Calculation formulas

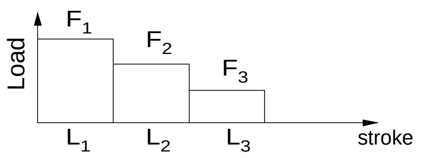
1. Dynamic load rating
(N) and
Basic life rating

$$L_{10} = \left(\frac{C_a}{F_m}\right)^3 \text{ or } C_{req} = F_m\,(L_{10})^{1/3}_{req}$$

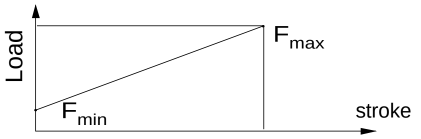
L_{10} = life (million of revolutions)
C_a = basic dynamic load rating
C_{req} = required dynamic load rating
F_m = cubic mean load (N)

2. Cubic mean load
(N)

$$F_m = \frac{(F_1^3 L_1 + F_2^3 L_2 + F_3^3 L_3 + \ldots)^{1/3}}{(L_1 + L_2 + L_3 + \ldots)^{1/3}}$$



$$F_m = \frac{F_{min} + 2F_{max}}{3}$$



3. Critical speed of screw shaft
(no safety factor)
(rpm)
(a factor of 0,8 is generally recommended)

$$n_{cr} = 490 \,.\, 10^5 \,.\, \frac{f_1\, d_2}{l^2}$$

d_2 = root diameter (mm)
l = free length, or distance between the two support bearings (see page 6)
f_1 = 0,9 fixed, free
3,8 fixed, supported
5,6 fixed, fixed

4. Speed limit of the mechanism
(maxi speed applied through very short periods)

For instance : n x d_0 < 50 000 with composite inserts for SX - SN
n x d_0 < 90 000 for SL
if > 50 000/90 000, consult SKF

n = revolutions per minute
d_0 = screw shaft nominal diameter

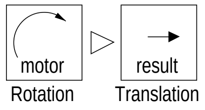
5. Buckling strength
(with a safety factor : 3)
(N)

$$F_c = \frac{34000 \,.\, f_3 \,.\, d_2^4}{l^2}$$

d_2 = root diameter (mm)
l = free length, or distance between the two support bearings (see page 6)
f_3 = mounting correction factor
0,25 fixed, free
1 supported, supported
2 fixed, supported
4 fixed, fixed

6. Theoretical efficiency

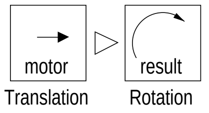
• direct
(η)



$$\eta = \frac{1}{1 + \dfrac{K \,.\, d_0}{P_h}}$$

K = 0,02 for SH
K = 0,018 for SX, SL, SN, TN, PN, TL
d_0 = nominal diameter of screw shaft
P_h = lead (mm)

• indirect
(η')



$$\eta' = 2 - \frac{1}{\eta}$$

7. Practical efficiency
(η_p)

$$\eta_p = \eta \,.\, 0{,}9$$

The value 0,9 used is an average value between the practical efficiency of a new screw and that of a properly run in screw. It should be used for industrial applications in all normal working conditions. For extreme cases, call us.

Calculation formulas

8. Input torque in a steady state **(Nm)**

$$T = \frac{F \, . \, P_h}{2000.\pi.\eta_p}$$

F = maximum load of the cycle (N)
P_h = lead (mm)
η_p = practical efficiency

9. Power required in a steady state **(W)**

$$P = \frac{F.n.P_h}{60000.\eta_p}$$

n = revolutions per minute

10. Preload torque **(Nm)**

$$T_{pr} = \frac{F_{pr}.P_h}{1000.\pi}\left(\frac{1}{\eta_p} - 1\right)$$

F_{pr} = preload force between a nut and the shaft (N)

11. Restraining torque **(Nm)**
(considering system backdriving)

$$T_B = \frac{F.P_h.\eta'}{2000.\pi}$$

F = load (N)
For safety, we can use the theoretical indirect efficiency
η' = indirect efficiency

12. Nominal motor torque when accelerating **(Nm)**

For a horizontal screw

$$T_t = T_f + T_{pr} + \frac{P_h\left[F + m_L.\mu_f.g\right]}{2000.\pi.\eta_p} + \dot{\omega}\Sigma I$$

For a vertical screw

$$T_t = T_f + T_{pr} + \frac{P_h\left[F + m_L.g\right]}{2000.\pi.\eta_p} + \dot{\omega}\Sigma I$$

T_f = torque from friction in support bearings, motors, seals, etc… (Nm)
T_{pr} = preload torque
μ_f = coefficient of friction
η_p = real direct efficiency
$\dot{\omega}$ = angular acceleration (rad/s^2)
m_L = mass of the load (kg)
g = acceleration of gravity (9,8 m/s^2)
$\Sigma I = I_M + I_L + I_S . \, l \, . \, 10^{-9}$

13. Nominal braking torque when decelerating **(Nm)**

For a horizontal screw

$$T'_t = T_f + T_{pr} + \frac{P_h.\eta'.\left[F + m_L.\mu_f.g\right]}{2000.\pi} + \dot{\omega}\Sigma I$$

For a vertical screw

$$T_t = T_f + T_{pr} + \frac{P_h.\eta'.\left[F + m_L.g\right]}{200.\pi} + \dot{\omega}\Sigma I$$

$I_L = m_L \left(\frac{P_h}{2\,\pi}\right)^2 10^{-6}$
η' = theoretical indirect efficiency
I_M = inertia of motor (kgm^2)
I_S = inertia of screw shaft per metre (kgmm^2/m)
l = length of screw shaft (mm)