Grade Data Sheet

316 316L 316H

Grade 316 is the standard molybdenum-bearing austenitic grade, second stainless steel in importance to 304. The molybdenum gives 316 better overall corrosion resistant properties than Grade 304, particularly higher resistance to pitting and crevice corrosion in chloride environments. It has excellent forming and welding characteristics. It is readily brake or roll formed into a variety of parts for applications in the industrial, architectural, and transportation fields. Grade 316 also has outstanding welding characteristics. Post-weld annealing is not required when welding thin sections. The austenitic structure gives excellent toughness, even down to cryogenic temperatures.

Grade 316L, the low carbon version of 316, is immune from sensitisation (grain boundary carbide precipitation) and so is extensively used in heavy gauge welded components (over about 6mm). Grade 316H, with its higher carbon content has some application at elevated temperatures, as does stabilised grade 316Ti. Nitrogen-strengthened versions are also available as 316N and 316LN.

Corrosion Resistance

Excellent in a range of atmospheric environments and many corrosive media - generally more resistant than 304. Subject to pitting and crevice corrosion in warm chloride environments, and to stress corrosion cracking above about 50°C. Considered resistant to potable water with up to about 1000mg/L chlorides at ambient temperatures, reducing to about 500mg/L at 60°C.

316 is usually regarded as the standard "marine grade stainless steel", but it is not resistant to warm sea water. In many marine environments 316 does exhibit surface corrosion, usually visible as brown staining. This is particularly associated with crevices and rough surface finish. Consult Atlas Technical Assistance for specific environmental recommendations.

Heat Resistance

Good oxidation resistance in intermittent service to 870°C and in continuous service to 925°C. Continuous use of 316 in the 425-860°C range is not recommended if subsequent aqueous corrosion resistance is important. Grade 316L is more resistant to carbide precipitation and can be used in the above temperature range. Grade 316H has higher strength at elevated temperatures and is sometimes used for structural and pressure-containing applications at temperatures above about 500°C, but the titanium stabilised grade 316Ti is often a more appropriate choice.

Heat Treatment

Solution Treatment (Annealing)

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

Welding

Excellent weldability by all standard fusion methods, both with and without filler metals. AS 1554.6 pre-qualifies welding of 316 with Grade 316 and 316L with Grade 316L rods or electrodes (or their high silicon equivalents). Heavy welded sections in Grade 316 require post-weld annealing for maximum corrosion resistance. This is not required for 316L. Grade 316Ti may also be used as an alternative to 316 for heavy section welding.

Machining

A "Ugima" improved machinability version of grade 316 is available in round and hollow bar products. Ugima machines significantly better than standard 316 or 316L, giving higher machining rates and lower tool wear in many operations.

"Dual Certification"

It is common for 316 and 316L to be stocked in "Dual Certified" form, particularly in plate, pipe and round bar. These items have chemical and mechanical properties complying with both 316 and 316L specifications. Such dual certified product may be unacceptable for high temperature applications.

Typical Applications

Food processing equipment. Laboratory equipment. Architectural panelling, railings & trim. Boat fittings. Chemical containers. Heat exchangers. Screens for mining, quarrying & water filtration. Threaded fasteners. Springs.

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Specified Properties

These properties are specified for flat rolled product (plate, sheet and coil) in ASTM A240/A240M. Similar but not necessarily identical properties are specified for other products such as pipe and bar in their respective specifications.

Composition Specification (%)

Grade		C	Mn	Si	P	S	Cr	Mo	Ni	N
316	min.	-	-	-	-	-	16.0	2.00	10.0	-
	max.	0.08	2.0	0.75	0.045	0.030	18.0	3.00	14.0	0.10
316L	min.	-	-	-	-	-	16.0	2.00	10.0	-
	max.	0.030	2.0	0.75	0.045	0.030	18.0	3.00	14.0	0.10
316H	min.	0.04	-	-	-	-	16.0	2.00	10.0	-
	max.	0.10	2.0	0.75	0.045	0.030	18.0	3.00	14.0	-

Mechanical Property Specification

Grade	Tensile Strength (MPa) min	Yield Strength 0.2% Proof (MPa) min	Elongation (% in 50mm) min	Hardness	
				Rockwell B (HR B) max	Brinell (HB) max
316	515	205	40	95	217
316L	485	170	40	95	217
316H	515	205	40	95	217
316H also has a requirement for a grain size of ASTM No 7 or coarser.					

Physical Properties

(typical values in the annealed condition)

Grade	Density (kg/m^3)	Elastic Modulus (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)
316 & 316L/H	8000	193	15.9	16.2	17.5	16.3	21.5	500	740

Grade Specification Comparison

Grade	UNS No	Euronorm		Swedish SS	Japanese JIS
		No	Name		
316	S31600	1.4401	X5CrNiMo17-12-2	2347	SUS 316
316L	S31603	1.4404	X2CrNiMo17-12-2	2348	SUS 316L
316H	S31609	-	-	-	-
These comparisons are approximate only. The list is intended as a comparison of functionally similar materials **not** as a schedule of contractual equivalents. If exact equivalents are needed original specifications must be consulted.					

Possible Alternative Grades

Grade	Why it might be chosen instead of 316
316Ti	Better resistance to temperatures of around 600-900°C is needed.
316N	Higher strength than standard 316.
317L	Higher resistance to chlorides than 316L, but with similar resistance to stress corrosion cracking.
904L	Much higher resistance to chlorides at elevated temperatures, with good formability
2205	Much higher resistance to chlorides at elevated temperatures, and higher strength than 316