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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

$$L = \sigma_{cso} \cdot \left(d_4 - d_2 \right) \cdot t_c$$

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$50000\,\text{N} = 2 \cdot \left(80\,\text{mm} - 40\,\text{mm} \right) \cdot 25.0\,\text{mm} \cdot 25\,\text{N/mm}^2$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

$$L = t_c \cdot d_2 \cdot \sigma_{c1}$$

Example with Units

$$50000.784\,\text{N} = 21.478\,\text{mm} \cdot 40\,\text{mm} \cdot 58.2\,\text{N/mm}^2$$

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

Evaluate Formula

Formula

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

Example with Units

$$50000.48\,\text{N} = 2 \cdot 23.5\,\text{mm} \cdot 40\,\text{mm} \cdot 26.596\,\text{N/mm}^2$$

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

Evaluate Formula

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

Evaluate Formula

Formula

$$\tau_p = \frac{P}{2 \cdot b \cdot t_c}$$

Example with Units

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

1.10) Permissible Shear Stress for Spigot Formula

Evaluate Formula

Formula

$$\tau_p = \frac{P}{2 \cdot a \cdot d_{ex}}$$

Example with Units

$$957854.4061\,\text{N/m}^2 = \frac{1500\,\text{N}}{2 \cdot 17.4\,\text{mm} \cdot 45\,\text{mm}}$$

1.11) Tensile Stress in Spigot Formula

Evaluate Formula

Formula

$$\sigma_t = \frac{P}{\left(\frac{\pi}{4} \cdot {d_{ex}}^2\right) - \left(d_{ex} \cdot t_c\right)}$$

Example with Units

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

2) Joint Geometry and Dimensions Formulas

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

Evaluate Formula

Formula

$$A = \left(d_4 - d_2 \right) \cdot c$$

Example with Units

$$1000\,\text{mm}^2 = \left(80\,\text{mm} - 40\,\text{mm} \right) \cdot 25.0\,\text{mm}$$

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

Evaluate Formula

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

Evaluate Formula

Formula

$$A_s = \frac{\pi \cdot d_2^{\,2}}{4} - d_2 \cdot t_c$$

Example with Units

$$397.5171\,\text{mm}^2 = \frac{3.1416 \cdot 40\,\text{mm}^{\,2}}{4} - 40\,\text{mm} \cdot 21.478\,\text{mm}$$

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

Evaluate Formula

Formula

$$d = \frac{d_4}{2.4}$$

Example with Units

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

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

Evaluate Formula

Formula

$$d = \frac{d_3}{1.5}$$

Example with Units

$$32\,\text{mm} = \frac{48\,\text{mm}}{1.5}$$

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

Evaluate Formula

Formula

$$d = \frac{t_c}{0.31}$$

Example with Units

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

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

Evaluate Formula

Formula

$$d = \frac{t_1}{0.45}$$

Example with Units

$$28.8889\,\text{mm} = \frac{13\,\text{mm}}{0.45}$$

2.8) Diameter of Socket Collar given Rod Diameter Formula

Evaluate Formula

Formula

$$d_4 = 2.4 \cdot d$$

Example with Units

$$85.6385\,\text{mm} = 2.4 \cdot 35.6827\,\text{mm}$$

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

Evaluate Formula

Formula

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

Example with Units

$$178.0448\,\text{mm} = \frac{4 \cdot 48.5\,\text{mm}^2 \cdot 98\,\text{N/mm}^2 \cdot \frac{21.478\,\text{mm}}{50000\,\text{N}} - 40\,\text{mm}}{2}$$

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

Evaluate Formula

Formula

$$d_4 = d_2 + \frac{L}{t_c \cdot \sigma_{c1}}$$

Example with Units

$$79.9994\,\text{mm} = 40\,\text{mm} + \frac{50000\,\text{N}}{21.478\,\text{mm} \cdot 58.2\,\text{N/mm}^2}$$

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

Evaluate Formula

Formula

$$d_4 = \frac{L}{2 \cdot c \cdot \tau_{so}} + d_2$$

Example with Units

$$80\,\text{mm} = \frac{50000\,\text{N}}{2 \cdot 25.0\,\text{mm} \cdot 25\,\text{N/mm}^2} + 40\,\text{mm}$$

2.12) Diameter of Spigot Collar given Rod Diameter Formula

Evaluate Formula

Formula

$$d_3 = 1.5 \cdot d$$

Example with Units

$$53.524\,\text{mm} = 1.5 \cdot 35.6827\,\text{mm}$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

$$d_2 = d_4 - \frac{L}{t_c \cdot \sigma_{c1}}$$

Example with Units

$$40.0006\,\text{mm} = 80\,\text{mm} - \frac{50000\,\text{N}}{21.478\,\text{mm} \cdot 58.2\,\text{N/mm}^2}$$

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

Evaluate Formula

Formula

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

Example with Units

$$39.9996\,\text{mm} = \frac{50000\,\text{N}}{2 \cdot 23.5\,\text{mm} \cdot 26.596\,\text{N/mm}^2}$$

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

Evaluate Formula

Formula

$$d_2 = d_4 - \frac{L}{2 \cdot c \cdot \tau_{so}}$$

Example with Units

$$40\,\text{mm} = 80\,\text{mm} - \frac{50000\,\text{N}}{2 \cdot 25.0\,\text{mm} \cdot 25\,\text{N/mm}^2}$$

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

Evaluate Formula

Formula

$$d_2 = \frac{L}{\sigma_c \cdot t_c}$$

Example with Units

$$18.4759\,\text{mm} = \frac{50000\,\text{N}}{126\,\text{N/mm}^2 \cdot 21.478\,\text{mm}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$35.6825\,\text{mm} = \sqrt{\frac{4 \cdot 50000\,\text{N}}{50\,\text{N/mm}^2 \cdot 3.1416}}$$

2.19) Thickness of Cotter given Compressive Stress in Socket Formula

Evaluate Formula

Formula

$$t_c = \frac{L}{\left(d_4 - d_2\right) \cdot \sigma_{cso}}$$

Example with Units

$$21.4777\,\text{mm} = \frac{50000\,\text{N}}{\left(80\,\text{mm} - 40\,\text{mm}\right) \cdot 58.20\,\text{N/mm}^2}$$

2.20) Thickness of Cotter given Compressive Stress in Spigot Formula

Evaluate Formula

Formula

$$t_c = \frac{L}{\sigma_{c1} \cdot d_2}$$

Example with Units

$$21.4777\,\text{mm} = \frac{50000\,\text{N}}{58.2\,\text{N/mm}^2 \cdot 40\,\text{mm}}$$

2.21) Thickness of Cotter given Shear Stress in Cotter Formula

Evaluate Formula

Formula

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

Example with Units

$$21.4777\,\text{mm} = \frac{50000\,\text{N}}{2 \cdot 24\,\text{N/mm}^2 \cdot 48.5\,\text{mm}}$$

2.22) Thickness of Cotter given Tensile Stress in Socket Formula

Evaluate Formula

Formula

$$t_c = \frac{\left(\frac{\pi}{4} \cdot \left(d_1^{\,2} - d_2^{\,2}\right)\right) - \frac{F_c}{\sigma_{tso}}}{d_1 - d_2}$$

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

Evaluate Formula

Formula

$$t_c = 0.31 \cdot d$$

Example with Units

$$11.0616\,\text{mm} = 0.31 \cdot 35.6827\,\text{mm}$$

2.24) Thickness of Cotter Joint given Bending Stress in Cotter Formula

Evaluate Formula

Formula

$$t_c = \left(2 \cdot d_4 + d_2\right) \cdot \left(\frac{L}{4 \cdot b^2 \cdot \sigma_b}\right)$$

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

Evaluate Formula

Formula

$$t_1 = 0.45 \cdot d$$

Example with Units

$$16.0572\,\text{mm} = 0.45 \cdot 35.6827\,\text{mm}$$

2.26) Width of Cotter by Bending Consideration Formula

Evaluate Formula

Formula

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

Example with Units

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

2.27) Width of Cotter by Shear Consideration Formula

Evaluate Formula

Formula

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

Example with Units

$$23.0856\,\text{mm} = \frac{23800\,\text{N}}{2 \cdot 24\,\text{N/mm}^2 \cdot 21.478\,\text{mm}}$$

3) Strength and Stress Formulas

3.1) Bending Stress in Cotter of Cotter Joint Formula

Evaluate Formula

Formula

$$\sigma_b = \left(3 \cdot \frac{L}{t_c \cdot b^2}\right) \cdot \left(\frac{d_2 + 2 \cdot d_4}{12}\right)$$

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

Evaluate Formula

Formula

$$\sigma_{cso} = \frac{L}{\left(d_4 - d_2\right) \cdot t_c}$$

Example with Units

$$58.1991\,\text{N/mm}^2 = \frac{50000\,\text{N}}{\left(80\,\text{mm} - 40\,\text{mm}\right) \cdot 21.478\,\text{mm}}$$

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

Evaluate Formula

Formula

$$\sigma_{c1} = \frac{L}{t_c \cdot d_2}$$

Example with Units

$$58.1991\,\text{N/mm}^2 = \frac{50000\,\text{N}}{21.478\,\text{mm} \cdot 40\,\text{mm}}$$

3.4) Compressive Stress of Spigot Formula

Evaluate Formula

Formula

$$\sigma_{cp} = \frac{L}{t_c \cdot D_s}$$

Example with Units

$$46.5593\,\text{N/mm}^2 = \frac{50000\,\text{N}}{21.478\,\text{mm} \cdot 50.0\,\text{mm}}$$

3.5) Permissible Shear Stress for Cotter Formula

Evaluate Formula

Formula

$$\tau_p = \frac{P}{2 \cdot b \cdot t_c}$$

Example with Units

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

3.6) Permissible Shear Stress for Spigot Formula

Evaluate Formula

Formula

$$\tau_p = \frac{P}{2 \cdot a \cdot d_{ex}}$$

Example with Units

$$957854.4061\,\text{N/m}^2 = \frac{1500\,\text{N}}{2 \cdot 17.4\,\text{mm} \cdot 45\,\text{mm}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$23.9996\,\text{N/mm}^2 = \frac{50000\,\text{N}}{2 \cdot 21.478\,\text{mm} \cdot 48.5\,\text{mm}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$25\,\text{N/mm}^2 = \frac{50000\,\text{N}}{2 \cdot \left(80\,\text{mm} - 40\,\text{mm}\right) \cdot 25.0\,\text{mm}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$26.5957\,\text{N/mm}^2 = \frac{50000\,\text{N}}{2 \cdot 23.5\,\text{mm} \cdot 40\,\text{mm}}$$

3.10) Tensile Stress in Rod of Cotter Joint Formula

Evaluate Formula

Formula

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

Example with Units

$$49.9994\,\text{N/mm}^2 = \frac{4 \cdot 50000\,\text{N}}{3.1416 \cdot 35.6827\,\text{mm}^2}$$

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

Evaluate Formula

Formula

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

Example with Units

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

3.12) Tensile Stress in Spigot Formula

Evaluate Formula

Formula

$$\sigma_t = \frac{P}{\left(\frac{\pi}{4} \cdot d_{ex}^{\,2}\right) - \left(d_{ex} \cdot t_c\right)}$$

Example with Units

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

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

Evaluate Formula

Formula

$$\sigma_t sp = \frac{L}{\frac{\pi \cdot d_2^{\,2}}{4} - d_2 \cdot t_c}$$

Example with Units

$$125.7808\,\text{N/mm}^2 = \frac{50000\,\text{N}}{\frac{3.1416 \cdot 40\,\text{mm}^{\,2}}{4} - 40\,\text{mm} \cdot 21.478\,\text{mm}}$$

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)*
- d_1 Outside Diameter of Socket *(Millimeter)*
- d_2 Diameter of Spigot *(Millimeter)*
- d_3 Diameter of Spigot Collar *(Millimeter)*
- d_4 Diameter of Socket Collar *(Millimeter)*
- d_{ex} External Diameter of Spigot *(Millimeter)*
- D_s Spigot Diameter *(Millimeter)*
- F_c Force on Cotter Joint *(Newton)*
- **L** Load on Cotter Joint *(Newton)*
- L_a Gap between End of Slot to End of Spigot *(Millimeter)*
- **P** Tensile Force on Rods *(Newton)*
- t_1 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*

- $\sigma_{t}so$ Tensile Stress In Socket *(Newton per Square Millimeter)*
- $\sigma_{t}sp$ Tensile Stress In Spigot *(Newton per Square Millimeter)*
- σt_{rod} Tensile Stress in Cotter Joint Rod *(Newton per Square Millimeter)*
- τ_{co} Shear Stress in Cotter *(Newton per Square Millimeter)*
- τ_{so} Shear Stress in Socket *(Newton per Square Millimeter)*
- τ_{sp} Shear Stress in Spigot *(Newton per Square Millimeter)*
- τ_{p} Permissible Shear Stress *(Newton per Square Meter)*

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