12R10, T302 Datasheet
Spring Wire

Zapp is certified according to ISO 9001

12R10 and T302 are austenitic stainless steels characterized by moderate tensile strength,
high corrosion resistance and moderate fatigue and relaxation resistance. Service temperature: -200 to 250°C
(-330 to 480°F).

Standards

- ASTM: 302
- ISO: X9CrNi18-8 Grade 1NS
- EN Number: 1.4310NS
- EN Name: X10CrNi18-8NS
- Alloy Number: 1.4310
- JIS: SUS 302/304-WPB

Product standards

EN	10270-3
Standards not fully fulfilled	
ISO	6931-1
ASTM	A 313/A 313M
JIS	G 4314

Chemical composition (nominal) %

Steel grade	C	Si	Mn	P	S	Cr	Ni
12R10	0.08	0.5	1.2	≤ 0.040	≤ 0.010	18.0	8.2
T302	0.07	0.5	1.3	≤ 0.035	≤ 0.015	18.5	8.0

Forms of supply

Surface finish	Size range, mm
Coated	0.20 - 10.00
Nicoat A (nickel coating)	0.22 - 2.50
Bright	0.15 - 0.80
Nicoat B (nickel coating + bright)	0.18 - 0.80
Mechanically polished	0.40 - 6.00
Flat wire	
Width	0.50 - 7.00
Thickness	0.05 - 4.00
Wall thickness	< 25

Delivery forms

Standard delivery forms are:

- Coils with weight up to 150 kgs
- Spools of various types with wire weight up to 1,000 kgs
- Compact coils with weight up to 1,200 kgs
- Straightened lengths up to 4 m

Mechanical properties

Mechanical properties in the 'as delivered' condition
Tensile strength and proof strength, MPa (ksi)

Wire diameter		Nominal, Rm[1]		Nominal $Rp_{0.2}$	
mm	in.	MPa	ksi	MPa	ksi
0.15 – 0.20	0.0059 - 0.0079	2,365	343	1,890	274
> 0.20 – 0.30	> 0.0079 - 0.012	2,310	335	1,850	268
> 0.30 – 0.40	> 0.012 - 0.016	2,260	328	1,810	262
> 0.40 – 0.50	> 0.016 - 0.020	2,200	319	1,760	255
> 0.50 – 0.65	> 0.020 - 0.026	2,150	312	1,720	249
> 0.65 – 0.80	> 0.026 - 0.031	2,095	304	1,680	244
> 0.80 – 1.00	> 0.031 - 0.039	2,045	297	1,635	237
> 1.00 – 1.25	> 0.039 - 0.049	1,990	289	1,590	231
> 1.25 – 1.50	> 0.049 - 0.059	1,935	281	1,550	225
> 1.50 – 1.75	> 0.059 - 0.069	1,880	273	1,505	218
> 1.75 – 2.00	> 0.069 - 0.079	1,830	265	1,465	212
> 2.00 – 2.50	> 0.079 - 0.098	1,775	257	1,420	206
> 2.50 – 3.00	> 0.098 - 0.118	1,720	249	1,375	199
> 3.00 – 3.50	> 0.118 - 0.138	1,665	241	1,330	193
> 3.50 – 4.25	> 0.138 - 0.167	1,615	234	1,290	187
> 4.25 – 5.00	> 0.167 - 0.197	1,560	232	1,250	181
> 5.00 – 6.00	> 0.197 - 0.236	1,505	218	1,205	175
> 6.00 – 7.00	> 0.236 - 0.276	1,450	210	1,160	168
> 7.00 – 8.50	> 0.276 - 0.335	1,400	203	1,120	162
> 8.50 – 10.00	> 0.335 – 0.394	1,345	195	1,075	156
Flat wire		800 – 2,200	116 - 319	0.85*R_m	0.85 * ksi
Other strength levels		On request			

[1] Tolerance on tensile strength ± 7.0 % in accordance with EN 10270-3 (ISO 6931-1).

Tensile strength can be increased by 150 - 250 MPa (22 - 36 ksi) by tempering. Click on heat treatment for further information. The tensile strength variation between spools/coils within the same production lot is ±50 MPa (7 ksi) maximum. Proof strength in the tempered condition is approx. 85 % of the tempered tensile strength. Tensile strength values are guaranteed and are measured directly after production. During storage, the strength will increase slightly due to ageing. Depending on the storage conditions, ageing can increase the strength by 0 - 50 MPa (0 - 7 ksi).

Shear modulus, MPa (ksi)

As delivered: approx. 71,000 (10,295)
Tempered: approx. 73,000 (10,585)

Straightened lengths

After straightening, the strength is approx. 7 % lower.

Modulus of elasticity, MPa (ksi)

As delivered: approx. 185,000 (26,825)
Tempered: approx. 190,000 (27,550)
The strength will decrease by 3 – 4 % per 100 °C (184 °F) increase in service temperature.

Physical properties

Density: 7.9 g/cm^3, 0.29 lb/in^3

Specific heat capacity

500 J/kg °C	in the temperature range 50 – 100 °C
0.12 Btu/lb °F	in the temperature range 120 – 210 °F

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	15	68	9
100	16	210	9
200	18	390	10.5
300	19	570	11.5

Resistivity

Temperature, °C	μΩm	Temperature, °F	μΩin.
20	0.80	68	**31**
100	0.85	200	33
200	0.90	400	36
300	0.95	600	38

Thermal expansion[1]

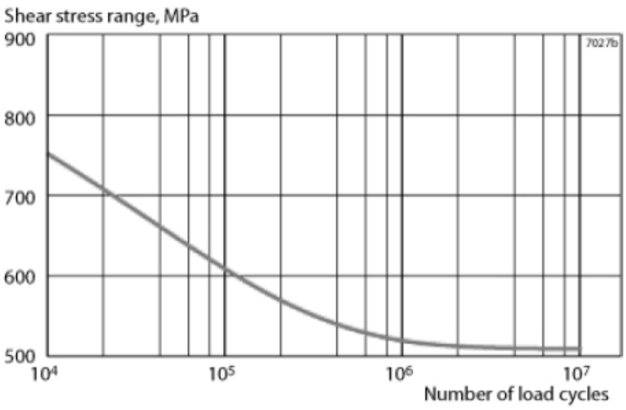
Temperature, °C	per °C	Temperature, °F	per °F
20 – 100	17.0	68 – 210	9.5
20 – 200	17.5	68 – 390	9.5
20 - 300	18.5	68 - 570	10.0

[1] Mean values in temperature ranges (x10^{6})

Permeability, μmax: about 10

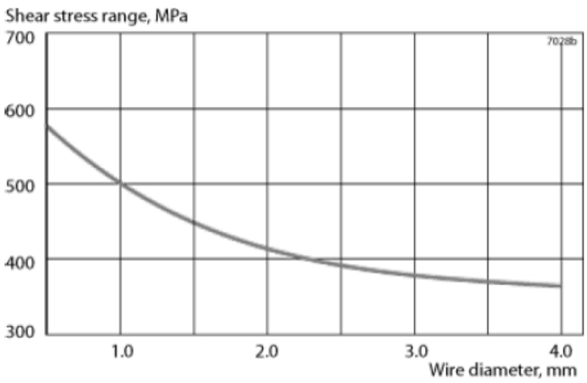
Fatigue strength – tempered and pre-stressed cylindrical helical springs

Wöhler diagram, mean stress 450 MPa



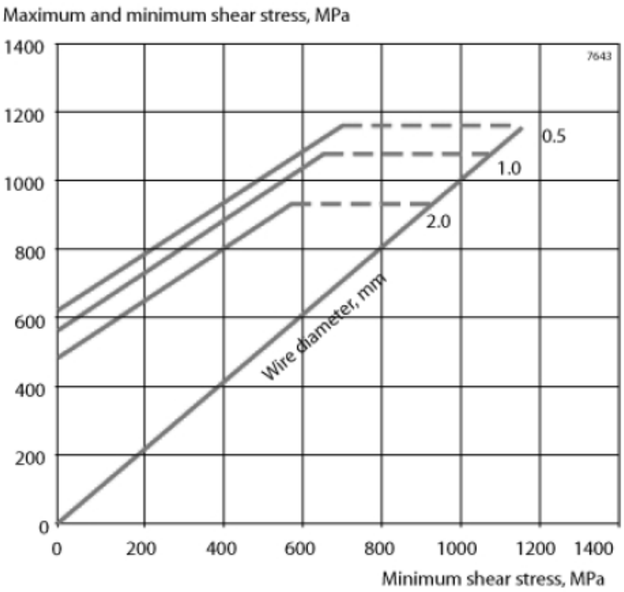
The curve is valid for springs coiled from wire 1 mm in diameter and represents a 90% security against failure.
Shear stress range = double the stress amplitude.
To reach 99.9% certainty against failure the curve must be lowered to about 80 % of present values.

Stress range for different wire diameters, mean stress 450 MPa



Shear stress range at 10 load cycles as a function of the wire diameter.

Modified Goodman diagramme for different wire diameters



Heat treatment

By tempering springs at 350 °C (660 °F)/0.5 - 3 h, the tensile strength will increase by about 100 - 250 MPa (15 - 35 ksi). If a shorter tempering time is used the tempering effect will be lower. In continuous conveyor furnaces,where the holding time at temperature is very short (min. 3 minutes), the temperature can be increased to about 425 °C (780 °F).
In the 'as delivered' condition, the ratio proof strength/ tensile strength is about 0.80. After tempering the ratio will be about 0.85.
Please note that tension springs coiled with initial tension must not be tempered at the same high temperature as other types of spring. We recommend batch annealing at 200 °C (390 °F)/0.5 - 3 h, or continuous tempering in a conveyor furnace with a holding time of 3 - 20 minutes at about 250 °C (480 °F).

At elevated temperatures the fatigue strength decreases at:

100 °C (210 °F)	by about 5 %
200 °C (390 °F)	by about 10 %

Bending

The minimum bending radius should not be less than half the wire diameter. Wire surfaces should be free from any damage caused by tooling, since slight imperfections in the surface can lead to fracture even at large bending radii.

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