Grade Data Sheet

2101

LDX2101® is a duplex (ferritic/austenitic) stainless steel grade with a useful combination of corrosion resistance and high strength. Because it has almost no molybdenum and a low nickel content the grade is an economical alternative to 304 or 316 in some applications. In 2101 nickel is largely replaced by manganese and molybdenum's corrosion resistance role largely taken over by nitrogen. Yield strength is about double that of the standard austenitic grades 304 and 316.

LDX2101 was developed by Outokumpu as a "lean duplex" grade; it has since been allocated designations UNS S32101 and 1.4162 in the American and European standards systems. It also has ASME pressure vessel endorsement, initially under Code Case 2418.

Corrosion Resistance

General corrosion resistance between Grades 304 and 316 in most environments. Good resistance to localised corrosion including intergranular, pitting and crevice corrosion; the Pitting Resistance Equivalent (PRE) of 2101 is 26 – slightly higher than that of 316, but actual pitting and crevice corrosion behaviour is generally a between that of 304 and 316.

Grade 2101 is also resistant to chloride stress corrosion cracking (SCC) at temperatures up to over 100°C. It can perform well in environments which cause premature failure of austenitic grades.

Consult Atlas Technical Assistance for specific environmental recommendations.

Heat Resistance

Although 2101 has good high temperature oxidation resistance this grade, like other duplex stainless steels, suffers from embrittlement if held 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.

Low Temperature Performance

2101 is not generally recommended for use below -50°C because of its ductile-to-brittle-transition, again common to all duplex stainless steels.

Heat Treatment

Solution treatment (annealing)

Heat to 1020-1080°C and cool rapidly. This grade cannot be hardened by thermal treatment, but does work harden.

Welding

Weldable by all standard electric methods. Filler of 2209 rods or electrodes ensures that deposited metal has the correctly balanced duplex structure. Heat input should be kept low (although this is less restrictive than for other duplex grades) and no pre- or post-heat should be used. Unlike other duplex grades welding of 2101 without filler metal may be possible.

The lower co-efficient of thermal expansion of all duplex stainless steels compared with austenitic grades reduces distortion and associated stresses.

Machining

The high strength that makes 2101 useful in many applications also reduces its machinability, but overall it machines slightly better than 316.

Fabrication

The high strength of 2101 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 2101 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.

Typical Applications

Chemical processing, transport and storage. All structural and pressure applications requiring high strength and good corrosion resistance at economical cost.

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Specified Properties

These properties are specified for Grade 2101 (S32101) flat rolled product (plate over 5mm thick) in ASTM A240/A240M. Similar but not necessarily identical properties are specified for other products such as sheet, pipe and bar in their respective specifications.

Composition Specification (%)

Grade		C	Mn	Si	P	S	Cr	Mo	Ni	Cu	N
2101	min.	-	4.00	-	-	-	21.0	0.10	1.35	0.10	0.20
	max.	0.040	6.00	1.00	0.040	0.030	22.0	0.80	1.70	0.80	0.25

Mechanical Property Specification

Grade	Tensile Strength (MPa) min	Yield Strength 0.2% Proof (MPa) min	Elongation (% in 50mm) min	Hardness	
				Rockwell C (HR C)	Brinell (HB)
2101	650	450	30	-	290 max

Physical Properties

(typical values in the annealed condition)

Grade	Density (kg/m^3)	Elastic Modulus (GPa)	Mean Coefficient of Thermal Expansion			Thermal Conductivity		Specific Heat 0-100°C (J/kg.K)	Electrical Resistivity at 20°C (nΩ.m)
			0-100°C (μm/m/°C)	0-300°C (μm/m/°C)	0-538°C (μm/m/°C)	at 100°C (W/m.K)	at 300°C (W/m.K)		
2101	7800	200	13.0	14.0	-	16	18	530	800

Grade Specification Comparison

Grade	UNS No	Euronorm		Swedish SS	Japanese JIS
		No	Name		
2101	S32101	1.4162	-	-	-

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.

Possible Alternative Grades

Grade	Why it might be chosen instead of 2304
304L	Generally slightly lower pitting and crevice corrosion resistance than 2101 and lower strength, but more easily cold formed and more readily available. 304 is non-magnetic.
316L	Generally slightly higher pitting and crevice corrosion resistance than 2101, more easily cold formed and more readily available, but lower strength. 316 is non-magnetic.
2205	Higher resistance to corrosion is required, eg resistance to higher temperature chloride solutions. Grade 2205 is often more readily available than 2101.
F18MS / 444	Slightly higher pitting and crevice corrosion resistance than 2101, more easily cold formed and lower cost. F18MS / 444 is only available in thin gauge sheet and coil.
2304	Slightly higher resistance to corrosion is required, eg resistance to higher temperature chloride solutions. Grade 2304 is generally less readily available than 2101.