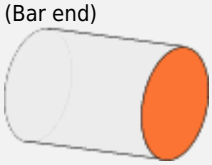
ENGINEERING STEELS + ALLOYS

2205 DUPLEX STAINLESS STEEL BAR

2205 is a (two phase) ferritic/austenitic stainless steel with high strength and excellent corrosion resistance, as supplied in the annealed condition with a maximum brinell hardness of 290 (Rc31).Characterised by high yield strength, double that of the standard austenitic stainless steel grades, good fatigue strength plus excellent resistance to stress corrosion cracking, crevice, pitting, erosion and general corrosion in severe environments. Again generally out performing the standard austenitic stainless steel grades. 2205 cannot be hardened by thermal treatment, but strength and hardness can be increased substantially by cold working, with subsequent reduction in ductility.It is used extensively by the Marine, Chemical, Petrochemical, Pulp and Paper, Oil and Gas, Transport and allied processing industries.

Typical uses are: Anchor Guides, Conveyors, Fasteners, Bushings, High Strength Pump Shafts, Propellor Shafts, plus various applications currently using standard austenitic stainless steel grades.

Material Magnetic due to its part ferritic structure.

Colour Code	Stocked Sizes	
Fluro Orange (Bar end) 	Stock Sizes	25.4 mm to 255 mm diameter.
	Bar Finish	
	Peeled, Turned Centreless Ground.	

Related Specifications	
Germany	W.Nr 1.4462 DIN X2CrNiMoN22 5 3
USA	ASTM A276-98b UNS S31803

Chemical Composition		
	Min. %	**Max %**
Carbon	0	0.03
Silicon	0	1.00
Manganese	0	2.00
Nickel	4.50	6.50
Chromium	21.00	23.00
Molybdenum	2.50	3.50
Nitrogen	0.08	0.20
Phosphorous	0	0.03
Sulphur	0	0.02

Mechanical Property Requirements - Annealed (As Supplied) to ASTM A276-98b UNS S31803 for Hot and Cold Finished	
Temsile Strength Mpa Min.	620
0.2% Yield Strength Mpa Min.	448
Elongation in 50mm % Min.	25
Hardness HB Max	290
Typical Mechanical Properties at room temperature - Annealed	

Temsile Strength Mpa		650 - 900
Yield Strength Mpa		570
Elongation in 50mm %		30
Impact Charpy J		130
Hardness	HB	235
	Rc	23

Elevated Temperature Properties*

While the oxidation resistance of 2205 is good at high temperature as with other duplex stainless steel grades, it is subject to embrittlement when exposed to temperatures above 300ºC even for short periods. It is subject to embrittlement at 475ºC when exposed for 2 hours only, also between 370ºC and 540ºC over a longer period.Precipitation of sigma phase will also occur above 650ºC resulting in decreased ductility and corrosion resistance. *2205 is therefore not recommended for use at temperatures above 300ºC.

Typical Mechanical Properties at Elevated Temperatures for 63.5 mm Dia Section - Annealed Condition

Test Temperature ºC	315	370	480
Temsile Strength Mpa	650	640	
Yield Strength Mpa	390	375	
Charpy V Notch Impact After 100 Hours at Temp J	45	22	5

N.B. Should embrittlement occur then annealing is required to rectify.

Low Temperature Properties

2205 is not recommended for use at temperatures below -50ºC, again due to its embrittling effect resulting in low ductility.N.B. Unlike high temperature exposure however, the embrittling effect of low temperature exposure is not permanent, existing only for the duration at low temperature.

Typical Charpy V-Notch Impact Properties at Low and Sub Zero Temperatures

Test Temperature ºC	25	0	-20	-45
Impact Test Charpy V-Notch	160	60	30	15

Bending

Cold Bending

Cold bending will be extremely difficult due to the high yield strength. Any cold working causing more than 10% deformation should be followed by annealing.

Hot Bending

Hot bending should be performed at 950ºC - 1000ºC followed by annealing.

Corrosion Resistance

General Corrosion

2205 has superior resistance to general corrosion in most media than 316L or 317L austenitic stainless steel grades

Stress Corrosion Cracking

2205 has a much higher resistance to stress corrosion cracking than 304L or 316L austenitic stainless steel grades.

Pitting Corrosion / Crevice Corrosion

2205 has a higher resistance to pitting corrosion than 316L or 317L austenitic stainless steel grades.

Crevice Corrosion

2205 has a higher resistance to crevice corrosion and erosion corrosion than 316L austenitic stainless steel grade.

Corrosion Fatigue

2205 has better fatigue strength in corrosive environments than the standard austenitic stainless steel grades due to its higher strength and higher corrosion resistance.N.B. For optimum corrosion resistance, surfaces must be free of scale and foreign particles. Finished parts should be passivated.

Forging

Heat uniformly to 1150°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 mechanical properties and 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 25mm of section may be used as a guide.Please consult your heat treater for best results.

Machining

The machinability of 2205 in the annealed as supplied condition is lower than either 304 and 316 due to it's higher yield strength (approximately double).Typically 80% as machinable as the standard 304 and 316 grades, but lower against the improved machinability 304 and 316 grades. N.B. All machining should be carried out as per machine manufacturers recommendations for suitable tool type, feeds and speeds.

Welding

2205 is readily weldable by the various standard electric arc welding processes.Oxcyacetylene welding is however not recommended due to the possibility of carbon pick up in the weld area.

Welding Procedure

Welding of 2205 should always be carried out using duplex stainless electrodes* similar to the parent metal.No pre-heat or post-heat is required. Post weld annealing, while not necessary for many applications, will however provide optimum corrosion resistance in severe service conditions.*Please consult your welding consumables supplier.

316L due to its low carbon content has greater resistance to intergranular corrosion than all the austenitic stainless steel grades except 304L grade and 321 titanium stabilized grade.