



# 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

$$\sigma_{
m b} = rac{32 \cdot {
m M_b}}{\pi \cdot {
m d}^3}$$

Open Calculator 🗗

$$ext{ex} = rac{32 \cdot 450000 ext{N*mm}}{\pi \cdot (37 ext{mm})^3}$$

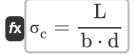
2) Bending Stress in Knuckle Pin given Load, Thickness of Eyes and Pin Diameter

$$\sigma_{
m b} = rac{32 \cdot rac{
m L}{2} \cdot \left(rac{
m b}{4} + rac{
m a}{3}
ight)}{\pi \cdot {
m d}^3}$$

$$ext{ex} \ 93.84296 ext{N/mm}^2 = rac{32 \cdot rac{50000 ext{N}}{2} \cdot \left(rac{40 ext{mm}}{4} + rac{26 ext{mm}}{3}
ight)}{\pi \cdot (37 ext{mm})^3}$$



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



Open Calculator 🚰

$$oxed{ex} 33.78378 ext{N/mm}^2 = rac{50000 ext{N}}{40 ext{mm} \cdot 37 ext{mm}}$$

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

fx 
$$\sigma_{c} = rac{L}{2 \cdot a \cdot d}$$

Open Calculator

$$ext{ex} 25.98753 ext{N/mm}^2 = rac{50000 ext{N}}{2 \cdot 26 ext{mm} \cdot 37 ext{mm}}$$

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

$$M_{
m b} = rac{
m L}{2} \cdot \left(rac{
m b}{4} + rac{
m a}{3}
ight)$$

$$=$$
  $46666.7 \text{N*mm} = \frac{50000 \text{N}}{2} \cdot \left(\frac{40 \text{mm}}{4} + \frac{26 \text{mm}}{3}\right)$ 



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

 $au_{
m eye} = rac{
m L}{
m b\cdot (d_o-d)}$ 

Open Calculator

$$ext{ex} 29.06977 ext{N/mm}^2 = rac{50000 ext{N}}{40 ext{mm} \cdot (80 ext{mm} - 37 ext{mm})}$$

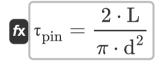
7) Shear Stress in Fork of Knuckle Joint given Load, Outer Diameter of Eye and Pin Diameter

$$au_{
m fork} = rac{L}{2 \cdot a \cdot (d_o - d)}$$

Open Calculator

$$ext{ex} \ 22.36136 ext{N/mm}^2 = rac{50000 ext{N}}{2 \cdot 26 ext{mm} \cdot (80 ext{mm} - 37 ext{mm})}$$

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



$$ext{ex} 23.25127 ext{N/mm}^2 = rac{2 \cdot 50000 ext{N}}{\pi \cdot (37 ext{mm})^2}$$

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

 $\left| \left( \sigma_{
m t} {
m eye} 
ight) = rac{
m L}{
m b \cdot (d_o - d)} 
ight|$ 

Open Calculator

 $ext{ex} \ 29.06977 ext{N/mm}^2 = rac{50000 ext{N}}{40 ext{mm} \cdot (80 ext{mm} - 37 ext{mm})}$ 

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

 $ag{K} \left( \sigma_{
m t} {
m fork} 
ight) = rac{
m L}{2 \cdot {
m a} \cdot ({
m d_o} - {
m d})}$ 

Open Calculator

 $ext{ex} \ 22.36136 ext{N/mm}^2 = rac{50000 ext{N}}{2 \cdot 26 ext{mm} \cdot (80 ext{mm} - 37 ext{mm})}$ 

### 11) Tensile Stress in Rod of Knuckle Joint

 $ag{fx} \left( \sigma_{
m t} {
m rod} 
ight) = rac{4 \cdot {
m L}}{\pi \cdot {
m d}_{
m rk}^2}$ 

Open Calculator

 $ext{ex} 66.24555 ext{N/mm}^2 = rac{4 \cdot 50000 ext{N}}{\pi \cdot (31 ext{mm})^2}$ 



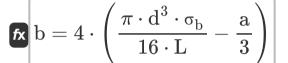
### 12) Thickness of Eye End of Knuckle Joint given Bending Moment in Pin

$$b=4\cdot\left(2\cdotrac{
m M_b}{
m L}-rac{
m a}{3}
ight)$$

Open Calculator 🗗

$$\mathbf{ex} \left[ 37.33333 \mathrm{mm} = 4 \cdot \left( 2 \cdot \frac{450000 \mathrm{N*mm}}{50000 \mathrm{N}} - \frac{26 \mathrm{mm}}{3} \right) \right]$$

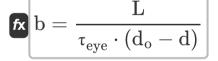
13) Thickness of Eye End of Knuckle Joint given Bending Stress in Pin



Open Calculator

$$ext{ex} \ 30.57708 ext{mm} = 4 \cdot \left( rac{\pi \cdot \left( 37 ext{mm} 
ight)^3 \cdot 82 ext{N/mm}^2}{16 \cdot 50000 ext{N}} - rac{26 ext{mm}}{3} 
ight)$$

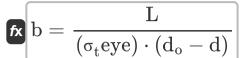
14) Thickness of Eye End of Knuckle Joint given Shear Stress in Eye 🛂



$$= \frac{50000 \text{N}}{24 \text{N/mm}^2 \cdot (80 \text{mm} - 37 \text{mm})}$$



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



Open Calculator 🗗

 $ext{ex} 25.83979 ext{mm} = rac{50000 ext{N}}{45 ext{N/mm}^2 \cdot (80 ext{mm} - 37 ext{mm})}$ 

# 16) Thickness of Eye of Knuckle Joint given Rod Diameter

fx  $b = 1.25 \cdot d_{rk}$ 

Open Calculator

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

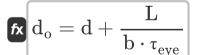
### Fork 🛂

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

fx  $\mathrm{d_o} = 2\cdot\mathrm{d}$ 

Open Calculator 🗗

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



$$89.08333 ext{mm} = 37 ext{mm} + rac{50000 ext{N}}{40 ext{mm} \cdot 24 ext{N/mm}^2}$$



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

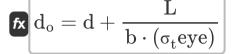


$$\mathrm{d}_{\mathrm{o}} = rac{\mathrm{L}}{2 \cdot \mathrm{ au_{fork}} \cdot \mathrm{a}} + \mathrm{d}$$

Open Calculator 2

50000N $ext{ex} 75.46154 ext{mm} = rac{300001 ext{V}}{2 \cdot 25 ext{N/mm}^2 \cdot 26 ext{mm}} + 37 ext{mm}$ 

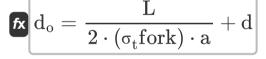
# 20) Outer Diameter of Eye of Knuckle Joint given Tensile Stress in Eye



Open Calculator 2

50000N $\frac{500001N}{40\text{mm} \cdot 45\text{N/mm}^2}$ 64.77778mm = 37mm + -

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



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

$$\mathbf{a} = 3 \cdot \left( 2 \cdot rac{\mathrm{M_b}}{\mathrm{L}} - rac{\mathrm{b}}{4} 
ight)$$

Open Calculator 🗗

$$\mathbf{ex} \left[ 24 \mathrm{mm} = 3 \cdot \left( 2 \cdot \frac{450000 \mathrm{N*mm}}{50000 \mathrm{N}} - \frac{40 \mathrm{mm}}{4} \right) \right]$$

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

$$\mathbf{a} = 3 \cdot \left( rac{\pi \cdot \mathrm{d}^3 \cdot \sigma_\mathrm{b}}{16 \cdot \mathrm{L}} - rac{\mathrm{b}}{4} 
ight)$$

Open Calculator

ex 
$$18.93281 \mathrm{mm} = 3 \cdot \left( \frac{\pi \cdot (37 \mathrm{mm})^3 \cdot 82 \mathrm{N/mm^2}}{16 \cdot 50000 \mathrm{N}} - \frac{40 \mathrm{mm}}{4} \right)$$

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

$$\mathbf{fx} egin{bmatrix} \mathbf{a} = rac{\mathbf{L}}{2 \cdot \mathbf{\sigma_c} \cdot \mathbf{d}} \end{bmatrix}$$

$$\mathbf{ex} = \frac{50000 \mathrm{N}}{2 \cdot 30 \mathrm{N/mm^2 \cdot 37 mm}}$$



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

fx  $a=0.75\cdot d_{
m rk}$ 

Open Calculator 🗗

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

 $\left| \mathbf{a} = rac{\mathrm{L}}{2 \cdot au_{\mathrm{fork}} \cdot (\mathrm{d_o} - \mathrm{d})} 
ight|$ 

Open Calculator

 $ext{ex} \ 23.25581 ext{mm} = rac{50000 ext{N}}{2 \cdot 25 ext{N} / ext{mm}^2 \cdot (80 ext{mm} - 37 ext{mm})}$ 

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



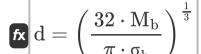
Open Calculator 🚰

 $ext{ex} \ 21.93945 ext{mm} = rac{50000 ext{N}}{2 \cdot 26.5 ext{N/mm}^2 \cdot (80 ext{mm} - 37 ext{mm})}$ 



#### Pin 🛂

### 28) Diameter of Knuckle Pin given Bending Moment in Pin



Open Calculator

$$= \frac{32 \cdot 450000 \text{N*mm}}{\pi \cdot 82 \text{N/mm}^2} \right)^{\frac{1}{3}}$$

### 29) Diameter of Knuckle Pin given Bending Stress in Pin

$$\mathbf{f}$$
  $\mathbf{d} = \left(rac{32 \cdot rac{L}{2} \cdot \left(rac{b}{4} + rac{a}{3}
ight)}{\pi \cdot \sigma_{b}}
ight)^{rac{1}{3}}$ 

Open Calculator 🗗

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

$$\mathrm{fx} = rac{\mathrm{L}}{\mathrm{\sigma_{\mathrm{c}} \cdot \mathrm{b}}}$$

$$ext{ex} \ 41.66667 ext{mm} = rac{50000 ext{N}}{30 ext{N}/ ext{mm}^2 \cdot 40 ext{mm}}$$



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

 $\left. \mathbf{f} \mathbf{z} 
ight| \mathrm{d} = rac{\mathrm{L}}{2 \cdot \mathbf{\sigma}_{\mathrm{c}} \cdot \mathrm{a}} 
ight|$ 

Open Calculator 🗗

 $ext{ex} \ 32.05128 ext{mm} = rac{50000 ext{N}}{2 \cdot 30 ext{N}/ ext{mm}^2 \cdot 26 ext{mm}}$ 

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

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

Open Calculator

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

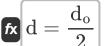
33) Diameter of Pin of Knuckle Joint given Load and Shear Stress in Pin

 $\mathrm{d} = \sqrt{rac{2\cdot\mathrm{L}}{\pi\cdot au_\mathrm{pin}}}$ 

Open Calculator 🗗

 $ext{ex} \ 37.04086 ext{mm} = \sqrt{rac{2 \cdot 50000 ext{N}}{\pi \cdot 23.2 ext{N/mm}^2}}$ 

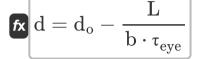
#### 34) Diameter of Pin of Knuckle Joint given Outer Diameter of Eye



Open Calculator 2

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

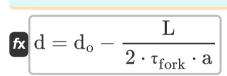
# 35) Diameter of Pin of Knuckle Joint given Shear Stress in Eve



Open Calculator



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



Open Calculator

# $= 80 ext{mm} - \frac{1.53846 ext{mm}}{2 \cdot 25 ext{N/mm}^2 \cdot 26 ext{mm}}$

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

$$\mathrm{d} = \mathrm{d_o} - rac{\mathrm{L}}{\mathrm{b} \cdot (\sigma_\mathrm{t} \mathrm{eye})}$$

Open Calculator

$$\mathbf{ex} \ 52.2222 \mathrm{mm} = 80 \mathrm{mm} - \frac{50000 \mathrm{N}}{40 \mathrm{mm} \cdot 45 \mathrm{N/mm^2}}$$





50000N



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

 $\mathbf{f} \mathbf{z} \left[ \mathrm{d} = \mathrm{d_o} - rac{\mathrm{L}}{2 \cdot (\sigma_{\mathrm{t}} \mathrm{fork}) \cdot \mathrm{a}} 
ight]$ 

Open Calculator

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

fx  $d_1 = 1.5 \cdot d$ 

Open Calculator

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

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

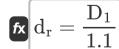


Open Calculator 🗗

 $oxed{45.04505 ext{mm}} = rac{50000 ext{N}}{30 ext{N}/ ext{mm}^2 \cdot 37 ext{mm}}$ 

## Rod 🛂

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



Open Calculator

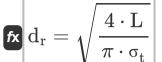
 $= \frac{39 \text{mm}}{1.1}$ 



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



Open Calculator

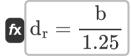
 $ext{ex} \ 35.68248 ext{mm} = \sqrt{rac{4 \cdot 50000 ext{N}}{\pi \cdot 50 ext{N/mm}^2}}$ 

# 43) Enlarged Diameter of Rod of Knuckle Joint near Joint

fx  $D_1 = 1.1 \cdot d_r$ 

Open Calculator

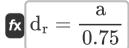
### 44) Rod Diameter of Knuckle Joint given Thickness of Eye



Open Calculator 🗗

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

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



Open Calculator 🖸

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





#### Variables Used

- a Thickess of Fork Eye of Knuckle Joint (Millimeter)
- a Thickess of Fork Eye of Knuckle Joint (Millimeter)
- **b** Thickess of Eye of Knuckle Joint (Millimeter)
- **b** Thickess of Eye of Knuckle Joint (Millimeter)
- **d** Diameter of Knuckle Pin (Millimeter)
- d<sub>1</sub> Diameter of Knuckle Pin Head (Millimeter)
- **D**<sub>1</sub> Enlarged Diameter of Knuckle Joint Rod (Millimeter)
- **d** Outer Diameter of Eye of Knuckle Joint (*Millimeter*)
- **d**<sub>r</sub> Diameter of Rod of Knuckle Joint (Millimeter)
- d<sub>rk</sub> Diameter of Rod of Knuckle Joint (Millimeter)
- I Length of Knuckle Pin in Eye End (Millimeter)
- L Load on Knuckle Joint (Newton)
- L Load on Knuckle Joint (Newton)
- M<sub>b</sub> Bending Moment in Knuckle Pin (Newton Millimeter)
- σ<sub>b</sub> Bending Stress in Knuckle Pin (Newton per Square Millimeter)
- $\sigma_c$  Compressive Stress in Knuckle Pin (Newton per Square Millimeter)
- $\sigma_t$  Tensile Stress in Knuckle Joint Rod (Newton per Square Millimeter)
- σ<sub>t</sub>eye Tensile Stress in Eye of Knuckle Joint (Newton per Square Millimeter)
- σ<sub>t</sub>fork Tensile Stress in Fork of Knuckle Joint (Newton per Square Millimeter)
- σ<sub>t</sub>rod Tensile Stress in Knuckle Joint Rod (Newton per Square Millimeter)





- Teve Shear Stress in Eye of Knuckle Joint (Newton per Square Millimeter)
- Tfork Shear Stress in Fork of Knuckle Joint (Newton per Square Millimeter)
- T<sub>pin</sub> 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





#### **Check other formula lists**

- Design of Clamp and Muff Coupling Formulas
- Design of Cotter Joint Formulas
- Design of Knuckle Joint Formulas
- Packing Formulas

- Retaining Rings and Circlips
   Formulas
- Riveted Joints Formulas
- Seals Formulas
- Threaded Bolted Joints
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