Mechanical Alloys

When selecting wire for mechanical applications there are four classifications from which to choose a specific material or alloy. They are: nickel base lockwires, carbon steels, stainless steels and superalloys. A three-part evaluation procedure is recommended: 1) initial screening based on temperature and corrosion requirements; 2) analysis of physical properties; and 3) final screening on the basis of specific properties, material, and forming costs.

MATERIAL	COMPOSITION (%)									NOM. TENSILE STRENGTH (PSI) (SIZE RANGE: .002-.032)		MATERIAL CHARACTERISTICS
	C (MAX.)	Mn (MAX.)	Si (MAX.)	P (MAX.)	S (MAX.)	Cr	Ni	Fe	OTHERS	ANNEALED	FULL HARD (SPRING)	
#302 Stainless Steel	.15	2	1	.045	.03	17 - 19	8 - 10	Bal.	—	105,000 to 145,000	300,000 to 360,000	Most widely used stainless steel spring material due to its excellent combination of physical properties and corrosion resistance.
#304 Stainless Steel	.08	2	1	.045	.03	18 - 20	8 - 12	Bal.	—	105,000 to 145,000	300,000 to 360,000	Similar to Type 302 except for a slightly lower carbon and higher nickel content, which results in a more ductile, lower tensile alloy in the annealed condition. The major use of this alloy is in annealed and 1/4 hard wire products such as cold heading wire, weaving, or screen wire, and lockwire.
#316 Stainless Steel	.08	2	1	.045	.03	16 - 18	10 - 14	Bal.	Mo 2 - 3	95,000 to 130,000	245,000 to 275,000	Molydenum gives this material high creep strength at elevated temperatures and excellent corrosion resistance. (Generally better than Types 302, 304 and 321.) Especially resistant to pit-type corrosion.
#321 Stainless Steel	.08	2	1	.045	.03	17 - 19	9 - 12	Bal.	Ti 5 x C Min.	110,000 to 150,000	225,000 to 275,000	Good where welding is used in fabrication or where heat is encountered as a service condition. Stabilized with titanium to prevent sensitization. (Carbide precipitation and intergranular corrosion.)
17-7 PH	.09	1	1	.04	.03	16 - 18	6.5 - 7.75	Bal.	Al .75 - 1.5	—	260,000 to 295,000	Corrosion resistance comparable to Type 302 with physical properties comparable to music wire. Particularly useful where a compact, corrosion resistant spring is required. Considerably better than Type 302 for springs operating up to 600°F.
Inconel* 600	.15	1	.5	—	.015	14 -17	72 min.	6 - 10	Cu .5 max.	90,000 to 130,000	180,000 to 230,000	Resists corrosion and oxidation to 2150°F. Provides springs with high resistance to corrosion and heat up to 750°F. Tough and ductile down to -310°F; is nonmagnetic, easily fabricated and welded. Used for structural parts, cathode ray tube spiders, thyratron grids, sheathing, tube supports, spark plug electrodes.
Inconel* X-750	.08	1.2	.5	—	.01	14 -17	70 min.	5 - 9	Cu .5 max. Al .4 - 1 Ti 2.25 - 2.75 Cb .7 - 1.2	130,000 to 160,000	220,000 to 250,000	Age hardenable, nonmagnetic, corrosion and oxidation resistant; high creep-rupture strength to 1300°F. Heavy cold working develops tensile strength of 290,000 psi. Stays tough and ductile to -423°F. Resists chloride-ion stress-corrosion cracking. For springs operating to 1200°F and tube structural parts.
Monel* 400	.3	2	.5	—	.024	—	63 - 70	2.5 max.	Cu Bal.	70,000 to 95,000	145,000 to 180,000	This material is noted for its toughness over a considerable range of temperatures, and has excellent resistance to many corrosive environments. Monel 400 can be hardened only by cold-working. It is useful at temperatures up to 1050°F, and has very good mechanical properties at temperatures below zero. Melting point is 2370-2460°F.
Music Spring	1	.6	.3	.025	.03	—	—	Bal.	—	—	330,000 to 480,000	Music spring wire is high carbon steel of uniform chemical analysis. This wire is drawn within rigid tensile, smoothness, and roundness requirements and although very high in tensile strength, must be capable of wrapping around itself without showing signs of cracking or unevenness.

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