Austenitic Heat Resisting Steel

Material Data Sheet

Steel Designation:	Name	Material-No.
	X15CrNiSi20-12	**1.4828**

Scope

This data sheet applies for hot and cold rolled sheet and strip, semi-finished products, bars, rods and sections as well as for welded circular steel tubes for mechanical and general engineering purposes.

Application

For construction parts which should be resistant to scaling up to about 1000 °C and extensively inured to the effect of sulfureous gases. Inclination to carburization in reduced gases, especially above 900 °C, is very low.

Chemical composition (heat analysis in %)

Product form	C	Si	Mn	P	S	Cr	Ni	N
C, H, P, L	≤ 0,20	≤ 1,50-2,00	≤ 2,00	≤ 0,045	≤ 0,015	19,00-21,00	11,00-13,00	≤ 0,11
T_W*	≤ 0,20	≤ 1,50-2,50	≤ 2,00	≤ 0,045	≤ 0,030	19,00-21,00	11,00-13,00	

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

* according to DIN EN 10296-2:2005-06

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/mm² min		Tensile strength R_m N/mm²	Elongation A % min. Long products[3]	Flat products 0,5 ≤ *a/d* < 3	Flat products 3 ≤ *a/d*
			$R_{p0,2}$	$R_{p1,0}$				
C,H,P	a ≤ 12	215	190	230	500 - 720	40[1]	40 [4)5)]	40 [4)5)]
L	d ≤25							
T_w*	a= 12	-	230	270	min. 550		30 [4)5)6)]	30 [4)5)6)]

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 %.

Creep properties - estimated average values about the long-term behaviour 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	120	80	190	120	65
700	50	25	75	36	16
800	20	10	35	18	7,5
900	8	4	15	8,5	3

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

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 kg/dm³	Thermal conductivity W/m K at 20 °C	Thermal conductivity W/m K at 500 °C	Specific heat capacity at 20 °C J/kg K	Electrical resistivity at 20 °C Ω mm²/m
7,9	15	21	500	0,85

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

200 °C	400 °C	600 °C	800 °C	1000 °C
16,5	17,5	18,0	18,5	19,5

Guidelines on the temperatures 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.

Processing / Welding

Standard welding processes for this steel are:

- TIG-welding
- Arc welding (E)
- MAG-welding solid wire
- Laser beam welding

Process	**Filler metal** similar D	higher alloyed C, CM
TIG	Thermanit D / 1.4829	Thermanit C Si / 1.4842
MAG solid wire	Thermanit D / 1.4829	Thermanit C Si / 1.4842
Arc welding (E)	Thermanit D / 1.4829	Thermanit C / 1.4842 + Thermanit CM
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 1.4828all 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.

1.4828 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.

1.4828 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.

1.4828 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.

Heat resisting tubes are delivered regarding testing in accordance to DIN EN 10216-5 respectively DIN EN 10217-7.
In Germany, SEW 470 still applies for heat resisting tubes.

Editor

THYSSENKRUPP MATERIALS INTERNATIONAL GMBH
Technical Sales / Quality Management
Am Thyssenhaus 1
45128 Essen

References

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Stahl-Eisen-material data sheet 470:1976-02	Verlag Stahleisen GmbH, Postfach 10 51 64, D-40042 Düsseldorf
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Important note

Information given in this data sheet about property or applicability of materials respective products are 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.