

GENERAL CHARACTERISTICS OF THE MATERIALS USED

Selecting the proper material for designing and manufacturing springs washers requires metallurgical expertise and application understanding.

Our engineering department will suggest common or specific alloys having:

- The best ratio tensile strength/elasticity modulus
 - The best ratio stored energy/volume and weight
- Additional materials are available and the below table is not exhaustive.

Type	Chemical	Description	Standard	Werkstoff Nr. (DIN)	Modulus of elasticity (at 20°C) Mpa	Tensile Strength (at 20°C) Mpa	Operating Temperature (°C)	Application	Borrelly designation	
Stainless Steels	Austenitic	X10 Cr Ni 18-8	Stainless Steel 301-302	NFEN 10-088	1.4310	180 000	1 500	-180 à +300	Wave washer, Belleville disc spring, diaphragm spring, Ondufil™ wave spring, spring ring, spiral retaining ring. Material is specified for corrosion resistance.	I10
		X5 Cr Ni 18-10	Stainless Steel 304	NFEN 10-088	1.4301	190 000	1 200	-180 à +300	Ondufil™ wave spring with low elasticity and good corrosion resistance. It also can be used for spiral retaining ring.	I01
		X10 Cr Ni 18-8	11R51 (301HS)	NFEN 10-088	(1.4310)	183 000	1 800	-180 à +300	High fatigue resistance wave washer.	I51
		X2CrNiMo17-12-2	Stainless Steel 316L	NFEN 10-088	1.4404	200 000	1 100	-180 à +300	Spiral retaining ring in contact with sea water.	I04
	Austenitic titanium stabilized	X6 Cr Ni MoTi 17-12-2	Stainless Steel 316Ti	NFEN 10-088	1.4571	190 000	1 300	+300	Highly corrosive environment. Mostly used for Ondufil™ wave spring and spiral retaining ring.	I71
	Structurally hardened	X7 Cr Ni Al 17-7	17-7 - Ph (631)	NFEN 10-088	1.4568	200 000	Mini 1 600 (cond C)	+350	Material is required for corrosion resistance, fatigue and stress resistance. Operating temperature up to 350°C. Mostly used for wave washer, Ondufil™ wave spring and spiral retaining ring.	I68
		X5 Cr Ni Cu Nb 16-4	17-4 - Ph (630)	NFEN 10-088	1.4542	200 000	1 200	-200 à +316	Large dimensions Belleville disc spring in corrosive environment.	I42
Super Alloys	Ni Cr15 Fe7 Ti Al	INCONEL X 750	NFEN 10-302	2.4669	214 000	1 100	-200 à +750	Wave washer, Belleville disc spring, diaphragm spring, Ondufil™ wave spring, spring ring, spiral retaining ring. Material is specified for operating temperature up to 750°C	IN9	
	Ni Cr19 Fe19 Nb5 Mo3	INCONEL 718	NFEN 10-302	2.4668	203 000	1 300	-250 à +700	Wave washer, Belleville disc spring, diaphragm spring, Ondufil™ wave spring, spring ring, spiral retaining ring. Material is specified for operating temperature up to 700°C	IN8	
	Ni Cr20 Ti Al	NIMONIC 90	NFEN 10-302	2.4969	216 000	1 100	-200 à +600	Belleville disc spring for hot-weld nut and bolt, gas turbine and some aerospace applications.	N90	
	X6NiCrTiMoVa25.15	A 286	NFA 47-301	1.4980	201 000	1 000	-200 à + 700	High temperature Ondufil™ wave spring.	A86	
Others	Non ferrous	Cube 2	Beryllium Copper	NFL 14-721	2.1247	130 000	1 300	-250 à +250	Wave washer, Belleville disc spring, diaphragm spring, Ondufil™ wave spring, spring ring, spiral retaining ring. Material is specified for cryogenic temperature.	UB
	Austenitic – Ferritic steels	X2CrNiMoN22.5.3	Super Duplex SAF 2205	NFEN 10-088	1.4462	190 000	1 450	-200 à +300	Ondufil™ wave spring and spiral retaining ring. High corrosion and fatigue resistance.	SY
		X2CrNiMoN25-7-4	Super Duplex SAF 2507	NFEN 10-088	1.4410	190 000	1 550	-200 à +300	Ondufil™ wave spring and spiral retaining ring. High corrosion and fatigue resistance.	SX
	Refractory	NiMo16Cr15W	Hastelloy C 276	NFEN 10-088	2.4819	208 000	310	450	Nickel - Molybdenum - Chromium with Tungsten alloy having high corrosion resistance in severe environment.	C76
		NiCu30Fe	Monel 400	NFEN 10-088	2.4360	182 000	240	-10 à 480	Excellent corrosion resistance under stress in sea water and chemical environments wave washer.	M40
X1CrNiMoCu25.20.5		Uranus B6	NFEN 10-088	1.4539	200 000	300	-60 à +400	Wave washer, Ondufil™ wave spring, spiral retaining ring. Very good resistance to intergranular stress corrosion.	UB6	
Titanium	Ti-6Al-4V	Titanium TA6V	NFEN 10-088	3.7165	105 000	1 100	+300	Aerospace and medical Belleville disc spring and diaphragm spring.	TI	
Carbon spring Steel	C75S / CK75	Carbon Steel	NFEN 10132-4	1.1248	210 000	1 400	-30 à +150	Wave washer, Belleville disc spring, diaphragm spring, Ondufil™ wave spring, spring ring, spiral retaining ring. Watertight and greased environments.	XT /XR /XD	
	51CrV4	Chromium-Molybdenum Steel	NFEN 10132-4	1.8159	206 000	1 400	-20 à +150	We will choose this steel if high carbon tempered spring steel is not specified because of fatigue resistance / specific heat treatment requirements.	CV	
	45Si Cr Mo 6	Low alloyed Steel	NFEN 10-089	1.8062	210 000	1 500	-20 à +200	Large thickness Belleville disc spring with high internal stress level.	SC	

Additional materials: Alloy 800- Alloy 800 HT – Titanium T40 – INCONEL 600 – INCONEL 625 – Phynox – Durimphy and Composite.