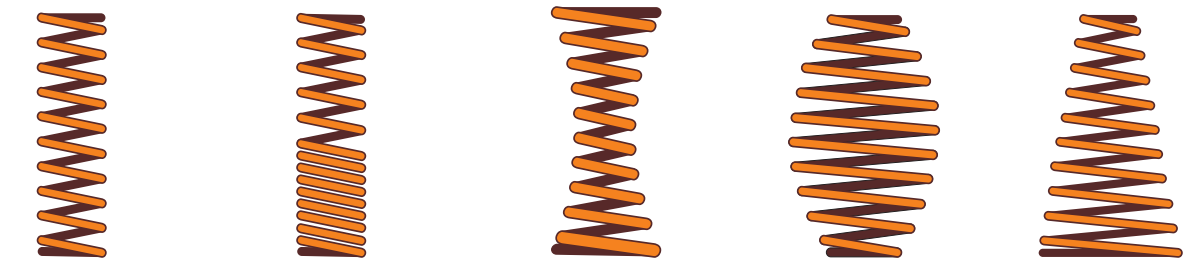
COMPRESSION SPRING

WIRECOM™ (INDIA) PRIVATE LIMITED
Where... Quality Springs to Life!

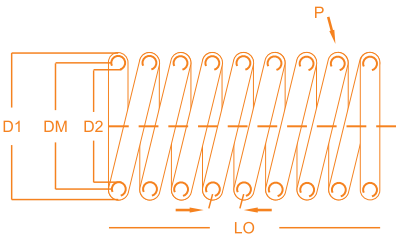
Compression Springs are designed to operate with a compressive load in "Push Mode". Compression Spring also has variable pitch between coils which are used to reduce solid height, buckling and surging to produce nonlinear load deflection characteristics. Compression springs offer resistance to linear compressing forces and are in fact one of the most efficient energy storage devices available.

Common Forms



STRAIGHT SPRING | VARIABLE PITCH SPRING | HOURGLASS SPRING | BARREL SPRING | CONICAL SPRING

How to Design a Compression Spring



- The index tells how tight a spring's coils are and it can directly affect the strength of such. A spring with very tight coils tends to have a stronger spring rate. That is why the lower the index, the more strength/ stress the spring. Therefore, the higher the index the weaker the spring.
  - The spring index is the relationship between the mean diameter and wire diameter. Springs with small indexes increase tooling wear and are more likely to require additional processing steps to ensure adequate life. Large index springs often require additional tolerance on both diameter and length.
  - **Spring index, I = Spring mean diameter (D) / Wire diameter (d)**
    - A spring cannot be manufactured when the spring index is below 4.
    - If spring index ranges from 4.1 to 5.9 your spring may be manufactured, but at a higher cost due to the complications it implies.
    - If spring index ranges from 6 to 12, your spring has an ideal index and can be manufactured.
    - If spring index ranges from 12.1 to 15, your spring has a higher index and a difficulty grade that makes it a bit harder to manufacture, but it's not excessively complicated.
    - If spring index ranges from 15.1 to 25 it may still be manufactured but at a higher cost.
    - A spring index above 25 is very complicated and cannot be manufactured.
- Does spring need to fit over a shaft, thus the inner diameter is a fixed measurement. Does spring need to go in a hole, thus the outer diameter is a fixed measurement. Does spring need to fit into a space that is a certain depth or width, thus the spring would have a maximum free length.
- The permissible shear stress for the spring wire should be half of the ultimate tensile strength.

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DESIGN FORMULAE	
Parameter	**Formula**
Spring outer diameter [OD]	OD = D + d
Spring inner diameter [ID]	ID = D - d
Spring index [C]	C = D/d
Wahl factor [K_w]	KW=(4C−1/4C−4)+(0.615/C)
Shear stress at spring body (corrected with Wahl factor)- used for unpre-stressed springs [τ_s]	τ=KW8FDπd3
Shear stress at spring body (uncorrected)- used for pre-stressed springs [T_s]	τ=2C+12C×8FDπd3
Spring rate [k]	k=d^4G/8D^3Na
OD at solid height [$OD_{at\ solid}$]	OD at solid=$\sqrt{D2+p2-d2\ \pi\ 2+d}$
Spring stability condition	Lf < π D α [2(E-G)2G+E]1/2
Hooke's Law	Δ F=k Δ x

List of Parameters

OD - Spring Outer Diameter
ID - Spring Inner Diameter
D - Spring Mean Diameter
d - Wire Diameter
p - Pitch

Lf - Spring Free Length
Ls - Spring Solid Height
F - Axial Force
Fs - Force at Solid Length
ΔF - Force difference (Ex: F2-F1)

Δx - Deflection (Ex: L2-L1)
Nt - Total Coils
Na - Active Coils
G - Shear modulus of material

Type of Spring Ends				
Parameter	**Open or Plain (Not Ground)**	**Open or Plain (Ground)**	**Squared or Closed (Not Ground)**	**Squared or Closed (Ground)**
Total Coils [N_t]	N_a	N_a+1	N_a+2	N_a+2
Free Height [L_f]	pN_a+d	p(N_a+1)	pN_a+3d	pN_a+2d
Solid Height [L_s]	d(N_t+1)	dN_t	d(N_t+1)	dN_t
Pitch [p]	(L_f - d) / N_a	L_f / (N_a+1)	(L_f -3d) / N_a	(L_f -2d) / N_a

Key Parameters

- The squareness influences how the axis force produced by the spring can be transferred to adjacent parts.
  - Squareness, e1 = Maximum 5% of the free length
- Parallelism relates to the ends of the spring and how parallel they are to one another.
  - Parallelism, e2 = Maximum 3% of the Outer diameter

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WIRE – RANGE : 0.15 MM - 12 MM

Material

- Spring steel is considered a general use steel because of its ability to be durable, yet flexible with a high degree of strength. It has the unique ability to be formed, shaped, and post heat treated, which makes it one of the premium choices for manufacturing springs for automotive, auto electrical and electrical applications.
- Stainless steel is good for corrosion resistant and Inconel is best for springs being used at very high temperatures.
- When it comes to springs that are required to be non-magnetic, Stainless Steel 316 can be used. This material type isn't 100% non-magnetic though. Stainless steel 316 is only 90% non-magnetic.

Shear Modulus of Material (G)		
Material	**G Value N/mm^2 [Kgf/mm^2]**	**Material Grade**
Spring Steel	78 X 10^3 [8 X 10^3]	SUP 6, 7, 9, 9A, 10, 11A, 12, 13
Hard Steel Wire	78 X 10^3 [8 X 10^3]	SW-B, SW-C
Piano Wire	78 X 10^3 [8 X 10^3]	SWP
Oil Tempered Steel Wire	78 X 10^3 [8 X 10^3]	SWO, SWO-V, SWOC-V, SWOSC-V, SWOSM, AWOSC-B
Stainless Steel Wire	69 X 10^3 [7 X 10^3]	SUS 302
Stainless Steel Wire	69 X 10^3 [7 X 10^3]	SUS 304
Stainless Steel Wire	69 X 10^3 [7 X 10^3]	SUS 304 N1
Stainless Steel Wire	69 X 10^3 [7 X 10^3]	SUS 316
Stainless Steel Wire	74 X 10^3 [7.5 X 10^3]	SUS 631 J1

Finish

Compression Springs are available in Nickel, Yellow and White Zinc Plating, Black Oxidizing, Lacquering, Green Passivation and Trivalent Passivation. Stainless Steel Springs are available with Bright Finish.

Manufacturing Process

Compression Springs are manufactured on imported CNC Spring Coiling Machines with SPC on line with free length sorting device for critical load value.

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Testing & Certification Process

Each spring manufactured goes through a series of rigorous tests conducted on in house testing facilities such as Computerized Load Testing, UTS Testing, Torsion testing, Profile Projector amongst others. All springs are supplied with ROHS raw material compliant report. We also provide PPAP documents for automobiles and electrical industries as per requirement. Springs are also tested for its lifecycles on special fatigue testing for specific requirements.

Common Applications

Automobile Components, Umbrella, Ball Pens, Switches, Switchgears, MCB, RCCB, ELCB, Photocopy & Printing Machine, Door & Luggage Locks, Gas Regulators, Lighters, Aerosol Valves & Pumps, Short & Long Core Auto Tube Valves ,washing machines & refrigerator ,Textile machines,and many more.

Reference Standards

- **IS4454(Part 1) :2001 –** Cold Drawn unalloyed Steel Wire - wire grades SL, SM, SH, DM & DH
- **IS4454 (Part 2) : 2001 –** Oil Hardened and Tempered Steel Wire
- **IS4454 (Part 2) : 2001 –** Stainless Steel Wire
- **IS7608 : 1987 –** Phosphor Bronze Wires

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