



Langley Alloys

Duplex

Alloy 2205

Specifications:

UNS S32205 F60, UNS S31803 F51, ASTM A479, ASTM A182, F51, F60, EN 1.4462 X2CrNiMoN 22.5.3, NACE MR0175 / ISO 15156, Norsok MDS 47, API 6A

Alloy 2205 is a 22% Cr duplex stainless steel, supplied in the solution annealed condition. As a duplex stainless steel, it combines the desirable properties of both austenitic and ferritic grades. The high Chromium, Molybdenum and Nitrogen content results in a Pitting Resistance Equivalent number (PREN) of 34, providing pitting and crevice corrosion resistance superior to Alloy 316L or Alloy 317L austenitic stainless steels in almost all corrosive media. Due to its excellent corrosion properties, it is well-suited to environments containing chlorides and hydrogen sulphide, for use in oil & gas extraction from sour wells, in refineries and in process solutions contaminated with chlorides.

It also has good erosion fatigue properties as well as lower thermal expansion and higher thermal conductivity than austenitic steels. The yield strength is about twice that of austenitic stainless steels, allowing a designer to save weight and make the alloy more cost competitive when compared to Alloy 316L or Alloy 317L.

Key Features:

- Higher strength than standard stainless steels
- Higher corrosion resistance than Alloy 316L stainless steel in a wide variety of corrosive chemicals including sulphuric, phosphoric and nitric acids
- Good resistance to pitting and crevice corrosion in seawater
- High stress corrosion resistance
- Lower thermal expansion than austenitic stainless steels
- Higher thermal conductivity than austenitic stainless steels

Typical Applications:

- Process industry components in sulphuric acid, nitric acid, phosphoric acid, ethylene oxide, polypropylene & PVC production

- Equipment handling organic & fatty acids, chemical storage, tankers, heat exchangers
- Marine industry and shipbuilding propellers, shafts, rudders, shaft seals, pumps, bolts, fasteners, valves, instrumentation,
- Oil and chemical tankers
- Oil & Gas industry pumps, valves, pipe, vessels, wellhead equipment, subsea equipment, separators, heat exchangers
- Pollution control systems, effluent scrubbing, flue gas desulphurisation (FGD)
- Waste water treatment, sour water purification
- Pulp & paper industry applications such as pulp liquor heaters, bleach tower linings, digesters, brownstock washers
- Food industry applications including brewery piping, evaporators, hot liquor tanks, presses

Physical Properties:

Density (Kg/m ³)	7810
Magnetic Permeability (20°C)	<50
Young's Modulus (kN/mm ²)	190
Specific Electrical Resistance, 20°C (μΩ.m)	0.85
Mean coefficient of thermal expansion, 20 - 300°C (m/m/°C)	11 x 10 ⁻⁶
Specific Heat, 20°C (J/kg.K)	400
Thermal conductivity, 20°C (W/m.K)	15

Product Forms Available:

Bar	✓
Plate	✓
Tube	Enquiry
Fittings	Enquiry
Forgings	To order
Castings	To order

Mechanical Properties:

0.2% Proof Stress	450 N/mm ²	91.4ksi
Tensile Strength	655 N/mm ²	123.3ksi
Elongation, 5.65√S0	25%	
Reduction of area	45%	
Hardness (Brinell)	< 270	
Impact Strength (-46°C)	Longitudinal < 100mm 100 - 260mm ≥ 260mm	80J 45J (35J min) for info only
	Transverse 50 - 260mm ≥ 260mm	45J (35J min) for info only

Notes:

1. Testing shall be carried out in accordance with ASTM A370 or EN ISO 6892-1 (tensile), EN ISO 6506-1 (hardness)
2. Minimum properties quoted (tested at room temperature in a longitudinal direction)
3. Testing performed on each melt of material per heat treatment batch
4. Hardness shall be in accordance with NACE MR0175
5. Additional tests routinely undertaken:
 - a) ASTM G48A corrosion test (at 50°C)
No pitting and < 4.0g/m² weight loss
 - b) Ferrite content 35-55%
 - c) Microstructure certified free from grain boundary carbides, sigma, chi and laves phases

Chemical Composition:

	Cr	Ni	Mo	Co	Nb (+Ta)	Ti	V	W	Cu	C	Mn	N	Si	P	S	Fe	Al
Min	22.00	4.50	3.00									0.14	0.20				
Max	23.00	6.50	3.50							0.03		0.20	0.70	0.030	0.020	Bal	

Product Comparison:

Alloy Comparisons	S32205	S17400 (17-4PH)	N07718	Ferralium® 255-SD50
Pitting Resistance Equivalent number	34	16	31	>40
0.2% Proof Strength (N/mm ²)	450	1070	550 max	600
Corrosion Rate (mm/year) - Seawater	<0.01	~1	<0.01	<0.01
Corrosion Rate (mm/year) - 10% sulphuric acid at 80°C	0.4	10	<0.15	<0.15
Corrosion Rate (mm/year) - Boiling 50% nitric acid	<0.15	<0.15	<0.15	<0.15
Wear Properties related to Hardness (HRC), typical	RC25	RC38	RC20	RC28

Machining Advice:

Operation	Cutting Speed m/min (ft/min)	Feed Rate mm/rev (in/rev)	Depth of cut mm (in)
Milling	45 (130)	0.05 - 0.13 mm/tooth (0.02 - 0.005 in/tooth)	0.5 - 6.0 (0.02 - 0.25)
Drilling - 6.4mm (1/4") dia	250 rpm	0.075 (0.003)	
Drilling - 12.7mm (1/2") dia	250 rpm	0.125 (0.005)	
Drilling - 25.4mm (1") dia	150 rpm	0.28 (0.011)	
Turning - Roughing	30 - 45 (100 - 150)	0.20 - 0.38 (0.008 - 0.015)	2.0 (0.08)
Turning - Finishing	50 - 60 (165 - 200)	0.13 - 0.20 (0.005 - 0.008)	0.3 (0.01)
Tooling	Milling/Turning: Carbide (SANDVIK GC 235, SECO T25M) Drilling: HSS, point angle 118°, chisel angle 120°		

Production Route:

Alloy 2205 is produced through high-precision steelmaking processes to ensure cleanliness and consistency.

- All material shall be refined by Vacuum Oxygen Decarburisation (VOD) or Argon Oxygen Decarburisation (AOD)
- Further refinement by Electric Slag Refining (ESR) is allowable
- The minimum forging ratio utilised is at least 4:1
- Solution treatment shall be carried out at a temperature between 1060 - 1120°C for a minimum of one hour
- This will be followed by immediate water quench
- Bars are supplied peeled and polished to a surface finish of 125CLA or better
- Each bar is ultrasonically tested and visually inspected

Further Processing:

- Order processing and stock control is facilitated by a fully-integrated computer system which links to item production and inspection
- Automated band saws are available for accurate stock cutting up to a section size of 650mm (25")
- First-stage processing, including water jet cutting, turning, boring and grinding can be undertaken to help manage your overall supply chain
- Additional documentation and certification can be supplied as required

Unique metals for your demanding applications

UK

The Wharf | 504-506 Lowfield Dr | Newcastle Under Lyme
Staffordshire | ST5 0UU | UK
+44 (0)1782 610250

sales@langleyalloys.com

USA

102 Longview Street | Conroe
Houston | Texas 77301 | USA
+001 (281) 819 5588

usa@langleyalloys.com

www.langleyalloys.com

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