outokumpu
high performance stainless steel

Ultra 254 SMO

EN 1.4547, ASTM UNS S31254

General characteristics

Ultra 254 SMO is a 6% molybdenum and nitrogen-alloyed austenitic stainless steel with extremely high resistance to both uniform and localized corrosion. This product was developed especially for oil and gas offshore platforms and the pulp and paper industry.

Typical applications

- Applications requiring resistance to chlorinated seawater
- Flue gas cleaning
- Maritime exhaust gas cleaning (EGC)
- Bleaching equipment in the pulp and paper industry
- Flanges and valves

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	0.60-3.00	30-1250	0.60-3.00	350-1250
2E	Cold rolled, heat treated, mech. desc. pickled	0.50-6.35	36-2040	0.50-6.35	300-2040
2R	Cold rolled, bright annealed	0.60-3.00	30-1250	0.60-3.00	350-1250

Continous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled	4.50-6.00	50-1250	4.50-6.00	350-1250

Quarto plate products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled			8.00-20.00	400-2700

Chemical composition

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

The chemical composition is given as % by mass.

	C	Mn	Cr	Ni	Mo	N	Other
Typical	**0.01**		**20.0**	**18.0**	**6.1**	**0.20**	**Cu:0.7**
ASME II A SA-240	≤0.020	≤1.00	19.50-20.50	17.50-18.50	6.00-6.50	0.18-0.25	Cu:0.50-1.00
ASTM A240	≤0.020	≤1.00	19.5-20.5	17.5-18.5	6.0-6.5	0.18-0.25	Cu:0.50-1.00
EN 10028-7	≤0.020	≤1.00	19.5-20.5	17.5-18.5	6.0-7.0	0.18-0.25	Cu:0.50-1.00
EN 10088-2	≤0.020	≤1.0	19.5-20.5	17.5-18.5	6.0-7.0	0.18-0.25	Cu:0.5-1.0
EN 10088-3	≤0.020	≤1.00	19.5-20.5	17.5-18.5	6.0-7.0	0.18-0.25	Cu:0.50-1.00
EN 10088-4	≤0.020	≤1.0	19.5-20.5	17.5-18.5	6.0-7.0	0.18-0.25	Cu:0.5-1.0
IS 6911	≤0.020	≤1.00	19.5-20.5	17.5-18.5	6.0-6.5	0.18-0.25	Cu:0.50-1.00

Corrosion resistance

Uniform corrosion

The high content of alloying elements gives Ultra 254 SMO exceptionally good resistance to uniform corrosion. It can withstand a wide range of acids due to the high alloying content of chromium and molybdenum. For guidance on material selection in a large number of environments, consult the tables and isocorrosion diagrams in the Outokumpu Corrosion Handbook.

Pitting and crevice corrosion

Resistance to pitting and crevice corrosion is determined mainly by the chromium, molybdenum, and nitrogen content. Ultra 254 SMO has high amounts of these elements and is suitable for demanding environments like chlorinated sea water.

Stress corrosion cracking

Resistance to stress corrosion cracking increases with increased content of nickel and molybdenum in particular. This means that Ultra 254 SMO has very good resistance to stress corrosion cracking.

More information is available in Outokumpu Corrosion Handbook.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	CPT	CCT
43	87±3	35

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

Mechanical properties

The addition of nitrogen to Ultra 254 SMO gives higher proof strength and tensile strength. Despite the greater strength, the possibilities for cold as well as hot forming are very good.

Mechanical properties at room temperature are shown 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
Typical (thickness 1 mm)	**375**	**415**	**735**	**60**				
ASME II A SA-240	≥ 310		≥ 655				≤ 223	
ASTM A240	≥ 310		≥ 655			≤ 96HRB	≤ 223	
EN 10028-7	≥ 320	≥ 350	650 - 850	≥ 35				
EN 10088-2	≥ 320	≥ 350	650 - 850	≥ 35				
EN 10088-4	≥ 320	≥ 350	650 - 850	≥ 35				
IS 6911	≥ 310		≥ 690			≤ 96HRB	≤ 223	

Hot rolled coil and sheet	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
Typical (thickness 4 mm)								
ASME II A SA-240	≥ 310		≥ 655				≤ 223	
ASTM A240	≥ 310		≥ 655				≤ 223	
EN 10028-7	≥ 320	≥ 350	650 - 850	≥ 35				
EN 10088-2	≥ 320	≥ 350	650 - 850	≥ 35				
EN 10088-4	≥ 320	≥ 350	650 - 850	≥ 35				
IS 6911	≥ 310		≥ 690			≤ 96HRB	≤ 223	

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**	**350**	**680**	**50**			**160**	
ASME II A SA-240	≥ 310		≥ 655			≤ 96HRB	≤ 223	
ASTM A240	≥ 310		≥ 655			≤ 96HRB	≤ 223	
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	≥ 310		≥ 655			≤ 96HRB	≤ 223	

Wire rod	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV

Typical	**340**	**380**	**680**	**50**				

[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 typical values of some physical properties are given in the table below.

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
8.0	195	16,5	14	500	0.85	No*

*) Austenitic stainless steel grades may be magnetizable to a certain degree after cold deformation, e.g. in temper rolled condition.

Fabrication

Ultra 254 SMO cold hardens considerably faster than conventional austenitic grades. This, together with the initial high strength, makes it necessary to apply high forming forces. The springback for Ultra 254 SMO is also greater than for conventional austenitic steels. In complicated cold forming operations, intermediate annealing of the material may sometimes be necessary, especially if the workpiece is welded.

Machining

The work hardening behavior together with the toughness means that highly alloyed grades are often perceived as problematic from a machining perspective, e.g. operations such as turning, milling, and drilling. This applies to an even greater extent to most highly alloyed steels, especially those that have a high nitrogen content. However, with the right choice of tools, tool settings, and cutting speeds, these materials can be sucessfully machined. Machining guidelines for Ultra 254 SMO can be found here :Machining guidelines Ultra 254 SMO

Welding

Ultra 254 SMO is well suited for welding, and the methods used for welding conventional austenitic steels can be used. However, due to its stable austenitic structure, it is somewhat more sensitive to hot cracking in connection with welding, and generally welding should be performed using a low heat input. On delivery, sheet, plate, and other processed products have a homogeneous austenitic structure with an even distribution of alloying elements in the material. Solidification after partial remelting, e.g. by welding, causes redistribution of elements such as molybdenum, chromium, and nickel. These variations, segregation, remain in the cast structure of the weld and can impair the material's corrosion resistance in certain environments.

More detailed information concerning welding procedures can be obtained from the Outokumpu Welding Handbook, available from our sales offices.

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Standards & approvals

The most commonly used international product standards are given in the table below.

Standard	Designation
ASME SA-240M Code Sect. II. Part A	UNS S31254 / 254
ASTM A240/A240M	UNS S31254 / 254
EN 10028-7, PED 2014/68/EU	1.4547
EN 10088-2	1.4547
EN 10088-3	1.4547

EN 10088-4	1.4547
IS 6911, AMENDMENT NO. 2	ISS 312

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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