Austral Wright Metals

at the cutting edge

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Austral Bronze Crane Copper Limited
ACN 008 466 840

PRODUCT DATA SHEET

Grades

Stainless Steel

321, 321H (UNS S32100, S32109)
347, 347H (UNS S34700, S34709)
348, 348H (UNS S34800, S34803)

These grades are versions of the most common stainless steel, grade 304. They contain carbide forming or stabilising elements such as titanium, niobium and tantalum, which form carbides in preference to chromium carbide, and so prevent sensitisation. The grades were more common before the development of steelmaking equipment for reliable and economical manufacture of 304L grade, which is now used in most applications.

Grade 321 is stabilised with titanium, 347 with niobium (columbium, Cb, in USA practice), and 348 with niobium plus tantalum, with a controlled cobalt content. Grade 348 is mainly used in nuclear applications. Each grade has an 'H' version, with guaranteed high carbon (~0.07%), which can be used in pressure vessels to higher temperatures.

The grades are used:

- where the steel will be used at temperatures in the carbide precipitation range, 425 to 900°C, and subsequently exposed to corrosive environments
- where heavy parts (> 5 mm thickness) are fabricated by welding, and will not be subsequently solution annealed

In practice, grade 304L is most often used nowadays, except for components for heat treatment equipment and furnaces which are used intermittently, and may face corrosive conditions while cool.

The grades have similar corrosion resistance to grade 304 which has not been sensitised. They are not suitable for decorative applications, as the stabilising additions produce inclusions which impair surface quality. They are not available in BA finish, and are usually used as heavy sections in 2D or No 1 finish.

Chemical Composition Specification, % maximum or range (ASTM A240 – Flat Products)

		Carbon	Nickel	Chromium	Cobalt	Stabilising Addition	
S32100	321	0.08	9.00 – 12.00	17.00 – 19.00		Titanium = 5 x (C+N) – 0.70	
S32109	321H	0.04 – 0.10	9.00 – 12.00	17.00 – 19.00		Titanium = 4 x (C+N) – 0.70	
S34700	347	0.08	9.00 – 13.00	17.00 – 19.00		Niobium = (10 x C) – 1.00	
S34709	347H	0.04 – 0.10	9.00 – 13.00	17.00 – 19.00		Niobium = (8 x C) – 1.00	
S34800	348	0.08	9.00 – 13.00	17.00 – 19.00	0.20	(Niobium + Tantalum) (10 x C) – 1.00	Tantalum 0.10 max
S34709	347H	0.04 – 0.10	9.00 – 13.00	17.00 – 19.00	0.20	(Niobium + Tantalum) (8 x C) – 1.00	Tantalum 0.10 max

All these grades also contain these maximum amounts:

Silicon	Manganese	Phosphorus	Sulphur
0.75	2.00	0.045	0.030

Room Temperature Mechanical Property Specification (ASTM A240 – Flat Products)

	0.2% Proof Stress MPa	Tensile Strength MPa	Elongation %	Hardness HB (max)
321, 321H	205	515	40	217
347, 347H	205	515	40	201
348, 348H	205	515	40	201
304L	170	485	40	201

Typical Applications Welded construction and parts heated in the carbide precipitation range, subsequently requiring the corrosion resistance of grade 304: boilers, exhaust manifolds, fasteners, fire walls, furnace heating elements, jet engine parts, mufflers for stationary engines, stack liners.

Finishes: No1 (hot rolled, annealed and pickled), 2D (cold rolled).

Physical Properties (Typical, annealed)

Property	at	Value	Unit	Property	At	Value	Unit
Density		8,027	Kg/m^3	Melting Range		1400-1430	^{o}C
Electrical Conductivity	25^{o}C	1.25	% IACS	Specific Heat		500	J/kg. ^{o}C
Electrical Resistivity	25^{o}C	0.72	Micro ohm . m	Relative Magnetic Permeability		1.02	
				Coefficient of Expansion	0 – 100^{o}C	16.6	/ ^{o}C
Modulus of Elasticity	20^{o}C	193	GPa		0 – 315^{o}C	17.2	/ ^{o}C
Shear Modulus	20^{o}C	77	GPa		0 – 540^{o}C	18.6	/ ^{o}C
Poisson's Ratio	20^{o}C	0.30		Thermal Conductivity	100^{o}C	16.1	W / m . ^{o}C

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

Pressure Vessels AS1210, Pressure Vessels, allows the use of grade 321, 321H, 347, 347H, 348 and 348H. The following extract from table 3.3.1(B) gives the design temperatures and strengths for plate for these grades, with the unstabilised 304 type grades for comparison:

Grade	Maximum Design Temperature ^{o}C	Design Tensile Strength, MPa	
		at Maximum Design Temperature	at 600^{o}C
304	550	67	–
304L	425	63	–
304H	800	10	60
321	550	69	–
321H	800	2	44
347	550	86	–
347H	800	6	57
348	550	86	–
348H	800	6	57

High Temperature Service The generally accepted maximum service temperatures for these grades in air are the same as for grade 304 - 870^{o}C for intermittent, 925^{o}C for continuous service.

Heat Treatment Solution annealing is performed at 1000 - 1120^{o}C, followed by rapid cooling. The grades cannot be hardened by heat treatment. Stress relieving is rarely required due to their high ductility and frequent use at high temperatures.

Weldability These grades are readily weldable by most fusion techniques (GTAW / TIG, GMAW / MIG / MAG, MMAW / stick, SAW), with no preheat, postheat or control of interpass temperature needed. Grade 347 welding consumables are used for 321 and 347 grades, and are prequalified in AS1554.6:1994 for welding to most other austenitic grades. Pickling and passivation is not usually required for use at elevated temperatures.

ASTM Specifications

Plate, sheet & strip	Bar	Wire	Forgings	Tube & Pipe
A240	A276, A479	A580	A473	A213, A249, A271, A511, A554, A312, A376, A409, A430