



Stainless Steel Bar 316-316L

Colour code: Bottle Green/Marigold

Introduction

Atlas 316 is the standard molybdenum-bearing stainless steel, second in importance to 304 amongst the austenitic stainless steels. 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. Post-weld annealing is not required when welding thin sections.

Atlas 316L is immune from sensitisation (grain boundary carbide precipitation) and so is extensively used in heavy gauge welded components (over about 6mm). The austenitic structure also gives these grades excellent toughness, even down to cryogenic temperatures.

Related Specifications

Grade	UNS No	British BS	Euronorm		Swedish SS	Japanese JIS
			No	Name		
316	S31600	316S31	1.4401	X5CrNiMo17-12-2	2347	SUS 316
316L	S31603	316S11	1.4404	X2CrNiMo17-12-2	2348	SUS 316L

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.

Chemical Composition Specification values in %, according to ASTM A276

Grade	C	Mn	Si	P	S	Cr	Mo	Ni
316	≤ 0.08	≤ 2.0	≤ 1.00	≤ 0.045	≤ 0.030	16.0-18.0	2.0-3.0	10.0-14.0
316L	≤ 0.03	≤ 2.0	≤ 1.00	≤ 0.045	≤ 0.030	16.0-18.0	2.0-3.0	10.0-14.0

Atlas 316 bar is generally stocked in "Dual Certified" form. These products have chemical and mechanical properties complying with both 316 and 316L specifications. Such dual certified product does not meet 316H specifications and may be unacceptable for high temperature (over about 500°C) applications.

Conditions of Supply – Specified Mechanical Properties

Values below are specified values according to ASTM A276, condition A, for cold finished bars.

Diameter (mm)	Tensile Strength (MPa) min	0.2% Proof Stress (MPa) min	Elongation (% in 50mm) min	Reduction of Area (%) min
≤12.70	620	310	30	40
>12.70	515	205	30	40

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Conditions of Supply – Typical Physical Properties

Density (kg/m ³)	Elastic Modulus (GPa)	Mean Coefficient of Thermal Expansion			Thermal Conductivity		Specific Heat 0-100 °C (J/kg.K)	Electrical Resistivity (nΩ.m)
		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)		
8000	193	15.9	16.2	17.5	16.3	21.5	500	740

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 Atlas 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 Atlas 316 in the 425-860°C range is not recommended if subsequent aqueous corrosion resistance is important. Atlas 316 is reasonably 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.

Conditions of Supply – Finish, Dimensions and Tolerances

Surface Finish

Round bar up to 25.4mm diameter is all cold drawn. Round bars over 25.4 and up to 127.00mm diameter are smooth-turned and polished. Round bars over 127.00mm diameter are all peeled.

All hexagon bar and all square bar is cold drawn.

Diameter and A/F tolerances

Round Bar: Cold drawn h9; Smooth-turned and Polished h10; Peeled up to 160mm k12; Peeled over 160mm +1.5mm/-0; Centreless ground h9 or h8

Square Bar: h11; Hex Bar: h11.

Straightness – maximum deviation from a straight line

Round Bar: 1.5mm in 1500mm and may not exceed: 1.5mm x length in mm / 1500mm

Squares and Hexagon: 1.5mm in 1500mm and may not exceed: 1.5mm x length in mm / 1500mm

Other tolerances may be supplied for more critical applications upon enquiry.

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Length Tolerance

Sizes up to 25.4mm:	Mill Lengths and Set Lengths, +50mm/-0
Sizes up from 25.4mm to 50.8mm:	Mill Lengths and Set Lengths, +100mm/-0
Sizes over 50.8mm:	Mill Lengths and Set Lengths, +/- 300mm
(varies depending on size)	

UGIMA® 316 AND ugima2® 316 for top performance in machining

A **UGIMA®** improved machinability version of grade 316 is available in round, hexagon and square bar. **UGIMA®** 316 machines significantly better than standard 316 or 316L, enabling a higher rate of metal removal and lower tool wear in many operations. Surface quality and reliability of machining results will improve too when using **UGIMA®** 316. **UGIMA2®** 316 is the new generation product offering further benefits of improved chip-breakability, substantially longer tool life and productivity benefits also in the low machining speed range.

For **UGIMA®** 316 and **UGIMA2®** 316 detailed set-up tables are available on request, specifying machining parameters (surface speed, feed rate, depth of cut and type of tool) for high-speed tooling and carbide insert tooling for the most common machining operations (roughing, finishing, drilling, parting-off etc.). Machinability assistance is available for optimal set-up and problem-solving for specific machining jobs.

Heat Treatment

The following temperature ranges are applicable for the respective heat treatment operations.

Forging	Annealing
900 – 1200°C	1010 – 1120°C

Cool rapidly after annealing. Atlas316 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). Both can be applied for Atlas316. Heavy welded sections do not require post-weld annealing for maximum corrosion resistance. Grade 316Ti may also be used as an alternative to Atlas 316 for heavy section welding.

Applications of Atlas 316

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

Possible Alternative Grades

Grade	Why it may be chosen instead of Atlas 316/316L
316Ti	Better resistance to temperatures of around 600-900°C is needed.
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

Disclaimer

Whilst every effort has been made to ensure accuracy of the information in this Datasheet, Atlas Specialty Metals accepts no liability for damages arising from its use.