



Duplex Stainless Steel Bar 2205

Colour code: Lime

Introduction

2205 is the most widely used duplex (ferritic/austenitic) stainless steel grade. It finds applications due to both excellent corrosion resistance and high strength.

The standard S31803 composition has over the years been refined by many steel suppliers, and the resulting restricted composition range was endorsed as UNS S32205 in 1996. S32205 gives better guaranteed corrosion resistance, but much of the S31803 currently produced also complies with S32205.

Atlas 2205 is not generally suitable for use at temperatures above 300°C as it suffers from precipitation of brittle micro-constituents, nor below -50°C because of its ductile-to-brittle-transition.

Related Specifications

Grade	UNS No	British BS	Euronorm		Swedish SS	Japanese JIS
			No	Name		
2205	S31803 / S32205	318S13	1.4462	X2CrNiMoN22-5-3	2377	SUS329J3L

These comparisons are approximate only. The list is intended as a comparison of functionally similar materials **not** as a schedule of contractual equivalents. If exact equivalents are needed original specifications must be consulted.

Chemical Composition

Specification values in %, according to ASTM A276

Grade	C	Mn	Si	P	S	Cr	Mo	Ni	N
2205 (S31803)	≤ 0.03	≤ 2.0	≤ 1.0	≤ 0.030	≤ 0.020	21.0-23.0	2.5-3.5	4.5-6.5	0.08-0.20
2205 (S32205)	≤ 0.03	≤ 2.0	≤ 1.0	≤ 0.030	≤ 0.020	22.0-23.0	3.0-3.5	4.5-6.5	0.14-0.20

Atlas 2205 complies with grade S31803 as well as grade S32205.

Conditions of Supply – Specified Mechanical Properties

Values below are specified values according to ASTM A276, condition A, for cold finished bars.

Grade	Tensile Strength (MPa) min	Yield Strength 0.2% Proof (MPa) min	Elongation (% in 50mm) min	Hardness	
				Rockwell C (HR C)	Brinell (HB)
2205	655	450	25	31 max	293 max

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Conditions of Supply – Typical Physical Properties

Density (kg/m ³)	Elastic Modulus (GPa)	Mean Coefficient of Thermal Expansion			Thermal Conductivity		Specific Heat 0-100 °C (J/kg.K)	Electrical Resistivity (nΩ.m)
		0-100°C (µm/m/°C)	0-315°C (µm/m/°C)	0-538°C (µm/m/°C)	at 100°C (W/m.K)	at 500°C (W/m.K)		
7800	200	13.7	14.7	-	19.0	-	450	850

Corrosion Resistance

Atlas 2205 possesses excellent general corrosion resistance; superior to Grade 316 in most environments. Excellent resistance to localised corrosion including intergranular, pitting and crevice corrosion; the CPT of 2205 is generally at least 35°C. The grade is also resistant to chloride stress corrosion cracking (SCC) at temperatures of up to about 150°C. Grade 2205 will often perform well in environments which cause premature failure of austenitic grades. It has better resistance to sea water than grade 316. Consult Atlas Technical Assistance for specific environmental recommendations.

Heat Resistance

Although Atlas 2205 has good high temperature oxidation resistance this grade, like other duplex stainless steels, suffers from embrittlement if held for even short times at temperatures above 300°C. If embrittled this can only be rectified by a full solution annealing treatment. Duplex stainless steels are almost never used above 300°C.

Conditions of Supply – Finish, Dimensions and Tolerances

Surface Finish

Round bar up to 25.4mm diameter is all cold drawn. Round bars over 25.4 and up to 127.00mm diameter are smooth-turned and polished. Round bars over 127.00mm diameter are all peeled.

All hexagon bar and all square bar is cold drawn.

Diameter and A/F tolerances

Round Bar: Cold drawn h9; Smooth-turned and Polished h10; Peeled up to 160mm k12; Peeled over 160mm +1.5mm/-0; Centreless ground h9 or h8

Square Bar: h11; Hex Bar: h11.

Straightness – Maximum deviation from a straight line

Round Bar: 1.5mm in 1500mm and may not exceed: 1.5mm x length in mm / 1500mm

Squares and Hexagon: 1.5mm in 1500mm and may not exceed: 1.5mm x length in mm / 1500mm

Other tolerances may be supplied for more critical applications upon enquiry.

Length Tolerance

Sizes up to 25.4mm:

Mill Lengths and Set Lengths, +50mm/-0

Sizes up from 25.4mm to 50.8mm:

Mill Lengths and Set Lengths, +100mm/-0

Sizes over 50.8mm:

Mill Lengths and Set Lengths, +/- 300mm

(varies depending on size)

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Heat Treatment

The following temperature ranges are applicable for the respective heat treatment operations.

Forging	Annealing
900 – 1200°C	1010 – 1120°C

Cool rapidly after annealing. Atlas 2205 cannot be hardened by thermal treatment.

Processing

The high strength that makes 2205 useful in many applications also reduces its machinability. The high work-hardening rate further decreases the machinability of 2205. Cutting speeds are approximately 20% slower than for a standard grade 304.

The high strength of 2205 also makes bending and forming more difficult; these operations will require larger capacity equipment than would be required for austenitic stainless steels. The ductility of 2205 is less than that of an austenitic grade (but is not low when compared to most other structural materials), so severe forming operations, such as cold heading, are not generally possible. If severe cold working is required it is recommended that intermediate annealing be carried out.

Welding

Weldable by all standard methods, but should not generally be welded without filler metal as this may result in excessive ferrite. AS 1554.6 pre-qualifies welding of 2205 with 2209 rods or electrodes to ensure that deposited metal has the correctly balanced duplex structure. Nitrogen added to the shielding gas will also assist in ensuring adequate austenite in the structure. Heat input must be kept low and no pre- or post-heat should be used. The lower co-efficient of thermal expansion of all duplex stainless steels compared with austenitic grades reduces distortion and associated stresses.

Applications of Atlas 2205

Chemical processing, transport and storage. Oil and gas exploration and processing equipment. Marine and other high chloride environments. Pulp & Paper digesters, liquor tanks and paper machines.

Possible Alternative Grades

Grade	Why it may be chosen instead of Atlas 2205
904L	Better formability is needed, with similar corrosion resistance and lower strength.
UR52N+	Higher resistance to corrosion is required, eg resistance to higher temperature seawater.
6%Mo	Higher corrosion resistance is required, but with lower strength and better formability.
316L	The high corrosion resistance and strength of 2205 are not needed... 316L is lower cost.
329	Similar corrosion resistance and mechanical properties but higher machinability.

Disclaimer

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