

Design fundamentals

The following are the relevant calculations which underlie screw design and safe operation of a Speedy, Easy or Rondo leadscrew.

Calculations at dynamic load:

Critical rotational speed n_{per}

Permissible rotational speeds must differ substantially from the screw's own frequency.

$$n_{per} = K_D \cdot 10^6 \cdot \frac{d_2}{l_a^2} \cdot S_n \text{ [min}^{-1}\text{]}$$

n_{per} = permissible rotational speed [min^{-1}]

K_D = characteristic constant [-]

as a function of bearing configuration > see aside

d_2 = core screw diameter [mm]

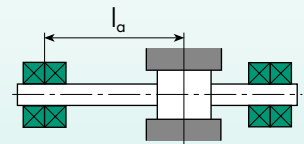
l_a = bearing distances [mm] > see aside

(always include maximum allowable l_a in calculation!)

S_n = safety factor [-], usually $S_n = 0.5 \dots 0.8$

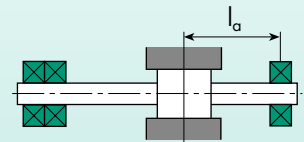
Config. 1: fixed – fixed

→ $K_D = 276$



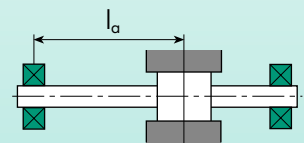
Config. 2: fixed – single

→ $K_D = 190$



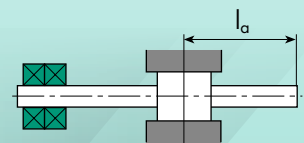
Config. 3: single – single

→ $K_D = 122$



Config. 4: fixed – free

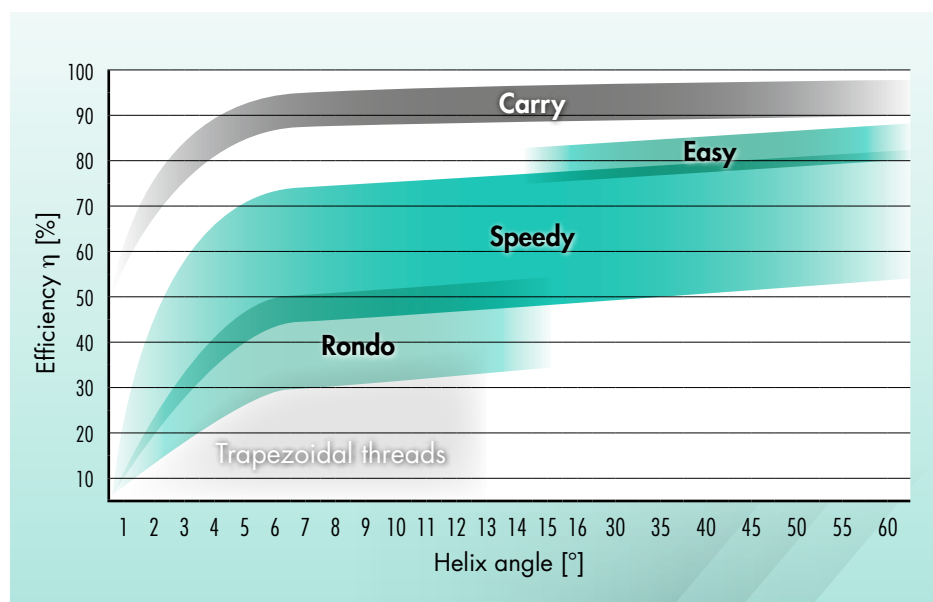
→ $K_D = 43$



Efficiency η_p (practical)

The efficiency η depends on the helix angle and reaches the following values:

- **Speedy** ~0.5 ... 0.75
- **Easy** > 0.8
- **Rondo** ~0.3 ... 0.5





Driving torque M

depends upon the type of power transmission

- Case 1: torque → linear movement

$$M_a = \frac{F_a \cdot p}{2000 \cdot \pi \cdot \eta} \text{ [Nm]}$$

- Case 2: axial force → torque

$$M_e = \frac{F_a \cdot p \cdot \eta'}{2000 \cdot \pi} \text{ [Nm]}$$

M_a = input torque [Nm], case 1

M_e = output torque [Nm], case 2

F_a = axial force [N]

p = pitch [mm]

η = efficiency [%]

η' = corrected efficiency [%]

Input performance P

$$P = \frac{M_a \cdot n}{9550} \text{ [kW]}$$

P = input performance [kW]

n = rotational speed [min^{-1}]

A safety margin of 20% is recommended when selecting drives.

Basic calculations

Maximum authorized load depending on speed

$$F_{\text{per.}} = C_0 \cdot f_L \text{ [N]}$$

C_0 = static load rate [N]

f_L = load factor [-] for POM-C nuts

Circumferential speed v_c [m/min]	Load factor f_L [-]
5	0.95
10	0.75
20	0.45
30	0.37
40	0.12
50	0.08

Example

- Parameters:

Speedy 10/50 with non-preloaded POM-C nut, $d_0 = 10$ mm,
 $p = 50$ mm and $C_0 = 1250$ N;
 required moving speed $v_s = 200$ mm/sec.

- We need to find: $F_{\text{per.}}$

Therefore we calculate n [min^{-1}],

$$n = \frac{v_s \text{ [mm/sec.]} \cdot 60}{p \text{ [mm]}} = \frac{200 \cdot 60}{50} = 240 \text{ min}^{-1}$$

the circumferential speed v_c [m/min]

$$v_c = \frac{d_0 \text{ [mm]} \cdot \pi \cdot n \text{ [min}^{-1}\text{]}}{1000} = \frac{10 \cdot \pi \cdot 240}{1000} = 7.53 \text{ m/min}$$

and find the load factor f_L in above table:

f_L at v_c of 7.53 m/min ≈ 0.85 [-]

- It follows:

$$F_{\text{per.}} = C_{\text{stat}} \cdot f_L = 1250 \cdot 0.85 = 1062.5 \text{ N}$$

So the maximum load for a Speedy 10/50 at $v_s = 200$ mm/sec.
 (→ $n = 240 \text{ min}^{-1}$) is 1060 N.