outokumpu
high performance stainless steel

Ultra 6XN

EN 1.4529, ASTM UNS N08926

General characteristics

6% Mo, high Ni, and N alloyed austenitic grade with extremely high resistance to both uniform and localized corrosion. Commonly used in applications to withstand chlorinated sea water also used in flue gas cleaning.

High performance austenitic stainless steels differ substantially from more conventional grades with regard to resistance to corrosion and, in some cases, also mechanical and physical properties. This is mainly due to the high contents of chromium, nickel, molybdenum and nitrogen. High performance austenitic stainless steels have good weldability and excellent formability. Outokumpu manufactures a number of steels of this type: 904L, 254 SMO®, 4565 and 654 SMO®, the grade 4529 can also be delivered if specified.

Typical applications

- In applications to withstand chlorinated sea water
- Flue gas cleaning
- Process equipment in chemical industry
- Bleaching equipment in the pulp and paper industry
- Desalination
- Seawater handling
- Hydrometallurgy
- Food and beverage
- Pharmaceuticals
- Heat exchangers

Products & dimensions

Cold rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
2B	Cold rolled, heat treated, pickled, skin passed	1.50-6.35	800-1600		
2E	Cold rolled, heat treated, mech. desc. pickled	0.40-6.35	36-1560	2.00-6.35	800-1600

Continous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled	7.00-8.00	800-1600	7.00-8.00	800-1600

Quarto plate products, available dimensions (mm)

Surface finish	Coil / Strip		Plate / Sheet	
	Thickness	Width	Thickness	Width

1D	Hot rolled, heat treated, pickled			8.00-45.00	400-2700

Chemical composition

The typical chemical composition for this grade is given in the table below, together with composition limits given for this grade according to different standards. The required standard will be fully met as specified on the order.

The chemical composition is given as % by weight.

	C	Mn	Cr	Ni	Mo	N	Other
Typical	**0.01**		**20.5**	**24.8**	**6.5**	**0.20**	**Cu:0.6**
ASME II A SA-240	≤0.020	≤2.00	19.00-21.00	24.00-26.00	6.00-7.00	0.15-0.25	Cu:0.50-1.50
ASTM A240	≤0.030	≤2.00	20.0-22.0	23.5-25.5	6.0-7.0	0.18-0.25	
ASTM A240	≤0.020	≤2.00	19.0-21.0	24.0-26.0	6.0-7.0	0.15-0.25	Cu:0.5-1.5
EN 10028-7	≤0.020	≤1.00	19.00-21.00	24.00-26.00	6.00-7.00	0.15-0.25	Cu:0.50-1.50
EN 10088-2	≤0.020	≤1.0	19.0-21.0	24.0-26.0	6.0-7.0	0.15-0.25	Cu:0.5-1.5
EN 10088-3	≤0.020	≤1.0	19.0-21.0	24.0-26.0	6.0-7.0	0.15-0.25	Cu:0.5-1.5
EN 10088-4	≤0.020	≤1.0	19.0-21.0	24.0-26.0	6.0-7.0	0.15-0.25	Cu:0.5-1.5
IS 6911	≤0.020	≤2.00	19.0-21.0	24.0-26.0	6.0-7.0	0.15-0.25	Cu:0.50-1.50

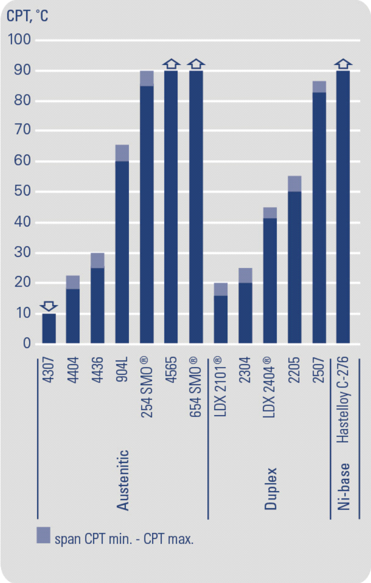
Corrosion resistance

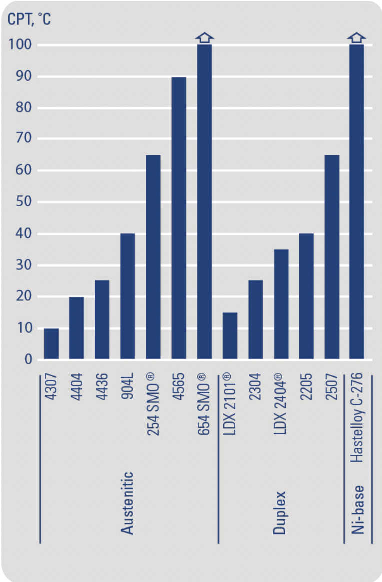
Uniform corrosion

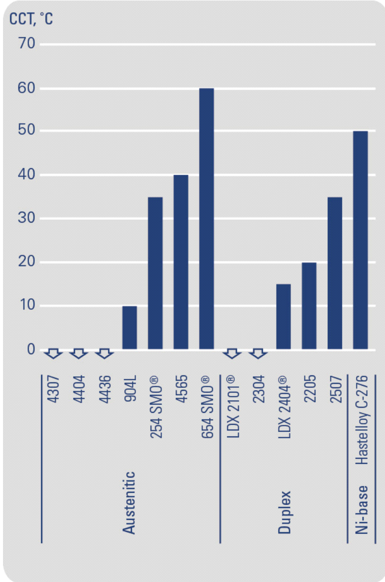
Uniform corrosion occurs when all, or at least a large section, of the passive layer is destroyed. This typically occurs in acids or in hot alkaline solutions. The influence of the alloy composition on the resistance to uniform corrosion may vary significantly between different environments; chromium is essential for ensuring the passivity of stainless steels, nickel helps reduce the corrosion rate of depassivated steel, molybdenum enhances passivity (except for strongly oxidising environments, such as warm concentrated nitric acid) and copper has a positive effect in the presence of reducing acids such as dilute sulphuric acid. In an environment with constant temperature and chemical composition, uniform corrosion occurs at a steady rate. This rate is often expressed as a loss of thickness per unit time, e.g. mm/y. Stainless steels are normally considered to be resistant to uniform corrosion in environments in which the corrosion rate does not exceed 0.1 mm/y. Impurities may drastically affect the corrosivity of acid solutions. For guidance on materials selection in a large number of environments capable of causing uniform corrosion, the tables and iso-corrosion diagrams in Outokumpu Corrosion Handbook may be consulted.

Pitting and Crevice corrosion

Chloride ions in a neutral or acidic environment facilitate local breakdown of the passive layer. As a result, pitting and crevice corrosion can propagate at a high rate, causing corrosion failure in a short time. Since the attack is small and may be covered by corrosion products or hidden in a crevice, it often remains undiscovered until perforation or leakage occurs. Resistance to pitting corrosion is determined mainly by the content of chromium, molybdenum and nitrogen in the stainless steel. This is often illustrated using the pitting resistance equivalent (PRE) for the material, which can be calculated using the formula: PRE = %Cr + 3.3 x %Mo + 16 x %N. The PRE value can be used for rough comparisons of different materials. A more reliable means, however, is to rank the steel according to the critical pitting temperature (CPT) of the material. There are several different methods available, for example ASTM G 150 that uses the Avesta Cell with a 1M NaCl solution (35 000 ppm or mg/l chloride ions). The CPT-values are shown in the table below. Higher contents of chromium, molybdenum and nitrogen also enhance the crevice corrosion resistance of the stainless steel. Typical values of the critical crevice corrosion temperature (CCT) in 6% FeCl3 + 1% HCl according to ASTM G48 Method F are included in the table below. The CPT and CCT values vary with product form and surface finish, the values given are for ground surfaces. Both ASTM G150 and G48 are methods for ranking the relative pitting or crevice corrosion resistance for the different stainless steels but they do not give the maximum temperature for using these alloys in real service environments.







CPT according to ASTM G150
Wet ground to 320 grit

Pitting corrosion resistance		Crevice corrosion resistance
PRE	**CPT**	**CCT**
45	>90	35

PRE Pitting Resistant Equivalent calculated using the formula: PRE = %Cr + 3.3 x %Mo + 16 x %N
CPT Corrosion Pitting Temperature as measured in the Avesta Cell (ASTM G 150), in a 1M NaCl solution (35,000 ppm or mg/l chloride ions).
CCT Critical Crevice Corrosion Temperature is the critical crevice corrosion temperature which is obtained by laboratory tests according to ASTM G 48 Method F

Mechanical properties

The mechanical properties of the available products are given in the table below.

Cold rolled coil and sheet	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
ASME II A SA-240	≥ 295		≥ 650					
ASTM A240	≥ 310		≥ 690			≤ 100HRB		
ASTM A240	≥ 295		≥ 650					
IS 6911	≥ 295		≥ 650					

Hot rolled coil and sheet	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
ASME II A SA-240	≥ 295		≥ 650					
ASTM A240	≥ 295		≥ 650					
IS 6911	≥ 295		≥ 650					

Hot rolled quarto plate	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
Typical (thickness 15 mm)	**320**	**340**	**700**	**50**			**180**	
ASME II A SA-240	≥ 295		≥ 650					
ASTM A240	≥ 295		≥ 650					

EN 10028-7	≥ 300	≥ 340	650 - 850	≥ 40				
EN 10088-2	≥ 300	≥ 340	650 - 850	≥ 40				
EN 10088-4	≥ 300	≥ 340	650 - 850	≥ 40				
IS 6911	≥ 295		≥ 650					

[1)]Elongation according to EN standard:
A_{80} for thickness below 3 mm.
A for thickness = 3 mm.
Elongation according to ASTM standard $A_{2''}$ or A_{50}.

Physical properties

The physical properties at room temperature are shown in the table below. Data according to EN10088 or EN10095.

Density kg/dm^3	Modulus of elasticity GPa	Thermal exp. at 100 °C 10^{-6}/°C	Thermal conductivity W/m°C	Thermal capacity J/kg°C	Electrical resistance µΩm	Magnetizable
8.1	195	15,8	12	450	1.00	No

Fabrication

Welding

Outokumpu 4529 can be welded with all conventional welding methods like:

Shielded metal arc welding (SMAW)
Gas tungsten arc welding, TIG (GTAW)
Gas metal arc welding, MIG (GMAW)
Flux-cored arc welding (FCAW)
Plasma arc welding (PAW)
Submerged arc welding (SAW)

An over-alloyed nickel-base filler should be used to overcome molybdenum segregatin. If autogenous welding is performed and no post weld heat treatment is used, the weld will have a reduced coroosion resistance. When welding thick gauges, the maximum heat input is 1.5 kJ/mm

Standards & approvals

Outokumpu produce and certify materials to most international and national standards. Work is continuously on-going to get the different grades approved for relevant standards. The most commonly used international product standards are given in the table below.

Standard	Designation
ASME SA-240M Code Sect. II. Part A	UNS N08926
ASTM A240/A240M	UNS N08926; UNS N08926
EN 10028-7, PED 2014/68/EU	1.4529
EN 10088-2	1.4529
EN 10088-3	1.4529
EN 10088-4	1.4529
IS 6911, AMENDMENT NO. 2	ISS 904LN

Contacts & Enquiries

Contact your nearest sales office

www.outokumpu.com/contacts

Working towards forever.

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: Clean energy, clean water and efficient infrastructure. Because we believe in a world that lasts forever.

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