

# Glossary of Spring Terminology

**Active Coils ( $n_a$ )** those coils which are free to deflect under load.

**Angular Relationship of Ends Relative** position of hooks or loops of an extension spring (or ends of a torsion spring) to each other.

**Baking** Heating of electroplated springs to relieve hydrogen embrittlement.

**Block** See Solid Height.

**Buckling** Bowing or lateral displacement of a compression spring. This effect is related to slenderness ratio  $L/D$ .

**Close Wound** Adjacent coils are touching.

**Closed and Ground Ends** Same as Closed Ends, except the first and last coils are ground to provide a flat bearing surface.

**Closed Ends** Compression spring ends with coil pitch angle reduced so they are square with the spring axis and touch the adjacent coils.

**Closed Length** See Solid Height.

**Coils Per Inch** The number of coils in one inch.

**Deflection (F)** Motion imparted to a spring by application or removal of an external load.

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

**Endurance Limit** Maximum stress, at a given stress ratio, at which material will operate in a given environment for a stated number of cycles without failure.

**Fixture Tempering** Restraining parts during tempering to improve dimensional control.

**Free Angle** Angular relationship between arms of a helical torsion spring which is not under load.

**Free Length (L)** Overall length of a spring which is not under load.

**Gradient** See Rate

**Heat Setting A process** to pre-relax a spring in order to improve stress

relaxation resistance in service.

**Helical Springs** Springs made of bar stock or wire coiled into a helical form. This category includes compression, extension and torsion springs.

**Hooks** Open loops or ends of extension springs that are generally longer than a standard loops.

**Hysteresis** Mechanical energy loss occurring during loading and unloading of a spring within the elastic range. It is illustrated by the area between load-deflection curves.

**Initial Tension ( $P_i$ )** The force that tends to keep coils of a closewound extension spring closed and which must be overcome before the coils start to open.

**Loops** Circular formed ends with at the ends of extension springs that provide a means for attachment.

**Mean Diameter ( $M$ )** The average diameter of the mass of spring material, equal to one-half the sum of the outside and inside diameters. In a helical spring, this is the equivalent to the outside diameter minus one wire diameter.

**Modulus in Shear or Torsion ( $G$ )** (Modulus of Rigidity) The coefficient of stiffness used for compression and extension springs.

**Modulus in Tension or Bending ( $E$ )** (Young's Modulus) The coefficient of stiffness used for torsion or flat springs.

**Moment ( $M$ )** A product of the distance from the spring axis to the point of load application, and the force component normal to the distance line.

**Natural Frequency** The lowest inherent rate of free vibration of a spring vibrating between its own ends.

**Passivation** An acid treatment for stainless steel which removes iron deposits and improves corrosion resistance.

**Patenting** The process of heating carbon steel above its critical temperature and cooling at a controlled rate to achieve a fine paralytic microstructure.

**Pitch ( $p$ )** Distance from center to center of wire in adjacent coils in an open-wound spring.

**Plain Ends** End coils of a helical spring having a constant pitch and ends not squared.

**Plain Ends, Ground** Same as Plain Ends, except wire ends are ground square with the axis.

**Preset** See Set Removal

**Rate (R)** The change in load per unit of deflection. Generally expressed as Lbs/in or N/mm

**Residual Stress** Stress mechanically induced by such means as set removal, shot-peening, cold working, or forming. It may be beneficial or not, depending on the spring application.

**Set Permanent** Change of length, height or position after a spring is stressed beyond material's elastic limit.

**Set Point** Stress at which some arbitrarily chosen amount of set (usually 2%) occurs. Set percentage is the set divided by the deflection which produced it.

**Set Removal** An operation which causes a permanent loss of length or height due to spring deflection.

**Shot-Peening** Blasting the surfaces of spring material with steel or glass pellets to induce compressive stresses that improve fatigue life.

**Slenderness Ratio** Ratio of spring length to mean diameter  $L/D$  in helical springs.

**Solid Height (H)** Length of a compression spring when deflected under sufficient load to bring all adjacent coils into contact .no additional deflection is possible.

**Spiral Springs** Springs formed from flat strip or wire wound in the form of a spiral, loaded by torque about an axis normal to the plane of the spiral.

**Spring Index** Ratio of mean diameter to wire diameter.

**Squared and Ground Ends** See Closed and Ground Ends.

**Squared Ends** See Closed Ends.

**Squareness** Angular deviation, between the axis of a compression spring in a free state and a line normal to the end planes.

**Squareness Under Load** same as Squareness but measured while there is a load applied to the spring.

**Stress Range** Difference in operating stresses at minimum and maximum loads.

**Stress Ratio** Minimum stress divided by maximum stress.

**Stress Relief** A low temperature heat treatment given springs to relieve residual stresses produced by prior cold forming.

**Torque (M)** A twisting action in torsion springs which produces rotation. Equal

to the load multiplied by the distance (or moment arm) from the load to the axis of the spring. Generally expressed as in-lbs or N-mm. *also see Moment*

**Total Number of Coils ( $N_t$ )** The sum of the number of active and inactive coils in a spring body.

**Wahl Factor** A factor to correct stress in helical springs effects of curvatures and direct shear.