Important Deflection in Spring Formulas PDF

Formulas
Examples
with Units

List of 23
Important Deflection in Spring Formulas

1) Close Coiled Helical Spring Formulas

1.1) Deflection for Close-Coiled Helical Spring Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

2) Spring of Square Section Wire Formulas

2.1) Deflection of Square Section Wire Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$2.3747\,\text{mm} = \frac{44.7 \cdot 85\,\text{N} \cdot 225\,\text{mm}^3 \cdot 9}{40\,\text{GPa} \cdot 45\,\text{mm}^4}$$

2.2) Load given Deflection of Square Section Wire Spring Formula

Evaluate Formula

Formula

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

Example with Units

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

2.3) Mean radius given Deflection of Square Section Wire Spring Formula

Evaluate Formula

Formula

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

Example with Units

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

2.4) Modulus of Rigidity using Deflection of Square Section Wire Spring Formula

Evaluate Formula

Formula

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

Example with Units

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

2.5) Number of Coils given Deflection of Square Section Wire Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$12.8859 = \frac{3.4\,\text{mm} \cdot 40\,\text{GPa} \cdot 45\,\text{mm}^4}{44.7 \cdot 225\,\text{mm}^3 \cdot 85\,\text{N}}$$

2.6) Width given Deflection of Square Section Wire Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$41.1381\,\text{mm} = \left(\frac{44.7 \cdot 85\,\text{N} \cdot 225\,\text{mm}^3 \cdot 9}{3.4\,\text{mm} \cdot 40\,\text{GPa}} \right)^{\frac{1}{4}}$$

2.7) Leaf Springs Formulas

2.7.1) Deflection in Leaf Spring given Moment Formula

Evaluate Formula

Formula

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

Example with Units

$$4.585\,\text{mm} = \left(\frac{67.5\,\text{kN*m} \cdot 4170\,\text{mm}^2}{8 \cdot 20000\,\text{MPa} \cdot 0.0016\,\text{m}^4} \right)$$

2.7.2) Length given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$3590.9351\,\text{mm} = \sqrt{\frac{8 \cdot 3.4\,\text{mm} \cdot 20000\,\text{MPa} \cdot 0.0016\,\text{m}^4}{67.5\,\text{kN*m}}}$$

2.7.3) Modulus of Elasticity given Deflection in Leaf Spring and Moment Formula

Evaluate Formula

Formula

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

Example with Units

$$26970.3757\,\text{MPa} = \frac{67.5\,\text{kN*m} \cdot 4170\,\text{mm}^2}{8 \cdot 3.4\,\text{mm} \cdot 0.0016\,\text{m}^4}$$

2.7.4) Moment given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$50.0549\,\text{kN*m} = \frac{8 \cdot 3.4\,\text{mm} \cdot 20000\,\text{MPa} \cdot 0.0016\,\text{m}^4}{4170\,\text{mm}^2}$$

2.7.5) Moment of Inertia given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0022\,\text{m}^4 = \frac{67.5\,\text{kN*m} \cdot 4170\,\text{mm}^2}{8 \cdot 20000\,\text{MPa} \cdot 3.4\,\text{mm}}$$

2.7.6) For Centrally Loaded Beam Formulas

2.7.6.1) Deflection in Leaf Spring given Load Formula

Evaluate Formula

Formula

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

Example with Units

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

2.7.6.2) Load given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$84.8794\,\text{N} = \frac{8 \cdot 494\,\text{mm} \cdot 20000\,\text{MPa} \cdot 8 \cdot 300\,\text{mm} \cdot 460\,\text{mm}^3}{3 \cdot 4170\,\text{mm}^3}$$

2.7.6.3) Modulus of Elasticity in Leaf Spring given Deflection Formula

Evaluate Formula

Formula

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

Example with Units

$$20028.4192\,\text{MPa} = \frac{3 \cdot 85\,\text{N} \cdot 4170\,\text{mm}^3}{8 \cdot 494\,\text{mm} \cdot 8 \cdot 300\,\text{mm} \cdot 460\,\text{mm}^3}$$

2.7.6.4) Number of plates given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

$$8.0114 = \frac{3 \cdot 85\,\text{N} \cdot 4170\,\text{mm}^3}{8 \cdot 494\,\text{mm} \cdot 20000\,\text{MPa} \cdot 300\,\text{mm} \cdot 460\,\text{mm}^3}$$

2.7.6.5) Thickness given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

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

2.7.6.6) Width given Deflection in Leaf Spring Formula

Evaluate Formula

Formula

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

Example with Units

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

Variables used in list of Deflection in Spring Formulas above

- **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 in list of Deflection in Spring Formulas above

- Functions: **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

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