Important Design of Cotter Joint Formulas PDF



Formulas Examples with Units

List of 51

Important Design of Cotter Joint Formulas

1) Forces and Loads on Joint Formulas [

1.1) Force on Cotter given Shear Stress in Cotter Formula [



Example with Units

 $L = 2 \cdot t_{c} \cdot b \cdot \tau_{co}$

 $50000.784 \,\mathrm{N} = 2 \cdot 21.478 \,\mathrm{mm} \cdot 48.5 \,\mathrm{mm} \cdot 24 \,\mathrm{N/mm^2}$

1.2) Load Taken by Cotter Joint Rod given Tensile Stress in Rod Formula 🕝

Evaluate Formula

Evaluate Formula

$$L = \frac{\pi \cdot d^2 \cdot \sigma t_{rod}}{4}$$

Example with Units

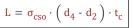
 $50000.61 \,\mathrm{N} = \frac{3.1416 \cdot 35.6827 \,\mathrm{mm}^2 \cdot 50 \,\mathrm{N/mm^2}}{4}$

1.3) Load Taken by Socket of Cotter Joint given Compressive Stress Formula 🦵

Formula

Example with Units

Evaluate Formula (



$$| 50000.784 \, \text{N} = 58.20 \, \text{N/mm}^2 \cdot \left(80 \, \text{mm} - 40 \, \text{mm} \right) \cdot 21.478 \, \text{mm}$$

1.4) Load Taken by Socket of Cotter Joint given Shear Stress in Socket Formula 🕝

Formula

Example with Units

Evaluate Formula 🕝

$$L = 2 \cdot \left(\ d_4 - d_2 \ \right) \cdot c \cdot \tau_{SO} \quad \boxed{ 50000 \, \text{N} \, = 2 \cdot \left(\, 80 \, \text{mm} \, - 40 \, \text{mm} \, \right) \cdot 25.0 \, \text{mm} \, \cdot 25 \, \text{N/mm}^2}$$

1.5) Load Taken by Socket of Cotter Joint given Tensile Stress in Socket Formula 🕝

Evaluate Formula C

$$L = \sigma_t so \cdot \left(\frac{\pi}{4} \cdot \left(\left. d_1^2 - d_2^2 \right) - t_c \cdot \left(\left. d_1 - d_2 \right) \right) \right)$$

$$50000.8227 \,\mathrm{N} \,=\, 68.224 \,\mathrm{N/mm^2} \,\cdot \left(\frac{3.1416}{4} \cdot \left(54 \,\mathrm{mm}^2 - 40 \,\mathrm{mm}^2\right) - 21.478 \,\mathrm{mm} \,\cdot \left(54 \,\mathrm{mm} - 40 \,\mathrm{mm}\right)\right)$$

1.6) Load Taken by Spigot of Cotter Joint given Compressive Stress in Spigot Considering Crushing Failure Formula

Evaluate Formula (

$$L = t_{c} \cdot d_{2} \cdot \sigma_{c1}$$

1.7) Load Taken by Spigot of Cotter Joint given Shear Stress in Spigot Formula 🕝

Formula

Example with Units

Evaluate Formula (

 $L = 2 \cdot L_a \cdot d_2 \cdot \tau_{\text{SD}} \ \middle| \ \middle| \ 50000.48 \, \text{N} \ = 2 \cdot 23.5 \, \text{mm} \, \cdot 40 \, \text{mm} \, \cdot 26.596 \, \text{N/mm}^2$

1.8) Maximum Load taken by Cotter Joint given Spigot Diameter, Thickness and Stress Formula 🕝

Formula

Evaluate Formula [

$$L = \left(\frac{\pi}{4} \cdot d_2^2 - d_2 \cdot t_c\right) \cdot \sigma_t sp$$

Example with Units

$$50000.8885 \,\text{N} = \left(\frac{3.1416}{4} \cdot 40 \,\text{mm}^{2} - 40 \,\text{mm} \cdot 21.478 \,\text{mm}\right) \cdot 125.783 \,\text{N/mm}^{2}$$

1.9) Permissible Shear Stress for Cotter Formula 🕝

Formula

Example with Units

Evaluate Formula (

 $719988.7106\,\text{N/m}^2 = \frac{1500\,\text{N}}{2\cdot 48.5\,\text{mm} \cdot 21.478\,\text{mm}}$

1.10) Permissible Shear Stress for Spigot Formula 🕝

Example with Units

Evaluate Formula

 $\tau_{\rm p} = \frac{\rm P}{2 \cdot {\rm a} \cdot {\rm d}_{\rm ex}} \left[-\frac{1500 \, \rm n}{957854.4061 \, \rm n/m^2} \right] = \frac{1500 \, \rm n}{2 \cdot 17.4 \, \rm mm \cdot 45 \, mm}$

1.11) Tensile Stress in Spigot Formula 🕝

Formula

Evaluate Formula 🕝

$$\sigma_{t} = \frac{P}{\left(\frac{\pi}{4} \cdot d_{ex}^{2}\right) - \left(d_{ex} \cdot t_{c}\right)}$$

$$2.4041 \,\text{N/mm}^2 = \frac{1500 \,\text{N}}{\left(\frac{3.1416}{4} \cdot 45 \,\text{mm}^2\right) - \left(45 \,\text{mm} \cdot 21.478 \,\text{mm}\right)}$$

2) Joint Geometry and Dimensions Formulas [7]

2.1) Cross Section Area of Socket End Resisting Shear Failure Formula 🕝

Formula

Example with Units

 $A = (d_4 - d_2) \cdot c$ | 1000 mm² = (80 mm - 40 mm) · 25.0 mm

2.2) Cross Section Area of Socket of Cotter Joint Prone to Failure Formula

Evaluate Formula (

Evaluate Formula

Evaluate Formula

Evaluate Formula

Evaluate Formula

Evaluate Formula

Evaluate Formula C

Formula $A = \frac{\pi}{4} \cdot \left(d_1^2 - d_2^2 \right) - t_c \cdot \left(d_1 - d_2 \right)$

Example with Units

$$732.892 \, \text{mm}^2 = \frac{3.1416}{4} \cdot \left(54 \, \text{mm}^2 - 40 \, \text{mm}^2\right) - 21.478 \, \text{mm} \cdot \left(54 \, \text{mm} - 40 \, \text{mm}\right)$$

2.3) Cross Section Area of Spigot of Cotter Joint Prone to Failure Formula 🕝

 $A_{s} = \frac{\pi \cdot d_{2}^{2}}{4} - d_{2} \cdot t_{c}$ 397.5171 mm² = $\frac{3.1416 \cdot 40 \text{ mm}^{2}}{4} - 40 \text{ mm} \cdot 21.478 \text{ mm}$

2.4) Diameter of Rod of Cotter Joint given Socket Collar Diameter Formula (

 $d = \frac{d_4}{2.4} \qquad 33.3333 \, \text{mm} = \frac{80 \, \text{mm}}{2.4}$

2.5) Diameter of Rod of Cotter Joint given Spigot Collar Diameter Formula C

Formula Example with Units $d = \frac{d_3}{1.5}$ $32 \text{ mm} = \frac{48 \text{ mm}}{1.5}$

2.6) Diameter of Rod of Cotter Joint given Thickness of Cotter Formula 🗂

 $d = \frac{t_c}{0.31} \qquad 69.2839 \, \text{mm} = \frac{21.478 \, \text{mm}}{0.31}$

2.7) Diameter of Rod of Cotter Joint given Thickness of Spigot Collar Formula C

Example with Units $d = \frac{t_1}{0.45}$ 28.8889 mm = $\frac{13 \text{ mm}}{0.45}$

2.8) Diameter of Socket Collar given Rod Diameter Formula 🕝

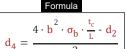
Formula
$$\frac{\mathbf{d_4} = 2.4 \cdot \mathbf{d}}{\mathbf{d_4}}$$

Example with Units

Evaluate Formula (

 $85.6385\,\mathrm{mm} = 2.4\cdot35.6827\,\mathrm{mm}$

2.9) Diameter of Socket Collar of Cotter Joint given Bending Stress in Cotter Formula 🕝





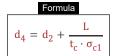
Evaluate Formula (

Evaluate Formula (

Evaluate Formula (

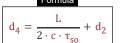
 $d_4 = \frac{4 \cdot b^2 \cdot \sigma_b \cdot \frac{t_c}{L} - d_2}{3} \left[178.0448 \, \text{mm} \right] = \frac{4 \cdot 48.5 \, \text{mm}^2 \cdot 98 \, \text{N/mm}^2 \cdot \frac{21.478 \, \text{mm}}{50000 \, \text{N}} - 40 \, \text{mm}}{3}$

2.10) Diameter of Socket Collar of Cotter Joint given Compressive Stress Formula 🕝



Example with Units

2.11) Diameter of socket collar of cotter joint given shear stress in socket Formula 🕝



Example with Units $d_4 = \frac{L}{2 \cdot c \cdot \tau_{so}} + d_2 \left| \quad 80 \, \text{mm} \right| = \frac{50000 \, \text{N}}{2 \cdot 25.0 \, \text{mm} \cdot 25 \, \text{N/mm}^2} + 40 \, \text{mm}$

2.12) Diameter of Spigot Collar given Rod Diameter Formula C



Example with Units

Evaluate Formula (

 $d_3 = 1.5 \cdot d$ 53.524 mm = 1.5 · 35.6827 mm

2.13) Diameter of Spigot of Cotter Joint given Bending Stress in Cotter Formula 🕝



Evaluate Formula

 $d_2 = 4 \cdot b^2 \cdot \sigma_b \cdot \frac{t_c}{L} - 2 \cdot d_4$

Example with Units

 $236.0895 \, \text{mm} = 4 \cdot 48.5 \, \text{mm}^{2} \cdot 98 \, \text{N/mm}^{2} \cdot \frac{21.478 \, \text{mm}}{50000 \, \text{m}} - 2 \cdot 80 \, \text{mm}$

2.14) Diameter of Spigot of Cotter Joint given Compressive Stress Formula 🕝



Example with Units

Evaluate Formula C

 $d_2 = d_4 - \frac{L}{t_c \cdot \sigma_{c1}} \left| \quad 40.0006 \, \text{mm} \right| = 80 \, \text{mm} - \frac{50000 \, \text{N}}{21.478 \, \text{mm} \cdot 58.2 \, \text{N/mm}^2}$

2.15) Diameter of Spigot of Cotter Joint given Shear Stress in Spigot Formula 🕝

Example with Units

Evaluate Formula (

Evaluate Formula (

Evaluate Formula (

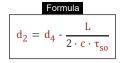
Evaluate Formula (

Evaluate Formula

$$d_2 = \frac{L}{2 \cdot L_a \cdot \tau_{sp}}$$

 $d_2 = \frac{L}{2 \cdot L_a \cdot \tau_{SD}} \left| \quad 39.9996 \,_{mm} \right| = \frac{50000 \,_{N}}{2 \cdot 23.5 \,_{mm} \cdot 26.596 \,_{N/mm^2}}$

2.16) Inside Diameter of Socket of Cotter Joint given Shear Stress in Socket Formula 🕝



$$d_{2} = d_{4} - \frac{L}{2 \cdot c \cdot \tau_{so}} \qquad 40 \text{ mm} = 80 \text{ mm} - \frac{50000 \text{ N}}{2 \cdot 25.0 \text{ mm} \cdot 25 \text{ N/mm}^{2}}$$

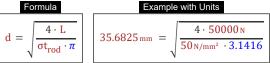
2.17) Minimum Diameter of Spigot in Cotter Joint Subjected to Crushing Stress Formula 🕝



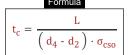
$d_2 = \frac{L}{\sigma_c \cdot t_c} \qquad 18.4759 \, \text{mm} = \frac{50000 \, \text{N}}{126 \, \text{N/mm}^2 \cdot 21.478 \, \text{mm}}$

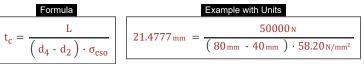
2.18) Minimum Rod Diameter in Cotter Joint given Axial Tensile Force and Stress Formula 🕝





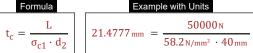
2.19) Thickness of Cotter given Compressive Stress in Socket Formula 🕝





2.20) Thickness of Cotter given Compressive Stress in Spigot Formula C





Evaluate Formula [

2.21) Thickness of Cotter given Shear Stress in Cotter Formula C

$$t_c = \frac{L}{2 \cdot \tau_{co} \cdot b} \qquad \begin{array}{|l|l|} \hline \text{Example with Units} \\ \hline \\ 21.4777 \, \text{mm} \end{array} = \frac{50000 \, \text{N}}{2 \cdot 24 \, \text{N/mm}^2 \cdot 48.5 \, \text{mm}} \\ \hline \end{array}$$

2.22) Thickness of Cotter given Tensile Stress in Socket Formula C

$$t_{c} = \frac{\left(\frac{\pi}{4} \cdot \left(d_{1}^{2} - d_{2}^{2}\right)\right) - \frac{F_{c}}{\sigma_{t}so}}{d_{1} - d_{2}}$$

Example with Units

$$68.5926 \, \text{mm} = \frac{\left(\frac{3.1416}{4} \cdot \left(54 \, \text{mm}^2 - 40 \, \text{mm}^2\right)\right) - \frac{5000 \, \text{N}}{68.224 \, \text{N/mm}^2}}{54 \, \text{mm} - 40 \, \text{mm}}$$

2.23) Thickness of Cotter Joint Formula [7]

Formula

Example with Units $t_c = 0.31 \cdot d$ | 11.0616 mm = 0.31 \cdot 35.6827 mm Evaluate Formula

Evaluate Formula

Evaluate Formula (

2.24) Thickness of Cotter Joint given Bending Stress in Cotter Formula [7]

 $t_{c} = \left(2 \cdot d_{4} + d_{2}\right) \cdot \left(\frac{L}{4 \cdot b^{2} \cdot \sigma_{b}}\right)$

Example with Units

$$10.845 \, \text{mm} \, = \, \left(\, 2 \cdot 80 \, \text{mm} \, + \, 40 \, \text{mm} \, \, \right) \cdot \left(\frac{50000 \, \text{N}}{4 \cdot 48.5 \, \text{mm}^{2} \cdot 98 \, \text{N/mm}^{2}} \right)$$

2.25) Thickness of Spigot Collar when Rod Diameter is Available Formula C

Example with Units Formula Example with Units $t_1 = 0.45 \cdot d \hspace{0.2cm} \boxed{ 16.0572 \, \text{mm} } = 0.45 \cdot 35.6827 \, \text{mm}$ Evaluate Formula (

Evaluate Formula C

2.26) Width of Cotter by Bending Consideration Formula C

Formula $b = \left(3 \cdot \frac{L}{t_c \cdot \sigma_b} \cdot \left(\frac{d_2}{4} + \frac{d_4 \cdot d_2}{6}\right)\right)^{0.5}$

$$34.4636 \, \text{mm} \ = \left(3 \cdot \frac{50000 \, \text{N}}{21.478 \, \text{mm} \, \cdot 98 \, \text{N/mm}^2} \cdot \left(\frac{40 \, \text{mm}}{4} + \frac{80 \, \text{mm} \, - 40 \, \text{mm}}{6}\right)\right)^{0.5}$$

2.27) Width of Cotter by Shear Consideration Formula [

Formula

$$b = \frac{V}{2 \cdot \tau_{co} \cdot t_{c}}$$

Evaluate Formula (

3) Strength and Stress Formulas (7)

3.1) Bending Stress in Cotter of Cotter Joint Formula C

 $\sigma_{b} = \left(3 \cdot \frac{L}{t_{a} \cdot b^{2}}\right) \cdot \left(\frac{d_{2} + 2 \cdot d_{4}}{12}\right)$

Evaluate Formula

Example with Units

$$49.4838 \,\text{N/mm}^2 = \left(3 \cdot \frac{50000 \,\text{N}}{21.478 \,\text{mm} \cdot 48.5 \,\text{mm}^2}\right) \cdot \left(\frac{40 \,\text{mm} + 2 \cdot 80 \,\text{mm}}{12}\right)$$

3.2) Compressive Stress in Socket of Cotter Joint given Diameter of Spigot and of Socket Collar Formula 🕝

Example with Units

$$\sigma_{\rm cso} = \frac{\rm L}{\left(\, d_4 - d_2 \, \right) \cdot t_{\rm c}} \left[58.1991 \, \rm N/mm^2 \, = \frac{50000 \, \rm N}{\left(\, 80 \, \rm mm \, - 40 \, mm \, \right) \cdot 21.478 \, mm} \right]$$

3.3) Compressive Stress in Spigot of Cotter Joint Considering Crushing Failure Formula 🕝

Formula Example with Units $\sigma_{c1} = \frac{L}{t_c \cdot d_2} \qquad 58.1991 \, \text{N/mm}^2 = \frac{50000 \, \text{N}}{21.478 \, \text{mm} \cdot 40 \, \text{mm}}$

Evaluate Formula (

Evaluate Formula (

3.4) Compressive Stress of Spigot Formula C

Formula

 $\sigma_{cp} = \frac{L}{t_c \cdot D_s} = \frac{50000 \,\text{N}}{46.5593 \,\text{N/mm}^2} = \frac{50000 \,\text{N}}{21.478 \,\text{mm} \cdot 50.0 \,\text{mm}}$

Evaluate Formula C

3.5) Permissible Shear Stress for Cotter Formula 🕝

Evaluate Formula (

3.6) Permissible Shear Stress for Spigot Formula 🕝

Example with Units

Evaluate Formula (

$$\tau_{\rm p} = \frac{\rm P}{2 \cdot \rm a \cdot \rm d_{\rm ex}}$$

$$\tau_{p} = \frac{P}{2 \cdot a \cdot d_{ex}} \qquad 957854.4061 \, \text{N/m}^{2} = \frac{1500 \, \text{N}}{2 \cdot 17.4 \, \text{mm} \cdot 45 \, \text{mm}}$$

3.7) Shear Stress in Cotter given Cotter Thickness and Width Formula C

Evaluate Formula

Evaluate Formula 🕝

Formula
$$\tau_{co} = \frac{L}{2 \cdot t_c \cdot b}$$

Formula Example with Units
$$\tau_{co} = \frac{L}{2 \cdot t_c \cdot b} \qquad 23.9996 \, \text{N/mm}^2 = \frac{50000 \, \text{N}}{2 \cdot 21.478 \, \text{mm} \cdot 48.5 \, \text{mm}}$$

3.8) Shear Stress in Socket of Cotter Joint given Inner and Outer Diameter of Socket Formula

Example with Units

$$\tau_{so} = \frac{L}{2 \cdot \left(d_4 - d_2\right) \cdot c}$$

$$\tau_{\text{so}} = \frac{L}{2 \cdot \left(d_4 - d_2\right) \cdot c} \qquad \boxed{25 \, \text{N/mm}^2 = \frac{50000 \, \text{N}}{2 \cdot \left(80 \, \text{mm} - 40 \, \text{mm}\right) \cdot 25.0 \, \text{mm}}}$$

3.9) Shear Stress in Spigot of Cotter Joint given Diameter of Spigot and Load Formula 🕝

Formula

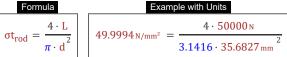
Example with Units

Evaluate Formula [

$$\tau_{\rm sp} = \frac{L}{2 \cdot L_{\rm a} \cdot d_2}$$

3.10) Tensile Stress in Rod of Cotter Joint Formula 🕝

Formula



Evaluate Formula (

3.11) Tensile Stress in Socket of Cotter Joint given Outer and Inner Diameter of Socket Formula 🕝

Formula

Evaluate Formula @

$$\sigma_{t}so = \frac{L}{\frac{\pi}{4} \cdot \left(d_{1}^{2} - d_{2}^{2}\right) - t_{c} \cdot \left(d_{1} - d_{2}\right)}$$

$$68.2229 \,\text{N/mm}^2 = \frac{50000 \,\text{N}}{\frac{3.1416}{4} \cdot \left(54 \,\text{mm}^2 - 40 \,\text{mm}^2\right) - 21.478 \,\text{mm} \cdot \left(54 \,\text{mm} - 40 \,\text{mm}\right)}$$

3.12) Tensile Stress in Spigot Formula

Formula

 $125.7808 \, \text{N/mm}^2 =$

$$= \frac{P}{\left(\frac{\pi}{2} \cdot d_{av}^{2}\right) - \left(d_{av} \cdot t_{c}\right)}$$

Evaluate Formula 🕝

Example with Units

$$2.4041 \,\mathrm{N/mm^2} = \frac{1500 \,\mathrm{N}}{\left(\frac{3.1416}{4} \cdot 45 \,\mathrm{mm}^2\right) - \left(45 \,\mathrm{mm} \cdot 21.478 \,\mathrm{mm}\right)}$$

3.13) Tensile Stress in Spigot of Cotter Joint given Diameter of Spigot, Thickenss of Cotter and Load Formula 🕝

Formula

Example with Units

50000 N

3.1416 · 40 mm ² - 40 mm · 21.478 mm

Evaluate Formula 🕝

$$\sigma_{t}sp = \frac{L}{\frac{\pi \cdot d_{2}^{2}}{4} - d_{2} \cdot t_{c}}$$

Variables used in list of Design of Cotter Joint Formulas above

- a Spigot Distance (Millimeter)
- A Cross Sectional Area of Socket (Square Millimeter)
- A_S Cross Sectional Area of Spigot (Square Millimeter)
- **b** Mean Width of Cotter (Millimeter)
- C Axial Distance From Slot to End of Socket Collar (Millimeter)
- **d** Diameter of Rod of Cotter Joint (Millimeter)
- d₁ Outside Diameter of Socket (Millimeter)
- d₂ Diameter of Spigot (Millimeter)
- d₃ Diameter of Spigot Collar (Millimeter)
- d₄ Diameter of Socket Collar (Millimeter)
- dex External Diameter of Spigot (Millimeter)
- Ds Spigot Diameter (Millimeter)
- Fc Force on Cotter Joint (Newton)
- L Load on Cotter Joint (Newton)
- La Gap between End of Slot to End of Spigot (Millimeter)
- P Tensile Force on Rods (Newton)
- t₁ Thickness of Spigot Collar (Millimeter)
- t_c Thickness of Cotter (Millimeter)
- **V** Shear Force on Cotter (Newton)
- σ_b Bending Stress in Cotter (Newton per Square Millimeter)
- σ_c Crushing Stress induced in Cotter (Newton per Square Millimeter)
- σ_{c1} Compressive Stress in Spigot (Newton per Square Millimeter)
- σ_{cp} Stress in Spigot (Newton per Square Millimeter)
- σ_{cso} Compressive Stress In Socket (Newton per Square Millimeter)
- σ_t Tensile Stress (Newton per Square Millimeter)

Constants, Functions, Measurements used in list of Design of Cotter Joint Formulas above

- constant(s): pi,
 3.14159265358979323846264338327950288
 Archimedes' constant
- Functions: sqrt, sqrt(Number)
 A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: Length in Millimeter (mm)
 Length Unit Conversion
- Measurement: Area in Square Millimeter (mm²)
 Area Unit Conversion
- Measurement: Pressure in Newton per Square Meter (N/m²)
 Pressure Unit Conversion
- Measurement: Force in Newton (N)
 Force Unit Conversion
- Measurement: Stress in Newton per Square Millimeter (N/mm²)
 Stress Unit Conversion

- σ_tso Tensile Stress In Socket (Newton per Square Millimeter)
- σ_tsp Tensile Stress In Spigot (Newton per Square Millimeter)
- σt_{rod} Tensile Stress in Cotter Joint Rod (Newton per Square Millimeter)
- T_{CO} Shear Stress in Cotter (Newton per Square Millimeter)
- T_{SO} Shear Stress in Socket (Newton per Square Millimeter)
- T_{Sp} Shear Stress in Spigot (Newton per Square Millimeter)
- $au_{\mathbf{p}}$ Permissible Shear Stress (Newton per Square Meter)

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