outokumpu
high performance stainless steel

Core 347/4550

EN 1.4550, ASTM TYPE 347H / UNS S34709

General characteristics

Core 347/4550 is a niobium stabilized alternative Core 321/4541 with improved intergranular corrosion resistance and good mechanical properties at high temperatures. Core 347/4550 is particularly useful in applications with intermittent heating in the range 400–900 °C/750–1650 °F. Core 347/4550 is an austenitic stainless steel that belongs to the standard CrNi stainless steels. Core 347/4550 can be welded in all dimensions without becoming susceptible to intergranular corrosion.

The austenitic CrNi standard grades are the most widely used group of stainless steels. Their well-balanced material properties make them suitable for the fabrication of many products.

Typical applications

- High temperature gaskets
- Rocket engine parts
- Expansion joints
- Aircraft collector rings
- Exhaust manifolds
- Chemical production equipment
- Flanges and valves

Products & dimensions

Cold rolled products, available dimensions (mm)

		Coil / Strip		Plate / Sheet	
Surface finish		Thickness	Width	Thickness	Width
2B	Cold rolled, heat treated, pickled, skin passed	0.30-4.00	30-1600	0.30-3.00	350-1250
2BB	Bright-pickled	0.25-4.00	30-1250	0.25-4.00	600-1250
2C	Cold rolled, heat treated	0.80-4.00	30-1250		
2D	Cold rolled, heat treated, pickled	0.25-4.00	30-1250	0.25-4.00	600-1250
2E	Cold rolled, heat treated, mech. desc. pickled	0.50-4.00	30-1250	0.50-4.00	600-1250
2G	Ground	0.30-3.00	30-1250	0.30-3.00	600-1250
2H	Work hardened	0.05-3.25	3-1350	0.40-3.25	600-1000
2J	Brushed or dull polished	0.30-3.00	30-1250	0.30-3.00	600-1250
2R	Cold rolled, bright annealed	0.05-3.00	3-1250	0.30-3.00	350-1250

Continous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1C	Hot rolled, heat treated, not descaled	2.00-10.00	50-1550		
1D	Hot rolled, heat treated, pickled	3.00-6.00	50-1250	3.00-6.00	350-1250
1G	Ground	2.50-3.00	1000-1050	2.50-3.00	1000-1050
1U	Black hot rolled	2.00-10.00	50-1550		

Quarto plate products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled			5.00-130.00	400-3200

Chemical composition

The chemical composition may vary slightly between different product standards. The required standard will be fully met as specified on the order.

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	**0.05**		**17.5**	**9.5**			**Nb**
ASME II A SA-240	≤0.08	≤2.00	17.0-19.0	9.0-13.0			
ASME II A SA-240	0.04-0.10	≤2.00	17.0-19.0	9.0-13.0			
ASTM A240	≤0.08	≤2.00	17.0-19.0	9.0-13.0			
ASTM A240	0.04-0.10	≤2.00	17.0-19.0	9.0-13.0			
EN 10028-7	≤0.08	≤2.00	17.00-19.00	9.00-12.00			
EN 10088-2	≤0.08	≤2.0	17.0-19.0	9.0-12.0			
EN 10088-3	≤0.08	≤2.0	17.0-19.0	9.0-12.0			
IS 6911	≤0.08	≤2.00	17.0-19.0	9.0-13.0	≤0.70		
IS 6911	0.04-0.10	≤2.00	17.0-19.0	9.0-13.0	≤0.70		

Corrosion resistance

Core 347/4550 has excellent corrosion resistance in solutions of many halogen-free organic and inorganic compounds over a wide temperature and concentration range. It can withstand many organic and sufficiently diluted mineral acids depending on the temperature of the solution. Core 347/4550 may suffer from uniform corrosion in strong mineral acids, for instance hot concentrated nitric acid, and hot strong alkaline solutions.

Due to its niobium content, the risk of senzitisation for intergranular corrosion is strongly reduced when compared to other austenitic CrNi standard grades with normal carbon content.

In aqueous solutions containing halogenides, e.g. chlorides or bromides, pitting and crevice corrosion may occur depending on halogenide concentration, temperature, pH-value, concentration of oxidizing compounds and crevice geometry, if applicable. The presence of corrosion-inhibiting or accelerating compounds like e.g. transition metal ions or organic compounds may influence the corrosion behavior of Core 347/4550.

Core 347/4550 is prone to chloride-induced stress corrosion cracking at temperatures over about 50 °C depending on the applied stress and the chloride concentration in the environment. Prior cold deformation of the structure under load increases the risk of stress corrosion cracking.

Due to its niobium stabilization against intergranular corrosion, Core 347/4550 can be used in the temperature range in which chromium carbides would precipitate in other austenitic CrNi standard grades. Its maximum service temperature in dry air is 850°C. The presence of other corrosive compounds in the hot atmosphere, like water or sulfur compounds, may reduce the maximum service temperature significantly.

For more information on corrosion resistance, please refer to the Outokumpu Corrosion Handbook or contact the our corrosion experts.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	**CPT**	**CCT**
18	<10	<0

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 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
Typical (thickness 1 mm)	**275**	**300**	**620**				**82**	
ASME II A SA-240	≥ 205		≥ 515				≤ 201	
ASME II A SA-240	≥ 205		≥ 515				≤ 201	
ASTM A240	≥ 205		≥ 515				≤ 201	
ASTM A240	≥ 205		≥ 515			≤ 92HRB	≤ 201	
IS 6911	≥ 205		≥ 515			≤ 92HRB	≤ 201	
IS 6911	≥ 205		≥ 515			≤ 92HRB	≤ 201	

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)	**320**	**365**	**640**	**53**				
ASME II A SA-240	≥ 205		≥ 515				≤ 201	
ASME II A SA-240	≥ 205		≥ 515				≤ 201	
ASTM A240	≥ 205		≥ 515				≤ 201	
ASTM A240	≥ 205		≥ 515				≤ 201	
IS 6911	≥ 205		≥ 515			≤ 92HRB	≤ 201	
IS 6911	≥ 205		≥ 515			≤ 92HRB	≤ 201	

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)	**260**	**290**	**595**	**45**				
ASME II A SA-240	≥ 205		≥ 515			≤ 92HRB	≤ 201	
ASME II A SA-240	≥ 205		≥ 515			≤ 92HRB	≤ 201	
ASTM A240	≥ 205		≥ 515			≤ 92HRB	≤ 201	
ASTM A240	≥ 205		≥ 515			≤ 92HRB	≤ 201	
EN 10028-7	≥ 200	≥ 240	500 - 700	≥ 40				
EN 10088-2	≥ 200	≥ 240	500 - 700	≥ 40				
IS 6911	≥ 205		≥ 515			≤ 92HRB	≤ 201	
IS 6911	≥ 205		≥ 515			≤ 92HRB	≤ 201	

Wire rod	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
Typical	**250**	**280**	**580**	**45**				

[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

Data according to EN 10088

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
7.9	200	16,0	15	500	0.73	No

Fabrication

Cold forming

Core 347/4550 can be readily formed and fabricated by the full range of cold forming operations. It can be used in heading, drawing, and bending. Any cold working operations will increase the strength and hardness of the material, and may leave it slightly magnetic. Work hardening is accentuated by the partial transformation of the austenite phase of the material to hard martensite.

Welding

Core 347/4550 has excellent weldability and is suitable for the full range of conventional welding methods (like MMA, MIG, MAG, TIG, SAW, LBW, or RSW), except gas welding. Core 347/4550 has about 50% higher thermal expansion and lower heat conductivity compared to carbon steels. This means that larger deformation and higher shrinkage stresses may result from welding.

In thin sections, autogenous welding may be used. To ensure that the weld metal properties (e.g. strength, corrosion resistance) are equivalent to those of the parent metal, matching or slightly over-alloyed fillers should preferably be used. Suitable filler metals are 19 9 Nb or 19 9 L.

Generally, post-weld heat treatment is not required. In special cases where there is high risk of stress corrosion cracking or fatigue, stress relief treatment may be considered.

In order to fully restore the corrosion resistance of the weld seam, the weld discoloration should be removed by pickling and passivation.

Surface slag particles containing Nb might form with TIG and plasma welding.

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

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	TYPE 347H / UNS S34709; TYPE 347H / UNS S34709
ASTM A240/A240M	TYPE 347H / UNS S34709; TYPE 347H / UNS S34709
EN 10028-7, PED 2014/68/EU	1.4550
EN 10088-2	1.4550
EN 10088-3	1.4550
IS 6911, AMENDMENT NO. 2	ISS 347; ISS 347H

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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