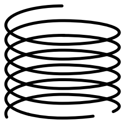
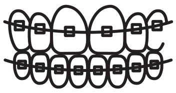
11R51 / 11R51HV Data Sheet
Medical Wire

Zapp is certified according to ISO 9001


11R51 and 11R51HV

11R51 and 11R51HV (vacuum remelted) are austenitic stainless steels alloyed with molybdenum that are characterized by high tensile strength and high resistance to corrosion, fatigue and relaxation.

Vacuum-remelted 11R51HV offers higher cleanliness compared to 11R51, which is usually required for medical applications.

Compared with the standard grade 12R10 medical wire, 11R51 and 11R51HV offer:

- Higher tensile strength and tempering effect
- Higher relaxation resistance, especially at elevated temperatures
- Higher fatigue strength
- Better corrosion resistance, through the addition of molybdenum

Service temperature: -200 to 300 °C (-330 to 570 °F)

Standards

- UNS: S30151
- ISO: X9 CrNi 18-8
- EN Number: 1.4310
- EN Name: X10CrNi18-8

Product Standards	
EN	10270-3
ISO	6931-1
ASTM	F 899, A 313/A 313M

Applications

11R51 medical wire is used in applications such as

- root canal files
- reamers
- broaches
- surgical suture needles
- braces, and
- acupuncture needles.

Chemical Composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo
0.08	1.5	1.8	≤ 0.025	≤ 0.010	17.0	7.5	0.7

Forms of Supply

The wire can be supplied in the following surface finishes:

- Coated
- Bright drawn
- Nicoat A (nickel coating + dry drawn)
- Nicoat P (nickel coating + bright drawn)
- Mechanically polished

Depending upon dimension, surface finish and customer requirements the material can be delivered on spools, in coils or as straightened lengths.

Mechanical Properties

11R51 can be delivered with mechanical properties according to EN 10 270-3, see table below. Other mechanical properties can be offered upon request.

Wire diamenter		Nominal			
		R_m[1]		$R_{p0.2}$	
mm	in.	MPa	ksi	MPa	ksi
0.15 – 0.20	0.0059 - 0.0079	2,530	367	2,150	312
> 0.20 – 0.30	> 0.0079 - 0.012	2,470	358	2,100	305
> 0.30 – 0.40	> 0.012 - 0.016	2,420	351	2,060	299
> 0.40 – 0.50	> 0.016 - 0.020	2,365	343	2,010	292
> 0.50 – 0.65	> 0.020 - 0.026	2,310	335	1,960	284
> 0.65 – 0.80	> 0.026 - 0.031	2,260	328	1,920	278
> 0.80 – 1.00	> 0.031 - 0.039	2,200	319	1,870	271
> 1.00 – 1.25	> 0.039 - 0.049	2,150	312	1,830	265
> 1.25 – 1.50	> 0.049 - 0.059	2,100	305	1,785	259
> 1.50 – 1.75	> 0.059 - 0.069	2,040	296	1,730	251
> 1.75 – 2.00	> 0.069 - 0.079	1,990	289	1,690	245
> 2.00 – 2.50	> 0.079 - 0.098	1,880	273	1,600	232
> 2.50 – 3.00	> 0.098 - 0.118	1,830	265	1,555	225
> 3.00 – 3.50	> 0.118 - 0.138	1,775	257	1,510	219
> 3.50 – 4.25	> 0.138 - 0.167	1,720	249	1,460	212
> 4.25 – 5.00	> 0.167 - 0.197	1,670	242	1,420	206
> 5.00 – 6.00	> 0.197 - 0.236	1,610	233	1,370	199
> 6.00 – 7.00	> 0.236 - 0.276	1,560	226	1,330	193
> 7.00 – 8.50	> 0.276 - 0.335	1,505	218	1,280	186

Other strength levels

[1] tolerance on tensile strength + / - 7.0 % in accordance with EN 10 270-3 grade 1.4310HS

The tensile strength can be increased by 150 - 300 MPa (22 - 44 ksi) by tempering. Please 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.

The proof strength in the tempered condition is approx. 90 % of the tempered tensile strength.

The tensile strength values are guaranteed and are measured directly after production. During storage, the strength will increase marginally due to ageing. Depending on the storage conditions, ageing can increase the strength by 0 - 80 MPa (0 - 12 ksi). S-2140

Straightened Lengths

After straightening the strength is approx. 7% lower.

Physical Properties

The physical properties of a steel are related to a number of factors, including alloying elements, heat treatment and manufacturing route, but the following data can be used for rough calculations.

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	0.90	70	35.0
100	0.95	210	37.0
200	1.00	390	39.0
300	1.05	570	41.5

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})

Magnetic Permeability

- µmax: about 35

Shear Modulus, MPa (ksi)

- as delivered: approx. 71,000 (10 295)
- tempered: approx. 73,000 (10 585)

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 (180 °F) increase in service temperature.

Corrosion Resistance

It is very important to avoid corrosion in spring applications so as not to impair spring properties.

11R51/11R51HV are austenitic stainless steels and have sufficient corrosion resistance in most spring applications.

The corrosion resistance of the material is slightly higher compared to 12R10 and standard ASTM 301, due to the addition of molybdenum.

Heat Treatment

By tempering at 425 °C (780 °F)/0.5 - 4 h, the tensile strength will increase by about 150 - 300 MPa (20 - 45 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 475°C (780 °F).
- In the ‘as delivered’ condition the ratio of proof strength/tensile strength is about 0.85. After tempering the ratio will be about 0.90.

Please note that tension springs coiled with initial tension must not be tempered at the same high temperatures other types of spring.

We recommend batch tempering at 250 °C (480 °F)/ 0.5–3 h, or continuous tempering in a conveyor furnace with a holding time of 3 - 5 minutes at about 300 °C (570 °F).

Bending

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

Zapp Precision Metals (Sweden) AB
PRECISION WIRE
Järnverksleden 18
811 34 Sandviken
Sweden
Phone +46 26 265467
precisionmetals-sweden@zapp.com
www.zapp.com

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