

Ferritic Stainless Steel 4003

Steel Grade

Outokumpu	EN	ASTM	UNS
4003	1.4003	-	S40977

Characteristic Properties

Outokumpu 4003 is a ferritic stainless steel that can be used as an alternative to mild steel in moderately corrosive environments. Thanks to its superior corrosion resistance compared to carbon steels, structures made of 4003 usually have lower maintenance costs and longer service life. It offers benefits to more highly alloyed stainless steel such as strength, abrasion resistance and durability. In addition, 4003 is weldable and formable allowing it to be fabricated using conventional techniques.

Typical Applications

The properties of 4003 make it the ideal material for all applications of conventional structural steel, with the advantage of improved resistance to service in moderately corrosive environments. Typical applications are within the transportation sector, e.g. railroad carriages, buses, trucks and containers as well as in industrial applications, e.g. equipment for sugar production, hoppers, conveyors and silos.

Chemical Composition

The chemical composition may vary slightly between different product standards. The required standard will be fully met as specified on the order.

Chemical Composition (wt-%) acc. to EN10088.

Table 1

Outokumpu Steel Name	International Steel designation		Chemical Composition (wt-%) acc. to EN 10088			
	EN	UNS	Cr	Ni	N max	C max
4003	1.4003	S40977	10.5-12.5	0.30-1.0	0.030	0.030

Mechanical Properties

The mechanical properties of 4003 make it an attractive choice for applications where high strength and stiffness is desired. The engineering properties are on par with carbon steels. As opposed to many other ferritic steels it retains its toughness, even when welded, at temperatures below the freezing point.

Outokumpu uses European Standard EN10088 when applicable. The permitted design values may vary between product forms. The appropriate values are given in the relevant specification.

Mechanical Properties

Hot and cold rolled strip, minimum values according to EN 10088-2 at 20°C, transverse direction

Table 2

Steel Grade	Proof Strength $R_{p0.2}$ MPa	Tensile Strength R_m MPa	Elongation A_{80} %
4003	320	450	20

Tensile Properties at elevated temperatures according to EN 10088-2

Proof Strength $R_{p0.2}$ (MPa), minimum values

Table 3

Grade	Proof Strength $R_{p0.2}$ (MPa), minimum values				
	100°C	150°C	200°C	250°C	300°C
4003	240	235	230	220	215

Physical Properties

Guidance data from EN 10088-1

Physical Properties, typical values at 20°C

Table 4

Density	Kg/dm ³	7.7
Modulus of Elasticity	GPa	220
Thermal Conductivity	W/m°C	25
Electrical Resistivity	$\mu\Omega\text{m}$	0.60
Magnetizable		Yes

Physical Properties at elevated temperatures

Modulus of Elasticity (GPa)

Table 5

Steel Grade	Modulus of Elasticity at (GPa)				
	20°C	100°C	200°C	300°C	400°C
4003	220	215	210	205	195

Physical Properties at elevated temperatures

Linear expansion (RT → T) $\times 10^{-6}/^{\circ}\text{C}$

Table 6

Steel Grade	Thermal Expansion between 20°C and T				
	100°C	200°C	300°C	400°C	500°C
4003	10.4	10.8	11.2	11.6	11.9

Corrosion Resistance

The corrosion resistance of Outokumpu 4003 is superior to that of carbon steel thanks to its higher chromium content. As its resistance to chloride induced aqueous corrosion and its resistance in strong acids is limited compared to standard austenitic steels, 4003 should only be used in mildly corrosive environments. As all ferritic grades, 4003 has an excellent resistance to stress corrosion cracking.

Grade 4003 can be used in most indoor atmospheric applications but also in outdoor applications where aesthetics

is not a key requirement. Alternatively, corrosion protective coatings, like epoxy or acrylic based primers and paint systems, can be applied. Please contact producers of such systems for details.

Outokumpu 4003 provides an oxidation resistance sufficient for many applications at temperatures up to about 700°C. For higher temperatures, scale formation starts and a grade with higher chromium content should be considered.

Fabrication

Forming

The formability of Outokumpu 4003 is comparable to many high quality carbon steels. It is well suited for standard cold forming operations like bending, flanging and drawing, but has limited stretch formability.

When performing demanding forming operations it might be necessary to perform drawing in several steps with intermediate annealing.

Annealing

Annealing of 4003 at 700-760°C for a couple of minutes restores the ferritic structure. Notice that when rapidly cooled from more elevated temperatures, a martensitic structure might be obtained.

Machining

Outokumpu 4003 is relatively easy to machine. Compared to austenitic grades, it has lower tendency to form edges, which gives a larger machining window. Since the machinability is comparable to that of structural carbon steels, the same recommendations regarding choice of tool, cutting speed and cutting feed can be used.

Welding

Outokumpu 4003 has good weldability and can be welded with the common fusion and resistance welding methods. Recommended fillers are ISO 13 or ISO 19 9L. It can be satisfactorily welded to mild steel provided an over alloyed filler, e.g. ISO 23 12 L, is used.

To restrain grain growth in the HAZ, high heat input must be avoided. Shielding gasses should be based on Ar/He, mixed with some oxygen to improve arc stability. Hydrogen and nitrogen must not be used.

Surface Properties

Outokumpu 4003 is available in both hot and cold rolled finishes.

Surface finishes

Table 7

	Available surface finishes	
4003	1D	Hot rolled, heat treated, pickled
	2E	Cold rolled, heat treated, mechanically descaled, pickled
	2D	Cold rolled, heat treated, pickled
	2B	Cold rolled, heat treated, pickled, skin passed

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Outokumpu is an international stainless steel company. Our vision is to be the undisputed number one in stainless, with success based on operational excellence. Customers in a wide range of industries use our stainless steel and services worldwide. We are dedicated to helping our customers gain competitive advantage

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