SANDVIK

SANDVIK 13RM19 STRIP STEEL

DATASHEET

Sandvik 13RM19 is a stainless spring steel combining high mechanical strength with a non-magnetic structure. This combination of properties has previously been found mainly in expensive Co-Ni-base or Cu-Be alloys. Corrosion resistance is comparable to ASTM 301.

Sandvik 13RM19 also possesses good fatigue properties and excellent ductility, which makes it a most suitable choice for springs and other high-strength applications where ferromagnetic materials cannot be used.

Sandvik 13RM19 main characteristics:

- Non-magnetic structure in all conditions
- High mechanical strength in the cold rolled condition. Strength can be further increased by tempering, without any effect on the non-magnetic structure.
- High elastic limit and energy storing capacity in the cold rolled and tempered condition which is important for spring applications.

Service temperature: up to 250°C (480°F)

STANDARDS

- EN Number: 1.4369
- EN Name: X 11 CrNiMnN 19-8-6

CHEMICAL COMPOSITION (NOMINAL) %

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni
0.11	0.8	6.0	≤0.030	≤0.015	18.5	7

Others: N=0.25

FORMS OF SUPPLY

Strip steel can be supplied in coils, bundles, on plastic spools or in lengths. The edges can be either slit, deburred or smoothly rounded. For more information, see the packing guide on our website www.smt.sandvik.com/strip or the brochure S-3411-ENG.

Conditions and dimensions

Sandvik 13RM19 is supplied in the cold rolled or solution annealed (bright annealed or annealed and pickled) condition.

Condition	Tensile strength, Rm		Thickness	
	MPa	ksi	mm	in.

Condition	Tensile strength, Rm		Thickness	
	MPa	ksi	mm	in.
Annealed	850	123	0.03-4	0.0012-0.16
Cold rolled	1100	160	0.025-3.2	0.001-0.13
Cold rolled	1300	189	0.02-2.8	0.0008-0.11
Cold rolled	1500	218	0.015-1.9	0.0006-0.075
Cold rolled	1600	232	0.015-0.9	0.0006-0.035

Widths: 2-345 mm (0.08 - 13.6 in.)

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.

MECHANICAL PROPERTIES

Static strength

Nominal values at 20°C (68°F)

Condition[1)]	Tensile strength, Rm		Proof strength, $R_{p0,2}$[a)]		Elongation, $A_{11,3}$
	MPa	ksi	MPa	ksi	%
A	850	123	470	68	45
C	1100	160	975	142	12
CT	1130	164	1020	148	11
C	1300	189	1150	167	10
CT	1350	196	1220	177	8
C	1500	218	1350	196	3
CT	1650	239	1500	218	2
C	1600	232	1440	209	2
CT	1800	261	1630	237	1

1)A = Annealed, C = Cold rolled, CT = Cold rolled and tempered, 480°C (896°F)/2 h. See further under section 'Heat treatment'.

a)$R_{p0.2}$corresponds to 0.2% offset yield strength. 1 MPa = 1 N/mm^2

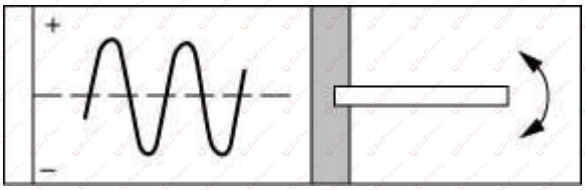
Fatigue strength

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

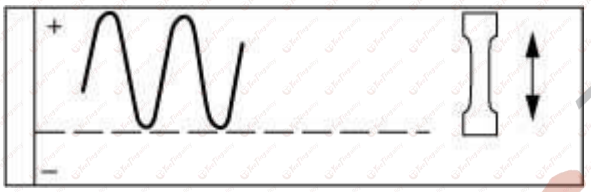
Bending transversal to rolling direction.



Comparision made for different ticknesses and tensile strength levels.

Tensile strength, Rm		Thickness		Fatigue limit	
MPa	ksi	mm	in.	MPa	ksi
1600	232	0.40	0.016	± 605	±88
1800	261	0.20	0.008	± 680	±99
1800	261	0.40	0.016	± 635	±92

Fluctuating tensile stress
Minimum stress = 0
Specimens parallel to rolling direction.



Comparision made for different ticknesses and tensile strength levels.

Tensile strength, Rm		Thickness		Fatigue limit	
MPa	ksi	mm	in.	MPa	ksi
1600	232	0.40	0.016	500 ± 500	73 ± 73
1800	261	0.40	0.016	535 ± 535	78 ± 78

PHYSICAL PROPERTIES

The physical properties of a steel relate 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/cm^3 (0.29 lb/in.^{3})

Resistivity: 0.7 mWm (27.6 mWin.)

Modulus of elasticity: 190 000 MPa (27600 ksi)

Thermal expansion **mean values in temperature ranges (x10^{-6})**

Temperature, °C	per °C	Temperature, °F	per °F
30 - 100	16.5	85 - 200	9
30 - 200	17	85 - 400	9.5
30 - 300	18	85 - 550	10

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	15	68	8.5
100	16	200	9
300	19	600	11

MAGNETIC PROPERTIES

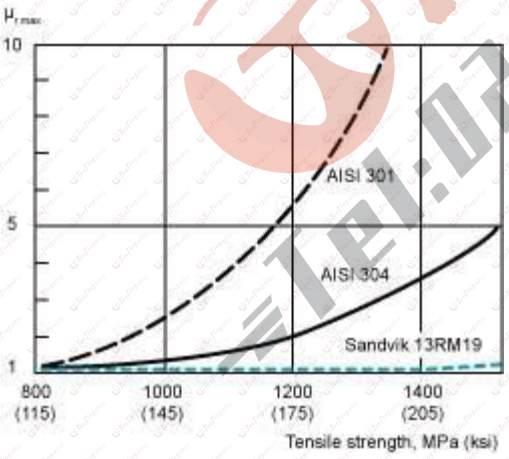
From a magnetic point of view, materials can be divided into three groups, para-, dia- and ferromagnetic materials. In many practical cases, para- and diamagnetic materials will, however, interact strongly with the magnetic fields. In some cases, the ferromagnetic properties are desired, while in other situations no interaction with a magnetic field can be accepted.

The magnetic properties of a material are expressed as the magnetic susceptibility, c, or often as the magnetic permeability m = 1 + c. By definition, the magnetic susceptibility is placed at 0 for vacuums, from which it follows that m_0=1. The magnetic permeability for a certain material is expressed as m_r ,which is its relative permeability versus vacuum. Further, as m_r may vary with the magnetic field strength, the maximum value of $m_{r\,max}$ is often given as a representative value of the material.

Most types of high strength steel are ferromagnetic in spring hard conditions. The spring properties are achieved by hardening, e.g. carbon and chromium steels, or by cold rolling e.g. ASTM 301 (EN 1.4310). The origin of the properties is the martensitic structure. Higher alloyed steels e.g. ASTM 316, besides being more expensive, suffer from difficulties in reaching a high strength by cold working. If high strength is needed, together with a non-magnetic (para-magnetic) material, the option has traditionally been expensive Copper-Beryllium or Cobalt base alloys.

Sandvik 13RM19 is alloyed in such a way that the structure is very stable against a martensitic transformation but still allows a strong work hardening effect at deformation. Therefore, it is possible to obtain mechanical properties similar to ASTM 301, but maintain a non-magnetic structure. The low permeability is not influenced by a tempering operation. Sandvik 13RM19 also remains completely non-magnetic down to extremely low temperatures.

The following diagram shows typical values for the maximum relative magnetic permeability for Sandvik 13RM19, compared to ASTM 301 and 304.



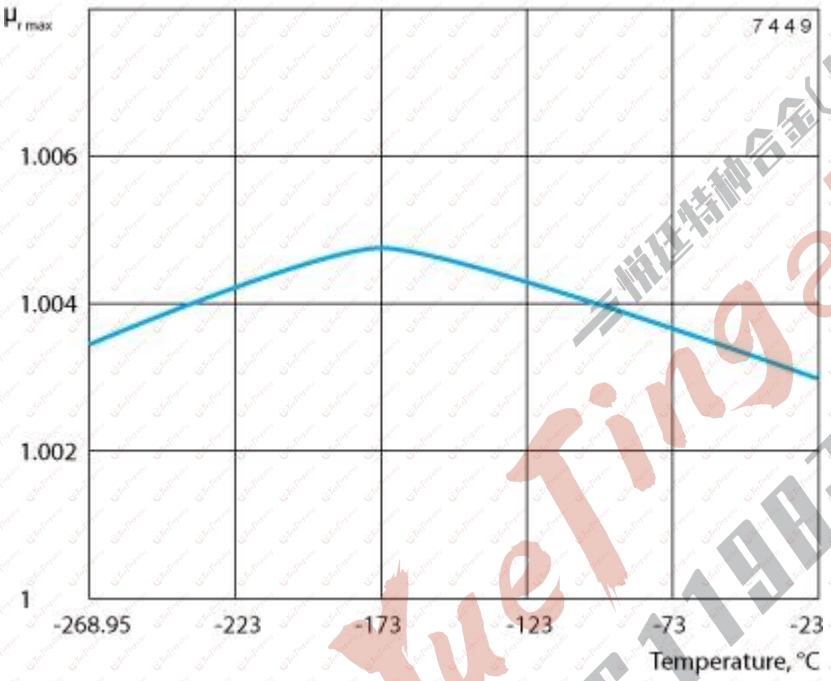
Typical values at 20°C (68°F)

Condition	Tensile strength, R_m		Maximum $\mu_{r\,max}$
	MPa	ksi	
A	850	123	1.003

Typical values at 20°C (68°F)

Condition	Tensile strength, Rm		Maximum μr max
	MPa	ksi	
C	1300	189	1.005
CT	1350	196	1.005
C	1600	232	1.03
CT	1800	261	1.03

Sandvik 13RM19 remains non-magnetic down to very low temperatures. The diagram below shows the magnetic permeability down to 4.2 K (-268.95°C) for material in the annealed condition.



CORROSION RESISTANCE

Sandvik 13RM19 has a corrosion resistance comparable to that of ASTM 301/304. The high nitrogen content is known to be beneficial for resistance to pitting and crevice corrosion. However, all austenitic steels of this type are susceptible to stress corrosion cracking (SCC) when in contact with chloride solutions at elevated temperatures.

HEAT TREATMENT

The strength of cold rolled steel can be increased by a tempering operation at 480°C (896°F) for 2 hours. For cold rolled Sandvik 13RM19 with a tensile strength above about 1400 MPa, an increase in tensile strength of about 100-200 MPa (14.5-29 ksi) can be expected. 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 discolouration, parts should be carefully cleaned before heattreatment.

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

WELDING

Sandvik 13RM19, like most austenitic stainless steels, has 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 (210ºF), 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. If a low loss of nitrogen is essential, Argon with 1 - 2% Nitrogen can be used instead.

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

Due to the high carbon content of Sandvik 13RM19, 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

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*)	
MPa	mm	⊥	//
1300	0.25	0.5 t	t
1300	0.50	0.5 t	4 t
1500	0.25	1.5 t	3.5 t
1500	0.50	1.5 t	6 t

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

APPLICATIONS

The combination of high strength and non-magnetic behaviour makes Sandvik 13RM19 very suitable for springs and other high strength components in the electronic and computer industries.

Typical products where Sandvik 13RM19 can be used to advantage are printers, springs in generators, magnetic instrument housings, components in measuring instruments, zipper parts and other components that require non-magnetic properties. The grade is also used in surgical tools and other equipment for open architechture magnets in which surgery is performed simultaneously with magnetic resonance imaging.

The high strength also makes Sandvik 13RM19 suitable as a cable armouring material for high voltage cables, where transmission losses must be kept low.