

## 304 AUSTENITIC STAINLESS STEEL BAR

304 is a chromium-nickel austenitic stainless steel with good strength and excellent corrosion resistance as supplied in the annealed condition with a typical brinell hardness of 175. Characterised by high corrosion resistance in general atmospheric corrosive environments it exhibits excellent resistance to most oxidizing agents, general foodstuffs, sterilizing solutions, dyestuffs, most organic chemicals, plus a wide variety of inorganic chemicals also hot petroleum gases, steam combustion gases, nitric acid and to a lesser extent sulphuric acid. It displays good oxidation resistance at elevated temperatures and has excellent weldability.

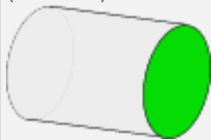
304 cannot be hardened by thermal treatment, but strength and hardness can be increased substantially by cold working, with subsequent reduction in ductility.

It is now available with improved machinability (by calcium injection treatment) which has little affect on corrosion resistance and weldability, while greatly increasing feeds and/or speeds plus extending tool life.

Used extensively by the Food Processing, Dairy Equipment, Dying Industry, Architectural Equipment, Hardware and Kitchenware Manufacturing Industry, Chemical, Petrochemical and Transport Industry etc..

Material non magnetic in the annealed condition, but can become mildly magnetic following cold working. Annealing is required to rectify if necessary.

N.B. Optimum corrosion resistance is achieved in the annealed condition.

Colour Code	Stocked Sizes	
Bright Green (Bar end)	Stocked Sizes	4.76 mm to 203.2 mm diameter.
	<b>Bar Finish</b>	
	Peeled, Cold Drawn Turned and Polished, and Centreless Ground.	

### Related Specifications

Australia	AS 2837-1986-304
Germany	W.Nr 1.4301 X5CrNi 18 10
Great Britain	BS970 Part3 1991 304S15/304S31 BS970 1955 EN58E
Japan	JIS G4303 SuS 304
USA	ASTM A276-98b 304 SAE 30304 AISI 304 UNS S30400

### Chemical Composition

	Min. %	Max %
Carbon	0	0.08
Silicon	0	1.00
Manganese	0	2.00
Nickel	8.00	10.50
Chromium	18.00	20.00
Nitrogen	0	0.10
Phosphorous	0	0.045
Sulphur	0	0.03

\*Molybdenum option addition.

### Mechanical Property Requirements - Annealed to ASTM A276-98b 304

Finish	Hot Finish	Cold Finish	Cold Finish
Dia or Thickness mm	All	Up to & incl 12.7mm	Over 12.7mm
Tensile Strength Mpa Min.	515	620	515
Yield Strength Mpa Min.	205	310	205
Elongation in 50mm % Min.	40	30	30

### Typical Mechanical Properties At Room Temperature - Annealed

Finish	Cold Drawn	Other	
Tensile Strength Mpa	680	590	
Yield Strength Mpa	500	240	
Elongation in 50mm %	42	55	
Impact Charpy V J	190	183	
Hardness	HB	195	155
	Rc	13	

### Elevated Temperature Properties

304 displays good oxidation resistance in continuous service up to 930 °C and in intermittent service up to 870 °C. Continuous service however, between 430 °C and 870 °C is not recommended, nor is slow cooling through this range due to the problem of intergranular corrosion. 304L (low carbon type) can be employed to overcome this problem. Mechanical properties are reduced as temperature increases.

### Typical Mechanical Properties - Annealed at Elevated Temperatures

Temperature °C	20	430	550	650	760	870	
Short - Time Tensile Tests	Tensile Strength Mpa	580	425	370	310	205	140
	Yield Strength Mpa	240	150	130	115	95	70
	Elongation in 50mm %	60	40	35	32	33	40
Creep Tests	Stress for % Creep in 10,000 hours Mpa			115	50	15	

### Low Temperature Properties

304 has excellent low temperature properties with increased tensile and yield strength without loss of toughness in the annealed condition.

### Typical Mechanical Properties - Annealed at Zero and Sub-Zero Temperatures

Temperature °C	0	-70	-130	-180	-240
Tensile Strength Mpa	870	1000	1300	1400	1650
Yield Strength Mpa	260	300	350	375	450
Elongation in 50mm %	57	50	45	40	30
Impact Charpy V J	190	190	185	180	180

The combination of high strength and toughness at low temperature allows this grade to be used in extremely cold climates or high altitudes, also for storage or liquified gasses at very low temperatures. 304 even when cold worked will still have high strength and ductility at sub-zero temperatures.

### Cold Bending

304 has excellent cold working properties and cold bending can generally be carried out without difficulty, after cold working it will be mildly magnetic. Annealing is generally not required except following very severe cold working.

### Hot Bending

Hot bending should be performed at 950 °C - 1100 °C, followed by annealing to restore optimum corrosion resistance.

## **Corrosion Resistance - All Corrosion Types**

### **General Corrosion**

304 has better resistance to general corrosion in most media than 303 or 302 grades but not as good as 316 and 316L grades.

### **Stress Corrosion Cracking**

304 has better resistance to stress corrosion cracking than 303 grade, but not as good as 316 or 316L grades.

### **Pitting Corrosion / Crevice Corrosion**

304 has better resistance to both pitting and crevice corrosion than 303 grade but not as good as the molybdenum bearing grades 316 and 316L etc.

### **Intergranular Corrosion**

304 has better resistance to intergranular corrosion than the higher carbon grades 303, 310 or 302, but not as good as the low carbon grades 304L and 316L, or the titanium stabilised grade 321.N.B. It is most important that oxygen is always allowed to circulate freely on all stainless steel surfaces to ensure that a chrome oxide film is always present to protect it. If this is not the case, rusting will occur as with other types of non stainless steel. For optimum corrosive resistance, surfaces must be free of scale and foreign particles. Finished parts should be passivated.

### **Forging**

Heat uniformly to 1150 °C - 1200 °C, hold until temperature is uniform throughout the section. Do not forge below 900 °C. Finished forgings should be air cooled. Finally forgings will require to be annealed in order to obtain optimum corrosion resistance.

### **Heat Treatment**

#### **Annealing**

Heat to 1020 °C - 1100 °C, hold until temperature is uniform throughout the section. \*Soak as required. Quench in water to obtain optimum corrosion resistance.\*Actual soaking time should be long enough to ensure that the part is heated thoroughly throughout its section to the required temperature, 30 minutes per 25 mm of section may be used as a guide. Please consult your heat treater for best results.

#### **Machining**

304 improved machinability is slightly more easy to machine than improved machinability 316 or 316L grades. But more difficult to machine than 303 free machining grade and most of the 400 series stainless steels. It has a typical machinability rating of around 55% - 60% of free machining (S1214) mild steel. Due to its high work hardening rate, cutting or drilling tools etc. must be kept sharp at all times and not cause unnecessary work hardening of the surface etc. All machining should be carried out as per machine manufacturers recommendations for suitable tool type, feeds and speeds.

#### **Welding**

304 is readily weldable by shielded fusion and resistance welding processes, followed by air cooling giving good toughness. Oxyacetylene welding is not recommended due to possible carbon pick up in the weld area. Small sections may be welded without loss of corrosion resistance due to intergranular carbide precipitation, but larger sections or for service in the more extreme condition, post weld annealing is recommended.

#### **Welding Procedure**

Welding electrodes or rods should be 308 or \*similar depending upon application. No pre heat or post heat is generally required.\*Please consult your welding consumables supplier.

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