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# Dynamometer Formulas

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# List of 19 Dynamometer Formulas

## Dynamometer

### 1) Constant for Particular Shaft for Torsion Dynamometer

$$fx \quad k = \frac{G \cdot J}{L_{\text{shaft}}}$$

Open Calculator 

$$ex \quad 8.571429 = \frac{40\text{N/m}^2 \cdot 0.09\text{m}^4}{0.42\text{m}}$$

### 2) Distance Moved in One Revolution by Rope Brake Dynamometer

$$fx \quad d = \pi \cdot (D_{\text{wheel}} + d_{\text{rope}})$$

Open Calculator 

$$ex \quad 5.340708\text{m} = \pi \cdot (1.6\text{m} + 0.1\text{m})$$

### 3) Load on Brake for Rope Brake Dynamometer

$$fx \quad W = W_{\text{dead}} - S$$

Open Calculator 

$$ex \quad 12.5\text{N} = 14.5\text{N} - 2\text{N}$$



#### 4) Polar Moment of Inertia of Shaft for Hollow Shaft for Torsion Dynamometer

$$fx \quad J = \frac{\pi}{32} \cdot (d_o^4 - d_i^4)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 0.090912m^4 = \frac{\pi}{32} \cdot ((1.85m)^4 - (1.8123m)^4)$$

#### 5) Polar Moment of Inertia of Shaft for Solid Shaft for Torsion Dynamometer

$$fx \quad J = \frac{\pi}{32} \cdot D_{shaft}^4$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 0.090553m^4 = \frac{\pi}{32} \cdot (0.98m)^4$$

#### 6) Polar Moment of Inertia of Shaft for Torsion Dynamometer

$$fx \quad J = \frac{T \cdot L_{shaft}}{G \cdot \theta}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 0.08998m^4 = \frac{13N \cdot m \cdot 0.42m}{40N/m^2 \cdot 1.517rad}$$

#### 7) Power Transmitted by Torsion Dynamometer

$$fx \quad P = \frac{2 \cdot \pi \cdot N \cdot T}{60}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 680.6784W = \frac{2 \cdot \pi \cdot 500 \cdot 13N \cdot m}{60}$$



## 8) Power Transmitted for Epicyclic-Train Dynamometer

$$fx \quad P = \frac{2 \cdot \pi \cdot N \cdot T}{60}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 680.6784W = \frac{2 \cdot \pi \cdot 500 \cdot 13N \cdot m}{60}$$

## 9) Power Transmitted for Epicyclic-Train Dynamometer using Tangential Effort

$$fx \quad P = \frac{2 \cdot \pi \cdot N \cdot P_t \cdot r_p}{60}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 680.092W = \frac{2 \cdot \pi \cdot 500 \cdot 36.08N \cdot 0.36m}{60}$$

## 10) Tangential Effort for Epicyclic-Train Dynamometer

$$fx \quad P_t = \frac{W_{end} \cdot L_{horizontal}}{2 \cdot a_{gear}}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 36.08977N = \frac{19N \cdot 0.6843m}{2 \cdot 0.18013m}$$

## 11) Tension in Slack Side of Belt for Belt Transmission Dynamometer

$$fx \quad T_2 = T_1 - \frac{W_{end} \cdot L_{horizontal}}{2 \cdot a_{pulley}}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$ex \quad 19.07683N = 26.30N - \frac{19N \cdot 0.6843m}{2 \cdot 0.9m}$$



## 12) Tension in Tight Side of Belt for Belt Transmission Dynamometer

$$fx \quad T_1 = T_2 + \frac{W_{\text{end}} \cdot L_{\text{horizontal}}}{2 \cdot a_{\text{pulley}}}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 26.3N = 19.07683N + \frac{19N \cdot 0.6843m}{2 \cdot 0.9m}$$

## 13) Torque Acting on Shaft for Torsion Dynamometer

$$fx \quad T = \frac{G \cdot \theta \cdot J}{L_{\text{shaft}}}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$ex \quad 13.00286N \cdot m = \frac{40N/m^2 \cdot 1.517rad \cdot 0.09m^4}{0.42m}$$

## 14) Torque on Shaft of Prony Brake Dynamometer

$$fx \quad T = W_{\text{end}} \cdot L_{\text{horizontal}}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 13.0017N \cdot m = 19N \cdot 0.6843m$$

## 15) Torque on Shaft of Prony Brake Dynamometer using Radius of Pulley

$$fx \quad T = F \cdot R$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 13N \cdot m = 8N \cdot 1.625m$$



## 16) Torque Transmitted for Epicyclic Train Dynamometer

$$fx \quad T = P_t \cdot r_p$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$ex \quad 12.9888N \cdot m = 36.08N \cdot 0.36m$$

## 17) Torque Transmitted if Power is known for Epicyclic-Train Dynamometer

$$fx \quad T = \frac{60 \cdot P}{2 \cdot \pi \cdot N}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$ex \quad 12.9985N \cdot m = \frac{60 \cdot 680.6W}{2 \cdot \pi \cdot 500}$$

## 18) Torsion Equation for Torsion Dynamometer

$$fx \quad T = k \cdot \theta$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$ex \quad 13.00286N \cdot m = 8.571429 \cdot 1.517rad$$

## 19) Torsion Equation for Torsion Dynamometer using Modulus of Rigidity

$$fx \quad T = \frac{G \cdot \theta \cdot J}{L_{shaft}}$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487\_img.jpg\)](#)

$$ex \quad 13.00286N \cdot m = \frac{40N/m^2 \cdot 1.517rad \cdot 0.09m^4}{0.42m}$$



## Variables Used

- **$a_{\text{gear}}$**  Distance between Center of Gear and Pinion (Meter)
- **$a_{\text{pulley}}$**  Distance between Loose Pulleys and T-Frame (Meter)
- **$d$**  Distance Moved (Meter)
- **$d_i$**  Shaft Inner Diameter (Meter)
- **$d_o$**  Shaft Outer Diameter (Meter)
- **$d_{\text{rope}}$**  Diameter of Rope (Meter)
- **$D_{\text{shaft}}$**  Shaft Diameter (Meter)
- **$D_{\text{wheel}}$**  Diameter of Wheel (Meter)
- **$F$**  Frictional Resistance between Block and Pulley (Newton)
- **$G$**  Modulus of Rigidity (Newton per Square Meter)
- **$J$**  Polar Moment of Inertia of Shaft (Meter<sup>4</sup>)
- **$k$**  Constant for a Particular Shaft
- **$L_{\text{horizontal}}$**  Distance between Weight and Center of Pulley (Meter)
- **$L_{\text{shaft}}$**  Shaft Length (Meter)
- **$N$**  Speed of Shaft in RPM
- **$P$**  Power (Watt)
- **$P_t$**  Tangential Effort (Newton)
- **$R$**  Radius of Pulley (Meter)
- **$r_p$**  Pitch Circle Radius (Meter)
- **$S$**  Spring Balance Reading (Newton)
- **$T$**  Total Torque (Newton Meter)
- **$T_1$**  Tension in Tight Side of Belt (Newton)










- **$T_2$**  Tension in Slack Side of Belt (Newton)
- **$W$**  Load Applied (Newton)
- **$W_{\text{dead}}$**  Dead Load (Newton)
- **$W_{\text{end}}$**  Weight at Outer End of Lever (Newton)
- **$\theta$**  Angle of Twist (Radian)





## Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Measurement:** **Length** in Meter (m)  
*Length Unit Conversion* 
- **Measurement:** **Pressure** in Newton per Square Meter (N/m<sup>2</sup>)  
*Pressure Unit Conversion* 
- **Measurement:** **Power** in Watt (W)  
*Power Unit Conversion* 
- **Measurement:** **Force** in Newton (N)  
*Force Unit Conversion* 
- **Measurement:** **Angle** in Radian (rad)  
*Angle Unit Conversion* 
- **Measurement:** **Torque** in Newton Meter (N\*m)  
*Torque Unit Conversion* 
- **Measurement:** **Second Moment of Area** in Meter<sup>4</sup> (m<sup>4</sup>)  
*Second Moment of Area Unit Conversion* 



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