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Torque Transmitted by a Hollow Circular Shaft Formulas

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List of 16 Torque Transmitted by a Hollow Circular Shaft Formulas

Torque Transmitted by a Hollow Circular Shaft



1) Maximum Shear Stress at Outer Surface given Diameter of Shaft on Hollow Circular Shaft

$$fx \quad \tau_m = \frac{16 \cdot d_o \cdot T}{\pi \cdot (d_o^4 - d_i^4)}$$

[Open Calculator](#)

$$ex \quad -0.195051MPa = \frac{16 \cdot 14mm \cdot 4N \cdot m}{\pi \cdot ((14mm)^4 - (35mm)^4)}$$

2) Maximum Shear Stress at Outer Surface given Total Turning Moment on Hollow Circular Shaft

$$fx \quad \tau_m = \frac{T \cdot 2 \cdot r_h}{\pi \cdot (r_h^4 - r_i^4)}$$

[Open Calculator](#)

$$ex \quad 4.8E^{-8}MPa = \frac{4N \cdot m \cdot 2 \cdot 5500mm}{\pi \cdot ((5500mm)^4 - (5000mm)^4)}$$



3) Maximum Shear Stress at Outer Surface given Turning Force on Elementary Ring

$$\text{fx } \tau_s = \frac{T_f \cdot d_o}{4 \cdot \pi \cdot (r^2) \cdot b_r}$$

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

$$\text{ex } 111.4085\text{MPa} = \frac{2000.001\text{N} \cdot 14\text{mm}}{4 \cdot \pi \cdot ((2\text{mm})^2) \cdot 5\text{mm}}$$

4) Maximum shear stress induced at outer surface given shear stress of elementary ring

$$\text{fx } \tau_s = \frac{d_o \cdot q}{2 \cdot r}$$

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

$$\text{ex } 0.389928\text{MPa} = \frac{14\text{mm} \cdot 0.111408\text{MPa}}{2 \cdot 2\text{mm}}$$

5) Maximum Shear Stress Induced at Outer Surface given Turning Moment on Elementary Ring

$$\text{fx } \tau_s = \frac{T \cdot d_o}{4 \cdot \pi \cdot (r^3) \cdot b_r}$$

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

$$\text{ex } 111.4085\text{MPa} = \frac{4\text{N} \cdot \text{m} \cdot 14\text{mm}}{4 \cdot \pi \cdot ((2\text{mm})^3) \cdot 5\text{mm}}$$



6) Outer Radius of Shaft given Shear Stress of Elementary Ring

$$fx \quad r_o = \frac{\tau_s \cdot r}{q}$$

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

$$ex \quad 2000.009mm = \frac{111.4085MPa \cdot 2mm}{0.111408MPa}$$

7) Outer Radius of Shaft using Turning Force on Elementary Ring

$$fx \quad r_o = \frac{2 \cdot \pi \cdot \tau_s \cdot (r^2) \cdot b_r}{T_f}$$

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

$$ex \quad 6.999999mm = \frac{2 \cdot \pi \cdot 111.4085MPa \cdot ((2mm)^2) \cdot 5mm}{2000.001N}$$

8) Outer Radius of Shaft using Turning Force on Elementary Ring given Turning Moment

$$fx \quad r_o = \frac{2 \cdot \pi \cdot \tau_s \cdot (r^2) \cdot b_r}{T}$$

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

$$ex \quad 3500.001mm = \frac{2 \cdot \pi \cdot 111.4085MPa \cdot ((2mm)^2) \cdot 5mm}{4N \cdot m}$$



9) Radius of Elementary Ring given Shear Stress of Elementary Ring

$$\text{fx } r = \frac{d_o \cdot q}{2 \cdot \tau_s}$$

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

$$\text{ex } 0.007\text{mm} = \frac{14\text{mm} \cdot 0.111408\text{MPa}}{2 \cdot 111.4085\text{MPa}}$$

10) Radius of Elementary Ring given Turning Force of Elementary Ring

$$\text{fx } r = \sqrt{\frac{T_f \cdot d_o}{4 \cdot \pi \cdot \tau_s \cdot b_r}}$$

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

$$\text{ex } 2\text{mm} = \sqrt{\frac{2000.001\text{N} \cdot 14\text{mm}}{4 \cdot \pi \cdot 111.4085\text{MPa} \cdot 5\text{mm}}}$$

11) Radius of Elementary Ring given Turning Moment of Elementary Ring

$$\text{fx } r = \left(\frac{T \cdot d_o}{4 \cdot \pi \cdot \tau_s \cdot b_r} \right)^{\frac{1}{3}}$$

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

$$\text{ex } 2\text{mm} = \left(\frac{4\text{N} \cdot \text{m} \cdot 14\text{mm}}{4 \cdot \pi \cdot 111.4085\text{MPa} \cdot 5\text{mm}} \right)^{\frac{1}{3}}$$



12) Shear Stress at Elementary Ring of Hollow Circular Shaft

$$\text{fx } q = \frac{2 \cdot \tau_s \cdot r}{d_o}$$

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

$$\text{ex } 31.831\text{MPa} = \frac{2 \cdot 111.4085\text{MPa} \cdot 2\text{mm}}{14\text{mm}}$$

13) Total Turning Moment on Hollow Circular Shaft given Diameter of Shaft

$$\text{fx } T = \frac{\pi \cdot \tau_m \cdot ((d_o^4) - (d_i^4))}{16 \cdot d_o}$$

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

$$\text{ex } -6.6\text{E}^{-6}\text{N}^*\text{m} = \frac{\pi \cdot 3.2\text{E}^{-7}\text{MPa} \cdot (((14\text{mm})^4) - ((35\text{mm})^4))}{16 \cdot 14\text{mm}}$$

14) Total Turning Moment on Hollow Circular Shaft given Radius of Shaft

$$\text{fx } T = \frac{\pi \cdot \tau_m \cdot ((r_h^4) - (r_i^4))}{2 \cdot r_h}$$

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

$$\text{ex } 26.50933\text{N}^*\text{m} = \frac{\pi \cdot 3.2\text{E}^{-7}\text{MPa} \cdot (((5500\text{mm})^4) - ((5000\text{mm})^4))}{2 \cdot 5500\text{mm}}$$



15) Turning Force on Elementary Ring

$$\text{fx } T_f = \frac{4 \cdot \pi \cdot \tau_s \cdot r^2 \cdot b_r}{d_o}$$

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

$$\text{ex } 2000.001\text{N} = \frac{4 \cdot \pi \cdot 111.4085\text{MPa} \cdot (2\text{mm})^2 \cdot 5\text{mm}}{14\text{mm}}$$

16) Turning Moment on Elementary Ring

$$\text{fx } T = \frac{4 \cdot \pi \cdot \tau_s \cdot (r^3) \cdot b_r}{d_o}$$

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

$$\text{ex } 4.000001\text{N}^*\text{m} = \frac{4 \cdot \pi \cdot 111.4085\text{MPa} \cdot ((2\text{mm})^3) \cdot 5\text{mm}}{14\text{mm}}$$








Variables Used

- b_r Thickness of Ring (Millimeter)
- d_i Inner Diameter of Shaft (Millimeter)
- d_o Outer Diameter of Shaft (Millimeter)
- q Shear Stress at Elementary Ring (Megapascal)
- r Radius of Elementary Circular Ring (Millimeter)
- r_h Outer Radius Of Hollow circular Cylinder (Millimeter)
- r_i Inner Radius Of Hollow Circular Cylinder (Millimeter)
- r_o Outer Radius of Shaft (Millimeter)
- T Turning Moment (Newton Meter)
- T_f Turning Force (Newton)
- τ_m Maximum Shear Stress on Shaft (Megapascal)
- τ_s Maximum Shear Stress (Megapascal)



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:** **Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Torque** in Newton Meter (N*m)
Torque Unit Conversion 
- **Measurement:** **Stress** in Megapascal (MPa)
Stress Unit Conversion 



Check other formula lists

- [Deviation of Shear Stress produced in a Circular Shaft subjected to Torsion Formulas](#) 
- [Expression for Strain Energy stored in a Body Due to Torsion Formulas](#) 
- [Expression for Torque in terms of Polar Moment of Inertia Formulas](#) 
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