Important Design of Knuckle Joint Formulas PDF

Formulas
Examples
with Units

List of 45
Important Design of Knuckle Joint Formulas

1) Eye Formulas

1.1) Bending Stress in Knuckle Pin given Bending Moment in Pin Formula

Evaluate Formula

Formula

$$\sigma_b = \frac{32 \cdot M_b}{\pi \cdot d^3}$$

Example with Units

$$90.4914\,\text{N/mm}^2 = \frac{32 \cdot 450000\,\text{N*mm}}{3.1416 \cdot 37\,\text{mm}^3}$$

1.2) Bending Stress in Knuckle Pin given Load, Thickness of Eyes and Pin Diameter Formula

Evaluate Formula

Formula

$$\sigma_b = \frac{32 \cdot \frac{L}{2} \cdot \left(\frac{b}{4} + \frac{a}{3}\right)}{\pi \cdot d^3}$$

Example with Units

$$90.2275\,\text{N/mm}^2 = \frac{32 \cdot \frac{45000\,\text{N}}{2} \cdot \left(\frac{44.3\,\text{mm}}{4} + \frac{26.6\,\text{mm}}{3}\right)}{3.1416 \cdot 37\,\text{mm}^3}$$

1.3) Compressive Stress in Pin Inside Eye of Knuckle Joint given Load and Pin Dimensions Formula

Evaluate Formula

Formula

$$\sigma_c = \frac{L}{b \cdot d}$$

Example with Units

$$27.4541\,\text{N/mm}^2 = \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot 37\,\text{mm}}$$

1.4) Compressive Stress in Pin Inside Fork of Knuckle Joint given Load and Pin Dimensions Formula

Evaluate Formula

Formula

$$\sigma_c = \frac{L}{2 \cdot a \cdot d}$$

Example with Units

$$22.8612\,\text{N/mm}^2 = \frac{45000\,\text{N}}{2 \cdot 26.6\,\text{mm} \cdot 37\,\text{mm}}$$

1.5) Max Bending Moment in Knuckle Pin given Load, Thickness of Eye and Fork Formula

Evaluate Formula

Formula

$$M_b = \frac{L}{2} \cdot \left(\frac{b}{4} + \frac{a}{3}\right)$$

Example with Units

$$448687.5\,\text{N*mm} = \frac{45000\,\text{N}}{2} \cdot \left(\frac{44.3\,\text{mm}}{4} + \frac{26.6\,\text{mm}}{3}\right)$$

1.6) Shear Stress in Eye of Knuckle Joint given Load, Outer Diameter of Eye and its Thickness Formula

Evaluate Formula

Formula

$$\tau_e = \frac{L}{b \cdot \left(d_o - d \right)}$$

Example with Units

$$23.6233\,\text{N/mm}^2 = \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

1.7) Shear Stress in Fork of Knuckle Joint given Load, Outer Diameter of Eye and Pin Diameter Formula

Evaluate Formula

Formula

$$\tau_f = \frac{L}{2 \cdot a \cdot \left(d_o - d \right)}$$

Example with Units

$$19.6713\,\text{N/mm}^2 = \frac{45000\,\text{N}}{2 \cdot 26.6\,\text{mm} \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

1.8) Shear Stress in Pin of Knuckle Joint given Load and Pin Diameter Formula

Evaluate Formula

Formula

$$\tau_p = \frac{2 \cdot L}{\pi \cdot d^2}$$

Example with Units

$$20.9261\,\text{N/mm}^2 = \frac{2 \cdot 45000\,\text{N}}{3.1416 \cdot 37\,\text{mm}^2}$$

1.9) Tensile Stress in Eye of Knuckle Joint given Load, Outer Diameter of Eye and its Thickness Formula

Evaluate Formula

Formula

$$\sigma_{te} = \frac{L}{b \cdot \left(d_o - d \right)}$$

Example with Units

$$23.6233\,\text{N/mm}^2 = \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

1.10) Tensile Stress in Fork of Knuckle Joint given Load, Outer Diameter of Eye and Pin Diameter Formula

Evaluate Formula

Formula

$$\sigma_{tf} = \frac{L}{2 \cdot a \cdot \left(d_o - d \right)}$$

Example with Units

$$19.6713\,\text{N/mm}^2 = \frac{45000\,\text{N}}{2 \cdot 26.6\,\text{mm} \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

1.11) Tensile Stress in Rod of Knuckle Joint Formula

Evaluate Formula

Formula

$$\sigma_t = \frac{4 \cdot L}{\pi \cdot d_{r1}^2}$$

Example with Units

$$59.621\,\text{N/mm}^2 = \frac{4 \cdot 45000\,\text{N}}{3.1416 \cdot 31\,\text{mm}^2}$$

1.12) Thickness of Eye End of Knuckle Joint given Bending Moment in Pin Formula

Evaluate Formula

Formula

$$b = 4 \cdot \left(2 \cdot \frac{M_b}{L} - \frac{a}{3} \right)$$

Example with Units

$$44.5333\,\text{mm} = 4 \cdot \left(2 \cdot \frac{450000\,\text{N*mm}}{45000\,\text{N}} - \frac{26.6\,\text{mm}}{3} \right)$$

1.13) Thickness of Eye End of Knuckle Joint given Bending Stress in Pin Formula

Evaluate Formula

Formula

$$b = 4 \cdot \left(\frac{\pi \cdot d^3 \cdot \sigma_b}{16 \cdot L} - \frac{a}{3} \right)$$

Example with Units

$$44.0989\,\text{mm} = 4 \cdot \left(\frac{3.1416 \cdot 37\,\text{mm}^3 \cdot 90\,\text{N/mm}^2}{16 \cdot 45000\,\text{N}} - \frac{26.6\,\text{mm}}{3} \right)$$

1.14) Thickness of Eye End of Knuckle Joint given Shear Stress in Eye Formula

Evaluate Formula

Formula

$$b = \frac{L}{\tau_e \cdot \left(d_o - d \right)}$$

Example with Units

$$43.6047\,\text{mm} = \frac{45000\,\text{N}}{24\,\text{N/mm}^2 \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

1.15) Thickness of Eye End of Knuckle Joint given Tensile Stress in Eye Formula

Evaluate Formula

Formula

$$b = \frac{L}{\sigma_{te} \cdot \left(d_o - d \right)}$$

Example with Units

$$23.2558\,\text{mm} = \frac{45000\,\text{N}}{45\,\text{N/mm}^2 \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

1.16) Thickness of Eye of Knuckle Joint given Rod Diameter Formula

Evaluate Formula

Formula

$$b = 1.25 \cdot d_{r1}$$

Example with Units

$$38.75\,\text{mm} = 1.25 \cdot 31\,\text{mm}$$

2) Fork Formulas

2.1) Outer Diameter of Eye of Knuckle Joint given Diameter of Pin Formula

Evaluate Formula

Formula

$$d_o = 2 \cdot d$$

Example with Units

$$74\,\text{mm} = 2 \cdot 37\,\text{mm}$$

2.2) Outer Diameter of Eye of Knuckle Joint given Shear Stress in Eye Formula

Evaluate Formula

Formula

$$d_o = d + \frac{L}{b \cdot \tau_e}$$

Example with Units

$$79.3251\,\text{mm} = 37\,\text{mm} + \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot 24\,\text{N/mm}^2}$$

2.3) Outer Diameter of Eye of Knuckle Joint given Shear Stress in Fork Formula

Evaluate Formula

Formula

$$d_o = \frac{L}{2 \cdot \tau_f \cdot a} + d$$

Example with Units

$$70.8346\,\text{mm} = \frac{45000\,\text{N}}{2 \cdot 25\,\text{N/mm}^2 \cdot 26.6\,\text{mm}} + 37\,\text{mm}$$

2.4) Outer Diameter of Eye of Knuckle Joint given Tensile Stress in Eye Formula

Evaluate Formula

Formula

$$d_o = d + \frac{L}{b \cdot \sigma_{te}}$$

Example with Units

$$59.5734\,\text{mm} = 37\,\text{mm} + \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot 45\,\text{N/mm}^2}$$

2.5) Outer Diameter of Eye of Knuckle Joint given Tensile Stress in Fork Formula

Evaluate Formula

Formula

$$d_o = \frac{L}{2 \cdot \sigma_{tf} \cdot a} + d$$

Example with Units

$$68.9194\,\text{mm} = \frac{45000\,\text{N}}{2 \cdot 26.5\,\text{N/mm}^2 \cdot 26.6\,\text{mm}} + 37\,\text{mm}$$

2.6) Thickness of Fork Eye of Knuckle Joint given Bending Moment in Pin Formula

Evaluate Formula

Formula

$$a = 3 \cdot \left(2 \cdot \frac{M_b}{L} - \frac{b}{4} \right)$$

Example with Units

$$26.775\,\text{mm} = 3 \cdot \left(2 \cdot \frac{450000\,\text{N*mm}}{45000\,\text{N}} - \frac{44.3\,\text{mm}}{4} \right)$$

2.7) Thickness of Fork Eye of Knuckle Joint given Bending Stress in Pin Formula

Evaluate Formula

Formula

$$a = 3 \cdot \left(\frac{\pi \cdot d^3 \cdot \sigma_b}{16 \cdot L} - \frac{b}{4} \right)$$

Example with Units

$$26.4492\,\text{mm} = 3 \cdot \left(\frac{3.1416 \cdot 37\,\text{mm}^3 \cdot 90\,\text{N/mm}^2}{16 \cdot 45000\,\text{N}} - \frac{44.3\,\text{mm}}{4} \right)$$

2.8) Thickness of Fork Eye of Knuckle Joint given Compressive Stress in Pin Inside Fork End Formula

Evaluate Formula

Formula

$$a = \frac{L}{2 \cdot \sigma_c \cdot d}$$

Example with Units

$$20.2703\,\text{mm} = \frac{45000\,\text{N}}{2 \cdot 30\,\text{N/mm}^2 \cdot 37\,\text{mm}}$$

2.9) Thickness of Fork Eye of Knuckle Joint given Rod Diameter Formula

Evaluate Formula

Formula

$$a = 0.75 \cdot d_{r1}$$

Example with Units

$$23.25\,\text{mm} = 0.75 \cdot 31\,\text{mm}$$

2.10) Thickness of Fork Eye of Knuckle Joint given Shear Stress in Fork Formula

Evaluate Formula

Formula

$$a = \frac{L}{2 \cdot \tau_f \cdot \left(d_o - d \right)}$$

Example with Units

$$20.9302\,\text{mm} = \frac{45000\,\text{N}}{2 \cdot 25\,\text{N/mm}^2 \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

2.11) Thickness of Fork Eye of Knuckle Joint given Tensile Stress in Fork Formula

Evaluate Formula

Formula

$$a = \frac{L}{2 \cdot \sigma_{tf} \cdot \left(d_o - d \right)}$$

Example with Units

$$19.7455\,\text{mm} = \frac{45000\,\text{N}}{2 \cdot 26.5\,\text{N/mm}^2 \cdot \left(80\,\text{mm} - 37\,\text{mm} \right)}$$

3) Pin Formulas

3.1) Diameter of Knuckle Pin given Bending Moment in Pin Formula

Evaluate Formula

Formula

$$d = \left(\frac{32 \cdot M_b}{\pi \cdot \sigma_b} \right)^{\frac{1}{3}}$$

Example with Units

$$37.0672\,\text{mm} = \left(\frac{32 \cdot 450000\,\text{N*mm}}{3.1416 \cdot 90\,\text{N/mm}^2} \right)^{\frac{1}{3}}$$

3.2) Diameter of Knuckle Pin given Bending Stress in Pin Formula

Evaluate Formula

Formula

$$d = \left(\frac{32 \cdot \frac{L}{2} \cdot \left(\frac{b}{4} + \frac{a}{3} \right)}{\pi \cdot \sigma_b} \right)^{\frac{1}{3}}$$

Example with Units

$$37.0311\,\text{mm} = \left(\frac{32 \cdot \frac{45000\,\text{N}}{2} \cdot \left(\frac{44.3\,\text{mm}}{4} + \frac{26.6\,\text{mm}}{3} \right)}{3.1416 \cdot 90\,\text{N/mm}^2} \right)^{\frac{1}{3}}$$

3.3) Diameter of Pin of Knuckle Joint given Compressive Stress in Eye End Portion of Pin Formula

Evaluate Formula

Formula

$$d = \frac{L}{\sigma_c \cdot b}$$

Example with Units

$$33.86\,\text{mm} = \frac{45000\,\text{N}}{30\,\text{N/mm}^2 \cdot 44.3\,\text{mm}}$$

3.4) Diameter of Pin of Knuckle Joint given Compressive Stress in Fork End Portion of Pin Formula

Evaluate Formula

Formula

$$d = \frac{L}{2 \cdot \sigma_c \cdot a}$$

Example with Units

$$28.1955\,\text{mm} = \frac{45000\,\text{N}}{2 \cdot 30\,\text{N/mm}^2 \cdot 26.6\,\text{mm}}$$

3.5) Diameter of Pin of Knuckle Joint given Diameter of Pinhead Formula

Evaluate Formula

Formula

$$d = \frac{d_1}{1.5}$$

Example with Units

$$40\,\text{mm} = \frac{60\,\text{mm}}{1.5}$$

3.6) Diameter of Pin of Knuckle Joint given Load and Shear Stress in Pin Formula

Evaluate Formula

Formula

$$d = \sqrt{\frac{2 \cdot L}{\pi \cdot \tau_p}}$$

Example with Units

$$35.14\,\text{mm} = \sqrt{\frac{2 \cdot 45000\,\text{N}}{3.1416 \cdot 23.2\,\text{N/mm}^2}}$$

3.7) Diameter of Pin of Knuckle Joint given Outer Diameter of Eye Formula

Evaluate Formula

Formula

$$d = \frac{d_o}{2}$$

Example with Units

$$40\,\text{mm} = \frac{80\,\text{mm}}{2}$$

3.8) Diameter of Pin of Knuckle Joint given Shear Stress in Eye Formula

Evaluate Formula

Formula

$$d = d_o - \frac{L}{b \cdot \tau_e}$$

Example with Units

$$37.6749\,\text{mm} = 80\,\text{mm} - \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot 24\,\text{N/mm}^2}$$

3.9) Diameter of Pin of Knuckle Joint given Shear Stress in Fork Formula

Evaluate Formula

Formula

$$d = d_o - \frac{L}{2 \cdot \tau_f \cdot a}$$

Example with Units

$$46.1654\,\text{mm} = 80\,\text{mm} - \frac{45000\,\text{N}}{2 \cdot 25\,\text{N/mm}^2 \cdot 26.6\,\text{mm}}$$

3.10) Diameter of Pin of Knuckle Joint given Tensile Stress in Eye Formula

Evaluate Formula

Formula

$$d = d_o - \frac{L}{b \cdot \sigma_{te}}$$

Example with Units

$$57.4266\,\text{mm} = 80\,\text{mm} - \frac{45000\,\text{N}}{44.3\,\text{mm} \cdot 45\,\text{N/mm}^2}$$

3.11) Diameter of Pin of Knuckle Joint given Tensile Stress in Fork Formula

Evaluate Formula

Formula

$$d = d_o - \frac{L}{2 \cdot \sigma_{tf} \cdot a}$$

Example with Units

$$48.0806\,\text{mm} = 80\,\text{mm} - \frac{45000\,\text{N}}{2 \cdot 26.5\,\text{N/mm}^2 \cdot 26.6\,\text{mm}}$$

3.12) Diameter of Pinhead of Knuckle Joint given Diameter of Pin Formula

Evaluate Formula

Formula

$$d_1 = 1.5 \cdot d$$

Example with Units

$$55.5\,\text{mm} = 1.5 \cdot 37\,\text{mm}$$

3.13) Length of Pin of Knuckle Joint in Contact with Eye End Formula

Evaluate Formula

Formula

$$l = \frac{L}{\sigma_c \cdot d}$$

Example with Units

$$40.5405\,\text{mm} = \frac{45000\,\text{N}}{30\,\text{N/mm}^2 \cdot 37\,\text{mm}}$$

4) Rod Formulas

4.1) Diameter of Rod of Knuckle Joint given its Enlarged Diameter near Joint Formula

Evaluate Formula

Formula

$$d_r = \frac{D_1}{1.1}$$

Example with Units

$$35.4545\,\text{mm} = \frac{39\,\text{mm}}{1.1}$$

4.2) Diameter of Rod of Knuckle Joint given Tensile Stress in Rod Formula

Evaluate Formula

Formula

$$d_r = \sqrt{\frac{4 \cdot L}{\pi \cdot \sigma_t}}$$

Example with Units

$$33.8514\,\text{mm} = \sqrt{\frac{4 \cdot 45000\,\text{N}}{3.1416 \cdot 50\,\text{N/mm}^2}}$$

4.3) Enlarged Diameter of Rod of Knuckle Joint near Joint Formula

Evaluate Formula

Formula

$$D_1 = 1.1 \cdot d_r$$

Example with Units

$$39\,\text{mm} = 1.1 \cdot 35.45455\,\text{mm}$$

4.4) Rod Diameter of Knuckle Joint given Thickness of Eye Formula

Evaluate Formula

Formula

$$d_r = \frac{b}{1.25}$$

Example with Units

$$35.44\,\text{mm} = \frac{44.3\,\text{mm}}{1.25}$$

4.5) Rod Diameter of Knuckle Joint given Thickness of Fork Eye Formula

Evaluate Formula

Formula

$$d_r = \frac{a}{0.75}$$

Example with Units

$$35.4667\,\text{mm} = \frac{26.6\,\text{mm}}{0.75}$$

Variables used in list of Design of Knuckle Joint Formulas above

- **a** Thickess of Fork Eye of Knuckle Joint *(Millimeter)*
- **b** Thickess of Eye of Knuckle Joint *(Millimeter)*
- **d** Diameter of Knuckle Pin *(Millimeter)*
- d_1 Diameter of Knuckle Pin Head *(Millimeter)*
- D_1 Enlarged Diameter of Knuckle Joint Rod *(Millimeter)*
- d_o Outer Diameter of Eye of Knuckle Joint *(Millimeter)*
- d_r Diameter of Knuckle Joint *(Millimeter)*
- d_{r1} Diameter of Rod of Knuckle Joint *(Millimeter)*
- **l** Length of Knuckle Pin in Eye End *(Millimeter)*
- **L** Load on Knuckle Joint *(Newton)*
- M_b Bending Moment in Knuckle Pin *(Newton Millimeter)*
- σ_b Bending Stress in Knuckle Pin *(Newton per Square Millimeter)*
- σ_c Compressive Stress in Knuckle Pin *(Newton per Square Millimeter)*
- σ_t Tensile Stress in Knuckle Joint Rod *(Newton per Square Millimeter)*
- σ_{te} Tensile Stress in Eye of Knuckle Joint *(Newton per Square Millimeter)*
- σ_{tf} Tensile Stress in Fork of Knuckle Joint *(Newton per Square Millimeter)*
- τ_e Shear Stress in Eye of Knuckle Joint *(Newton per Square Millimeter)*
- τ_f Shear Stress in Fork of Knuckle Joint *(Newton per Square Millimeter)*
- τ_p Shear Stress in Knuckle Pin *(Newton per Square Millimeter)*

Constants, Functions, Measurements used in list of Design of Knuckle 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: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Torque** in Newton Millimeter (N*mm) *Torque Unit Conversion*
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²) *Stress Unit Conversion*

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