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# Tribology Formulas

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# List of 13 Tribology Formulas

## Tribology

### 1) Absolute Viscosity from Petroff's Equation

[Open Calculator !\[\]\(339a16584d5da0f0a3ca4e9ec17bf6a1\_img.jpg\)](#)

$$\text{fx } \mu_{\text{viscosity}} = \frac{\mu_{\text{friction}} \cdot \Psi}{2 \cdot \pi^2 \cdot \left(\frac{N}{P}\right)}$$

$$\text{ex } 15.19818P = \frac{0.4 \cdot 0.005}{2 \cdot \pi^2 \cdot \left(\frac{10\text{rev/s}}{0.15\text{MPa}}\right)}$$

### 2) Diametrical Clearance Ratio or Relative Clearance from Petroff's Equation

[Open Calculator !\[\]\(6059a5aa8b4ca7bb793408023d6c6e42\_img.jpg\)](#)

$$\text{fx } \Psi = 2 \cdot \pi^2 \cdot \left(\frac{\mu_{\text{viscosity}}}{\mu_{\text{friction}}}\right) \cdot \left(\frac{N}{P}\right)$$

$$\text{ex } 0.003356 = 2 \cdot \pi^2 \cdot \left(\frac{10.2P}{0.4}\right) \cdot \left(\frac{10\text{rev/s}}{0.15\text{MPa}}\right)$$



### 3) Load per Projected Area of Bearing from Petroff's Equation

$$\text{fx } P = 2 \cdot \pi^2 \cdot \left( \frac{\mu_{\text{viscosity}}}{\mu_{\text{friction}}} \right) \cdot \left( \frac{N}{\psi} \right)$$

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

$$\text{ex } 0.10067\text{MPa} = 2 \cdot \pi^2 \cdot \left( \frac{10.2P}{0.4} \right) \cdot \left( \frac{10\text{rev/s}}{0.005} \right)$$

### 4) Petroffs Equation for Coefficient of Friction

$$\text{fx } \mu_{\text{friction}} = 2 \cdot \pi^2 \cdot \mu_{\text{viscosity}} \cdot \left( \frac{N}{P} \right) \cdot \left( \frac{1}{\psi} \right)$$

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

$$\text{ex } 0.268453 = 2 \cdot \pi^2 \cdot 10.2P \cdot \left( \frac{10\text{rev/s}}{0.15\text{MPa}} \right) \cdot \left( \frac{1}{0.005} \right)$$

## Vertical Shaft Rotating in Guide Bearing

### 5) Angular Length of Bearing given Length of Bearing in Direction of Motion

$$\text{fx } \beta = \frac{2 \cdot B}{D}$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e\_img.jpg\)](#)

$$\text{ex } 16.66667\text{rad} = \frac{2 \cdot 30\text{m}}{3.600\text{m}}$$



## 6) Diameter of Shaft given Shaft Speed and Surface Velocity of Shaft

$$fx \quad D = \frac{U}{\pi \cdot N}$$

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

$$ex \quad 0.210085m = \frac{6.6m/s}{\pi \cdot 10rev/s}$$

## 7) Eccentricity Ratio given Radial Clearance and Film Thickness at any Position

$$fx \quad \varepsilon = \frac{\frac{h}{c} - 1}{\cos(\theta)}$$

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

$$ex \quad 5.87399 = \frac{\frac{0.5m}{0.082m} - 1}{\cos(0.52rad)}$$

## 8) Journal Diameter given Angular Length of Bearing and Length of Bearing in Direction of Motion

$$fx \quad D = \frac{2 \cdot B}{\beta}$$

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

$$ex \quad 10m = \frac{2 \cdot 30m}{6rad}$$



### 9) Length of Bearing in Direction of Motion

$$fx \quad B = \frac{D \cdot \beta}{2}$$

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

$$ex \quad 10.8m = \frac{3.600m \cdot 6rad}{2}$$

### 10) Oil Film Thickness at any Position in Journal Bearing

$$fx \quad h = c \cdot (1 + \varepsilon \cdot \cos(\theta))$$

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

$$ex \quad 0.138929m = 0.082m \cdot (1 + 0.8 \cdot \cos(0.52rad))$$

### 11) Radial Clearance given Eccentricity Ratio and Thickness of Film at any Position

$$fx \quad c = \frac{h}{1 + \varepsilon \cdot \cos(\theta)}$$

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

$$ex \quad 0.295115m = \frac{0.5m}{1 + 0.8 \cdot \cos(0.52rad)}$$

### 12) Speed of Shaft given Diameter of Shaft and Surface Velocity of Shaft

$$fx \quad N = \frac{U}{\pi \cdot D}$$

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

$$ex \quad 0.583568rev/s = \frac{6.6m/s}{\pi \cdot 3.600m}$$



### 13) Surface Velocity of Shaft given Shaft Speed and Diameter

**fx**  $U = \pi \cdot D \cdot N$

Open Calculator 

**ex**  $113.0973\text{m/s} = \pi \cdot 3.600\text{m} \cdot 10\text{rev/s}$









## Variables Used

- **B** Length of Bearing in Direction of Motion (*Meter*)
- **c** Radial Clearance (*Meter*)
- **D** Shaft Diameter (*Meter*)
- **h** Oil Film Thickness at any Position  $\theta$  (*Meter*)
- **N** Shaft Speed (*Revolution per Second*)
- **P** Load per Projected Area of Bearing (*Megapascal*)
- **U** Surface Velocity of Shaft (*Meter per Second*)
- **$\beta$**  Angular or Circumferential Length of Bearing (*Radian*)
- **$\epsilon$**  Eccentricity Ratio
- **$\theta$**  Angle Measured from Point of Minimum of Oil Film (*Radian*)
- **$\mu_{\text{friction}}$**  Coefficient of Friction
- **$\mu_{\text{viscosity}}$**  Dynamic Viscosity (*Poise*)
- **$\psi$**  Diametrical Clearance Ratio or Relative Clearance












## Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Function:** **cos**,  $\cos(\text{Angle})$   
*Trigonometric cosine function*
- **Measurement:** **Length** in Meter (m)  
*Length Unit Conversion* 
- **Measurement:** **Pressure** in Megapascal (MPa)  
*Pressure Unit Conversion* 
- **Measurement:** **Speed** in Meter per Second (m/s)  
*Speed Unit Conversion* 
- **Measurement:** **Angle** in Radian (rad)  
*Angle Unit Conversion* 
- **Measurement:** **Frequency** in Revolution per Second (rev/s)  
*Frequency Unit Conversion* 
- **Measurement:** **Dynamic Viscosity** in Poise (P)  
*Dynamic Viscosity Unit Conversion* 





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