Autodesk Inventor Engineer s Handbook

هندبوک مهندسی نرم افزار Autodesk Inventor

انجمن اینونتور ایران

www.irinventor.com

Email: irinventor@chmail.ir
irinventor@hotmail.com

Tel: 09352191813 &

021-46088862

Transmission Mechanism

Power Screw Calculator Handbook

[قابل توجه خوانندگان عزیز: کلیه مطالب این هندبوک از سایت شرکت Autodesk کپی برداری شده است.]

Basic calculation of power screws

Calculates power screws loaded by torsion and pressure, and checks for buckling and pressure in the thread using metric or English units, depending on the specified standard. With the ANSI standard, English units are used with corresponding screw dimensions.

Input Parameters

F maximal axial force [N, lb]
T maximal.moment [Nm, lb ft]
f_1 thread friction factor between the nut and screw [-]

NoteThe influence of the angle of thread must be included in the thread friction factor value.

d screw thread diameter [mm, in]
p pitch [mm, in]
d_s mean screw diameter [mm, in]
d_{min} minimum screw diameter [mm, in]
H nut height [mm, in]
n factor for end conditions according to the diagrammatic picture of mounting types [-]
L maximum loaded length of a screw [mm, in]
S_y yield strength [MPa, psi]
k_s safety factor (The value is selected according to the required safety level.) [-]
p_a allowable thread pressure [MPa, psi]
E screw elasticity module [MPa, psi]

Calculated Parameters

Reduced length

$L_{red} = n\ L$

Min. section area

$S_{min} = \pi\ d_{min}^{\ 2} / 4$

Helix Angle (Lead angle)

$$\alpha = \arctan\left(\frac{p}{\pi \cdot d_s}\right)$$

Efficiency

For “Rotation to Shift”

$$\eta = \frac{\tan\alpha}{\tan(\alpha + \arctan f_1)} = \frac{1 - f_1 \tan\alpha}{1 + f_1 \cot\alpha}$$

For “Shift to Rotation”

$$\eta = \frac{\tan(\alpha - \arctan f_1)}{\tan\alpha} = \frac{1 - f_1 \cot\alpha}{1 + f_1 \tan\alpha}$$

If $\alpha < \arctan f_1$, $\eta = 0$

Maximum moment - if it is the output moment

$T = F\ p / (2\ \pi\eta)$

Maximum axial force - if it is the output force

$F = 2\ T\ \pi\eta / p$

Slenderness ratio

$\lambda = 4\ L_{red} / d_s$

Pressure stress

$\sigma_t = F / S_{min}$

Torsion stress

$$\tau_k = \frac{16 \cdot T}{\pi \cdot d_{min}^3}$$

Reduced stress

$$\sigma_{red} = \sqrt{\sigma_t^2 + 3\,\tau_k^2}$$

Rankin Critical Stress

$$\sigma_R = \frac{Sy}{1 + \frac{Sy\,\lambda^2}{\pi^2 E}}$$

Euler Critical Stress

$$\sigma_E = \pi^2 E / \lambda^2$$

Johnson Critical Stress

$$\sigma_J = Sy\left(1 - \frac{Sy\,\lambda^2}{4\pi^2 E}\right)$$

Calculated thread pressure

$$p_v = \frac{F}{0.75 \cdot \pi\, d_s\, (d - d_s)\frac{H}{p}}$$

Calculated factor of safety

$$k_v = \min\left(S_y / \sigma red, \min\left(\sigma_R, \sigma_F, \sigma_J\right) / \sigma_t\right)$$

Strength check

$$k_v \geq k_s$$

$$p_c \leq p_A$$

Thread friction factor f1

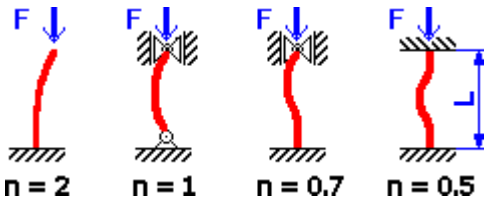
Thread	f_1
Acme thread	0.1 to 0.2
Ball power screws	0.01

Allowable thread pressure pa

For power screws

Material	*pa [MPa]*	*pa [psi]*
Steel - Cast iron	5 - 7	700 - 1000
Steel - Bronze	5 - 15	700 - 2200
Steel - Steel	7.5 - 10	1100 - 1450

Mounting Type:



The values are theoretical. You must include backlash and yielding in mounting.

Web: www.irinventor.ir
Email: irinventor@chmail.ir
& irinventor@hotmail.com

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