Autodesk Inventor Engineer s Handbook

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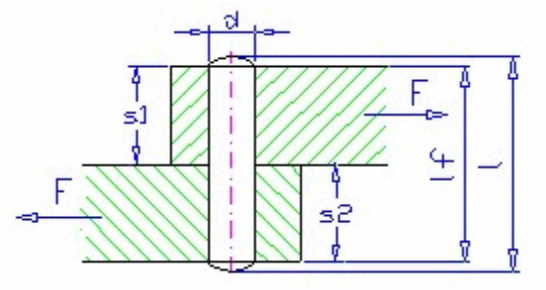
Joints / Fixed Joints

Pin Generators Handbook

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

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

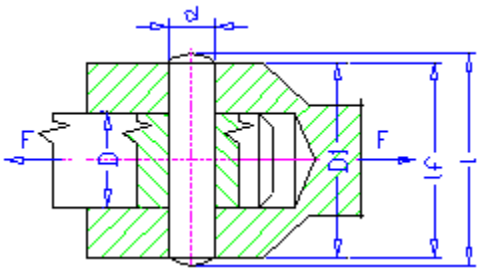
Interpretations of symbols in metric units:

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 - for steel and cast steel

D_1 = 2.5 D - 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

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

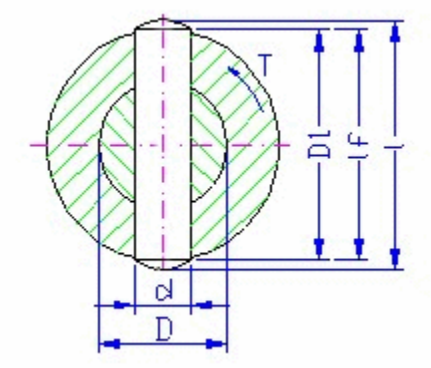
Interpretations of symbols in metric units:

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 - for steel and cast steel

D_1 = 2.5 D - 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

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

Pressure in rod

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

Pressure in clevis

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

Shear stress

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

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

where:

F	force [N]
σ_0	bending stress [MPa]
σ_{0D}	allowable bending stress [MPa]
M_0	bending moment [N mm]
W_0	bending section modulus [mm^3]
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

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

Pressure in rod

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

Pressure in clevis

$$p_2 = \frac{2F \cdot D}{d\left(D_1^2 - D^2\right)} \le p_{2D} \; [psi]$$

Shear stress

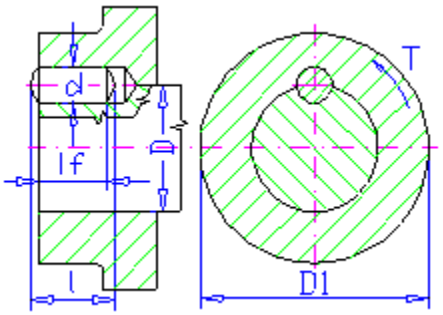
$$\tau = \frac{M_o}{W_o} \le \tau_D \qquad [psi]$$

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

where:

F	force [lb]
σ_0	bending stress [psi]
σ_{0D}	allowable bending stress [psi]
M_0	bending moment [ln ft]
W_0	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

Pin Material	*Immovable Mountings σ bA [MPa]*			*Rotary Joint Mountings τ A [MPa]*		
	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

NoteValues for grooved pins are 30 percent lower.

Allowable shaft torsion stresses

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

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