MACSTEEL®

Data Sheet

M STAINLESS STEEL | DUPLEX TECHNICAL DATA

Description

Duplex stainless steels have a microstructure of nearly equal portions of austenite and ferrite. This microstructure ensures that they are much more resistant to stress corrosion cracking (SCC) than conventional austenitic stainless steels.

Strength

The 0.2% proof Stress of the duplexes is about double that of conventional austenitic stainless steels. This often allows down-gauging in the design after considering Young's Modulus and buckling limitations. This often delivers a cost benefit.

Duplex classification

Type	ASTM	UNS	EN
Lean	LDX 2101	S32101	1.4162
	2304	S32304	1.4362
Standard	2205	S32205	1.4462
Super	2507	S32507	1.4410

Typical applications

The lean duplexes have similar general and pitting corrosion resistance to the standard austenitics grades like 304/304L and 316/316L. Typical applications include process and storage tanks, food and beverage industry, structural applications, etc. 2205 will be used in applications requiring better corrosion resistance, such as environments containing chlorides and polluted marine environments, desalination plants, etc.

The higher chromium, molybdenum and nitrogen contents give 2205 significantly improved pitting and crevice corrosion resistance in the presence of chlorides. 2205 also has better general corrosion resistance than the 316L types in most environments. 2205 is a highly suitable material for service in environments containing chlorides and hydrogen sulphide such as marine environments and the oil and gas extraction and processing industries.

Super duplex steels are highly alloyed and have a corrosion resistance comparable to high performance austenitics. Typical applications for super duplex steels are desalination plants, seawater systems, flue-gas cleaning, umbilicals, storage tanks and pressure vessels.

Chemical composition (EN 10088-2 & ASTM A240)

Grade	%C	%MN	%Si	%Cr	%Ni	%Mo
LDX 2101	0.04 max	4.0 - 6.0	1.0 max	21.0 - 22.0	1.35 - 1.90	0.10 - 0.25
2304	0.03 max	2.0 max	1.0 max	22.0 - 24.0	3.5 - 5.5	0.1 - 0.6
2205	0.03 max	2.0 max	1.0 max	22.0 - 23.0	4.5 - 6.5	3.0 - 3.5
2507	0.03 max	1.2 max	1.0 max	24.0 - 26.0	6.0 - 8.0	3.0 - 5.0

Mechanical properties (EN 10088-2 & ASTM A240)

	0.2% proof stress (MPa)	Tensile (MPa)	Elongation (%)	Hardness (HB)
LDX 2101	450 min	650 - 850	30 min	290 max
2304	400 min	630 - 850	25 min	290 max
2205	460 min	640 - 950	25 min	293 max
2507	530 min	730 - 930	20 min	310 max

Short time elevated temperature tensile strength (MPa)

Grade	100°C	300°C	500°C	700°C	900°C
2304	580	490	-	-	-
2205	630	560			

Maximum recommended service temperature

Continuous service: 300°C
Intermitted service: 300°C
Generally limited from -50°C to 300°C

General corrosion

Duplex stainless steels have general corrosion resistance ranging from similar to the 304L to being superior to 316L types, and this is dependent on the corrosion media.

Pitting corrosion

Pitting resistance is important, mainly in applications involving contact with chloride solutions and particularly in the presence of oxidising media. These conditions may be conducive to localised damage to the passive layer on the steel and a single deep pit may well be more damaging than a much greater number of relatively shallow pits. Where pitting corrosion is anticipated, steels with high pitting resistance equivalents (PRE), such as the duplexes, should be considered.

Atmospheric corrosion

The atmospheric corrosion resistance of duplex stainless steels is unequalled by virtually all other uncoated engineering materials. LDX 2101 is normally sufficient in urban and industrial environments. 2304 is suitable in marine environments.

Oxidation resistance

The duplexes have good oxidation resistance, both in intermittent and continuous service, up to 980°C for 2304/ 2205 and 880°C for 2001. However, continuous use of the duplexes between 300°C and 950°C may embrittle the steel and lower the corrosion resistance.

Cold working

The duplexes have good formability, but due to the higher proof strength, more power is required for most cold forming operations than with austenitic stainless steels. Roll forming can be readily applied to the duplexes but loadings will be about 60% higher than for mild steel and slower speeds should be used.

Severe deep draws may require an intermediate anneal. Cold bending reduces the maximum gauge capacity of the machine by about half, compared with austenitics. The minimum inner bend radius for the duplexes is three times the plate thickness and four times is recommended. Severe bends should be carried out transverse to the rolling direction. The duplexes exhibit greater spring back than mild steel and this should be compensated for by slight over bending.

Welding

The duplexes have good weldability in most applications, provided that the recommended procedures are adopted.
Recommended filler welding electrode: E2209.