



# DUPLEX 2205

UNS No - S32205 / S31803

Duplex 2205 are nitrogen improved duplex stainless steel that was created to combat normal corrosion issues experienced with the 300 series stainless steels. "Duplex" define a family of stainless steels that are neither completely austenitic, like 304 stainless, nor absolutely Ferritic, like 430 stainless. The structure of 2205 duplex stainless steel comprises of austenite pools encompassed by a persistent ferrite phase. In the annealed condition, 2205 consist around 40-50% ferrite. Frequently referred to as the workhorse grade, Duplex 2205 are the most generally utilized grades in the duplex family of stainless steels. One of the benefits of a duplex architecture is that it consolidates the great characteristics of a Ferritic alloy (stress corrosion cracking resistance and high strength) with those of an austenitic alloy (ease of fabrication and corrosion resistance). Use of 2205 Duplex stainless steel should be restricted to temperatures below 600° F. Extended high temperature exposure can embrittled 2205 stainless steel.

## Applications

- Chemical process vessels, piping and heat exchangers
- Pulp mill digesters, bleach washers, chip pre-steaming vessels
- Food processing equipment
- Oil field piping and heat exchangers
- Flue gas desulfurization equipment

## Characteristics

- High resistance to chloride stress corrosion cracking
- Resistance to chloride pitting and crevice corrosion
- Good general corrosion resistance
- Good sulphide stress corrosion resistance
- High Strength
- Good weldability and workability

# DUPLEX 2205

## Corrosion Resistance

2205 duplex stainless steel is a profitable solution for many applications where the 300 series stainless steels are helpless to chloride stress corrosion splitting. Stress corrosion cracking developed when stainless steels are subjected to tensile stress; while in contact with solutions includes chlorides. Increasing temperatures additionally build the weakness of stainless steels to stress corrosion cracking. The mix of chromium, molybdenum and nitrogen convey the very good resistance of 2205 to chloride pitting and crevice corrosion. This resistance is critical for services, for example, marine environments, brackish water, bleaching operations, closed loop water systems and some food processing applications. The high chromium, molybdenum and nitrogen substance of 2205 give corrosion resistance better than basic stainless steels, for example, 316L and 317L in many situations.

## Machining

Slow speeds, positive feeds, sharp tooling and rigid mounts are essential. It can be machinable with either high speed or carbide tooling, with speeds for carbide decreased by around 20 %.

## Forming

Because of its naturally high strength and work hardening rate, 2205 is hard to form. It will take a lower range than 316 stainless and a higher allowance must be made for spring back.

## Welding

Most standard welding techniques suit this grade, except welding without filler metals, which results in excess ferrite. AS 1554.6 pre-qualify welding for 2205 with 2209 rods or electrodes so that the saved metal has the right adjusted duplex structure. Adding nitrogen to the shielding gas guarantees that sufficient austenite is added to the structure. The heat input must be maintained at a low level, and the utilization of pre or post heat must be stayed away from. The co-efficient of thermal expansion for this grade is low; hence the distortion and stresses are lesser than that in austenite grades.

## Hot Working

Hot work should be done within the scope of 1750-2100 F, although room temperature forming is recommended whenever possible. When any hot forming is executed, a full anneal with rapid quench is required to reattain maximum stability and properties.

## Annealing

Anneal at 1868-1958 F (1020-1070 C), water quench.

## Chemical Properties

UNS	C	N	Si	P	S	Cr	Mn	Ni	Mo
<b>S31803</b>	0.03 max	0.08-0.20	1.0 Max	0.03 Max	0.02 Max	21.0- 23.0	2.0 max	4.5- 6.5	2.5- 3.5
<b>S32205</b>	0.03 max	0.14-0.20	1.0 Max	0.03 Max	0.02 Max	22.0- 23.0	2.0 max	4.5- 6.5	3.0- 3.5

# DUPLEX 2205

## Mechanical Properties

Tensile Strength (ksi)	0.2% Yield Strength (ksi)	Elongation% in 2 inches
90	65	25

## Physical Properties

Properties	Units	Temperature in °C
Density	7.88 g/cm <sup>3</sup>	Room
Specific Heat	0.11 Kcal/kg.C	20°
Melting Range	1385-1444 °C	-
Modulus of Elasticity	190 KN/mm <sup>2</sup>	20°
Electrical Resistivity	80 μΩ.cm	20°
Coefficient of Expansion	13.7 μm/m °C	20-100°
Thermal Conductivity	19.0 W/m-°K	20°

## ASTM Specifications

Pipe (SMLS) / Pipe Welded	Tube SMLS / Tube Welded	Sheet / Plate Strip	Bar	Fitting
A 790	A 789	A 240	A 276	A 182

## Availability

MANUFACTURING
Fasteners
Custom Machining
Custom Fabrication
Piping / Spools
Stamped Parts
B/W Fittings
S/W Fittings
Flanges
Compression Fittings

RAW MATERIALS
Pipes
Tubes
Bars
Sheets
Plates
-
-
-
-

### Disclaimer

The data and information in this data sheet are accurate to the best of our knowledge and belief, but are intended for general information only. Applications recommended for the materials are described only to help readers make their own evaluations and decisions, and are neither guarantees nor to be construed as express or implied warranties of suitability for these or other applications. Data referring to mechanical properties and chemical analyses are the result of tests performed on specimens obtained from specific locations with prescribed sampling procedures; any warranty thereof is limited to the values obtained at such locations and by such procedures. There is no warranty with respect to values of the materials at other locations. Sunmach and the Sunmach logo are registered trademarks of Sunmach Company. The contents & images of this datasheet are introduced for information purposes only and all the registered trademarks of their respective owners.

**SUNRISE MACHINATION LLP**

[www.sunmach.net](http://www.sunmach.net)

