

# 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) %

STro Tr	С	Status.	Stratus	Si	Status .	Mn	P	ar Steeling	Station .	Steffer.	S str	of States	STrafford.	of Cr. of	Straften.	Ni	Sketner Sket
STraT"	0.11	Stales (	S. Ke Trade	0.8	er Estatue	6.0	≤0.030	Staffin	Station .	d Staffin	≤0.015	aller Steeling	er Steffin	18.5	Station .	7 Str. 7 Str. 7	Steeling Steel

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 <a href="www.smt.sandvik.com/strip">www.smt.sandvik.com/strip</a> 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 stre	ngth,Rm	Thickness	green green green	ard area are	Stell 3	green green green
	MPa	ksi	mm	in.	Steen Steen Steen	Ster 3	ales, Ster, Ster,

Condition	Tensile stren	gth,Rm	Thickness						
Start Start Start Start	MPa	ksi	mm	, some strain					
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)

Condition1)	Tensile stre	ngth, Rm	Proof stre Rp0,2a)	ngth,	Elongation, A11,3	aren Statueren Statemen St
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СТ	1130	164	1020	148	11	alle green green
par C	1300	189	1150	167	10	and a standard a standard a
CT	1350	196	1220	177	8,000	al de la companya de
res Carrent Representation Statement	1500	218	1350	196	Andrew Barrer and the state of	neres Stationes Stationes St
CT garden garden	1650	239	1500	218	State of Sta	or Statistical Statistical St
Carrier Statement Statement Statement	1600	232	1440	209	garante 2 sente garante garante garante garante	Statistical Statistical St
CT grand grand grand	1800	261	1630	237	Statement I statement statement statement statement	Statistical Statistical St

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

## 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.

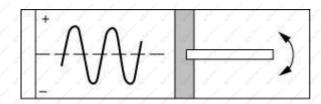
#### Reversed bending stress

Average stress = 0

Bending transversal to rolling direction.

a)Rp0.2corresponds to 0.2% offset yield strength. 1 MPa = 1 N/mm<sup>2</sup>





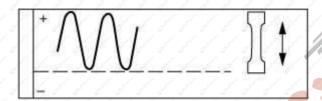
Comparision made for different ticknesses and tensile strength levels.

Tensile	strer	ngth, F	Rm	Shelman Shelma	Stell	Staffe	Skeling	Status	Thick	ness	Stelle	Shafted Shafted	Shaller She	Fatigue limit	Steller Steller	Shelling
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1600	State of	Staffing Staff	Stell.	232	State.	of Staff	STATE.	Steffer.	0.40	Steeling of	Street.	0.016	Stelland Ste	± 605	±88	Staffing 1
1800	er Eteller	Charles Star	aren Stelle	261	Strand.	Stort.	STATE	- Citalina	0.20	Station of the state of the sta	Stell	0.008	Steel Steel	± 680	±99	Steller .
1800	States.	Statem State	Steel	261	State of the state	31/1	State	Street Control	0.40	State of the state	St.	0.016		± 635	±92	Station .

Fluctuating tensile stress

Minimum stress = 0

Specimens parallel to rolling direction.



Comparision made for different ticknesses and tensile strength levels.

Tensile streng	th, Rm	Thicknes	SS	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/cm3 (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 / 9 / s
30 - 200	34.50° 34.50° 34.50° 34.50° 34.50°	85 - 400	9.5
30 - 300	3 18 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	85 - 550	start 10 start start start start

#### Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h°F
20	15	68	8.5
100	16	200	9 / / / / / /
300	19, 7	600	11 , , , ,

#### **MAGNETIC PROPERTIES**

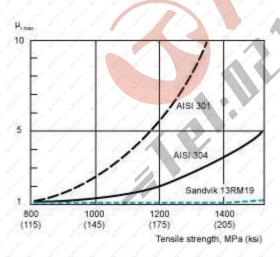
From a magnetic point of view, materials can be divided into three groups, para-, dia- and ferromagnetic materials. In many practical cases, para- and diamagnetic materials will, however, interact strongly with the magnetic fields. In some cases, the ferromagnetic properties are desired, while in other 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 m0=1. The magnetic permeability for a certain material is expressed as mr, which is its relative permeability versus vacuum. Further, as mr may vary with the magnetic field strength, the maximum value of mr 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.



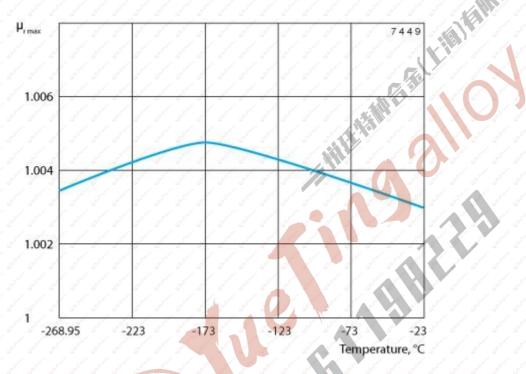
# Typical values at 20°C (68°F)

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(Trail	A state of the sta	Story.	Stole	Steller.	850	Real Street	Stal.	Steller.	The Steeling	N Star	123	3 Strain	Stal.	Skeling	N String	Start.	1.00	3 3	Stellan.	States.	al Staylor	Steller.	Stolen.	Steller.	Stell.	STAT.

#### Typical values at 20°C (68°F)

Condition	Tensile strength	1, Rm	Maximum µr max
	MPa	ksi	
C	1300	189	1.005
CT ST ST ST ST	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 (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. 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,Rm		Thickness (t)	Min. bending radius*)	
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1300	and the first of	0.25	0.5 t	terment to the transmit
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1500	Skallan	0.25	o1.5 t	3.5 t
1500	States at	0.50	1.5 t	6 t

 <sup>⊥</sup> 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.

Disclaimer: Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions. Continuous development may necessitate changes in technical data without notice. This datasheet is only valid for Sandvik materials.

