



Stainless Steel 1.4404

Material Data Sheet

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

Application

Construction encasement, doors, windows and armatures, offshore modules, cisterns and pipes for chemical tankers, production, warehousing and overland transportation of chemicals, food and beverages, pharmacy, synthetic fibre, paper and textile plants and pressure vessels. 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	Mo	Ni
≤ 0.030	1.00	2.00	0.045	0.015 ¹⁾	0.10	16.50 - 18.50	2.00 - 2.50	10.00 - 13.00

^{a)} Maximum value unless otherwise stated.

¹⁾ For machinability a controlled sulphur content of 0.015 - 0.030% is recommended and permitted.

Mechanical Properties (at room temperature in solution annealed condition)

Product Form	Thickness mm max.	Yield Strength		Tensile Strength R ^m N/mm ²	Elongation		Impact energy (ISO-V) Room Temperature ≥ 10mm Thick	
		0.2%	1%		A ¹⁾ % min (longitudinal)	A ¹⁾ % min (transverse)	J min. (longitudinal)	J min. (transverse)
		R _{p0.2} N/mm ² min.	R _{p1.0} N/mm ² min					
C	8	240 ³⁾	270 ³⁾	530 - 680 ³⁾	-	40	-	-
H	13.5	220 ³⁾	260 ³⁾	530 - 680 ³⁾	-	40	100	60
P	75	220 ³⁾	260 ³⁾	520 - 670 ³⁾	-	45	100	60
L	160	200 ⁴⁾	235 ⁴⁾	500 - 700 ⁴⁾	40	-	100	-
L	250 ²⁾	200 ⁵⁾	235 ⁵⁾	500 - 700 ³⁾	-	30	-	60
T _{w/s}	60	190 ⁶⁾	240 ⁶⁾	490 - 690 ⁴⁾	40	30	100	60 ⁷⁾

¹⁾ Gauge length and thickness according to DIN EN

²⁾ > 160mm

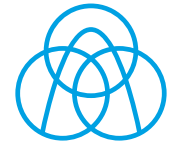
³⁾ Transverse test piece, with product widths < 300mm longitudinal test piece

⁴⁾ Longitudinal test piece

⁵⁾ Transverse test piece

⁶⁾ Longitudinal test piece, external diameter > 508mm transverse test piece

⁷⁾ Min. 60 j at - 196°C



Reference data on some physical properties

Density at 20°C kg/dm ³	Modulus of Elasticity kN/mm ² at				Thermal Conductivity at 20°C W/m K	Specific Thermal Ca- pacity at 20°C J/kg K	Specific Electrical Resistivity at 20°C Ω mm ² /m
	20°C	200°C	400°C	500°C			
8.0	200	186	172	165	15	500	0.75

Linear coefficient of thermal expansion 10 ⁻⁶ K ⁻¹ between 20°C and				
100°C	200°C	300°C	400°C	500°C
16.0	16.5	17.0	17.5	18.0

Guidelines on the temperature for hot forming and heat treatment¹⁾

Hot Forming		Heat Treatment AT (Solution Annealed), Microstructure		
Temperature °C	Type of Cooling	Temperature °C ^{2) 3) 4)}	Type of Cooling	Microstructure
1150 to 850	Air	1030 to 1110	Water, air	Austenite with a low content of ferrite

¹⁾ For simulative heat treatment test pieces the temperatures for solution annealing have to be agreed.

²⁾ Solution annealing is in 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.

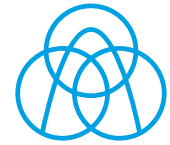
⁴⁾ For heat treatment within subsequent processing, the lower area of the stated temperature range for solution annealing has to be aspired, as otherwise the mechanical properties could be affected. If the lower limit for the solution annealing temperature was not undercut during hot forming, while repeating annealing a temperature of 1000°C as the lower limit is sufficient.

Processing / Welding

Standard welding process for these steel grades 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 GE-316 L	1.4430	Thermanit A	1.4576
MAG Solid Wire	Thermanit GE-316 L Si	1.4430	Thermanit A Si	1.4576
Arc Welding (E)	Thermanit GE Special	1.4430	Thermanit A Special	1.4576
	Thermanit GEW 316 L-17	1.4430	Thermanit AW	1.4576
SAW	Wire	Powder	Wire	Powder
	Thermanit GE-316L	Marathon 431 Marathon 213	Thermanit A Thermanit 18/17 E	Marathon 431 - 213 Marathon 104
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 conductivity a greater distortion has to be expected.

When welding 1.4404 all procedures, which work against this distortion (eg. 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.

1.4404 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 low 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 addition to hot cracks. A preferably fast cooling has to be aspired while welding as well, to avoid the vulnerability to intergranular corrosion and embrittlement.

1.4404 is very suitable for laser beam welding (weldability A in accordance with DVS bulletin 3203, part 3) 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 filler metal can be used. With avoiding oxidation within the seam surface during laser beam welding by applicable backhand welding, eg. 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.

1.4404 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 oleiferous 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, spatter 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, carefully flush with water must be done.

Remark

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

Editor

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Important Note

Information given in this data sheet about the condition or usability of materials respectively products are no warranty for their properties, but act as a description.

The information, we give on for advice, comply to the experiences of the manufacturer as well as our own. We cannot give warranty for the results of processing and application of the products.