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.

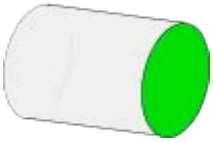
304 cannot be hardened by thermal treatment, but strength and hardness can be increased substantially by cold working, with subsequent reduction in ductility.

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  Bright Green (Bar end)	Stocked Sizes	5 mm to 155 mm diameter.
	Bar Finish	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 optional addition.

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

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

	Cold Finish	over 12.7 mm	515	205	30	

Typical Mechanical Properties At Room Temperature - Annealed

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

Elevated Temperature Properties

304 displays good oxidation resistance in continuous service up to 930 C and in intermittent service up to 870 ^{o}C.

Continuous service however, between 430 ^{o}C and 870 ^{o}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 ^{o}C	Short - Time Tensile Tests			Creep Tests
	Tensile Strength Mpa	Yield Strength Mpa	Elongation in 50 mm %	Stress for % Creep in 10,000 Hours Mpa
20	580	240	60	
430	425	150	40	
550	370	130	35	115
650	310	115	32	50
760	205	95	33	15
870	140	70	40	

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 ^{o}C	Tensile Strength Mpa	Yield Strength Mpa	Elongation in 50 mm %	Impact Charpy V J
0	870	260	57	190
-70	1000	300	50	190
-130	1300	350	45	185
-180	1400	375	40	180
-240	1650	450	30	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 ^{o}C - 1100 ^{o}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 ^{o}C - 1200 ^{o}C, hold until temperature is uniform throughout the section.

Do not forge below 900 ^{o}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 ^{o}C - 1100 ^{o}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.