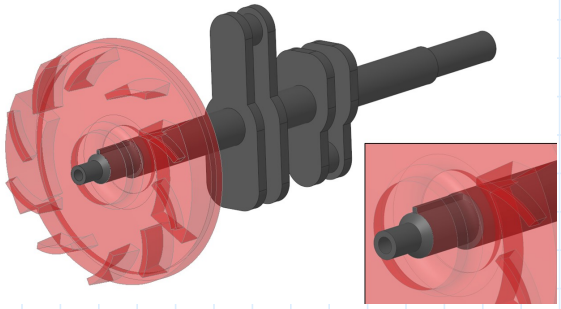
Shaft Key Calculations

A key is a mechanical component used to transfer power between a rotating shaft and a machine component.



$$K_s = \frac{K_a \cdot K_d}{K_f}$$ Service Factor

$K_d := 1$ Design factor for fixed (close fit) loaded

$K_a := 1$ Application factor
Uniform power source, uniform load

$K_f := 0.3$ Fatigue life factor for 10 million cycles

$$K_s := \frac{K_a \cdot K_d}{K_f} = 3.333$$

$T := 150 \cdot N \cdot m$ Torque

Key Dimensions

$w := 12.5 \cdot mm$

$l := 50 \cdot mm$

$h := 10 \cdot mm$

Shaft dimensions

$d := 50 \cdot mm$ Nominal diameter

$d_{re} := d - \frac{h}{2} = 45\ mm$ Reduced diameter

$\sigma_{max} := 250 \cdot MPa$ Steel yield strength

Calculation of Torque for Reduced Diameter

$$T_{max} = \frac{\left(\frac{\sigma_{max}}{2}\right) \cdot I}{\frac{d_{re}}{2}} \qquad T_{max} = \frac{\sigma_{max} \cdot I}{d_{re}}$$

$$I := \frac{\pi}{4} \cdot \left(\frac{d_{re}}{2}\right)^4 = \left(2.013 \cdot 10^5\right)\ mm^4$$

$$T_{max} := \frac{\sigma_{max} \cdot I}{d_{re}} = 1118.3\ N \cdot m$$

Stress Calculations

Shear Stress

$$\tau := \frac{T \cdot K_s}{l \cdot w \cdot \frac{d_{re}}{2}} = 35.556\ MPa$$

Compressive Stress

$$\sigma_c := \frac{T \cdot K_s}{\left(\frac{h}{2}\right) \cdot l \cdot \frac{d_{re}}{2}} = 88.889\ MPa$$