SANDVIK 11R51
STRIP STEEL

DATASHEET

Sandvik 11R51 is an austenitic stainless steel with excellent spring properties that in most cases fulfill demands regarding corrosion resistance, mechanical strength, fatigue and relaxation properties. Compared with the standard grade Sandvik 12R11, Sandvik 11R51 offers:

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

Service temperature: up to 300°C (570°F)

STANDARDS

- EN Number: 1.4310
- EN Name: X 10 CrNi 18-8
- SS: 2331

CHEMICAL COMPOSITION (NOMINAL)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo
0.10	1.2	1.2	≤0.035	≤0.010	16.5	6.5	0.7

APPLICATIONS

Sandvik 11R51 is suitable for springs and other high strength components in the mechanical, electronics and computer industries. It is a very good spring material that in most cases fulfils demands regarding corrosion resistance, mechanical strength, fatigue and relaxation properties, especially in dynamic loaded applications when better fatigue resistance is required.

CORROSION RESISTANCE

It is very important to avoid corrosion in spring applications so as not to impair spring properties. Sandvik 11R51 is an austenitic stainless steel and has sufficient corrosion resistance in most spring applications. The corrosion resistance is slightly higher compared to Sandvik 12R11 and standard ASTM 301, due to the addition of molybdenum. Compared to other low alloyed spring steels, Sandvik 11R51 has superior performance. However, all austenitic steels of this type are susceptible to stress corrosion cracking (SCC) when in contact with chloride solutions at elevated temperatures.

BENDING

The values given below have been obtained by bending according to Swedish standard SS 11 26 26 method 3 (in a 90° V-block with a 25 mm die opening, a sample of 35 mm width, turned so that the burrs of the blanked edges face into the bend). They can be used as guidance for the smallest recommended bending radius.

Nominal tensile strength, R_m	Thickness, t	Min. bending radius as function of thickness *)	
MPa	mm	⊥	//
1700	0.25	1.5 t	6.5 t
1700	0.50	2 t	9 t
1700	0.75	2.5 t	9.5 t
1700	1.0	3 t	9.5 t
1900	0.25	2 t	10 t
1900	0.50	3.5 t	11 t
1900	0.75	5 t	12 t
2050	0.25	2.5 t	14 t

*) ⊥ Bend transverse to the rolling direction
// Bend parallel to the rolling direction

FORMS OF SUPPLY

Sandvik 11R51 is supplied, as standard, in the cold rolled condition. Strip steel can be supplied in coils, bundles, on plastic spools or in lengths. The edges can be either slit, deburred or smoothly rounded. Contact us for more information.

Dimensions

The following range of thicknesses and widths can be supplied as standard. Please contact Sandvik if other dimensions are required.

Thickness, mm	Width, mm	Thickness, in.	Width, in.
0.015 - 1.5*	2 - 345	.0006 - .06	.079 - 13.6

* depending on requested tensile strength.

Tolerances

The thickness and width tolerances are +/- tolerances to the nominal size. The normal tolerance classes for most of our strip products are T2 and B1. Tighter tolerances as well as other tolerance limits can be offered upon request.

Stock standard

The following combinations of tensile strength and thickness are available from stock. Other combinations can be supplied on request.

Condition	Tensile strength, R_m		Thickness
	MPa	ksi	mm
C	1700	247	0.30/0.60
C	1900	276	0.15/0.20/0.25/0.30/0.40/0.50/0.60/0.70/ 0.75/0.80
C	2050	297	0.03/0.04/0.05/0.08/0.10/0.15/0.20/0.30

C = Cold rolled

HEAT TREATMENT

The strength of cold rolled Sandvik 11R51 can be increased by a tempering operation at 425°C (797°F) for 4 hours. An increase in tensile strength of approx. 100 to 250 MPa (14.5 to 36 ksi) can be expected, depending on the initial cold rolled tensile strength. Further information on the nominal tempering effect can be seen under the "Mechanical properties" section. This heat treatment is also beneficial for relaxation and fatigue resistance.

Tempering is normally carried out by the customer after forming. To avoid discoloration, parts should be carefully cleaned before heat treatment.

Tempering in open air furnaces gives a harmless brownish oxide on the surface.

MECHANICAL PROPERTIES

Static strength

Condition[1)]	Tensile strength, R_m		Proof strength, $R_{p0,2}$[a)]		Elongation, $A_{11,3}$
	MPa	ksi	MPa	ksi	%
C	1700	247	1600	232	1
CT	1900	276			
C	1900	276	1850	268	0.8
CT	2100	305			
C	2050	297	1975	286	0.5
CT	2300	334			

1) C = Cold rolled, CT = Cold rolled and tempered, 425°C (797°F)/4 h. See further under section 'Heat treatment'.

a) $R_{p0.2}$ corresponds to 0.2% offset yield strength.

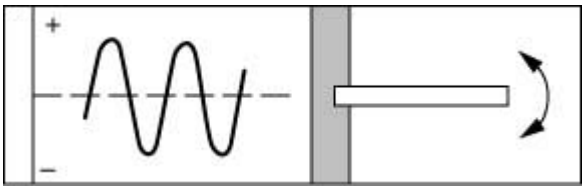
1 MPa = 1 N/mm^2

Fatigue strength

Nominal values at 20°C (68°F) in a normal dry atmosphere. The fatigue limit is defined as the stress at which 50% of the specimens withstand a minimum of 2 million load cycles.

Reversed bending stress

Average stress = 0
Bending transversal to rolling direction.

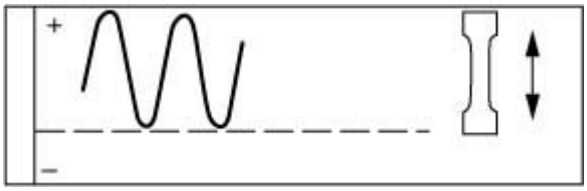


Comparison made for different thicknesses and tensile strength levels.

Tensile strength, Rm	Fatigue limit		Tensile strength, Rm	Fatigue limit	
	Thickness, mm			Thickness, in.	
	0.25	0.50		0.010	0.020
MPa	MPa	MPa	ksi	ksi	ksi
1700		± 580	247		± 84.2
1900		± 590	276		± 85.6
2100	± 775	± 630	305	± 113	± 91.4
2300	± 780		334	± 113	

Fluctuating tensile stress

Minimum stress = 0
Specimens parallel to rolling direction.



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Tensile strength, Rm	Fatigue limit		Tensile strength, Rm	Fatigue limit	
	Thickness, mm			Thickness, in.	
	0.25	0.50		0.010	0.020
MPa	MPa	MPa	ksi	ksi	ksi
1700	495 ± 495	425 ± 425	247	71.8 ± 71.8	61.7 ± 61.7
1900	510 ± 510	455 ± 455	276	74.0 ± 74.0	66.0 ± 66.0
2100	525 ± 525	500 ± 500	305	76.2 ± 76.2	72.6 ± 72.6
2300	540 ± 540	-	334	78.4 ± 78.4	-

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 generally be used for rough calculations. These values refer to cold rolled material, at a temperature of 20°C(68°F) unless otherwise stated.

Density 7.9 g/cm³ (0.29 lb/in³)

Resistivity 0.9 µΩm (35.4 µΩin.)

Modulus of elasticity

'as delivered': approx 185 000 MPa (26 825 ksi)
tempered: approx 190 000 MPa (27 550 ksi)

Shear modulus

´as delivered´: approx 71 000 MPa (10 295 ksi)

Specific heat capacity 500 J/kg °C (in the temperature range 50-100°C)

Thermal expansion **mean values in temperature ranges (x10⁻⁶)**

Temperature, °C	per °C	Temperature, °F	per °F
20 - 100 °C	15	68 - 200	8.5
20 - 200 °C	15.5	68 - 400	8.5
20 - 300 °C	16	68 - 550	9

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	15	68	8.5
100	15	200	8.5
300	19	600	11

WELDING

Sandvik 11R51, like most austenitic stainless steels, has a good weldability. Welding, however, introduces excess heat into the material closest to the weld that breaks down the structure formed by cold working. As a consequence, this will decrease the mechanical properties of the welded area. The lowest practical heat input, <1.0 kJ/mm, and interpass temperature for multipass welding, <100°C (210 ◦F), is recommended.

In most cases, the TIG (GTAW) method is preferable. It can be used either autogenously (without filler metal) or with filler metal. In both cases, pure argon (99.99%) should be used as the shielding gas.

When filler metal is used, Sandvik 19.9.L or Sandvik 19.9.LSi is recommended.

Due to the high carbon content of Sandvik 11R51, there is also a risk of carbide precipitation at the grain boundaries of the material in the heat affected zone (HAZ), which may decrease the corrosion resistance of the material in certain environments.

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