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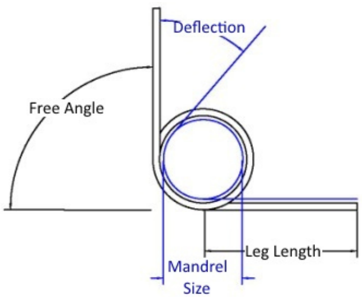
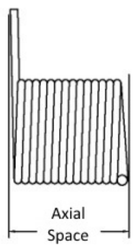
Torsion Spring Design

Torsion springs exert a torque when they are twisted or deflected. The spring torque and the length of the legs together create a force. Torsion springs can be made out of round, rectangular or shaped wire. A simple torsion spring has straight, but any bends or shapes can be formed. Double torsion springs can be used when twice the force is required or when you need an even distribution of torque.





Common Spring materials

TTorMaterial	Max. recommended % tensile in bending
Music Wire	80%
Chrome Silicon	80%
Chrome Vanadium	80%
302 Stainless Steel	60%
316 Stainless Steel	60%
17-7 Stainless	75%

*See our material data sheet for a more complete list

Spring Terms

ID = Inside Diameter
D = Mean Diameter
D_m = Minimum Diameter under deflection
θ = Deflection angle
d = wire diameter
L = leg length
N_a= number of active coils
Nt = number of total coils
R= Spring Rate
P = applied force
M = Moment or Torque
S_b = bending stress
c = spring index
ΔL = deflection
UTS= Ultimate Tensile Strength

Calculations

D= ID +d

$N_a = N_t + \frac{L}{3\pi d}$

$D_m = \frac{D * N_t}{N_t + \theta}$

$R = \frac{E * d^4}{10.8 * D * N_a}$

$S = \frac{32M}{\pi d^3} \times \frac{4c^2 - c - 1}{4c(c-1)}$

Design Tips

- Torsion springs should be deflected in the direction that closes the coils
- Inside diameters reduce to D_m when deflected. Mandrel size should be larger than D_m
- N_a takes into account the material in the legs. If the force is supplied close to the body of the spring N_t is a good approximation

Standard Torsion Springs

Selection

First choose material type and helix. Next, select a range of wire diameter that you think may be appropriate. Finally, select the amount of deflection you expect to have in the application. Keep in mind that the amount of deflection is also the same as the free position of the ends (see illustrations). The broad the ranges selected the more option will be offered.

Material

Music Wire: ASTM-A228

250 degree maximum operating temperature.

Stainless Steel Type 302: ASTM-A313

500 degree maximum operating temperature

Torque:

Torque values shown are at the degree of deflection listed for each spring. To find the torque values for any other position simply use a direct proportion of the required position divided by the listed position, i.e. if the torque is listed as .500 in-lbs at 180 degrees deflection, what is the torque at 90 degrees?

(90 deg./180 deg.) x .500 in-lb=.250 in-lb

Values listed are for average use. These values can be increased by 20% for very light or static use. Infinite life can be obtained by reducing values by 20% and proper mounting.

Load:

This is the direct force applied at a given radius. Torque can be converted to load by the formula given below.

Load (P) =Torque/Radius

If a spring has a torque of .985 in-lbs at 180, degrees deflection, what is the load exerted at a .500 inch radius?

.985/.500=1.97 lbs

Tolerances:

Torque: ± 10%
Diameter: ± 5%

Direction of Helix:

Stock torsion springs are available in both right and left hand helix. The direction must be specified.

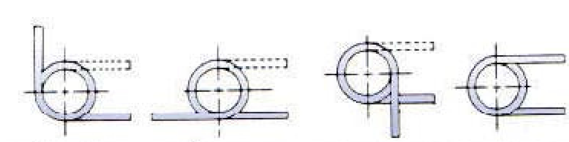
Torsion springs are designed to be used in the wrapped down position. If used in the opposite direction the loads available will be much lower than those listed.

Ends:

Straight legs are supplied as shown in the diagram. Special end configurations and forming can be supplied on request. To determine the end configuration in the free state match the degrees deflection to the appropriate figure below.

Mandrel Size:

The suggested mandrel size shown is for the listed deflection. If more deflection is required from a listed spring it will be necessary to reduce the mandrel size and allow additional axial space.



90° Deflection Fig. 1 | 180° Deflection Fig. 2 | 270° Deflection Fig. 3 | 360° Deflection Fig. 4

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