



# **Deflection in Spring Formulas**

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### List of 23 Deflection in Spring Formulas

### Deflection in Spring 🕑

#### Close-Coiled Helical Spring 🕑



$$\delta = rac{64 \cdot \mathrm{W}_{\mathrm{load}} \cdot \mathrm{R}^3 \cdot \mathrm{N}}{\mathrm{G}_{\mathrm{Torsion}} \cdot \mathrm{d}^4}$$

ex 3.4mm = 
$$\frac{64 \cdot 85 \text{N} \cdot (225 \text{mm})^3 \cdot 9}{40 \text{GPa} \cdot (45 \text{mm})^4}$$

Open Calculator 🗗

# 2) Diameter of Spring Wire or Coil given Deflection for Close-Coiled Helical Spring

$$fx d = \left(\frac{64 \cdot W_{load} \cdot R^3 \cdot N}{G_{Torsion} \cdot \delta}\right)^{\frac{1}{4}}$$

$$ex 45mm = \left(\frac{64 \cdot 85N \cdot (225mm)^3 \cdot 9}{40GPa \cdot 3.4mm}\right)^{\frac{1}{4}}$$

$$Open Calculator C$$





## 3) Load Applied on Spring Axially given Deflection for Close-Coiled Helical Spring

Open Calculator 🕑

Open Calculator

$$\overbrace{\text{ex}}{85\text{N}} = \frac{3.4\text{mm} \cdot 40\text{GPa} \cdot (45\text{mm})^4}{64 \cdot 9 \cdot (225\text{mm})^3}$$

 $\mathrm{W}_\mathrm{load} = rac{\delta \cdot \mathrm{G}_\mathrm{Torsion} \cdot \mathrm{d}^4}{64 \cdot \mathrm{N} \cdot \mathrm{R}^3}$ 

### 4) Mean Radius of Spring given Deflection for Close-Coiled Helical Spring

$$\mathbf{K} \mathbf{R} = \left(\frac{\delta \cdot \mathbf{G}_{\mathrm{Torsion}} \cdot \mathbf{d}^{4}}{64 \cdot \mathbf{W}_{\mathrm{load}} \cdot \mathbf{N}}\right)^{\frac{1}{3}}$$

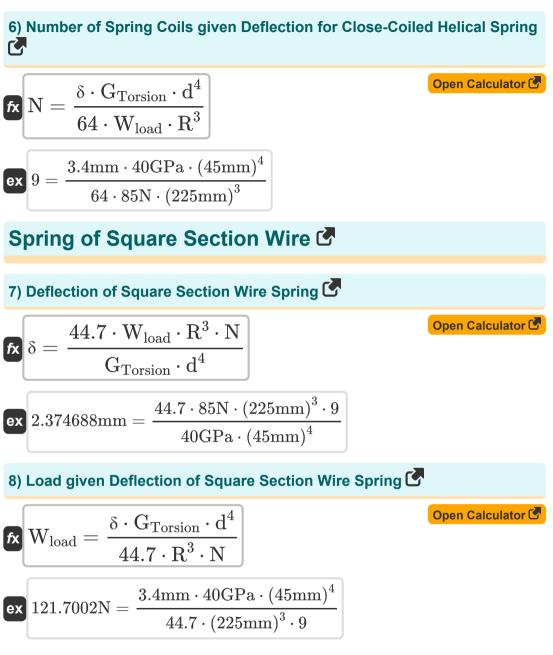
$$\mathbf{ex} 225 \mathrm{mm} = \left(\frac{3.4 \mathrm{mm} \cdot 40 \mathrm{GPa} \cdot (45 \mathrm{mm})^{4}}{64 \cdot 85 \mathrm{N} \cdot 9}\right)^{\frac{1}{3}}$$

#### 5) Modulus of Rigidity given Deflection for Close-Coiled Helical Spring 🕑

$$\mathbf{fx} \mathbf{G}_{\text{Torsion}} = \frac{64 \cdot W_{\text{load}} \cdot \mathbf{R}^3 \cdot \mathbf{N}}{\delta \cdot \mathbf{d}^4}$$
$$\mathbf{ex} \mathbf{40GPa} = \frac{64 \cdot 85N \cdot (225 \text{mm})^3 \cdot 9}{3.4 \text{mm} \cdot (45 \text{mm})^4}$$









()

9) Mean radius given Deflection of Square Section Wire Spring

$$\mathbf{K} \mathbf{R} = \left(\frac{\delta \cdot \mathbf{G}_{\text{Torsion}} \cdot \mathbf{d}^4}{44.7 \cdot \mathbf{W}_{\text{load}} \cdot \mathbf{N}}\right)^{\frac{1}{3}}$$

$$\mathbf{E} \mathbf{R} = \left(\frac{3.4 \text{mm} \cdot 40 \text{GPa} \cdot (45 \text{mm})^4}{44.7 \cdot 85 \text{N} \cdot 9}\right)^{\frac{1}{3}}$$

10) Modulus of Rigidity using Deflection of Square Section Wire Spring

Open Calculator

Open Calculator

$$\mathbf{K} \mathbf{G}_{\mathrm{Torsion}} = rac{44.7 \cdot \mathrm{W}_{\mathrm{load}} \cdot \mathrm{R}^3 \cdot \mathrm{N}}{\delta \cdot \mathrm{d}^4}$$

ex 27.9375GPa = 
$$rac{44.7 \cdot 85 \mathrm{N} \cdot (225 \mathrm{mm})^3 \cdot 9}{3.4 \mathrm{mm} \cdot (45 \mathrm{mm})^4}$$

11) Number of Coils given Deflection of Square Section Wire Spring

$$\mathbf{k} \mathbf{N} = \frac{\mathbf{\delta} \cdot \mathbf{G}_{\text{Torsion}} \cdot \mathbf{d}^4}{44.7 \cdot \mathbf{R}^3 \cdot \mathbf{W}_{\text{load}}}$$

$$\mathbf{ex} \mathbf{12.88591} = \frac{3.4 \text{mm} \cdot 40 \text{GPa} \cdot (45 \text{mm})^4}{44.7 \cdot (225 \text{mm})^3 \cdot 85 \text{N}}$$

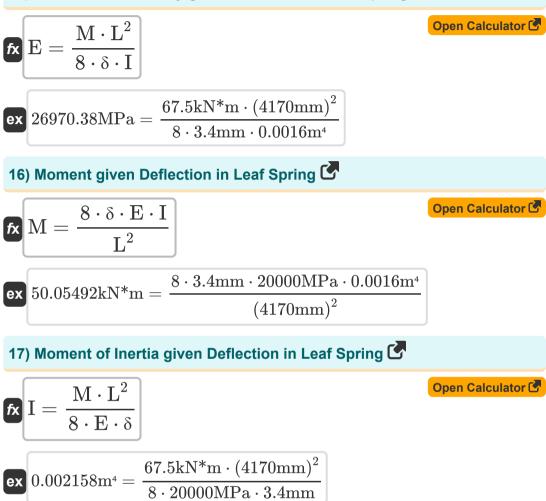


12) Width given Deflection of Square Section Wire Spring

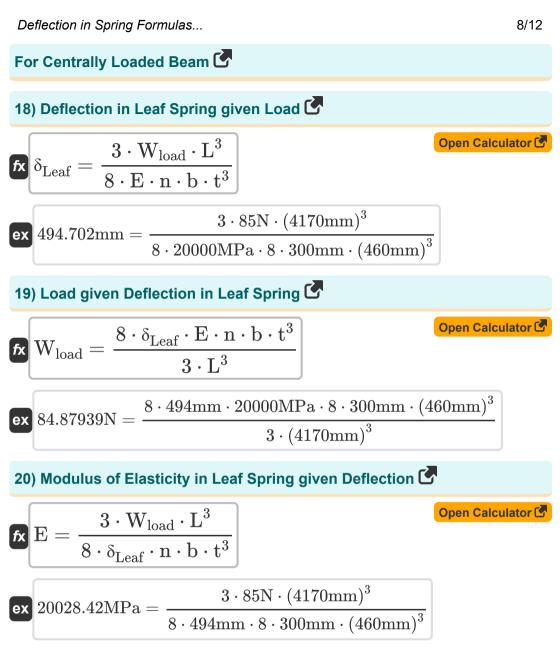
$$d = \left(\frac{44.7 \cdot W_{load} \cdot R^{3} \cdot N}{\delta \cdot G_{Torsion}}\right)^{\frac{1}{4}}$$
Open Calculator (\*)
$$d = \left(\frac{44.7 \cdot 85N \cdot (225mm)^{3} \cdot 9}{3.4mm \cdot 40GPa}\right)^{\frac{1}{4}}$$
Leaf Springs (\*)
(13) Deflection in Leaf Spring given Moment (\*)
$$\delta = \left(\frac{M \cdot L^{2}}{8 \cdot E \cdot I}\right)$$
Open Calculator (\*)
$$4.584964mm = \left(\frac{67.5kN^{*}m \cdot (4170mm)^{2}}{8 \cdot 20000MPa \cdot 0.0016m^{*}}\right)$$
(\*)
$$L = \sqrt{\frac{8 \cdot \delta \cdot E \cdot I}{M}}$$
Open Calculator (\*)
$$L = \sqrt{\frac{8 \cdot \delta \cdot E \cdot I}{M}}$$
Open Calculator (\*)
$$3590.935mm = \sqrt{\frac{8 \cdot 3.4mm \cdot 20000MPa \cdot 0.0016m^{*}}{67.5kN^{*}m}}$$



15) Modulus of Elasticity given Deflection in Leaf Spring and Moment 🕑











21) Number of plates given Deflection in Leaf Spring 🕑

$$f_{X} \mathbf{n} = \frac{3 \cdot W_{load} \cdot L^{3}}{8 \cdot \delta_{Leaf} \cdot E \cdot b \cdot t^{3}}$$

$$e_{X} 8.011368 = \frac{3 \cdot 85N \cdot (4170 \text{mm})^{3}}{8 \cdot 494 \text{mm} \cdot 20000 \text{MPa} \cdot 300 \text{mm} \cdot (460 \text{mm})^{3}}$$

$$22) \text{ Thickness given Deflection in Leaf Spring } \mathbf{C}$$

$$f_{X} \mathbf{t} = \left(\frac{3 \cdot W_{load} \cdot L^{3}}{8 \cdot \delta_{Leaf} \cdot E \cdot n \cdot b}\right)^{\frac{1}{3}}$$

$$Open Calculator \mathbf{C}$$

ex 460.2178mm = 
$$\left(\frac{3 \cdot 85 \text{N} \cdot (4170 \text{mm})^3}{8 \cdot 494 \text{mm} \cdot 20000 \text{MPa} \cdot 8 \cdot 300 \text{mm}}\right)^{\frac{1}{3}}$$

#### 23) Width given Deflection in Leaf Spring 🕑

fx 
$$b = rac{3 \cdot W_{load} \cdot L^3}{8 \cdot \delta_{Leaf} \cdot E \cdot n \cdot t^3}$$

ex 
$$300.4263 \text{mm} = \frac{3 \cdot 85 \text{N} \cdot (4170 \text{mm})^3}{8 \cdot 494 \text{mm} \cdot 20000 \text{MPa} \cdot 8 \cdot (460 \text{mm})^3}$$





Open Calculator 🕑

### Variables Used

- **b** Width of Cross Section (Millimeter)
- d Diameter of Spring (Millimeter)
- E Young's Modulus (Megapascal)
- GTorsion Modulus of Rigidity (Gigapascal)
- Area Moment of Inertia (Meter4)
- L Length in Spring (Millimeter)
- M Bending Moment (Kilonewton Meter)
- **n** Number of Plates
- N Number of Coils
- R Mean Radius (Millimeter)
- t Thickness of Section (Millimeter)
- Wload Spring Load (Newton)
- δ Deflection of Spring (Millimeter)
- δ<sub>Leaf</sub> Deflection of Leaf Spring (Millimeter)



### **Constants, Functions, Measurements used**

- 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 Gigapascal (GPa) Pressure Unit Conversion
- Measurement: Force in Newton (N) Force Unit Conversion
- Measurement: Moment of Force in Kilonewton Meter (kN\*m) Moment of Force Unit Conversion
- Measurement: Second Moment of Area in Meter<sup>₄</sup> (m<sup>₄</sup>) Second Moment of Area Unit Conversion
- Measurement: Stress in Megapascal (MPa) Stress Unit Conversion

- Deflection in Spring Formulas C Proof Load on Spring
- Maximum Bending Stress in Formulas G Spring Formulas
  - Stiffness Formulas

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