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Deflection in Spring Formulas

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List of 23 Deflection in Spring Formulas

Deflection in Spring

Close-Coiled Helical Spring

1) Deflection for Close-Coiled Helical Spring

$$\text{fx } \delta = \frac{64 \cdot W_{\text{load}} \cdot R^3 \cdot N}{G_{\text{Torsion}} \cdot d^4}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

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



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

$$\text{fx } W_{\text{load}} = \frac{\delta \cdot G_{\text{Torsion}} \cdot d^4}{64 \cdot N \cdot R^3}$$

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

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

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

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

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

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

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

$$\text{fx } G_{\text{Torsion}} = \frac{64 \cdot W_{\text{load}} \cdot R^3 \cdot N}{\delta \cdot d^4}$$

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

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



6) Number of Spring Coils given Deflection for Close-Coiled Helical Spring



$$\text{fx } N = \frac{\delta \cdot G_{\text{Torsion}} \cdot d^4}{64 \cdot W_{\text{load}} \cdot R^3}$$

[Open Calculator](#)

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

Spring of Square Section Wire

7) Deflection of Square Section Wire Spring

$$\text{fx } \delta = \frac{44.7 \cdot W_{\text{load}} \cdot R^3 \cdot N}{G_{\text{Torsion}} \cdot d^4}$$

[Open Calculator](#)

$$\text{ex } 2.374688\text{mm} = \frac{44.7 \cdot 85\text{N} \cdot (225\text{mm})^3 \cdot 9}{40\text{GPa} \cdot (45\text{mm})^4}$$

8) Load given Deflection of Square Section Wire Spring

$$\text{fx } W_{\text{load}} = \frac{\delta \cdot G_{\text{Torsion}} \cdot d^4}{44.7 \cdot R^3 \cdot N}$$

[Open Calculator](#)

$$\text{ex } 121.7002\text{N} = \frac{3.4\text{mm} \cdot 40\text{GPa} \cdot (45\text{mm})^4}{44.7 \cdot (225\text{mm})^3 \cdot 9}$$



9) Mean radius given Deflection of Square Section Wire Spring

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

$$\text{fx } R = \left(\frac{\delta \cdot G_{\text{Torsion}} \cdot d^4}{44.7 \cdot W_{\text{load}} \cdot N} \right)^{\frac{1}{3}}$$

$$\text{ex } 253.5946\text{mm} = \left(\frac{3.4\text{mm} \cdot 40\text{GPa} \cdot (45\text{mm})^4}{44.7 \cdot 85\text{N} \cdot 9} \right)^{\frac{1}{3}}$$

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

[Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba_img.jpg\)](#)

$$\text{fx } G_{\text{Torsion}} = \frac{44.7 \cdot W_{\text{load}} \cdot R^3 \cdot N}{\delta \cdot d^4}$$

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

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

[Open Calculator !\[\]\(47734e4656765d20df4fdbd5b7aff048_img.jpg\)](#)

$$\text{fx } N = \frac{\delta \cdot G_{\text{Torsion}} \cdot d^4}{44.7 \cdot R^3 \cdot W_{\text{load}}}$$

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



12) Width given Deflection of Square Section Wire Spring 

$$\text{fx } d = \left(\frac{44.7 \cdot W_{\text{load}} \cdot R^3 \cdot N}{\delta \cdot G_{\text{Torsion}}} \right)^{\frac{1}{4}}$$

Open Calculator 

$$\text{ex } 41.13812\text{mm} = \left(\frac{44.7 \cdot 85\text{N} \cdot (225\text{mm})^3 \cdot 9}{3.4\text{mm} \cdot 40\text{GPa}} \right)^{\frac{1}{4}}$$

Leaf Springs 13) Deflection in Leaf Spring given Moment 

$$\text{fx } \delta = \left(\frac{M \cdot L^2}{8 \cdot E \cdot I} \right)$$

Open Calculator 

$$\text{ex } 4.584964\text{mm} = \left(\frac{67.5\text{kN} \cdot \text{m} \cdot (4170\text{mm})^2}{8 \cdot 20000\text{MPa} \cdot 0.0016\text{m}^4} \right)$$

14) Length given Deflection in Leaf Spring 

$$\text{fx } L = \sqrt{\frac{8 \cdot \delta \cdot E \cdot I}{M}}$$

Open Calculator 

$$\text{ex } 3590.935\text{mm} = \sqrt{\frac{8 \cdot 3.4\text{mm} \cdot 20000\text{MPa} \cdot 0.0016\text{m}^4}{67.5\text{kN} \cdot \text{m}}}$$



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

$$\text{fx } E = \frac{M \cdot L^2}{8 \cdot \delta \cdot I}$$

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

$$\text{ex } 26970.38\text{MPa} = \frac{67.5\text{kN}\cdot\text{m} \cdot (4170\text{mm})^2}{8 \cdot 3.4\text{mm} \cdot 0.0016\text{m}^4}$$

16) Moment given Deflection in Leaf Spring

$$\text{fx } M = \frac{8 \cdot \delta \cdot E \cdot I}{L^2}$$

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

$$\text{ex } 50.05492\text{kN}\cdot\text{m} = \frac{8 \cdot 3.4\text{mm} \cdot 20000\text{MPa} \cdot 0.0016\text{m}^4}{(4170\text{mm})^2}$$

17) Moment of Inertia given Deflection in Leaf Spring

$$\text{fx } I = \frac{M \cdot L^2}{8 \cdot E \cdot \delta}$$

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

$$\text{ex } 0.002158\text{m}^4 = \frac{67.5\text{kN}\cdot\text{m} \cdot (4170\text{mm})^2}{8 \cdot 20000\text{MPa} \cdot 3.4\text{mm}}$$



For Centrally Loaded Beam

18) Deflection in Leaf Spring given Load

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

[Open Calculator !\[\]\(96cc62f861fdd6e50510c0224a756dff_img.jpg\)](#)

$$\text{ex } 494.702\text{mm} = \frac{3 \cdot 85\text{N} \cdot (4170\text{mm})^3}{8 \cdot 20000\text{MPa} \cdot 8 \cdot 300\text{mm} \cdot (460\text{mm})^3}$$

19) Load given Deflection in Leaf Spring

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

[Open Calculator !\[\]\(f95dab70c751fda7d824b8b03650f7aa_img.jpg\)](#)

$$\text{ex } 84.87939\text{N} = \frac{8 \cdot 494\text{mm} \cdot 20000\text{MPa} \cdot 8 \cdot 300\text{mm} \cdot (460\text{mm})^3}{3 \cdot (4170\text{mm})^3}$$

20) Modulus of Elasticity in Leaf Spring given Deflection

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

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c_img.jpg\)](#)

$$\text{ex } 20028.42\text{MPa} = \frac{3 \cdot 85\text{N} \cdot (4170\text{mm})^3}{8 \cdot 494\text{mm} \cdot 8 \cdot 300\text{mm} \cdot (460\text{mm})^3}$$



21) Number of plates given Deflection in Leaf Spring

[Open Calculator !\[\]\(5ebcf382a6ee952d6c5b8b948415801e_img.jpg\)](#)

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

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

22) Thickness given Deflection in Leaf Spring

[Open Calculator !\[\]\(a69696d69cfd88b51cbd02e5288eca32_img.jpg\)](#)

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

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

23) Width given Deflection in Leaf Spring

[Open Calculator !\[\]\(ac7494f141109b59d18bf9c3aeb84d93_img.jpg\)](#)

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

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









Variables Used

- **b** Width of Cross Section (*Millimeter*)
- **d** Diameter of Spring (*Millimeter*)
- **E** Young's Modulus (*Megapascal*)
- **G_{Torsion}** Modulus of Rigidity (*Gigapascal*)
- **I** 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*)
- **W_{load}** Spring Load (*Newton*)
- **δ** Deflection of Spring (*Millimeter*)
- **δ_{Leaf}** 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 Meter⁴ (m⁴)
Second Moment of Area Unit Conversion 
- **Measurement:** **Stress** in Megapascal (MPa)
Stress Unit Conversion 



Check other formula lists

- [Deflection in Spring Formulas](#) 
- [Maximum Bending Stress in Spring Formulas](#) 
- [Proof Load on Spring Formulas](#) 
- [Stiffness Formulas](#) 

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