thyssenkrupp

thyssenkrupp Materials (UK) Ltd

Stainless Steel 1.4539 — Material Data Sheet

This data sheet applies for hot and cold rolled sheet and strip, semi-finished products, bars, rolled wire and profiles as well as seamless and welded tubes for pressure purposes.

Application

Chemical plant, oil refinery, petrochemical plants, bleaching tanks for the paper industry, combustion gas desulfurisation plants, application in sea water, sulphuric and phosphoric acid. Due to the low C-content, the resistance to intergranular corrosion is also guaranteed in the welded condition.

Chemical Composition (heat analysis in %)[a)]

C	Si	Mn	P	S	N	Cr	Cu	Mo	Ni
0.02	0.70	2.00	0.03	0.01	0.15	19.00 - 21.00	1.20 - 2.00	4.00 - 5.00	24.00 - 26.00

[a)] Maximum value unless otherwise stated.

Mechanical Properties (at room temperature in annealed condition)

Product Form	Thickness mm max.	Yield Strength		Tensile Strength	Elongation min. in %		Impact Energy (ISO-V) KV ≥ 10mm thick	
		0.2% $R_{p0.2}$ N/mm²	1% $R_{p1.0}$ N/mm²	R^m N/mm²	A[1)] %min (longitudinal)	A[2)] %min (transverse)	J_{min} (longitudinal)	J_{min} (transverse)
C	8	240[3)]	270[3)]	530 - 730[3)]	-	35	-	-
H	13.5	220[3)]	260[3)]	530 - 730[3)]	-	35	100	60
P	75	220[3)]	260[3)]	520 - 720[3)]	-	35	100	60
L	160	230[4)]	260[3)]	530 - 730[4)]	35	-	100	-
L	250[2)]	230[5)]	260[3)]	530 - 730[5)]	-	30	-	60
$T_{w/s}$	60	230[6)]	250[3)]	520 - 720[6)]	35	30	120	90

[1)] Gauge length and thickness according to DIN EN
[2)] > 160mm
[3)] Transverse test piece, with product widths < 300mm long. test piece
[4)] Longitudinal test piece
[5)] Transverse test piece
[6)] Longitudinal test piece, external diameter > 508mm trans. test piece

Reference data on some physical properties

Density at 20°C kg/dm³	Modulus of Elasticity kN/mm² at				Thermal Conductivity at 20°C W/m K	Specific Thermal Capacity at 20°C J/kg K	Specific Electrical Resistivity at 20°C Ω mm²/m
	20°C	200°C	400°C	500°C			
8.0	195	182	166	158	12	450	1.0

Mean coefficient of thermal expansion 10^{-6} K^{-1} between 20°C and				
100°C	200°C	300°C	400°C	500°C
15.8	16.1	16.5	16.9	17.3

Guidelines on the temperature for hot forming and heat treatment[1)]

Hot Forming		Heat Treatment		
Temperature °C	Type of Cooling	Temperature °C [2)3)4)]	Type of Cooling	Microstructure
1150 to 850	Air	1010 to 1090	Water, air	Austenite

[1)] For simulative heat treatment test pieces the temperatures for solution annealing have to be agreed.
[2)] Solution annealing is applicable if the conditions for the hot forming and the concluding cooling are in such a way that the requirements for the mechanical properties of the product can be maintained.
[3)] If heat treatment is carried out in a continuous annealing furnace, usually the upper area of the mentioned temperature range is preferred or even exceeded.
[4)] For heat treatment within subsequent processing, the lower area of the stated temperature range for solution annealing has to be aspired has to be aspired, as otherwise the mechanical properties could be affected. If the lower limit for the solution annealing temperature was not undercut during hot forming, while repeating annealing a temperature of 1020°C as the lower limit is sufficient.

Processing / Welding

Standard welding processes for this steel grade are:

- TIG-Welding
- MAG-Welding Solid Wire
- Arc Welding (E)
- Submerged Arc Welding (SAW)
- Laser Beam Welding

Process	Filler Metal	
	Similar	Higher Alloyed
TIG	Thermanit 20/25 Cu 1.4519	Thermanit 30/40 E 2.4653 Thermanit 625 2.4831
MAG Solid Wire	Thermanit 20/25 Cu 1.4519	Thermanit 30/40 E 2.4653 Thermanit 625 2.4831
Arc Welding (E)	Thermanit 20/25 CuW 1.4519	Thermanit 30/40 E 2.4653 Thermanite 625 2.4831
SAW	Thermanit 20/25 Cu 1.4519	
Laser Beam Welding	See Page 3	

When choosing the filler metal, the corrosion stress has to be regarded, as well. The use of a higher alloyed filler metal can be necessary due to the cast structure of the weld metal.
A preheating is not necessary for this steel. A heat treatment after welding is normally not usual.
Austenitic steels only have 30% of the thermal conductivity of non-alloyed steels. Their fusion point is lower than that of non-alloyed steel 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 steel. In connection with a worse thermal conductivity, a greater distortion has to be expected.
When welding 1.4539 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 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.
1.4539 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 as possible have 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.
1.4539 is very suitable for laser beam welding (weldability A in accordance with DVS bulletin 3203, part 3). With a welding groove width smaller than 0.3mm respectively 0.1mm 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 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.
1.4539 is alos 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 mirco cracks and thus are well formable. While choosing an applicable processes 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 corrosions 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 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

thyssenkrupp Materials (UK) Ltd
Cox's Lane
Cradley Heath
West Midlands
B64 5QU

Important Note