tension control is much tighter.