SPECIFICATIONS & TOLERANCES

All the 19,000 + different types of Stock springs listed in this catalogue have been selected to reflect the most popular sizes ordered. Design and manufacturing tolerances generally follow the guideline requirements of:

BS 1726-1:2002 and BS EN 13906-1:2002 for compression springs
BS 1726-2:2002 and BS EN 13906-2:2002 for extension springs
BS 1726-3:2002 and BS EN 13906-3:2002 for torsion springs

Springs are manufactured from materials to military, aerospace and/or equivalent British or DIN standards.

Material data

Subject to the availability of material, springs may be made from either standard:

Music wire:
ASTM A228, DIN 17223, BS 5216, EN 10270-1 or JIS-G-3522

Stainless steel:
ASTM A313, DIN 17224, BS 2056, EN 10270-3 or JIS-G-4314

Oil tempered MB:
ASTM A229, DIN 17223, BS 2803 or EN 10270-2

Chrome silicon:
ASTM A401, DIN 17223, BS 2803 or EN 10270-2

Stress relief

Standard compression, die, extension and torsion springs as well as Belleville spring washers are stress relieved to remove strains induced during manufacture. Die and heavy duty compression springs are shot peened and prestressed to enhance their performance. Music Wire Springs (excluding die springs) are de-embrittled at no extra cost.

Finishing

Our Lite Pressure™ 316 stainless steel springs are ultrasonically cleaned as well as passivated to offer medical and food grade levels of cleanliness.

Passivation is in accordance with specification
BS EN 2516:1997 or ASTM A967.

Zinc plating is in accordance with specification BS EN 12329:2000 or ASTM B633 Class Fe/Zn 5 Type III (0.0002" thick with clear chromate) and baked for hydrogen embrittlement relief.

Die springs are painted different colours to denote duty:
Medium Load – Grey
Medium Load Plus – Beige
Medium Heavy Load – Purple
Heavy Load – Black
Extra Heavy Load – Orange

Note:
Other special finishes may be supplied on request at additional cost.

All our stock springs are RoHS compliant.

ROHS COMPLIANT

Operational Temperatures

Noticeable deterioration in performance of springs will become apparent if the temperature in which the springs are operating exceed the following maximum temperature recommendations.

MUSIC WIRE 120°C (250°F)
STAINLESS STEEL 260°C (500°F)
OIL TEMPERED MB 120°C (250°F)
CHROME SILICON 245°C (475°F)

Note:
For operation in sub-zero temperatures stainless steel must be used.

Tolerances

Spring manufacturing, as in many other production processes, is not exact. It can be expected to produce variations in such spring characteristics as load, mean coil diameter, free length, and the relationship of ends or hooks. The very nature of spring forms, materials and standard manufacturing processes cause inherent variations. The overall quality level for a given spring design, however, can be expected to be superior with spring manufacturers who specialise in precision, high-quality components. Normal or average tolerances on performance and dimensional characteristics may be expected to be different for each spring design. Manufacturing variations in a particular spring depend largely on variations in spring characteristics, such as index, wire diameter, number of coils, free length, deflection and ratio of deflection to free length.

End Information

Lite Pressure™ and instrument series compression springs have ends closed but not ground.

Standard compression, heavy duty and die springs have ends closed and ground square (tolerance 3°).

Extension springs have full loops, random position.

Direction of Helix

Lee Spring Lite Pressure™, compression, die and extension springs maybe left or right-hand wound at the company's discretion. If direction of wind is critical, please specify at time of ordering.

Continuous length springs are right-hand wound.

GLOSSARY

Active coils (effective coils, working coils). The coils of a spring that at any instant are contributing to the rate of the spring.

Buckling. The unstable lateral distortion of the major axis of a spring when compressed.

Closed end. The end of a helical spring in which the helix angle of the end coil has been progressively reduced until the end coil touches the adjacent coil.

Compression spring. A spring whose dimension, in the direction of the applied force, reduces under the action of that force.

Compression test. A test carried out by pressing a spring to a specified length a specified number of times.

Creep. The change in length of a spring over time when subjected to a constant force.

Deflection. The relative displacement of the ends of a spring under the application of a force.

Elastic deformation. The deformation that takes place when a material is subjected to any stress up to its elastic limit. On removal of the force causing this deformation the material returns to its original size and shape.

Elastic limit (limit of proportionality). The highest stress that can be applied to a material without producing permanent deformation.

End fixation factor. A factor used in the calculation of buckling to take account of the method of locating the end of the spring.

Extension spring. A spring whose length, in the direction of the applied force, increases under the application of that force.

Fatigue. The phenomenon that gives rise to a type of failure which takes place under conditions involving repeated or fluctuating stresses below the elastic limit of the material.

Fatigue limit. The value, which may be statistically determined, of the stress condition below which material may endure an infinite number of stress cycles.

Fatigue strength (endurance limit). A stress condition under which a material will have a life of a given number of cycles.

Fatigue test. A test to determine the number of cycles of stress that will produce failure of a component or test piece.

Finish. A coating applied to protect or decorate springs.

Free length. The length of a spring when it is not loaded.

NOTE. In the case of extension springs this may include the anchor ends.

Grinding. The removal of metal from the end faces of a spring by the use of abrasive wheels to obtain a flat surface which is square with the spring axis.

Helical spring. A spring made by forming material into a helix.

Helix angle. The angle of the helix of a helical coil spring.

Hysteresis. The lagging of the effect behind the cause of the effect. A measure of hysteresis in a spring is represented by the area between the loading and unloading curves produced when the spring is stressed within the elastic range.

Index. The ratio of the mean coil diameter of a spring to the material diameter for circular sections or radial width of cross section for rectangular or trapezoidal sections.

Initial tension. The part of the force exerted, when a close coiled spring is axially extended, that is not attributable to the product of the theoretical rate and the measured deflection.

Inside coil diameter of a spring. The diameter of the cylindrical envelope formed by the inside surface of the coils of a spring.

Loop (eye, hook). The formed anchoring point of a helical spring or wire form. When applied to an extension spring, it is usually called a loop. If closed, it may be termed an eye and if partially open may be termed a hook.

Modulus of elasticity. The ratio of stress to strain within the elastic range.

NOTE. The modulus of elasticity in tension or compression is also known as Young's modulus and that in shear as the modulus of rigidity.

Open end. The end of an open coiled helical spring in which the helix angle of the end coil has not been progressively reduced.

Outside coil diameter. The diameter of the cylindrical envelope formed by the outside surface of the coils of a spring.

Permanent set (set). The permanent deformation of a spring after the application and removal of a force.

Pitch. The distance from any point in the section of any one coil to the corresponding point in the next coil when measured parallel to the axis of the spring.

Prestressing (scragging). A process during which internal stresses are induced into a spring.

NOTE. It is achieved by subjecting the spring to a stress greater than that to which it is subjected under working conditions and higher than the elastic limit of the material. The plastically deformed areas resulting from this stress cause an advantageous redistribution of the stresses within the spring. Prestressing can only be performed in the direction of applied force.

Rate (stiffness). The force that has to be applied in order to produce unit deflection.

Relaxation. Loss of force of a spring with time when deflected to a fixed position.

NOTE. The degree of relaxation is dependent upon, and increases with, the magnitude of stress, temperature and time.

Safe deflection. The maximum deflection that can be applied to a spring without exceeding the elastic limit of the material.

Screw insert. A plug screwed into the ends of a helical extension spring as a means of attaching a spring to another component. The plug has an external thread, the diameter, pitch and form of which match those of the spring.

Shot peening. A cold working process in which shot is impacted on to the surfaces of springs thereby inducing residual stresses in the outside fibres of the material.

NOTE. The effect of this is that the algebraic sum of the residual and applied stresses in the outside fibres of the material is lower than the applied stress, resulting in improved fatigue life of the component.

Solid length. The overall length of a helical spring when each and every coil is in contact with the next.

Solid force. The theoretical force of a spring when compressed to its solid length.

Space (gap). The distance between one coil and the next coil in an open coiled helical spring measured parallel to the axis of the spring.

Spring seat. The part of a mechanism that receives the ends of a spring and which may include a bore or spigot to centralise the spring.

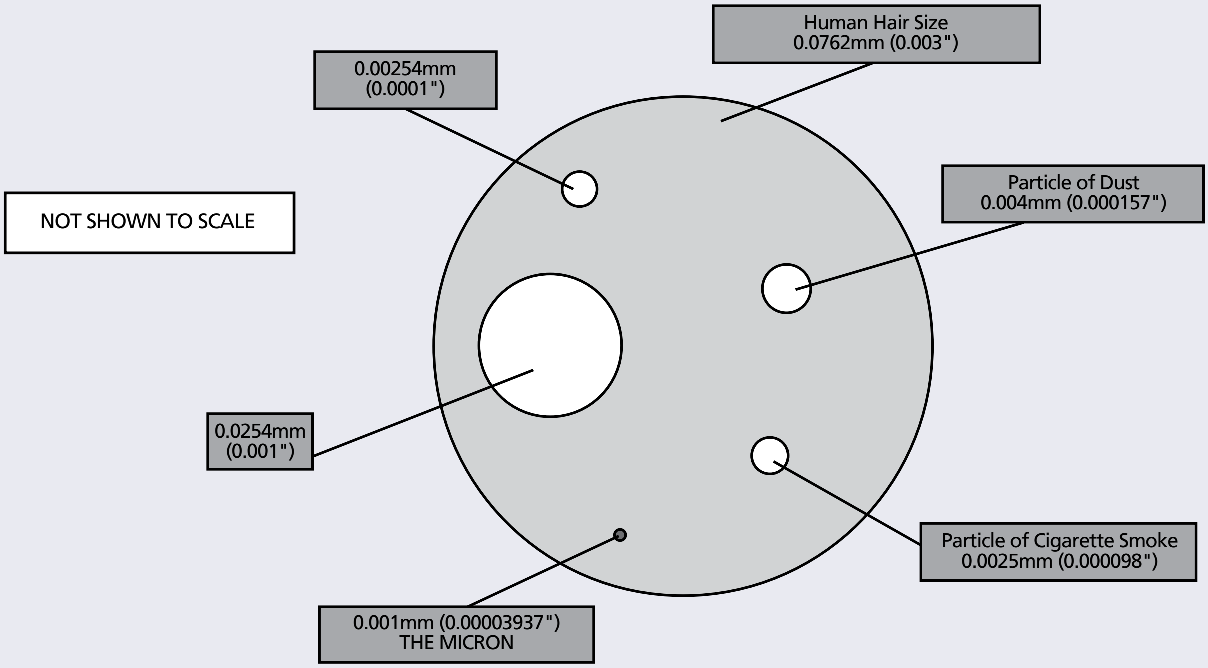
Stress (bonding stress, shear stress). The force divided by the area over which it acts. This is applied to the material of the spring, and for compression and extension springs is in torsion or shear, and for torsion springs is in tension or bending.

Stress correction factor. A factor that is introduced to make allowance for the fact that the distribution of shear stress across the wire diameter is not symmetrical. NOTE. This stress is higher on the inside of the coil than it is on the outside.

Stress relieving. A low temperature heat treatment carried out at temperatures where there is no apparent range in the metallurgical structure of the material. The purpose of the treatment is to relieve stresses induced during manufacturing processes.

Variable pitch spring. A helical spring in which the pitch of the active coils is not constant.

USING MICRONS



GEOMETRIC SOLUTIONS

The Diameter of a Circle equal in area to a given Square - multiply one side of the Square by 1.12838
The Side of a Hexagon inscribed in a Circle - multiply the Circle Diameter by 0.5
The Diameter of a Circle inscribed in a Hexagon - multiply one side of the Hexagon by 1.7321
The Side of an Equilateral Triangle inscribed in a Circle - multiply the Circle Diameter by 0.866
The Diameter of a Circle inscribed in an Equilateral Triangle - multiply one Side of the Triangle by 0.57735
The Area of a Square or Rectangle - multiply the base by the height
The Area of a Triangle - multiply the Base by half the Perpendicular
The Area of a Trapezoid - multiply half the sum of Parallel sides by the Perpendicular
The Area of a Regular Hexagon - multiply the square of one side by 2.598
The Area of a Regular Octagon - multiply the square of one side by 4.828
The Area of a Regular Polygon - multiply half the sum of Sides by the Inside Radius
The Circumference of a Circle - multiply the Diameter by 3.1416
The Diameter of a Circle, multiply the Circumference by 0.31831
The Square Root of the Area of a Circle x 1.12838 = the Diameter
The Circumference of a Circle x 0.159155 = the Radius
The Square Root of the area of a Circle x 0.56419 = the Radius
The Area of a Circle - multiply the Square of the Diameter by 0.7854
The Square of the Circumference of a circle x 0.07958 = the Area
Half the circumference of a Circle x half its diameter = the Area
The Area of the Surface of a Sphere - multiply the Diameter Squared by 3.1416
The Volume of a Sphere - multiply the Diameter Cubed by 0.5236
The Area of an Ellipse - multiply the Long Diameter by the Short Diameter by 0.78540
To find the Side of a Square inscribed in a Circle - multiply the Circle Diameter by 0.7071
To find the Side of a Square Equal in Area to a given Circle - multiply the Diameter by 0.8862

The information given in this catalogue is as complete and accurate as possible at the time of publication. However, Lee Spring reserve the right to modify this data at any time without prior notice should this become necessary.

CONVERSION DATA

Quantity	To convert from	To	Multiply by
Length	Feet (ft)	Metres	.3048
		Millimetres	304.8
	Metres (m)	Feet	3.2808
		Inches	39.3701
	Inches (in)	Metres	0.0254
		Millimetres	25.4
Area	Square Inches (in^2)	Square Millimetres	645.16
	Square Millimetres (mm^2)	Square Inches	0.00155
Volume	Cubic Inches (in^3)	Cubic Millimetres	16387.064
	Cubic Millimetres (mm^3)	Cubic Inches	0.000061024
Force	Pounds Force (lbf)	Newtons	4.4480
		Kilograms Force	0.4536
	Newtons (N)	Pounds Force	0.2249
		Kilograms Force	0.102
	Kilograms Force (kgf)	Newtons	9.807
		Pounds Force	2.2046
Rate	Pounds Force per Inch (lbf/in)	Kilograms Force per Millimetre	0.017858
		Newtons per Millimetre	0.1751
	Newtons per Millimetre (N/mm)	Pounds Force per Inch	5.7099
		Kilograms Force per Millimetre	0.102
	Kilograms Force per Millimetre (kgf/mm)	Newtons per Millimetre	9.807
		Pounds Force per Inch	55.998
Torque	Pound Force-inch (lbf/in)	Kilogram Force-Millimetre	11.52136
		Newton-Metre	0.11302
	Newton-Metre (Nm)	Pound Force-inch	8.84763
		Ounce Force-inch	141.562
		Kilogram Force-Millimetre	101.937
	Kilogram Force-Millimetre (kgf/mm)	Pound Force-inch	0.086796
		Newton-Metre	0.00981
		Ounce Force-inch	1.3887
	Ounce Force-inch (ozf/in)	Pound Force-inch	0.0625
		Newton-Metre	0.007064
		Kilogram Force-Millimetre	0.72
Stress	Pound Force per Square Inch (lbf/in^2)	kgf/mm^2	0.000703
		hbar	0.000689
		N/mm^2	0.006895
		tonf/in^2	0.000446
	Kilogram Force per Square Millimetre (kgf/mm^2)	lbf/in^2	1422.823
		hbar	0.981
		N/mm^2	9.81
		tonf/in^2	0.635
	Hectobars (hbar)	lbf/in^2	1450.38
		N/mm^2	10
		kgf/mm^2	1.019368
		tonf/in^2	0.6475
	Newton per Square Millimetre (N/mm^2)	lbf/in^2	145.038
		kgf/mm^2	0.101937
		hbar	0.1
		tonf/in^2	0.06475
	Ton Force per Square Inch (tonf/in^2)	lbf/in^2	2240.0
		kgf/mm^2	1.5743
		hbar	1.54442
		N/mm^2	15.4442
Pressure	Pound Force per Square Inch	to kPa	6.895

Length	1 cm	= 0.3937 in	1 in	= 25.4 mm	1 m	= 3.2808 ft
	1 ft	= 0.3048 m	1 km	= 0.6214 mile	1 mile	= 1.6093 km
Weight	1 g	= 0.0353 oz	1 oz	= 28.35 g		
	1 kg	= 2.2046 lb	1 lb	= 0.4536 kg		
	1 tonne	= 0.9842 ton	1 ton	= 1.016 tonne		
Area	1 m^2	= 1.196 yard^2	1 in^2	= 645.2 mm^2		
	1 hectare	= 2.471 acre	1 yard^2	= 0.8361 m^2		
	1 acre	= 0.4047 hectare	1 sq mile	= 259 hectare		

MATHEMATICAL SYMBOLS

+	plus or positive	≈	approximately equal to	√	square root
−	minus or negative	~	of the order of or similar to	∞	infinity
±	plus or minus, positive or negative	>	greater than	∝	proportional to
x	multiplied by	<	less than	∑	sum of
÷	divided by	≯	not greater than	Π	product of
=	equal to	≮	not less than	Δ	difference
≡	identically equal to	≥	greater than or equal to	∴	therefore
≠	not equal to	≤	less than or equal to	∠	angle
≢	not identically equal to	≫	much greater than	ll	parallel to
		≪	much less than	⊥	perpendicular to
				:	is to