Oshkosh COIL SPRING

Coil Spring Glossary

Custom Coil Springs & Wire Forms · Wisconsin · ISO 9001

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Common terms used when specifying compression, extension and torsion springs. Symbols in **orange** are those used on drawings and in spring calculations, including the OCS online spring calculator.

A

Active coils (n)
Those coils which are free to deflect under load.

Angular deflection
Rotation of the legs of a torsion spring from the free position under load, usually expressed in degrees.

Angular relationship of ends
The relative position of the plane of the hooks or loops of extension springs to each other.

Arms
See **Legs**

B

Baking (hydrogen relief)
Heat treatment performed promptly after plating or pickling to drive out absorbed hydrogen and reduce the risk of hydrogen embrittlement. Typically about 375–425°F (190–220°C) for four hours or more, per ASTM B850.

Body length
Length of the coiled body of an extension spring, excluding hooks or loops. For a close-wound spring, approximately (total coils + 1) × wire diameter.

Buckling
Bowing or lateral deflection of compression springs when compressed, related to the slenderness ratio (L/D).

C

Close-wound
Coiled with adjacent coils touching.

Closed and ground ends
See **Squared and ground ends**

Closed ends
See **Squared ends**

Closed length
See **Solid height**

Coatings
Non-electrolytic finishes such as powder coat, e-coat, black oxide, zinc flake or oil, applied for corrosion protection or appearance.

Coils per inch
See **Pitch**

Compression spring
An open-coiled helical spring that resists a compressive force applied along its axis and becomes shorter under load.

Crossover loop
Extension spring end in which the last coil is bent across to the center of the spring and then formed into a loop. Lower stress than a machine loop.

D

Dead coils
End coils of a compression spring that do not deflect under load, such as the closed coils of squared ends.

Deflection (F)
Motion of spring ends or arms under the application or removal of an external load (P).

Direction of coiling (helix)
Right hand or left hand, as with screw threads.

E

Elastic limit
Maximum stress to which a material may be subjected without permanent set.

Endurance limit
Maximum stress at which any given material will operate indefinitely without failure, for a given minimum stress.

Extended hook
Extension spring end in which the hook or loop is set out from the spring body on a straight length of wire to reach an attachment point.

Extension spring
A close-wound helical spring, usually with hooks or loops at each end, that resists a pulling force and becomes longer under load. Often wound with initial tension.

F

Fatigue life (cycle life)
The number of load cycles a spring can withstand before failure at a given stress range. Influenced by material, stress range, surface condition and processes such as shot peening.

Free angle
Angle between the arms of a torsion spring when the spring is not loaded.

Free length (L)
The overall length of a spring in the unloaded position.

G

Gradient
See **Rate**

H

Helix
The spiral form (open or closed) of compression, extension and torsion springs.

Hooks
Open loops or ends of extension springs.

Hydrogen embrittlement
Hydrogen absorbed during electroplating or pickling of carbon and alloy steels, tending to make the spring material brittle and susceptible to cracking and failure, particularly under sustained loads. Baking promptly after plating reduces the risk; see Baking.

Hysteresis
The mechanical energy loss that always occurs under cyclic loading and unloading of a spring, proportional to the area between the loading and unloading load-deflection curves within the elastic range of a spring.

I

Index
See **Spring index**

Initial tension
The force tending to keep the coils of an extension spring closed, which must be overcome before the coils start to open. A design consideration generally specified only as a reference value.

Inside diameter (ID)
Diameter of the cylinder enveloping the inside surface of the coils; outside diameter minus two wire diameters.

L

Legs
The straight ends of a torsion spring that extend from the body and through which the load is applied. Also called arms.

Length inside hooks
Distance between the inside surfaces of the hooks or loops of an extension spring in the free position. The usual way to specify extension spring length.

Load (P)
The force applied to a spring that causes a deflection (F).

Loops
Coil-like wire shapes at the ends of extension springs that provide for attachment and force application.

M

Machine loop
Extension spring end formed by bending the last coil up so the loop lies in the plane of the spring axis. The most common and economical end.

Mandrel (arbor)
The rod over which a spring is coiled, or the shaft a torsion spring is mounted on in service. A torsion spring's body diameter decreases as it winds up, so the mandrel must clear the reduced inside diameter at full deflection.

Mean coil diameter (D)
Outside spring diameter (OD) minus one wire diameter (d); equivalently, inside diameter (ID) plus one wire diameter.

Modulus in shear or torsion (G)
Coefficient of stiffness used for extension and compression springs.

Modulus in tension or bending (E)
Coefficient of stiffness used for torsion and flat springs (Young's modulus).

Moment (M)
See **Torque**

N

Natural frequency (surge)
The lowest frequency at which a spring vibrates freely between its ends. Operating near this frequency causes surge, which raises stresses and can cause early failure; it should be well above the operating frequency.

O

Open ends, ground
"Open ends, not ground" followed by an end grinding operation.

Open ends, not ground
Ends of a compression spring with a constant pitch for each coil.

Outside diameter (OD)
Diameter of the cylinder enveloping the outside surface of the coils.

P

Passivating
Acid treatment of stainless steel to remove contaminants and improve corrosion resistance.

Permanent set
A material that is deflected so far that its elastic properties have been exceeded, and does not return to its original condition upon release of load, is said to have taken permanent set.

Pitch (p)
The distance from center to center of the wire in adjacent active coils. Recommended practice is to specify the number of active coils rather than pitch.

Plating
An electrodeposited metal coating, such as zinc or nickel, applied for corrosion protection or appearance. High-strength spring steels require baking after plating.

Preset
The process of compressing a spring to solid height to remove any permanent deformation due to exceeding the elastic limit of the system. Should be optional unless specifically required.

R

Rate (R)
Change in load per unit deflection, generally given in pounds per inch (or N/mm). For torsion springs, change in torque per degree of rotation.

Relative position
See **Angular relationship of ends**

Remove set
See **Preset**

Residual stress
Stresses induced by set removal, shot peening, cold working, forming or other means. These stresses may or may not be beneficial, depending on the application.

S

Set
Permanent distortion which occurs when a spring is stressed beyond the elastic limit of the material.

Shot peening
Bombarding the spring surface with small steel shot to clean it and induce beneficial compressive residual stresses, thereby increasing fatigue life.

Slenderness ratio
Ratio of spring length (L) to mean coil diameter (D).

Solid height (H)
Length of a compression spring when under sufficient load to bring all coils into contact with adjacent coils.

Solid stress
Stress in a compression spring when compressed to solid height. If it is below the elastic limit, the spring will not take a set when closed solid.

Spring constant
See **Rate**

Spring index (C)
D/d, the ratio of mean coil diameter to wire diameter. The preferred range is about 4 to 12. Springs with an index below 4 are difficult to coil, and those above about 16 tend to tangle and are harder to hold to tolerance.

Squared and ground ends
End finish for compression springs where the pitch of the end coils is reduced so that the end coils touch, and the end is then ground to provide a flat end.

Squared ends
As squared and ground ends, except not ground.

Squareness of ends
Angular deviation between the axis of a compression spring and a normal to the plane of the ends.

Squareness under load
As in squareness of ends, except with the spring under load.

Stress range
The difference between the stresses at the minimum and maximum operating loads; a key factor in fatigue life.

Stress relieve
Low-temperature heat treatment to relieve residual stresses induced during coiling or forming, so that springs are more stable, better able to withstand higher stresses and have longer fatigue life.

T

Torque (M)
A twisting action in torsion springs which tends to produce rotation, equal to the load multiplied by the distance (moment arm) from the load to the axis of the spring body. Usually expressed in inch-ounces, inch-pounds or foot-pounds.

Torsion spring
A helical spring whose legs are rotated about the spring axis, resisting an applied torque. The wire is stressed in bending.

Total number of coils (N)
In compression springs, the sum of the active coils plus the dead coils forming the ends. In extension springs, equal to the active coils, not including the coils or material used to form the ends.

W

Wahl correction factor (K)
Multiplier applied to the basic torsional stress formula to account for direct shear and coil curvature: K = (4C − 1)/(4C − 4) + 0.615/C. It increases as the spring index (C) decreases.

Wire diameter (d)
Diameter of the wire used to make the spring.

A Brief History of the Spring

Simple, non-coiled springs have been used throughout human history, the archer's bow being one of the earliest. Bronze Age craftsmen made spring tweezers, and the Greek inventor Ctesibius of Alexandria is credited with making a springier bronze by raising its tin content and hardening the cast metal by hammering.

Coiled springs appeared in door locks in the early 15th century. Spring-driven clocks followed in the same century and developed into the first large watches by the 16th century.

In 1676 the English scientist Robert Hooke stated the principle now known as Hooke's Law, publishing it as a Latin anagram and revealing its solution in 1678: within its elastic limit, the force a spring exerts is proportional to its deflection. It remains the basis of spring rate calculations today.

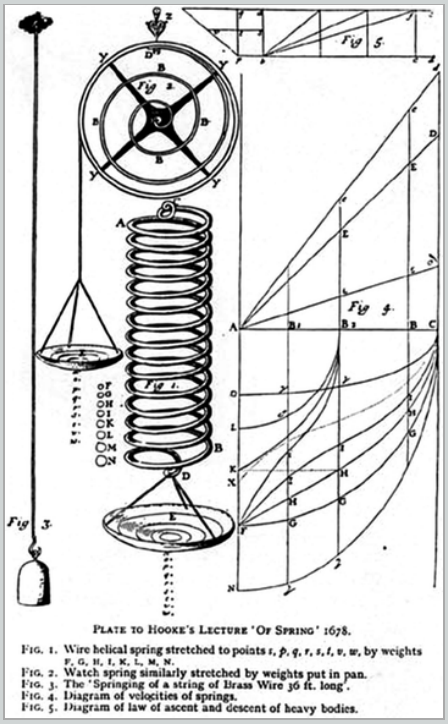

PLATE TO HOOKE'S LECTURE 'OF SPRING' 1678.

FIG. 1. Wire helical spring stretched to points *t, p, q, r, s, l, v, w*, by weights F, G, H, I, K, L, M, N.
FIG. 2. Watch spring similarly stretched by weights put in pan.
FIG. 3. The 'Springing of a string of Brass Wire 36 ft. long'.
FIG. 4. Diagram of velocities of springs.
FIG. 5. Diagram of law of ascent and descent of heavy bodies.

Plate from Robert Hooke's lecture "Of Spring," 1678 (public domain).

Definitions are provided for general reference and reflect common spring industry usage. Symbols follow common practice and may differ between references. The applicable drawing, specification, purchase order and OCS terms and conditions of sale govern all orders. © 2026 Oshkosh Coil Spring. Rev. Oct 2026.