Austenitic Heat Resisting Steel

Material Data Sheet

Steel designation:	Name	Material No.
	X8CrNiTi18-10	**1.4878**

Scope

This data sheet applies for hot and cold rolled sheet and strip and bars, semi-finished products, rods and sections.

Application

For construction parts which should be resistant to scaling up to about 850 °C and extensively inured to the effect of sulfureous gases. Inclination to carburization in reduced gases is very low.

Chemical composition (Heat analysis in %)

Product form	C	Si	Mn	P	S	Cr	Ni	Ti
C, H, P, L	≤ 0,10	≤ 1,00	≤ 2,00	≤ 0,045	≤ 0,015	17,00-19,00	9,00-12,00	5x%C ≤ 0,80

C = cold rolled strip; H = hot rolled sheet; P = hot rolled sheet; L = semi-finished products, bars, sections

Mechanical properties at room temperature in the solution annealed condition

Product form	Thickness *a* or Diameter *d* mm	HB max. 1)2)3)	Proof strength 3) $R_{p0,2}$ N/mm²min	Proof strength 3) $R_{p1,0}$ N/mm²min	Tensile strength R_m N/mm²	Elongation A % min. Long products 3)	Elongation A % min. Flat products $0,5 \le a/d < 3$	Elongation A % min. Flat products $3 \le a/d$
C,H,P	a ≤ 12	215	190	230	500 - 720	40 1)	40 4)5)	40 4)5)
L	d ≤25							

1) The maximum HB values may be raised by 100 units or the maximum tensile strength value may be raised by 200 N/mm² and the minimum elongation value be lowered to 20 % for cold worked sections and bars of ≤ 35 mm thickness.

2) For guidance only.

3) For rod, only the tensile values apply.

4) Longitudinal test piece 5) Transverse test piece

6) After cold forming the elongation for wall thicknesses ≤ 35 mm amounts to minimum 20 %.

7) Bars 8) Rods and sections

Creep properties - estimated average values about the long-term behavior at elevated temperature*

Temperature °C	1 %-Elongation 1) for 1000 h N/mm²	1 %-Elongation 1) for 10 000 h	Rupture 2) for 1000 h N/mm²	Rupture 2) for 10 000 h	Rupture 2) for 100 000 h
600	110	85	200	142	65
700	45	30	88	48	22
800	15	10	30	15	10

1) Stress related to the out put cross-section, which leads after 1000 or 10 000 h to a permanent elongation of 1 %.

2) Stress related to the out put cross-section, which leads after 1000, 10 000 or 100 000 h to breakage.

* for guidance only

Reference data on some physical properties (for guidance only)

Density at 20 °C	Thermal conductivity W/m K at		Specific heat capacity at 20 °C	Electrical resistivity at 20 °C
kg/dm³	20 °C	500 °C	J/kg K	Ω mm²/m
7,9	15	-	500	0,73

Coefficient of linear thermal expansion 10^{-6} K^{-1} between 20 °C and

200 °C	400 °C	600 °C	800 °C	1000 °C
17,0	18,0	18,5	19,0	-

Guidelines on the temperature for hot forming and heat treatment

Hot forming*		**Heat treatment [1] +AT (solution annealed), microstructure**		
Temperature °C	Type of cooling	Temperature °C[2]	Type of cooling[3]	Microstructure
1150 - 800	Air	1050 - 1150	Water, air	Austenite

1) Heat treatment is not necessary in any case, since the material is exposed high temperatures during application.

2) If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred or even exceeded.

3) Cooling has to be effected fast enough. * according to SEW 470

Processing / Welding

Standard welding processes for this steel are:

TIG-welding
MAG-welding massive wire
Arc welding (E)
Submerged Arc Welding (SAW)
Laser beam welding

Process	**Filler metal**			
	similar		higher alloyed	
TIG	Thermanit ATS 4 / 1.4948		Thermanit X / 1.4370	
MAG massive wire	Thermanit ATS 4 / 1.4948		Thermanit X / 1.4370	
Arc welding (E)	Thermanit ATS 4 / 1.4948		Thermanit X / 1.4370	
SAW	Wire	Powder	Wire	Poweder
	Thermanit ATS 4 / 1.4948	Marathon 104	Thermanit X / 1.4370	Marathon 104
Laser beam welding	see page 3			

Preheating is for this steel not necessary. Interpass temperature should not exceed 150 °C. Heat treatment after welding is normally not usual.

Austenitic steels have only 30 % of the thermal conductivity of non-alloyed steels. Their fusion point is lower than that of non-alloyed steels, therefore austenitic steels have to be welded with lower heat input than non-alloyed steels.

To avoid overheating or burn-thru of thinner sheets, higher welding speed has to be applied. Copper back-up plates for faster heat rejection are functional, whereas, to avoid cracks in the solder metal, it is not allowed to surface-fuse the copper back-up plate.

This steel has an extensively higher coefficient of thermal expansion as non-alloyed steels. In connection with a worse thermal conductivity, a greater distortion has to be expected.

When welding 1.4878 all procedures, which work against this distortion (e. g. back-step sequence welding, welding alternately on opposite sides with double-V butt weld, assignment of two welders when the components are accordingly large) have to be respected notably. For product thicknesses over 12 mm the double-V butt weld has to be preferred instead of a single-V butt weld. The included angle should be 60° - 70°, when using MIG-welding about 50° are enough. An accumulation of weld seams should be avoided.

Tack welds have to be affixed with relatively shorter distances from each other (significantly shorter than these of non-alloyed steels), in order to prevent strong deformation, shrinking or flaking tack welds. The tacks should be subsequently grinded or at least be free from crater cracks.

1.4878 in connection with austenitic weld metal and too high heat input the addiction to form heat cracks exists. The addiction to heat cracks can be confined, if the weld metal features a lower content of ferrite (delta ferrite). Contents of ferrite up to 10 % have a favorable effect and do not affect the corrosion resistance generally. The thinnest layer as possible has to be welded (stringer bead technique), because a higher cooling speed decreases the addiction to hot cracks.

A preferably fast cooling has to be aspired while welding as well, to avoid the vulnerability to intergranular corrosion and embrittlement.

1.4878 is very suitable for **laser beam welding**. With a welding groove width smaller 0,3 mm respectively 0,1 mm product thickness the use of filler metals is not necessary. With larger welding grooves a similar filler metal can be used. With avoiding oxidation within the seam surface during laser beam welding by applicable backhand welding, e. g. helium as inert gas, the welding seam is as corrosion resistant as the base metal. A hot crack hazard for the welding seam does not exist, when choosing an applicable process.

1.4878 is also suitable for **laser beam fusion cutting** with nitrogen or flame cutting with oxygen. The cut edges only have small heat affected zones and are generally free of micro cracks and thus are well formable. While choosing an applicable process the fusion cut edges can be converted directly. Especially, they can be welded without any further preparation.

While processing only stainless tools like steel brushes, pneumatic picks and so on are allowed, in order to not endanger the passivation.

It should be neglected to mark within the welding seam zone with oleigerous bolts or temperature indicating crayons.

The high corrosions resistance of this stainless steel is based on the formation of a homogeneous, compact passive layer on the surface. Annealing colors, scales, slag residues, tramp iron, spatters and such like have to be removed, in order to not destroy the passive layer.

For cleaning the surface the processes brushing, grinding, pickling or blasting (iron-free silica sand or glass spheres) can be applied. For brushing only stainless steel brushes can be used. Pickling of the previously brushed seam area is carried out by dipping and spraying, however, often pickling pastes or solutions are used. After pickling a carefully flushing with water has to be done.

Remark

In quenched condition the material can be slightly magnetizable. With increasing cold forming the magnetizability increases.

Editor

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References

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Stahl-Eisen-material bulletin 470:1976-02 Verlag Stahleisen GmbH, Postfach 10 51 64, D-40042 Düsseldorf
MB 821 "Properties" Informationsstelle Edelstahl Rostfrei, Postfach 10 22 05,
MB 822 "The converting of stainless steel" D-40013 Düsseldorf
Böhler Schweisstechnik Deutschland GmbH, Hamm

Important note

Information given in this data sheet about property or applicability of materials respective products is no assurance of characteristics but serve for description.

Information, with which we like to advise you, relate to the experience of the producers and our own. Warranty for the results of the treatment and application of the products cannot be granted.