Austral Wright Metals
at the cutting edge

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PRODUCT DATA SHEET

Grades 316, 316L, 316H

UNS S31600, S31603, S31609

Stainless Steel

Grade 316 is the second most commonly used stainless steel. It is an austenitic, corrosion resistant steel with excellent strength, toughness, fabrication characteristics and weldability. The low carbon version, 316L, may be required for full corrosion resistance when thicker sections are welded. The 316H version has a guaranteed minimum carbon content, which ensures good strength at high temperatures.

Chemical Composition (AS1449 / ASTM A240 – Flat Products)

		Carbon	Silicon	Mang-anese	Phos-phorus	Sul-phur	Nickel	Chromium	Molyb-denum	Nitrogen
316	Specification (max)	0.08	0.75	2.00	0.045	0.030	10.00 – 14.00	16.00 – 18.00	2.00 – 3.00	0.10
	Typical	0.037	0.45	1.60	0.032	0.007	10.72	16.95	2.12	0.031
316L	Specification (max)	0.03	0.75	2.00	0.045	0.030	10.00 – 14.00	16.00 – 18.00	2.00 – 3.00	0.10
	Typical	0.020	0.49	1.54	0.030	0.004	10.70	17.00	2.12	0.037
316H	Specification (max)	0.04 – 0.10	0.75	2.00	0.045	0.030	10.00 – 14.00	16.00 – 18.00	2.00 – 3.00	–
	Typical	0.050	0.37	1.67	0.033	0.009	10.69	16.90	2.13	0.025

Mechanical Properties (AS1449 / ASTM A240 – Flat Products)

		0.2% Proof Stress MPa	Tensile Strength MPa	Elongation %	Hardness HB (max)
316	Specification (min)	>= 205	>= 520	>= 40	<=217
	Typical values	270	600	55	145
316L	Specification (min)	>= 170	>= 485	>= 40	<= 217
	Typical values	270	600	55	145
316H	Specification (min)	>= 205	>= 515	>= 40	<=217
	Typical values	270	600	55	145

Typical Applications Brewing and dairy equipment, evaporators, drums, barrels, heat exchangers, chemical and food processing, water treatment plant, chemical processing equipment, architectural and boat fittings exposed to marine and polluted atmospheres.

Description Grade 316 is a member of the 18/8 chromium nickel family of austenitic stainless steels, with an addition of 2% molybdenum for improved corrosion resistance, particularly to localised corrosion in chloride containing environments. The very tough and ductile austenitic structure gives grade 316 excellent formability and fabrication characteristics.

In most applications the steel is used where its corrosion resistance gives long lasting service life and appearance. The ease of cleaning and of maintaining a hygienic surface on the steel make it excellent for many purposes.

The low carbon version, 316L, may be required for full corrosion resistance when sections thicker than about 5 mm are welded. The version with guaranteed high carbon, 316H, may be required for elevated temperature service, such as pressure vessels.

Austral Wright Metals can supply this grade as plate, coil, sheet, strip, round, hexagon, flat bar, angles, tube, pipe and welding consumables.

Finishes: No1 (hot rolled, annealed and pickled), 2D (cold rolled), 2B (cold rolled, skin passed), N4 (polished).

Flat products are available surface protected with white polyethylene (PE) film. Protection with blue poly vinyl chloride (PVC) for deep drawing or black PVC (for heavy forming) is also available.

Physical Properties (Typical, annealed)

Property	at	Value	Unit	Property	At	Value	Unit
Density		7,900	Kg/m³	Melting Range		1375-1400	°C
Electrical Conductivity	25°C	1.25	% IACS	Specific Heat		500	J/kg. °C
Electrical Resistivity	25°C	0.74	Micro ohm . m	Relative Magnetic Permeability		1.02	
				Coefficient of Expansion	0 – 100°C	15.9	x10⁻⁶ / °C
Modulus of Elasticity	20°C	193	GPa		0 – 315°C	16.2	x10⁻⁶ / °C
Shear Modulus	20°C	77	GPa		0 – 540°C	17.5	x10⁻⁶ / °C
Poisson's Ratio	20°C	0.30		Thermal Conductivity	100°C	16.2	W / m . °C

Toughness. Austenitic stainless steels are inherently tough, maintaining the ductile fracture mode and high absorbed energy in impact tests to cryogenic temperatures (-200°C).

Pressure Vessels AS1210, Pressure Vessels, allows the use of grade 316 up to a temperature of 800°C. The standard allows the use of higher design stresses for 316H at all temperatures.

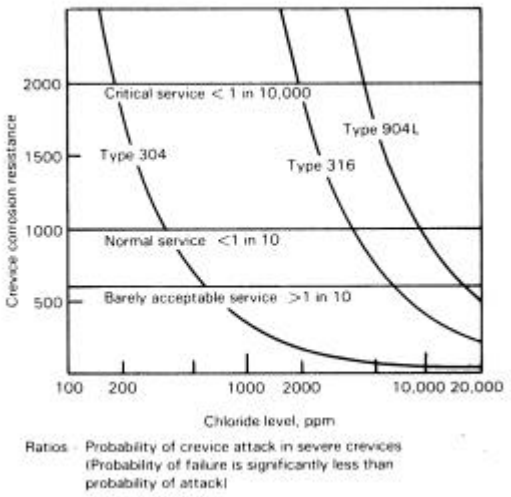
Corrosion Resistance Grade 316 has excellent corrosion resistance in many environments. Austral Wright Metals will be pleased to provide advice for specific applications.

Grade 316 gives good service in atmospheric conditions, resisting most environments. It is often used in marine conditions, or where industrial pollution is heavy. Best appearance is maintained where the design allows even rain washing of the surface, or where dirt deposits are occasionally washed off the steel.

Grade 316 has given excellent service in potable water. Pitting and crevice corrosion may occur in waters with higher chloride content, and 2000 ppm is accepted as the upper limit. The higher molybdenum content of 316 make it significantly more corrosion resistant than grade 304.

Grade 316 can be used with seawater, provided precautions are taken to avoid crevice corrosion developing under sediments, precipitation and biofouling, and at designed-in crevices.

Grade 316 (and grade 304) may suffer stress corrosion cracking in solutions containing chloride ions at temperatures over about 60°C. Stress corrosion cracking should be considered for all corrosion services where the corrosive liquid may contain chloride.



Ratios - Probability of crevice attack in severe crevices (Probability of failure is significantly less than probability of attack)

High Temperature Corrosion The generally accepted maximum service temperatures for grade 316 (and grade 304) in air are 870°C for intermittent service and 925°C for continuous service.

Cold Fabrication Grade 316 is readily workable, by the standard methods of sheet metal working, with the exception that it cannot be oxygen cut. Plasma cutting is normal. The deep drawing capability of grade 316 is outstanding, because of its high austenite stability.

Forging 316 is one of the easier austenitic stainless steels to forge, at temperatures above 925°C.

Machinability Grade 316 is relatively easy to machine, although more difficult than carbon steel. More power is required to machine grade 316. Cutting speed should be lower, the feed higher, tooling and equipment heavier. The machinability of 316 is about 60% that of AISI B1112 resulphurised free cutting carbon steel. A free machining version of 316 is available as bar.

Heat Treatment Solution annealing is performed at 1065 - 1120°C, followed by rapid cooling to prevent the precipitation of the chromium carbides. 316 cannot be hardened by heat treatment. Stress relieving is rarely required due to the high ductility of 316.

Weldability Grade 316 is readily weldable by most fusion techniques (GTAW / TIG, GMAW / MIG / MAG, MMAW / stick, SAW), with no preheat, postheat or control of interpass temperature needed. It is usually welded with filler metals of the same grade, 316 or 316L (or the silicon containing versions) which retains corrosion resistance and strength. These grades are pre-qualified weld metals to AS1554.6:1994 for welding grade 316 to itself.