

Autodesk Inventor

Engineer s Handbook

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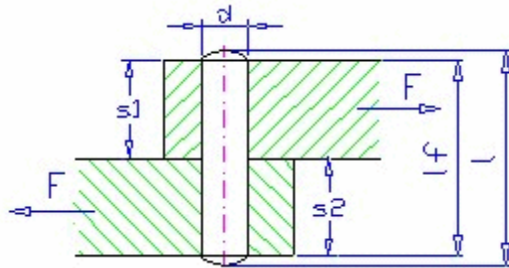
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Joins / Fixed Joins

Pin Generators Handbook

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

Secure pin



Active Pin Length

The pin active length l_f is a length reduced by chamfering and filleting. The active length usually carries loading.

Formulas

Shear stress check

$$\tau = \frac{4 \cdot F}{\pi \cdot d^2} \leq \tau_A$$

Contact pressure check

$$p_1 = \frac{F}{d \cdot s_1} \leq p_{1A} \quad p_2 = \frac{F}{d \cdot s_2} \leq p_{2A}$$

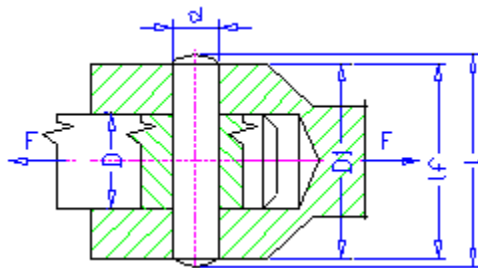
Interpretations of symbols in metric units:

- τ shear stress [MPa]
- τ_A allowable shear stress [MPa]
- d pin diameter [mm]
- p_1 pressure in the top board [MPa]
- p_2 pressure in the bottom board [MPa]
- p_{1A} allowable pressure in the top board [MPa]
- p_{2A} allowable pressure in the bottom board [MPa]
- s_1 thickness of the top board [mm]
- s_2 thickness of the bottom board [mm]

Interpretations of symbols in English units:

τ shear stress [psi]
 τ_A allowable shear stress [psi]
 d pin diameter [in]
 p_1 pressure in the top board [psi]
 p_2 pressure in the bottom board [psi]
 p_{1A} allowable pressure in the top board [psi]
 p_{2A} allowable pressure in the bottom board [psi]
 s_1 thickness of the top board [in]
 s_2 thickness of the bottom board [in]

Cross pin generator



Recommended values:

$$d = (0.2 - 0.3) D$$

$$D_1 = (1.5 - 2) D \text{ - for steel and cast steel}$$

$$D_1 = 2.5 D \text{ - for gray cast iron}$$

Active Pin Length

The pin active length l_f is a length reduced by chamfering and filleting. The active length usually carries loading.

Formulas

Shear stress check

$$\tau = \frac{2 \cdot F}{\pi \cdot d^2} \leq \tau_A$$

Contact pressure check

$$p_1 = \frac{F}{D \cdot d} \leq p_{1A} \quad p_2 = \frac{F}{(D_1 - D)d} \leq p_{2A}$$

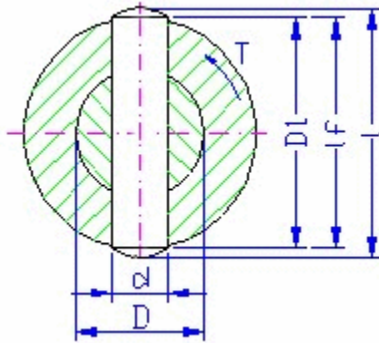
Interpretations of symbols in metric units:

- τ shear stress [MPa].
- τ_A allowable shear stress [MPa].
- d pin diameter [mm].
- p_1 pressure in the draw rod [MPa].
- p_2 pressure in the sleeve [MPa].
- p_{1A} allowable pressure in the sleeve [MPa].
- p_{2A} allowable pressure in the draw rod [MPa].
- D draw rod diameter [mm].
- D_1 sleeve diameter [mm].

Interpretations of symbols in English units:

- τ shear stress [psi]
- τ_A allowable shear stress [psi]
- d pin diameter [in]
- p_1 pressure in the draw rod [psi]
- p_2 pressure in the sleeve [psi]
- p_{1A} allowable pressure in the sleeve [psi]
- p_{2A} allowable pressure in the draw rod [psi]
- D draw rod diameter [in]
- D_1 sleeve diameter [in]

Radial pin generator



Recommended values:

$$d = (0.2 - 0.3) D$$

$$D_1 = (1.5 - 2) D \text{ - for steel and cast steel}$$

$$D_1 = 2.5 D \text{ - for gray cast iron}$$

Active Pin Length

The pin active length l_f is a length reduced by chamfering and filleting. The active length usually carries loading.

Formulas in metric units

Bending stress

$$\sigma_o = \frac{F}{2 \frac{\pi}{4} d^2} = \frac{4M}{\pi \cdot d^2 D} \leq \sigma_{oD} \quad [MPa]$$

Pressure in rod

$$p_1 = \frac{3F}{D \cdot d} \leq p_{1D} \quad [MPa]$$

Pressure in clevis

$$p_2 = \frac{2F \cdot D}{d(D_1^2 - D^2)} \leq p_{2D} \text{ [MPa]}$$

Shear stress

$$\tau = \frac{M_o}{W_o} \leq \tau_D \text{ [MPa]}$$

$$W_o = \frac{\pi}{16} \cdot \frac{D^4 - d^4}{D} \text{ [mm]}$$

where:

F force [N]

σ_o bending stress [MPa]

σ_{oD} allowable bending stress [MPa]

M_o bending moment [N mm]

W_o bending section modulus [mm³]

τ shear stress [MPa]

τ_D allowable shear stress [MPa]

d pin diameter [mm]

p_1 pressure in rod [MPa]

p_2 pressure in clevis [MPa]

p_{1D} allowable pressure in rod [MPa]

p_{2D} allowable pressure in clevis [MPa]

b rod width [mm]

a clevis arm width [mm]

D shaft diameter [mm]

Formulas in English units

Bending stress

$$\sigma_o = \frac{F}{2 \frac{\pi}{4} d^2} = \frac{4M}{\pi \cdot d^2 D} \leq \sigma_{oD} \text{ [psi]}$$

Pressure in rod

$$p_1 = \frac{3F}{D \cdot d} \leq p_{1D} \text{ [psi]}$$

Pressure in clevis

$$p_2 = \frac{2F \cdot D}{d(D_1^2 - D^2)} \leq p_{2D} \text{ [psi]}$$

Shear stress

$$\tau = \frac{M_o}{W_o} \leq \tau_D \text{ [psi]}$$

$$W_o = \frac{\pi}{16} \cdot \frac{D^4 - d^4}{D} \text{ [in]}$$

where:

F force [lb]

σ_o bending stress [psi]

σ_{oD} allowable bending stress [psi]

M_o bending moment [ln ft]

W_o bending section modulus [in^3]

τ shear stress [psi]

τ_D allowable shear stress [psi]

d pin diameter [in]

p_1 pressure in rod [psi]

p_2 pressure in clevis [psi]

p_{1D} allowable pressure in rod [psi]

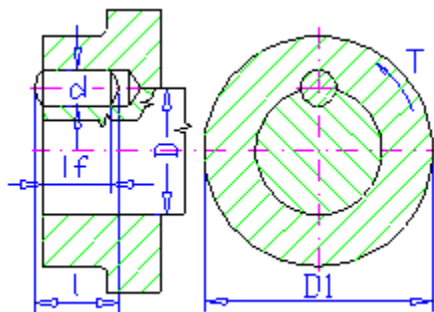
p_{2D} allowable pressure in clevis [psi]

b rod width [in]

a clevis arm width [in]

D shaft diameter [in]

Joint pin generator



Recommended values

$$d = (0.12 - 0.25) D$$

$$l = (1 - 1.5) D$$

Active Pin Length

The pin active length l_f is a length reduced by chamfering and filleting. The active length usually carries loading.

Formulas in metric units

Transferred torque

$$T = \frac{30 \cdot 10^3 \cdot P}{\pi \cdot n} \quad [Nm]$$

Shear stress check

$$\tau = \frac{2 \cdot 10^3 \cdot T}{D \cdot d \cdot l_f} \leq \tau_D \quad [MPa]$$

Contact pressure check

$$p_1 = p_2 = \frac{4 \cdot 10^3 \cdot T}{D \cdot d \cdot l_f} \leq p_{1D} \leq p_{2D} \quad [MPa]$$

where:

- P transferred power [kW]
- n speed [rpm]
- T torque [Nm]
- τ shear stress [MPa]
- τ_A allowable shear stress [MPa]
- d pin diameter [mm]
- p_1 pressure in the shaft [MPa]
- p_2 pressure in the hub [MPa]
- p_{1A} allowable pressure in the shaft [MPa]
- p_{2A} allowable pressure in the hub [MPa]
- D shaft diameter [mm]
- D_1 hub diameter [mm]
- l_f active pin length [mm]

Formulas in English units

Transferred torque

$$T = \frac{30 \cdot 550 \cdot P}{\pi \cdot n} \quad [lbft]$$

Shear stress check

$$\tau = \frac{2 \cdot 10^3 \cdot T}{D \cdot d \cdot l_f} \leq \tau_A \quad [psi]$$

Contact pressure check

$$p_1 = p_2 = \frac{4 \cdot 10^3 \cdot T}{D \cdot d \cdot l_f} \leq p_{1A} \leq p_{2A} \quad [psi]$$

where:

- P transferred power [HP]
- n speed [rpm]
- T torque [lb ft]
- τ shear stress [psi]
- τ_A allowable shear stress [psi]
- d pin diameter [in]
- p_1 pressure in the shaft [psi]
- p_2 pressure in the hub [psi]
- p_{1A} allowable pressure in the shaft [psi]
- p_{2A} allowable pressure in the hub [psi]
- D shaft diameter [in]
- D_1 hub diameter [in]
- l_f active pin length [in]

Allowable stresses for pin joints

Part Material	Immovable Mountings p_A [MPa]			Rotary Joint Mountings p_A [MPa]		
	constant	repeating	alternating	constant	repeating	alternating
Steel grade 37, 42	84	65	50	30	24	12
Steel grade 50, 60 - high grade and alloy steels	120	90	90	30	24	24
Cast steel	80	60	40	30	24	12
gray cast iron	70	50	30	40	32	16

<i>Pin Material</i>	<i>Immovable Mountings σ_{bA} [MPa]</i>			<i>Rotary Joint Mountings τ_A [MPa]</i>		
	constant	repeating	alternating	constant	repeating	alternating
11 373, 11 423, 11 110	80	55	35	50	35	25
11 500	110	80	50	70	50	35
11 600	130	95	60	85	60	42
11 700, 12 040	150	110	68	100	68	48

Note Values for grooved pins are 30 percent lower.

Allowable shaft torsion stresses

<i>Material of HB Hardness and R_m Strength [MPa]</i>	<i>Type of Torsion Load</i>	<i>Values of Allowable Stresses τ At [MPa]</i>
145 < HB < 250	constant	40
500 < R_m < 850	repeating	28
-	alternating	20
250 < HB < 350	constant	56
850 < R_m < 1200	repeating	40
-	alternating	28
HB > 350	constant	80
R_m > 1200	repeating	56
-	alternating	40

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