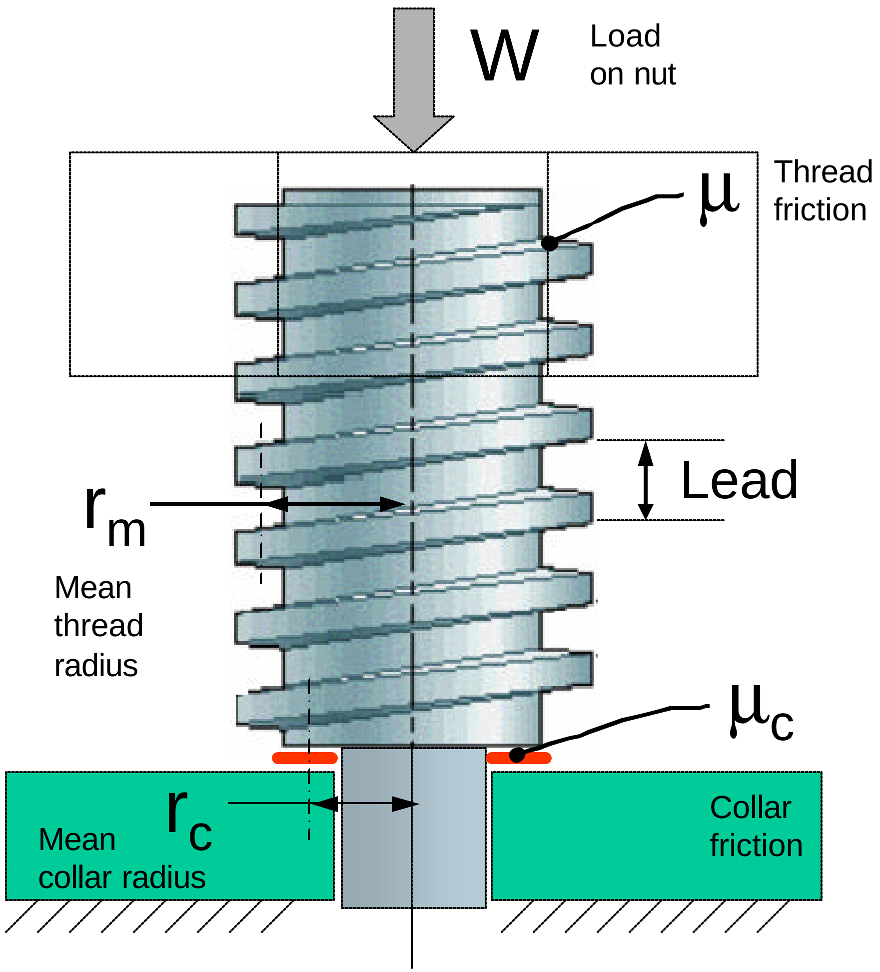
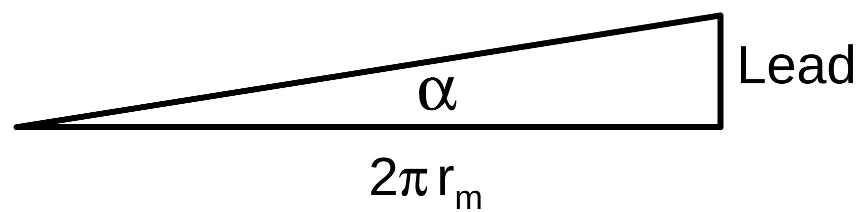
Power Screws



Looking at a square thread screw, we unwind one turn:



This shows an inclined ramp with angle

$$a = \tan^{-1} \frac{Lead}{2p\ r_m}$$

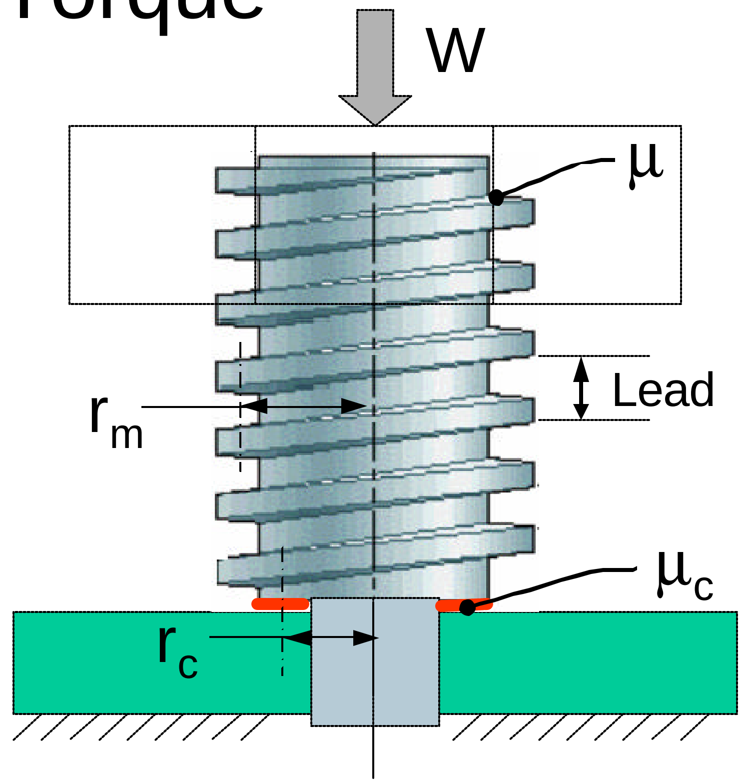
Power Screw Torque

The torque required to <u>raise</u> the load W is

$$T_{raise} = W\left[r_m \frac{m + \tan a}{1 - m \tan a} + m_c r_c \right]$$

and to <u>lower</u> the load, we flip two signs:

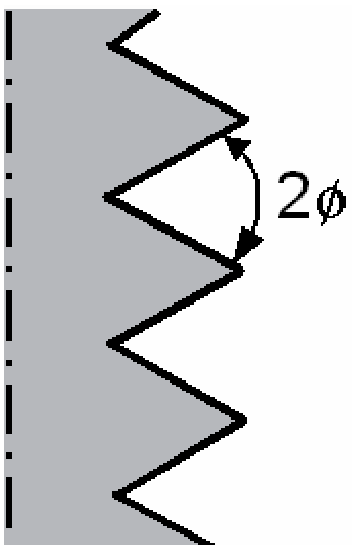
$$T_{lower} = W\left[r_m \frac{m - \tan a}{1 + m \tan a} + m_c r_c \right]$$



Power Screw Thread Angle

If the thread form is not square but has an angle 2 f, replace the thread friction μ with the effective friction

$$m_e = \frac{m}{\cos f}$$



The effect:

- Square: 2f = 0, f = 0, 1/cos$f$ = 1.0
- Acme: 2f = 29°, f = 14.5°, 1/cos$f$ = 1.033
- Unified: 2f = 60°, f = 30°, 1/cos$f$ = 1.15

The thread angle effectively increases surface friction between 3 and 15%

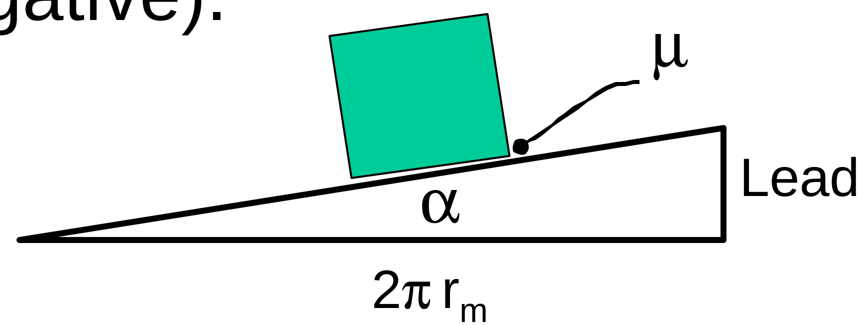
Power Screws - Overhauling

If the collar friction is small (e.g., it may have a ball thrust bearing), too small a thread friction may let the weight screw down on its own.

This can happen when $m < \tan a = \dfrac{Lead}{2p\ r_m}$

(the numerator goes negative).

$$T_{lower} = W\left[r_m \frac{m - \tan a}{1 + m \tan a} + \overset{0}{m_c} r_c \right]$$



This is the same case for a weight sliding down a ramp when the incline angle α exceeds $\tan^{-1}\mu$.