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Design of Knuckle Joint Formulas

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List of 45 Design of Knuckle Joint Formulas

Design of Knuckle Joint

Eye

1) Bending Stress in Knuckle Pin given Bending Moment in Pin

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

Open Calculator 

$$ex \quad 90.49143\text{N/mm}^2 = \frac{32 \cdot 450000\text{N}^*\text{mm}}{\pi \cdot (37\text{mm})^3}$$

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

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

Open Calculator 

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



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

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 27.45409\text{N/mm}^2 = \frac{45000\text{N}}{44.3\text{mm} \cdot 37\text{mm}}$$

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

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 22.86121\text{N/mm}^2 = \frac{45000\text{N}}{2 \cdot 26.6\text{mm} \cdot 37\text{mm}}$$

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

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

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



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

$$fx \quad \tau_e = \frac{L}{b \cdot (d_o - d)}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 23.62329\text{N/mm}^2 = \frac{45000\text{N}}{44.3\text{mm} \cdot (80\text{mm} - 37\text{mm})}$$

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

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 19.67127\text{N/mm}^2 = \frac{45000\text{N}}{2 \cdot 26.6\text{mm} \cdot (80\text{mm} - 37\text{mm})}$$

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

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 20.92614\text{N/mm}^2 = \frac{2 \cdot 45000\text{N}}{\pi \cdot (37\text{mm})^2}$$



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

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 23.62329\text{N/mm}^2 = \frac{45000\text{N}}{44.3\text{mm} \cdot (80\text{mm} - 37\text{mm})}$$

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

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 19.67127\text{N/mm}^2 = \frac{45000\text{N}}{2 \cdot 26.6\text{mm} \cdot (80\text{mm} - 37\text{mm})}$$

11) Tensile Stress in Rod of Knuckle Joint

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 59.621\text{N/mm}^2 = \frac{4 \cdot 45000\text{N}}{\pi \cdot (31\text{mm})^2}$$



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



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

Open Calculator

$$ex \quad 44.53333\text{mm} = 4 \cdot \left(2 \cdot \frac{450000\text{N} \cdot \text{mm}}{45000\text{N}} - \frac{26.6\text{mm}}{3} \right)$$

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

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

Open Calculator

$$ex \quad 44.09888\text{mm} = 4 \cdot \left(\frac{\pi \cdot (37\text{mm})^3 \cdot 90\text{N}/\text{mm}^2}{16 \cdot 45000\text{N}} - \frac{26.6\text{mm}}{3} \right)$$

14) Thickness of Eye End of Knuckle Joint given Shear Stress in Eye

$$fx \quad b = \frac{L}{\tau_e \cdot (d_o - d)}$$

Open Calculator

$$ex \quad 43.60465\text{mm} = \frac{45000\text{N}}{24\text{N}/\text{mm}^2 \cdot (80\text{mm} - 37\text{mm})}$$



15) Thickness of Eye End of Knuckle Joint given Tensile Stress in Eye 

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

Open Calculator 


$$ex \quad 23.25581\text{mm} = \frac{45000\text{N}}{45\text{N/mm}^2 \cdot (80\text{mm} - 37\text{mm})}$$

16) Thickness of Eye of Knuckle Joint given Rod Diameter 

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

Open Calculator 

$$ex \quad 38.75\text{mm} = 1.25 \cdot 31\text{mm}$$

Fork 17) Outer Diameter of Eye of Knuckle Joint given Diameter of Pin 

$$fx \quad d_o = 2 \cdot d$$

Open Calculator 

$$ex \quad 74\text{mm} = 2 \cdot 37\text{mm}$$

18) Outer Diameter of Eye of Knuckle Joint given Shear Stress in Eye 

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

Open Calculator 

$$ex \quad 79.32506\text{mm} = 37\text{mm} + \frac{45000\text{N}}{44.3\text{mm} \cdot 24\text{N/mm}^2}$$



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

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

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$ex \quad 70.83459\text{mm} = \frac{45000\text{N}}{2 \cdot 25\text{N/mm}^2 \cdot 26.6\text{mm}} + 37\text{mm}$$

20) Outer Diameter of Eye of Knuckle Joint given Tensile Stress in Eye 

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

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

$$ex \quad 59.57336\text{mm} = 37\text{mm} + \frac{45000\text{N}}{44.3\text{mm} \cdot 45\text{N/mm}^2}$$

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

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

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$ex \quad 68.91942\text{mm} = \frac{45000\text{N}}{2 \cdot 26.5\text{N/mm}^2 \cdot 26.6\text{mm}} + 37\text{mm}$$



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



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

Open Calculator

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

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

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

Open Calculator

$$ex \quad 26.44916\text{mm} = 3 \cdot \left(\frac{\pi \cdot (37\text{mm})^3 \cdot 90\text{N}/\text{mm}^2}{16 \cdot 45000\text{N}} - \frac{44.3\text{mm}}{4} \right)$$

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

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

Open Calculator

$$ex \quad 20.27027\text{mm} = \frac{45000\text{N}}{2 \cdot 30\text{N}/\text{mm}^2 \cdot 37\text{mm}}$$



25) Thickness of Fork Eye of Knuckle Joint given Rod Diameter

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

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$ex \quad 23.25\text{mm} = 0.75 \cdot 31\text{mm}$$

26) Thickness of Fork Eye of Knuckle Joint given Shear Stress in Fork

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

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

$$ex \quad 20.93023\text{mm} = \frac{45000\text{N}}{2 \cdot 25\text{N/mm}^2 \cdot (80\text{mm} - 37\text{mm})}$$

27) Thickness of Fork Eye of Knuckle Joint given Tensile Stress in Fork

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

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

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



Pin

28) Diameter of Knuckle Pin given Bending Moment in Pin

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

Open Calculator 

$$ex \quad 37.06722\text{mm} = \left(\frac{32 \cdot 450000\text{N} \cdot \text{mm}}{\pi \cdot 90\text{N}/\text{mm}^2} \right)^{\frac{1}{3}}$$

29) Diameter of Knuckle Pin given Bending Stress in Pin

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

Open Calculator 

$$ex \quad 37.03115\text{mm} = \left(\frac{32 \cdot \frac{45000\text{N}}{2} \cdot \left(\frac{44.3\text{mm}}{4} + \frac{26.6\text{mm}}{3} \right)}{\pi \cdot 90\text{N}/\text{mm}^2} \right)^{\frac{1}{3}}$$

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

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

Open Calculator 

$$ex \quad 33.86005\text{mm} = \frac{45000\text{N}}{30\text{N}/\text{mm}^2 \cdot 44.3\text{mm}}$$



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

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 28.19549\text{mm} = \frac{45000\text{N}}{2 \cdot 30\text{N/mm}^2 \cdot 26.6\text{mm}}$$

32) Diameter of Pin of Knuckle Joint given Diameter of Pinhead

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 40\text{mm} = \frac{60\text{mm}}{1.5}$$

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

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 35.14005\text{mm} = \sqrt{\frac{2 \cdot 45000\text{N}}{\pi \cdot 23.2\text{N/mm}^2}}$$



34) Diameter of Pin of Knuckle Joint given Outer Diameter of Eye 

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 40mm = \frac{80mm}{2}$$

35) Diameter of Pin of Knuckle Joint given Shear Stress in Eye 

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 37.67494mm = 80mm - \frac{45000N}{44.3mm \cdot 24N/mm^2}$$

36) Diameter of Pin of Knuckle Joint given Shear Stress in Fork 

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 46.16541mm = 80mm - \frac{45000N}{2 \cdot 25N/mm^2 \cdot 26.6mm}$$

37) Diameter of Pin of Knuckle Joint given Tensile Stress in Eye 

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

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$ex \quad 57.42664mm = 80mm - \frac{45000N}{44.3mm \cdot 45N/mm^2}$$



38) Diameter of Pin of Knuckle Joint given Tensile Stress in Fork

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$ex \quad 48.08058\text{mm} = 80\text{mm} - \frac{45000\text{N}}{2 \cdot 26.5\text{N/mm}^2 \cdot 26.6\text{mm}}$$

39) Diameter of Pinhead of Knuckle Joint given Diameter of Pin

$$fx \quad d_1 = 1.5 \cdot d$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$ex \quad 55.5\text{mm} = 1.5 \cdot 37\text{mm}$$

40) Length of Pin of Knuckle Joint in Contact with Eye End

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

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$ex \quad 40.54054\text{mm} = \frac{45000\text{N}}{30\text{N/mm}^2 \cdot 37\text{mm}}$$

Rod

41) Diameter of Rod of Knuckle Joint given its Enlarged Diameter near Joint

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

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58_img.jpg\)](#)

$$ex \quad 35.45455\text{mm} = \frac{39\text{mm}}{1.1}$$




42) Diameter of Rod of Knuckle Joint given Tensile Stress in Rod 

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

$$ex \quad 33.85138mm = \sqrt{\frac{4 \cdot 45000N}{\pi \cdot 50N/mm^2}}$$

43) Enlarged Diameter of Rod of Knuckle Joint near Joint 

$$fx \quad D_1 = 1.1 \cdot d_r$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

$$ex \quad 39mm = 1.1 \cdot 35.45455mm$$

44) Rod Diameter of Knuckle Joint given Thickness of Eye 

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

$$ex \quad 35.44mm = \frac{44.3mm}{1.25}$$

45) Rod Diameter of Knuckle Joint given Thickness of Fork Eye 

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

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19_img.jpg\)](#)

$$ex \quad 35.46667mm = \frac{26.6mm}{0.75}$$







Variables Used

- **a** Thickness of Fork Eye of Knuckle Joint (*Millimeter*)
- **b** Thickness of Eye of Knuckle Joint (*Millimeter*)
- **d** Diameter of Knuckle Pin (*Millimeter*)
- **d₁** Diameter of Knuckle Pin Head (*Millimeter*)
- **D₁** 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

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **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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