

DUPLEX STAINLESS STEEL MATERIAL FLANGES

USAGE OF DUPLEX/SUPERDUPLEX FLANGES

Duplex and super duplex stainless steel flanges are chosen for their superior strength and exceptional corrosion resistance, especially in harsh environments. These materials combine the best attributes of austenitic (300 series) and ferritic stainless steels, offering higher strength and resistance to pitting and crevice corrosion.



Duplex/Super duplex steel flanges are used in conjunction with duplex&super duplex steel pipes ATSM A790/928 Here are specific scenarios where duplex and super duplex flanges are the preferred choice:

1. Aggressive Corrosive Environments

Duplex and super duplex stainless steels have high chromium, molybdenum, and nitrogen content, which contribute to their outstanding resistance to chloride-induced pitting and crevice corrosion. They are ideal for use in environments exposed to saltwater, such as marine applications, offshore oil drilling, and processing plants near coastal areas.

2. High-Strength Requirements

The mechanical strength of duplex and super duplex stainless steels is significantly higher than that of standard austenitic and ferritic stainless steels. This makes them suitable for applications requiring robust flanges that can withstand high pressures and mechanical stress, such as pressure vessels, high-pressure piping systems, and structural applications.

3. Chemical Processing Industries

These materials excel in environments where they are exposed to a wide range of aggressive chemicals and high temperatures. Duplex and super duplex flanges are used in chemical processing plants for piping systems that transport corrosive substances, providing longevity and reliability.

4. Oil and Gas Industry

In the oil and gas sector, duplex and super duplex flanges are utilized for their combination of strength and corrosion resistance. They are particularly valuable in applications such as subsea equipment, offshore platforms, and processing equipment that handle sour gas (high in hydrogen sulfide).

5. Desalination and Water Treatment

The resistance of duplex and super duplex stainless steels to chloride corrosion makes them excellent choices for desalination plants and water treatment facilities, where they can withstand the corrosive effects of high-chloride waters.

6. Pollution Control Equipment

Duplex and super duplex stainless steels are used in flue gas desulfurization systems and other pollution control equipment. Their corrosion resistance is crucial in environments where they are exposed to acidic gases and other corrosive byproducts.

Key Considerations:

- **Cost vs. Benefits:** While duplex and super duplex stainless steels are more expensive than standard stainless steels, their enhanced properties can offer long-term cost savings through increased durability, reduced maintenance, and longer service life.
- **Welding and Fabrication:** These materials require careful welding and fabrication techniques to preserve their mechanical and corrosion-resistant properties. Proper procedures, including the use of suitable filler metals and post-weld heat treatment, may be necessary.
- **Material Availability:** Duplex and super duplex materials are more specialized than standard stainless steels, and their availability in certain forms or sizes may be limited. Planning and sourcing should take this into consideration.

Duplex steel (ASTM A182 2205) is an extremely corrosion-resistant, work-hardenable stainless steel, whose microstructure consists of a mixture of austenite and ferrite phases.

Due to this particular chemical and physical composition, duplex stainless steel UNS S31803 features the properties characteristic of both types of stainless steel materials (ferritic and austenitic).

Generally speaking, duplex stainless steel is way tougher than ferritic stainless steel, has a superior strength than austenitic steels (series 300 and 400), and has superior corrosion resistance when compared to SS304 and SS316 (high intragranular corrosion, also in chloride and sulfide environments).

Whilst austenitic stainless steels are non-magnetic, duplex stainless steel shows magnetic properties.

CHEMICAL COMPOSITION ASTM A182 DUPLEX AND SUPER DUPLEX

%	Duplex 2205 (ASTM A182 UNS S31803 – UNS S32205)	Super Duplex ASTM A182 UNS S32750 – 32760)
C	0-0.03	0.03 max
Mn	2.0	1.5
Si	1.0	0.8
P	0-0.03	0.035
S	0-0.02	0.02
Cr	21-23	24-26
Mo	2.5-3.5	3.0-5.0
Ni	4.5-6.5	5.5-8.0
N	0.08-0.2	0.2-0.35
Cu	–	0.5-3.0

The most widely used grade for Duplex flange is 2205, due to its superior resistance to corrosion and mechanical strength.

The designation “2205” is related to the chemical composition of this material, which features 22% of chromium and 5% of nickel.

Super Duplex flanges show an even superior strength and a higher corrosion resistance than standard duplex steel (and austenitic grades, of course).

The main difference between a duplex and a super duplex grade is the addition of copper to the alloy (in addition to increased amounts of Chromium, Moly, and Nickel).

The addition of copper gives Super Duplex Stainless Steel an improved resistance to hot chlorides and strong reducing acids, like sulphuric acid, compared to a standard Duplex grade.

Whilst UNS S31803, UNS 32205 (duplex) and UNS S32750, UNS S32760 are standard designations, most manufacturers of superalloys attribute proprietary names to these steels (for example UR52N+ is a Usinor/ Arcelor Super Duplex steel, Ferralium, Zeron, Sandvik SAF 2205 22Cr, etc).

MECHANICAL PROPERTIES A182 DUPLEX AND SUPER DUPLEX

Mechanical Properties	Duplex 2205 (ASTM A182 UNS S31803 – UNS S32205)	Super Duplex ASTM A182 UNS S32750 – 32760)
Tensile Strength (in MPa)	620	770
Proof Stress 0.2% (in MPa)	450	550
A5 Elongation (in %)	25	25

Physical Attribute	Duplex 2205 (ASTM A182 UNS S31803 – UNS S32205)	Super Duplex ASTM A182 UNS S32750 – 32760)
Density (g.cm ³)	7.805	7.810
Modulus of Elasticity (GPa)	200	205
Electrical Resistivity (Ω .m)	0.085×10 ⁻⁶	0.085×10 ⁻⁶
Thermal Conductivity (W/m.K)	19 at 100°C	17 at 100°C
Thermal Expansion (m/m.K)	13.7×10 ⁻⁶ to 100°C	13.5×10 ⁻⁶ to 200°C

The significant addition of Chromium in Duplex Steel grades, which protects the alloy against corrosion, is a source of steel embrittlement at temperatures over about 300°C. However, at lower temperatures duplex steels show better ductility properties than ferritic and martensitic stainless steels (they can easily be used at a temperature below -50 C°).



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