thyssenkrupp

thyssenkrupp Materials (UK) Ltd

Stainless Steel 1.4878 — Material Data Sheet

This data sheet applies for hot and cold rolled sheet, 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 sulphurous gases. Inclination to carbonisation in reduced gases is very low.

Chemical Composition (heat analysis in %)

Product Form	C	Si	Mn	P	S	Cr	Ni	N
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 strip P = hot rolled sheet L= semi-finished products, bars and sections

Mechanical Properties (at room temperature in annealed condition)

Product Form	Thickness a or diameter d mm	HB max. [1) 2) 3)]	Proof Strength[3)]		Tensile Strength	Elongation min. in %		
			$R_{p0.2}$ N/mm²	$R_{p1.0}$ N/mm²	R^m N/mm²	Long Products [3)]	Flat Products	
							0.5 ≤ a/d < 3	3 ≤ 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 ≤ 35mm 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 ≤ 35mm amounts to minimum 20%.

Creep Properties (estimated average values about the long-term behaviour at elevated temperature*)

Temperature °C	1% Elongation[1)] for		Rupture[2)] for		
	1,000 h N/mm²	10,000 h N/mm²	1,000 h N/mm²	10,00 h N/mm²	100,000 h N/mm²
600	110	85	200	142	65
700	45	30	88	48	22
800	15	10	30	15	10

[1)] Stress related to the output cross section, which leads after 1,000 or 10,000 h to a permanent elongation of 1%.
[2)] Stress related to the output cross section, which leads after 1,000 or 10,000 or 100,000 h to breakage.
* For guidance only

Reference data on some physical properties

Density at 20°C kg/dm³	Thermal Conductivity W/m K at		Specific Thermal Capacity at 20°C J/kg K	Electrical Resistivity at 20°C Ω mm²/m
	20°C	500°C		
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)]+A (annealed), Microstructure		
Temperature °C	Type of Cooling	Temperature °C	Type of Cooling	Microstructure
1150 - 800	Air	1050 - 1150[2)]	Air, Water[3)]	Austenite

[1)] Heat treatment is not necessary in any case, since the material is exposed to 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 grade are:

- TIG-Welding
- MAG-Welding Solid Wire
- Arc Welding (E)
- Laser Bean Welding

Process	Filler Metal			
	Similar		Higher Alloyed	
TIG	Thermanit ATS 4 / 1.4948		Thermanit X / 1.4370	
MAG Solid 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	Powder
	Thermanit ATS 4 / 1.4948	Marathon 104	Thermanit X / 1.4370	Marathon 104
Laser Beam Welding	See Page 3			

Preheating is not necessary for this steel. Interpass temperature should not exceed 150°C. Heat treatment after welding is not normally 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-through 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 12mm 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 those 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 favourable effect and do not affect the corrosion resistance generally. The thinnest layer 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 to 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 0.3mm respectively 0.1mm product thickness the use of filler metals is not necessary. With larger welding grooves a similar metal can be used. With avoiding oxidation within the seam surface during laser beam welding by applicable backhan 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 oleaginous bolts or temperature indicating crayons.
The high corrosion resistance of this stainless steel is based on the formation of a homogeneous, compact passive layer on the surface. Annealing colours, scales, slag residues, tramp iron, spatters and such like have to be removed, in order to not destroy the passive later.
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 careful flushing with water has to be done.

Remark

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

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Important Note