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# Vibration Isolation and Transmissibility Formulas

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# List of 18 Vibration Isolation and Transmissibility Formulas

## Vibration Isolation and Transmissibility

### 1) Angular Velocity of Vibration using Force Transmitted

fx

$$\omega = \frac{\sqrt{\left(\frac{F_T}{K}\right)^2 - k^2}}{c}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

ex

$$0.200022\text{rad/s} = \frac{\sqrt{\left(\frac{48021.6\text{N}}{0.8\text{m}}\right)^2 - (60000\text{N/m})^2}}{9000\text{Ns/m}}$$

### 2) Applied Force given Transmissibility Ratio

fx

$$F_a = \frac{F_T}{\varepsilon}$$

[Open Calculator !\[\]\(e3275251d0893157c3584e20c81dc3ba\_img.jpg\)](#)

ex

$$2501.125\text{N} = \frac{48021.6\text{N}}{19.2}$$



### 3) Applied Force given Transmissibility Ratio and Maximum Displacement of Vibration

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb\_img.jpg\)](#)

$$fx \quad F_a = \frac{K \cdot \sqrt{k^2 + (c \cdot \omega)^2}}{\varepsilon}$$

$$ex \quad 2501.125N = \frac{0.8m \cdot \sqrt{(60000N/m)^2 + (9000Ns/m \cdot 0.2rad/s)^2}}{19.2}$$

### 4) Damping Coefficient using Force Transmitted

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1\_img.jpg\)](#)

$$fx \quad c = \frac{\sqrt{\left(\frac{F_T}{K}\right)^2 - k^2}}{\omega}$$

$$ex \quad 9001.012Ns/m = \frac{\sqrt{\left(\frac{48021.6N}{0.8m}\right)^2 - (60000N/m)^2}}{0.2rad/s}$$

### 5) Force Transmitted

[Open Calculator !\[\]\(4fe57c3593bf1b21d272ae7ac8dfaf77\_img.jpg\)](#)

$$fx \quad F_T = K \cdot \sqrt{k^2 + (c \cdot \omega)^2}$$

$$ex \quad 48021.6N = 0.8m \cdot \sqrt{(60000N/m)^2 + (9000Ns/m \cdot 0.2rad/s)^2}$$



## 6) Magnification Factor given Transmissibility Ratio

[Open Calculator !\[\]\(dfbd6b3763a6d1d9afaa974f64e2e4b5\_img.jpg\)](#)

$$fx \quad D = \frac{\varepsilon \cdot k}{\sqrt{k^2 + (c \cdot \omega)^2}}$$

$$ex \quad 19.19137 = \frac{19.2 \cdot 60000\text{N/m}}{\sqrt{(60000\text{N/m})^2 + (9000\text{Ns/m} \cdot 0.2\text{rad/s})^2}}$$

## 7) Magnification Factor given Transmissibility Ratio given Natural Circular Frequency

[Open Calculator !\[\]\(ec9132f1d27c8919987d92907322654d\_img.jpg\)](#)

$$fx \quad D = \frac{\varepsilon}{\sqrt{1 + \left(\frac{2 \cdot c \cdot \omega}{c_c \cdot \omega_n}\right)^2}}$$

$$ex \quad 1.8537 = \frac{19.2}{\sqrt{1 + \left(\frac{2 \cdot 9000\text{Ns/m} \cdot 0.2\text{rad/s}}{1800\text{Ns/m} \cdot 0.194\text{rad/s}}\right)^2}}$$

## 8) Maximum Displacement of Vibration given Transmissibility Ratio

[Open Calculator !\[\]\(758ebdf4629c903da74c2e079717ae32\_img.jpg\)](#)

$$fx \quad K = \frac{\varepsilon \cdot F_a}{\sqrt{k^2 + (c \cdot \omega)^2}}$$

$$ex \quad 0.79964\text{m} = \frac{19.2 \cdot 2500\text{N}}{\sqrt{(60000\text{N/m})^2 + (9000\text{Ns/m} \cdot 0.2\text{rad/s})^2}}$$



## 9) Maximum Displacement of Vibration using Force Transmitted

$$fx \quad K = \frac{F_T}{\sqrt{k^2 + (c \cdot \omega)^2}}$$

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

$$ex \quad 0.8m = \frac{48021.6N}{\sqrt{(60000N/m)^2 + (9000Ns/m \cdot 0.2rad/s)^2}}$$

## 10) Natural Circular Frequency given Transmissibility Ratio

$$fx \quad \omega_n = \frac{\omega}{\sqrt{1 + \frac{1}{\epsilon}}}$$

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

$$ex \quad 0.194987rad/s = \frac{0.2rad/s}{\sqrt{1 + \frac{1}{19.2}}}$$

## 11) Stiffness of Spring using Force Transmitted

$$fx \quad k = \sqrt{\left(\frac{F_T}{K}\right)^2 - (c \cdot \omega)^2}$$

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

$$ex \quad 60000.01N/m = \sqrt{\left(\frac{48021.6N}{0.8m}\right)^2 - (9000Ns/m \cdot 0.2rad/s)^2}$$



## 12) Transmissibility Ratio

[Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7\_img.jpg\)](#)

$$\text{fx } \varepsilon = \frac{K \cdot \sqrt{k^2 + (c \cdot \omega)^2}}{F_a}$$

$$\text{ex } 19.20864 = \frac{0.8\text{m} \cdot \sqrt{(60000\text{N/m})^2 + (9000\text{Ns/m} \cdot 0.2\text{rad/s})^2}}{2500\text{N}}$$

## 13) Transmissibility Ratio given Force Transmitted

[Open Calculator !\[\]\(10f8862fc183b400327470ea85afe9ae\_img.jpg\)](#)

$$\text{fx } \varepsilon = \frac{F_T}{F_a}$$

$$\text{ex } 19.20864 = \frac{48021.6\text{N}}{2500\text{N}}$$

## 14) Transmissibility Ratio given Magnification Factor

[Open Calculator !\[\]\(35dc653d59570f8f891c312eeece91a2\_img.jpg\)](#)

$$\text{fx } \varepsilon = \frac{D \cdot \sqrt{k^2 + (c \cdot \omega)^2}}{k}$$

$$\text{ex } 19.19863 = \frac{19.19 \cdot \sqrt{(60000\text{N/m})^2 + (9000\text{Ns/m} \cdot 0.2\text{rad/s})^2}}{60000\text{N/m}}$$



## 15) Transmissibility Ratio given Natural Circular Frequency and Critical Damping Coefficient

[Open Calculator !\[\]\(feabb98897b440bc8695a03336a6e2df\_img.jpg\)](#)

$$\text{fx } \varepsilon = \frac{\sqrt{1 + \left(\frac{2 \cdot c \cdot \omega}{c_c \cdot \omega_n}\right)^2}}{\sqrt{\left(\frac{2 \cdot c \cdot \omega}{c_c \cdot \omega_n}\right)^2 + \left(1 - \left(\frac{\omega}{\omega_n}\right)^2\right)^2}}$$

$$\text{ex } 0.09842 = \frac{\sqrt{1 + \left(\frac{2 \cdot 9000 \text{Ns/m} \cdot 0.2 \text{rad/s}}{1800 \text{Ns/m} \cdot 0.194 \text{rad/s}}\right)^2}}{\sqrt{\left(\frac{2 \cdot 9000 \text{Ns/m} \cdot 0.2 \text{rad/s}}{1800 \text{Ns/m} \cdot 0.194 \text{rad/s}}\right)^2 + \left(1 - \left(\frac{0.2 \text{rad/s}}{0.194 \text{rad/s}}\right)^2\right)^2}}$$

## 16) Transmissibility Ratio given Natural Circular Frequency and Magnification Factor

[Open Calculator !\[\]\(642aa997563f9a325b310230bb5078b7\_img.jpg\)](#)

$$\text{fx } \varepsilon = D \cdot \sqrt{1 + \left(\frac{2 \cdot c \cdot \omega}{c_c \cdot \omega_n}\right)^2}$$

$$\text{ex } 198.7636 = 19.19 \cdot \sqrt{1 + \left(\frac{2 \cdot 9000 \text{Ns/m} \cdot 0.2 \text{rad/s}}{1800 \text{Ns/m} \cdot 0.194 \text{rad/s}}\right)^2}$$



## 17) Transmissibility Ratio if there is No Damping

$$\text{fx } \varepsilon = \frac{1}{\left(\frac{\omega}{\omega_n}\right)^2 - 1}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

$$\text{ex } 15.92047 = \frac{1}{\left(\frac{0.2\text{rad/s}}{0.194\text{rad/s}}\right)^2 - 1}$$

## 18) Transmitted Force given Transmissibility Ratio

$$\text{fx } F_T = \varepsilon \cdot F_a$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

$$\text{ex } 48000\text{N} = 19.2 \cdot 2500\text{N}$$










## Variables Used

- **C** Damping Coefficient (*Newton Second per Meter*)
- **C<sub>c</sub>** Critical Damping Coefficient (*Newton Second per Meter*)
- **D** Magnification Factor
- **F<sub>a</sub>** Applied Force (*Newton*)
- **F<sub>T</sub>** Force Transmitted (*Newton*)
- **k** Stiffness of Spring (*Newton per Meter*)
- **K** Maximum Displacement (*Meter*)
- **ε** Transmissibility Ratio
- **ω** Angular Velocity (*Radian per Second*)
- **ω<sub>n</sub>** Natural Circular Frequency (*Radian per Second*)



## Constants, Functions, Measurements used

- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **Measurement:** **Length** in Meter (m)  
*Length Unit Conversion* 
- **Measurement:** **Force** in Newton (N)  
*Force Unit Conversion* 
- **Measurement:** **Surface Tension** in Newton per Meter (N/m)  
*Surface Tension Unit Conversion* 
- **Measurement:** **Angular Velocity** in Radian per Second (rad/s)  
*Angular Velocity Unit Conversion* 
- **Measurement:** **Damping Coefficient** in Newton Second per Meter (Ns/m)  
*Damping Coefficient Unit Conversion* 



## Check other formula lists

- [Load for Various Types of Beams and Load Conditions Formulas](#) 
- [Critical or Whirling Speed of Shaft Formulas](#) 
- [Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas](#) 
- [Frequency of Free Damped Vibrations Formulas](#) 
- [Frequency of Under Damped Forced Vibrations Formulas](#) 
- [Natural Frequency of Free Transverse Vibrations Formulas](#) 
- [Natural Frequency of Free Transverse Vibrations Due to Uniformly Distributed Load Acting Over a Simply Supported Shaft Formulas](#) 
- [Natural Frequency of Free Transverse Vibrations of a Shaft Fixed at Both Ends Carrying a Uniformly Distributed Load Formulas](#) 
- [Values of length of beam for the various types of beams and under various load conditions Formulas](#) 
- [Values of static deflection for the various types of beams and under various load conditions Formulas](#) 
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