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Design of Valve Spring Formulas

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List of 47 Design of Valve Spring Formulas

Design of Valve Spring

Diameter of Spring Wire

1) Diameter of Wire of Engine Valve Spring

Open Calculator

fx $$d_{wire} = \sqrt{\frac{8 \cdot K \cdot ((P_i + k \cdot h_{max}) \cdot C)}{\pi \cdot f_s}}$$

ex $$4.22442\text{mm} = \sqrt{\frac{8 \cdot 1.2 \cdot ((120\text{N} + 9\text{N/mm} \cdot 11\text{mm}) \cdot 8)}{\pi \cdot 300\text{N/mm}^2}}$$

2) Diameter of Wire of Engine Valve Spring given Maximum Compression in Spring

Open Calculator

fx $$d_{wire} = \left(\frac{8 \cdot P \cdot N \cdot D^3}{G \cdot x}\right)^{\frac{1}{4}}$$

ex $$5.512036\text{mm} = \left(\frac{8 \cdot 340\text{N} \cdot 12 \cdot (46\text{mm})^3}{98900\text{N/mm}^2 \cdot 34.8\text{mm}}\right)^{\frac{1}{4}}$$

3) Diameter of Wire of Engine Valve Spring given Mean Coil Diameter

Open Calculator

fx $$d_{wire} = \frac{D}{8}$$

ex $$5.75\text{mm} = \frac{46\text{mm}}{8}$$

4) Diameter of Wire of Engine Valve Spring given Number of Active Turns of Spring

Open Calculator

fx $$d_{wire} = \left(\frac{8 \cdot D^3 \cdot k \cdot N}{G}\right)^{0.25}$$

ex $$5.400049\text{mm} = \left(\frac{8 \cdot (46\text{mm})^3 \cdot 9\text{N/mm} \cdot 12}{98900\text{N/mm}^2}\right)^{0.25}$$

5) Diameter of Wire of Engine Valve Spring given Torsional Shear Stress in Wire

Open Calculator

fx $$d_{wire} = \sqrt{\frac{8 \cdot K \cdot P \cdot C}{\pi \cdot f_s}}$$

ex $$5.26362\text{mm} = \sqrt{\frac{8 \cdot 1.2 \cdot 340\text{N} \cdot 8}{\pi \cdot 300\text{N/mm}^2}}$$

6) Diameter of Wire of Engine Valve Spring given Total Turns of Spring

Open Calculator

fx $$d_{wire} = \left(\frac{8 \cdot D^3 \cdot (k \cdot (N_t - 2))}{G} \right)^{0.25}$$

ex $$5.509197\text{mm} = \left(\frac{8 \cdot (46\text{mm})^3 \cdot (9\text{N/mm} \cdot (15 - 2))}{98900\text{N/mm}^2} \right)^{0.25}$$

7) Spring Index of Engine Valve Spring given Shear Stress, Maximum Force and Wire Diameter

Open Calculator

fx $$C = \frac{\pi \cdot f_s \cdot d_{wire}^2}{8 \cdot K \cdot P}$$

ex $$8.734667 = \frac{\pi \cdot 300\text{N/mm}^2 \cdot (5.5\text{mm})^2}{8 \cdot 1.2 \cdot 340\text{N}}$$

8) Wahl Factor for Engine Valve Spring given Mean Coil Diameter and Wire Diameter

Open Calculator

fx $$K = \frac{\pi \cdot f_s \cdot d_{wire}^2}{8 \cdot C \cdot P}$$

ex $$1.3102 = \frac{\pi \cdot 300\text{N/mm}^2 \cdot (5.5\text{mm})^2}{8 \cdot 8 \cdot 340\text{N}}$$

9) Wahl Factor for Engine Valve Spring given Spring Index

Open Calculator

fx $$K = \frac{\pi \cdot f_s \cdot d_{wire}^2}{8 \cdot C \cdot (P_i + k \cdot h_{max})}$$

ex $$2.034101 = \frac{\pi \cdot 300\text{N/mm}^2 \cdot (5.5\text{mm})^2}{8 \cdot 8 \cdot (120\text{N} + 9\text{N/mm} \cdot 11\text{mm})}$$

Frequency of Vibration

10) Mass of Engine Valve Spring given its Natural Frequency of Vibration and Stiffness

Open Calculator

fx $$m = \frac{k}{4 \cdot \omega_n^2}$$

ex $$0.161591\text{kg} = \frac{9\text{N/mm}}{4 \cdot (118\text{Hz})^2}$$

11) Natural Frequency of Vibration of Engine Valve Spring given its Mass and Stiffness

Open Calculator

fx $$\omega_n = \frac{\sqrt{\frac{k}{m}}}{2}$$

ex $$122.4745\text{Hz} = \frac{\sqrt{\frac{9\text{N/mm}}{0.15\text{kg}}}}{2}$$

12) Stiffness of Engine Valve Spring given its Natural Frequency of Vibration and Mass

Open Calculator

fx $$k = 4 \cdot m \cdot \omega_n^2$$

ex $$8.3544\text{N/mm} = 4 \cdot 0.15\text{kg} \cdot (118\text{Hz})^2$$

13) Stiffness of Engine Valve Spring given Total Turns of Spring

Open Calculator

fx $$k = \frac{G \cdot d_{wire}^4}{8 \cdot N \cdot D^3}$$

ex $$9.68506\text{N/mm} = \frac{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4}{8 \cdot 12 \cdot (46\text{mm})^3}$$

Length of Spring

14) Free Length of Engine Valve Spring

Open Calculator

fx $$L_f = N_t \cdot d_{wire} + 1.15 \cdot x$$

ex $$122.52\text{mm} = 15 \cdot 5.5\text{mm} + 1.15 \cdot 34.8\text{mm}$$

15) Solid Length of Engine Valve Spring

Open Calculator

fx $$L = \left(\left(\frac{G \cdot d_{wire}^4}{8 \cdot D^3 \cdot k}\right) + 2\right) \cdot d_{wire}$$

ex $$82.02377\text{mm} = \left(\left(\frac{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4}{8 \cdot (46\text{mm})^3 \cdot 9\text{N/mm}}\right) + 2\right) \cdot 5.5\text{mm}$$

16) Solid Length of Engine Valve Spring given its Free Length and Maximum Compression

Open Calculator

fx $$L = L_f - 1.15 \cdot x$$

ex $$89.98\text{mm} = 130\text{mm} - 1.15 \cdot 34.8\text{mm}$$

17) Solid Length of Engine Valve Spring given Number of Active Turns of Spring and Wire Diameter

Open Calculator

fx $$L = (N + 2) \cdot d_{wire}$$

ex $$77\text{mm} = (12 + 2) \cdot 5.5\text{mm}$$

18) Solid Length of Engine Valve Spring given Total Number of Turns of Spring and Wire Diameter

Open Calculator

fx $$L = N_t \cdot d_{wire}$$

ex $$82.5\text{mm} = 15 \cdot 5.5\text{mm}$$

19) Total Gap between Coils of Engine Valve Spring given Maximum Compression of Spring

Open Calculator

$$G_A = 0.15 \cdot x$$

$$5.22\text{mm} = 0.15 \cdot 34.8\text{mm}$$

Maximum Compression of Spring

20) Maximum Compression of Engine Valve Spring given its Free Length and Solid Length

Open Calculator

$$x = \frac{L_f - L}{1.15}$$

$$34.78261\text{mm} = \frac{130\text{mm} - 90\text{mm}}{1.15}$$

21) Maximum Compression of Engine Valve Spring given Number of Active Turns

Open Calculator

$$x = \frac{8 \cdot P \cdot N \cdot D^3}{G \cdot d_{wire}^4}$$

$$35.10562\text{mm} = \frac{8 \cdot 340\text{N} \cdot 12 \cdot (46\text{mm})^3}{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4}$$

22) Maximum Compression of Engine Valve Spring given Total Gap between Coils of Spring

Open Calculator

fx $$x = \frac{G_A}{0.15}$$

ex $$34\text{mm} = \frac{5.1\text{mm}}{0.15}$$

23) Maximum Compression of Engine Valve Spring given Total Turns

Open Calculator

fx $$x = \frac{8 \cdot P \cdot (N_t - 2) \cdot D^3}{G \cdot d_{wire}^4}$$

ex $$38.03108\text{mm} = \frac{8 \cdot 340\text{N} \cdot (15 - 2) \cdot (46\text{mm})^3}{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4}$$

Mean Coil Diameter of Spring

24) Diameter of Coil of Engine Valve Spring given Maximum Compression in Spring

Open Calculator

fx $$D = \left(\frac{G \cdot \left(d_{wire}^4\right) \cdot x}{8 \cdot (P) \cdot (N)} \right)^{\frac{1}{3}}$$

ex $$45.86612\text{mm} = \left(\frac{98900\text{N/mm}^2 \cdot \left((5.5\text{mm})^4\right) \cdot 34.8\text{mm}}{8 \cdot (340\text{N}) \cdot (12)} \right)^{\frac{1}{3}}$$

25) Diameter of Coil of Engine Valve Spring given Torsional Shear Stress in Wire

Open Calculator

fx $$D = C \cdot \left(\sqrt{\frac{8 \cdot K \cdot (P \cdot C)}{\pi \cdot f_s}} \right)$$

ex $$42.10896\text{mm} = 8 \cdot \left(\sqrt{\frac{8 \cdot 1.2 \cdot (340\text{N} \cdot 8)}{\pi \cdot 300\text{N/mm}^2}} \right)$$

26) Mean Coil Diameter of Engine Valve Spring given Number of Active turns of Spring

Open Calculator

fx $$D = \left(\frac{G \cdot \left(d_{wire}^4 \right)}{8 \cdot (N) \cdot k} \right)^{\frac{1}{3}}$$

ex $$47.13872\text{mm} = \left(\frac{98900\text{N/mm}^2 \cdot \left((5.5\text{mm})^4 \right)}{8 \cdot (12) \cdot 9\text{N/mm}} \right)^{\frac{1}{3}}$$

27) Mean Coil Diameter of Engine Valve Spring given Total Turns of Spring

Open Calculator

fx $$D = \left(\frac{G \cdot \left(d_{wire}^4 \right)}{8 \cdot (((N_t) - 2)) \cdot k} \right)^{\frac{1}{3}}$$

ex $$45.89764\text{mm} = \left(\frac{98900\text{N/mm}^2 \cdot \left((5.5\text{mm})^4 \right)}{8 \cdot (((15) - 2)) \cdot 9\text{N/mm}} \right)^{\frac{1}{3}}$$

28) Mean Coil Diameter of Engine Valve Spring given Wire Diameter

Open Calculator

fx $$D = 8 \cdot d_{wire}$$

ex $$44\text{mm} = 8 \cdot 5.5\text{mm}$$

Modulus of Rigidity of Spring Wire

29) Modulus of Rigidity of Engine Valve Spring given Maximum Compression in Spring

Open Calculator

fx $$G = \frac{8 \cdot P \cdot N \cdot D^3}{x \cdot d_{wire}^4}$$

ex $$99768.55\text{N/mm}^2 = \frac{8 \cdot 340\text{N} \cdot 12 \cdot (46\text{mm})^3}{34.8\text{mm} \cdot (5.5\text{mm})^4}$$

30) Modulus of Rigidity of Engine Valve Spring given Number of Active Turns of Spring

Open Calculator

$$G = \frac{8 \cdot P \cdot (N_t - 2) \cdot D^3}{x \cdot d_{wire}^4}$$

$$108082.6\text{N/mm}^2 = \frac{8 \cdot 340\text{N} \cdot (15 - 2) \cdot (46\text{mm})^3}{34.8\text{mm} \cdot (5.5\text{mm})^4}$$

31) Modulus of Rigidity of Engine Valve Spring given Total Number of Turns of Spring

Open Calculator

$$G = \frac{8 \cdot D^3 \cdot k \cdot (N_t - 2)}{d_{wire}^4}$$

$$99563.14\text{N/mm}^2 = \frac{8 \cdot (46\text{mm})^3 \cdot 9\text{N/mm} \cdot (15 - 2)}{(5.5\text{mm})^4}$$

Number of Active Turns

32) Number of Active Turns of Engine Valve Spring

Open Calculator

$$N = \frac{G \cdot d_{wire}^4}{8 \cdot D^3 \cdot k}$$

$$12.91341 = \frac{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4}{8 \cdot (46\text{mm})^3 \cdot 9\text{N/mm}}$$

33) Number of Active Turns of Engine Valve Spring given Maximum Compression in Spring

Open Calculator

fx $$N = \frac{G \cdot d_{wire}^4 \cdot x}{8 \cdot P \cdot D^3}$$

ex $$11.89553 = \frac{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4 \cdot 34.8\text{mm}}{8 \cdot 340\text{N} \cdot (46\text{mm})^3}$$

34) Number of Active Turns of Engine Valve Spring given Pitch of Spring

Open Calculator

fx $$N = \frac{L_f}{p} - 1$$

ex $$13.28571 = \frac{130\text{mm}}{9.1\text{mm}} - 1$$

35) Number of Active Turns of Engine Valve Spring given Total Turns

Open Calculator

fx $$N = N_t - 2$$

ex $$13 = 15 - 2$$

Pitch of Coils

36) Pitch of Engine Valve Spring

Open Calculator

fx $$p = \frac{(N + 2) \cdot d_{wire} + 1.15 \cdot \frac{8 \cdot P \cdot N \cdot D^3}{G \cdot d_{wire}^4}}{N + 1}$$

ex $$9.028574\text{mm} = \frac{(12 + 2) \cdot 5.5\text{mm} + 1.15 \cdot \frac{8 \cdot 340\text{N} \cdot 12 \cdot (46\text{mm})^3}{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4}}{12 + 1}$$

37) Pitch of Engine Valve Spring given its Free Length and Number of Active Turns

Open Calculator

fx $$p = \frac{L_f}{N + 1}$$

ex $$10\text{mm} = \frac{130\text{mm}}{12 + 1}$$

38) Pitch of Engine Valve Spring given its Free Length and Total Number of Turns

Open Calculator

fx $$p = \frac{L_f}{N_t - 1}$$

ex $$9.285714\text{mm} = \frac{130\text{mm}}{15 - 1}$$

Stress Due to Suction Pressure

39) Maximum Force on Engine Valve Spring given Maximum Compression in Spring

Open Calculator

fx $$P = \frac{G \cdot d_{wire}^4 \cdot x}{8 \cdot N \cdot D^3}$$

ex $$337.0401\text{N} = \frac{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4 \cdot 34.8\text{mm}}{8 \cdot 12 \cdot (46\text{mm})^3}$$

40) Maximum Force on Engine Valve Spring given Torsional Shear Stress in Wire

Open Calculator

fx $$P = \frac{\pi \cdot f_s \cdot d_{wire}^2}{8 \cdot K \cdot C}$$

ex $$371.2234\text{N} = \frac{\pi \cdot 300\text{N/mm}^2 \cdot (5.5\text{mm})^2}{8 \cdot 1.2 \cdot 8}$$

41) Stiffness of Engine Valve Spring

Open Calculator

fx $$k = \frac{P_2}{h_{max}}$$

ex $$22.72727\text{N/mm} = \frac{250\text{N}}{11\text{mm}}$$

42) Torsional Shear Stress in Wire of Engine Valve Spring

Open Calculator

fx $$f_s = \left(\frac{8 \cdot K \cdot (P_i + k \cdot h_{max} \cdot C)}{\pi \cdot d_{wire}^2} \right)$$

ex $$92.12783\text{N/mm}^2 = \left(\frac{8 \cdot 1.2 \cdot (120\text{N} + 9\text{N/mm} \cdot 11\text{mm} \cdot 8)}{\pi \cdot (5.5\text{mm})^2} \right)$$

43) Torsional Shear Stress in Wire of Engine Valve Spring given Maximum Force on Spring

Open Calculator

fx $$f_s = \frac{8 \cdot K \cdot P \cdot C}{\pi \cdot d_{wire}^2}$$

ex $$274.7672\text{N/mm}^2 = \frac{8 \cdot 1.2 \cdot 340\text{N} \cdot 8}{\pi \cdot (5.5\text{mm})^2}$$

44) Total Force on Engine Valve Spring

Open Calculator

fx $$P = P_i + k \cdot h_{max}$$

ex $$219\text{N} = 120\text{N} + 9\text{N/mm} \cdot 11\text{mm}$$

Total Number of Turns

45) Total Number of Turns of Engine Valve Spring given Maximum Compression in Spring

Open Calculator

$$N_t = \frac{G \cdot d_{wire}^4 \cdot x}{8 \cdot P \cdot D^3} + 2$$

$$13.89553 = \frac{98900\text{N/mm}^2 \cdot (5.5\text{mm})^4 \cdot 34.8\text{mm}}{8 \cdot 340\text{N} \cdot (46\text{mm})^3} + 2$$

46) Total Number of Turns of Engine Valve Spring given Pitch of Spring

Open Calculator

$$N_t = \frac{L_f}{p} + 1$$

$$15.28571 = \frac{130\text{mm}}{9.1\text{mm}} + 1$$

47) Total Turns of Engine Valve Spring given Number of Active Turns

Open Calculator

$$N_t = N + 2$$

$$14 = 12 + 2$$

Variables Used

- **C** Spring Index for Valve Spring
- **D** Mean Coil Diameter of Valve Spring *(Millimeter)*
- d_{wire} Wire Diameter of Valve Spring *(Millimeter)*
- f_s Shear Stress in Valve Spring *(Newton per Square Millimeter)*
- **G** Modulus of Rigidity of Valve Spring *(Newton per Square Millimeter)*
- G_A Total Axial Gap between Valve Spirng Coils *(Millimeter)*
- h_{max} Lift of Valve *(Millimeter)*
- **k** Stiffness of Valve Spring *(Newton per Millimeter)*
- **K** Wahl Factor of Valve Spring
- **L** Solid Length of Valve Spring *(Millimeter)*
- L_f Free Length of Valve Spring *(Millimeter)*
- **m** Mass of Valve Spring *(Kilogram)*
- **N** Active Coils in Valve Spring
- N_t Total Coils in Valve Spring
- **p** Pitch of Valve spring *(Millimeter)*
- **P** Axial Force on Valve Spring *(Newton)*
- P_2 Force to Lift Engine Valve *(Newton)*
- P_i Initial Spring Force on Valve *(Newton)*
- **x** Maximum Compression in Valve Spring *(Millimeter)*
- ω_n Natural Frequency Valve Spring *(Hertz)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Stiffness Constant** in Newton per Millimeter (N/mm)
  Stiffness Constant Unit Conversion
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

Check other formula lists

- **Design of Engine Valves Formulas**
- **Design of Push Rod Formulas**
- **Design of Rocker Arm Formulas**
- **Design of Valve Spring Formulas**
- **Engine Cylinder Formulas**

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