Stainless Steel 303, 303Se Grade Data Sheet

Grade 303, 303Se

Grade 303 represents the optimum in machinability among the austenitic stainless steels. It is primarily used when production involves extensive machining in automatic screw machines.

303 is also available ex-mill as a "Ugima" Improved Machinability grade, with machinability even higher than that of the standard 303.

The sulphur addition which is responsible for the improved machining and galling characteristics of Grade 303 lowers its corrosion resistance to below that of Grade 304. As for other austenitic grades the structure gives 303 excellent toughness, although the sulphur in 303 reduces its toughness slightly.

Grade 303Se (UNS S30323) has a selenium rather than sulphur addition, improving the hot and cold forming characteristics over those of 303 and providing a smoother machined surface finish. The machinability rate is also slightly reduced compared to 303. Grade 303Se is not readily available in Australia.

Corrosion Resistance

Good resistance to mildly corrosive atmospheres, but significantly less than Grade 304 due to the sulphur addition; the sulphide inclusions act as pit initiation sites. Grade 303 should not be exposed to marine or other similar environments, as these will result in rapid pitting corrosion. Because the sulphide inclusions in 303 are primarily aligned along the rolling direction the corrosion resistance is particularly reduced in cross-sections.

Grade 303, like other common austenitic stainless steels, is subject to stress corrosion cracking in chloride containing environments above about 50°C.

Heat Resistance

Good oxidation resistance in intermittent service to 760°C and in continuous service to 870°C. Continuous use in the 425-860°C range is not usually recommended due to carbide precipitation - 303 usually does not have a low carbon content so is susceptible to sensitisation, which can lead to intergranular corrosion.

Fabrication

As well as reducing the corrosion resistance, the sulphur additions in 303 also result in poor weldability and reduced formability compared to Grade 304. Sharp bends should not be attempted in 303. A practical compromise alternative may be a 304 Ugima Improved Machinability grade - this does not machine as readily as 303, but does offer better formability (as well as excellent weldability and significantly better corrosion resistance).

Heat Treatment

Solution Treatment (Annealing)

Heat to 1010-1120°C and cool rapidly. This grade cannot be hardened by thermal treatment.

Welding

Not generally recommended but, if unavoidable use Grade 308L or 309 electrodes. AS 1554.6 does not pre-qualify welding of 303. Welds must be annealed for maximum corrosion resistance, but even then, poor mechanical and corrosion properties will result.

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Machining

A "Ugima" improved machinability version of grade 303 is available ex-mill in many bar products. This machines significantly better even than standard 303, giving very high machining rates and lower tool wear in many operations. For ultra-high machining rates there are also available special grade variants such as Ugima 303UX. This includes copper to reduce the work hardening rate, in addition to the usual high sulphur and Improved Machinability steel making practices.

Typical Applications

Nuts and bolts. Bushings. Shafts. Electrical switchgear components. Gears. In general, any component that is heavily machined and where the corrosion resistance and fabrication properties of 303 are viable.

Specified Properties

These properties are specified for long product (bar) in ASTM A582M. Similar but not necessarily identical properties are specified for other products such as wire and forgings in their respective specifications. Grade 303 is not produced in flat rolled products.

Composition Specification (%)

Grade		C	Mn	Si	P	S	Cr	Mo	Ni	Se
303	min.	-	-	-	-	0.15	17.0	-	8.0	-
	max.	0.15	2.0	1.0	0.20	-	19.0		10.0	
303SE	min.	-	-	-	-	-	17.0	-	8.0	0.15
	max.	0.15	2.0	1.0	0.20	0.06	19.0		10.0	min.

Mechanical Property Specification

Grade	Tensile Strength (MPa)	Yield Strength 0.2% Proof (MPa)	Elongation (% in 50mm)	Hardness	
				Rockwell B (HR B)	Brinell (HB)
303	650 typical	300 typical	45 typical	-	262 max.

Note that ASTM A582 only specifies hardness – tensile properties included above are not guaranteed and for information only. Drawn bars, generally up to 25.4mm diameter, will have higher strength values. Proof (yield) stress values in particular will be significantly higher and the percentage elongation lower.

Physical Properties (Typical values in the annealed condition)

Grade	Density (kg/m³)	Elastic Modules (GPa)	Mean Coefficient of Thermal Expansion			Thermal Conductivity		Specific Heat	Electrical Resistivity
			0-100°C (µm/m/°C)	0-315°C (µm/m/°C)	0-538°C (µm/m/°C)	at 100°C (W/m.K)	at 500°C (W/m.K)	0-100°C (J/kg.K)	(nΩ.m)
303	7900	193	17.3	17.8	18.4	16.3	21.5	500	720

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Grade Specification Comparison

Grade	UNS NO	Euronorm		Swedish SS	Japanese JIS
		No	Name		
303	S30300	1.4305	X8CrNiS18-9	2346	SUS 303
303Se	S30323	-	-	-	SUS 303Se

Possible Alternative Grades

Grade	Why it might be chosen instead of 303, 303Se
303UX	Ugima 303UX offers the highest machinability for long run repetition machining.
304	Better corrosion resistance, formability or weldability are needed, at the expense of lower machinability. Consider 304 Ugima.
316	Higher resistance to pitting and crevice corrosion is required, in chloride environments. A lower machinability can be accepted.
416	Even higher machinability than 303 is needed, and a lower corrosion resistance can be tolerated. Or hardening by thermal treatment is required, while maintaining a high machinability.