

Core 321/4541

EN 1.4541, ASTM TYPE 321 / UNS S32100

General characteristics

Core 321/4541 is a titanium-stabilized austenitic stainless steel with improved intergranular corrosion resistance for an extended temperature range. Core 321/4541 is an austenitic stainless steel that belongs to the standard CrNi stainless steel family. Core 321/4541 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. Due to its titanium content, Core 321/4541 can be used at elevated temperatures. For high-temperature applications, the use of the optimized high-temperature Therma 321H/4878 is recommended.

Core 321/4541 is available in many product forms and dimensions, often also from many stainless steel stockholders. Polishing of Core 321/4541 is limited due to its titanium alloying.

Typical applications

- Annealing covers
- Stack liners
- Automotive exhaust systems
- Welded pressure vessels
- 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	0.30-6.35	12-1600	0.30-6.35	18-2050
2BB	Bright-pickled	0.20-3.50	30-1524	0.20-3.00	600-1500
2C	Cold rolled, heat treated	0.50-6.00	30-1520		
2D	Cold rolled, heat treated, pickled	0.30-6.35	30-1610	0.30-6.35	400-1610
2E	Cold rolled, heat treated, mech. desc. pickled	0.33-6.00	12-1530	0.33-6.35	18-2050
2G	Ground	0.30-3.58	12-1530	0.30-3.58	18-1530
2H	Work hardened	0.05-6.00	3-1500	0.30-6.00	350-1530
2J	Brushed or dull polished	0.30-3.00	30-1530	0.30-3.00	600-1530
2K	Satin finish	0.53-3.58	12-1524	0.53-3.58	18-1524
2M	Patterned	0.30-3.50	30-1530	0.30-3.50	600-1524
2R	Cold rolled, bright annealed	0.05-3.50	3-1500	0.30-1.22	18-1300

Continous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1C	Hot rolled, heat treated, not descaled	1.90-10.00	50-1550		
1D	Hot rolled, heat treated, pickled	2.54-9.52	50-1524	2.54-9.52	350-1524
1E	Hot rolled, heat treated, mech. desc.	1.36-4.50	35-1610	1.36-4.50	35-1610
1G	Ground	1.90-3.00	750-1350	1.90-3.00	750-1350
1M	Patterned	1.90-3.00	750-1350	1.90-3.00	750-1350
1U	Black hot rolled	1.90-10.00	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
1G	Ground			20.00-29.99	400-3200

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	0.04		17.3	9.1			Ti
ASME II A SA-240	≤0.08	≤2.00	17.0-19.0	9.0-12.0		≤0.10	
ASTM A240	≤0.08	≤2.00	17.0-19.0	9.0-12.0		≤0.10	
EN 10028-7	≤0.08	≤2.00	17.0-19.0	9.0-12.0			
EN 10088-2	≤0.08	≤2.0	17.0-19.0	9.0-12.0			
EN 10088-4	≤0.08	≤2.0	17.0-19.0	9.0-12.0			
GOST 5632-72	≤0.08	≤2.0	17.00-19.00	9.00-11.00	≤0.35	≤0.10	
GOST 5632-72	≤0.12	≤2.0	17.0-19.0	9.0-11.0	≤0.35	≤0.10	
GOST 5632-72 Chemical analysis	≤0.08	≤2.0	17.00-19.00	9.00-11.00	≤0.3	≤0.10	
GOST 5632-72 Chemical analysis	≤0.12	≤2.0	17.0-19.0	9.0-11.0	≤0.35	≤0.10	
IS 6911	≤0.08	≤2.0	17.0-19.0	9.0-12.0	≤0.70	≤0.10	
RM 2/1039-02	≤0.08	≤2.00	17.0-19.0	9.0-12.0			
RM 2/1077-02	≤0.08	≤2.00	17.0-19.0	9.0-12.0			
TLV936002	≤0.08	≤2.00	17.0-19.0	9.0-12.0			

Corrosion resistance

Core 321/4541 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 321/4541 may suffer from uniform corrosion in strong mineral acids, for instance hot concentrated nitric acid, and hot strong alkaline solutions. More detailed information on the corrosion properties of Core 321/4541 can be found in Outokumpu's Corrosion Tables published in the [Outokumpu Corrosion Handbook](#) and on www.outokumpu.com.

Due to its titanium content, the risk of sensitization to intergranular corrosion is strongly reduced 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, or crevice geometry, if applicable. The presence of corrosion-inhibiting or accelerating compounds like transition metal ions or organic compounds may influence the corrosion behavior of Core 321/4541.

Core 321/4541 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 titanium stabilization against intergranular corrosion, Core 321/4541 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 Outokumpu corrosion experts.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	CPT	CCT
17	<10	<0

Pitting Resistance Equivalent (PRE) is calculated using the following formula: $PRE = \%Cr + 3.3 \times \%Mo + 16 \times \%N$
 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 in soft annealed condition at room temperature are given in the table below. In addition to these values, several of the chromium-nickel grades is available in temper rolled condition with higher mechanical strength. Please contact your local Outokumpu sales company for more information.

Moderate strengths can be reached at elevated temperatures (~550 °C/1022 °F). Temperatures for excessive scaling are close to 850 °C/1562 °F. This grade, along with other austenitic corrosion-resistant steels, exhibits very high ductility and high elongation to fracture. It is not susceptible to brittle fracture in the solution annealed condition.

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)	260	285	625	70				
ASME II A SA-240	≥ 205		≥ 515				≤ 217	
ASTM A240	≥ 205		≥ 515			≤ 95HRB	≤ 217	
EN 10028-7	≥ 220	≥ 250	520 - 720	≥ 40				
EN 10088-2	≥ 220	≥ 250	520 - 720	≥ 40				
EN 10088-4	≥ 220	≥ 250	520 - 720	≥ 40				
GOST 5632-72	≥ 235	≥ 250	≥ 535	≥ 40				
GOST 5632-72	≥ 230	≥ 260	540 - 670	≥ 45				
IS 6911	≥ 205		≥ 515			≤ 95HRB	≤ 217	

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)	265	295	590	70			165	
ASME II A SA-240	≥ 205		≥ 515				≤ 217	
ASTM A240	≥ 205		≥ 515				≤ 217	
EN 10028-7	≥ 220	≥ 250	520 - 720	≥ 40				
EN 10088-2	≥ 220	≥ 250	520 - 720	≥ 40				
EN 10088-4	≥ 220	≥ 250	520 - 720	≥ 40				
GOST 5632-72	≥ 235	≥ 250	≥ 535	≥ 40				
GOST 5632-72	≥ 230	≥ 260	540 - 670	≥ 45				
IS 6911	≥ 205		≥ 515			≤ 95HRB	≤ 217	

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)	250	290	570	55				
ASME II A SA-240	≥ 205		≥ 515			≤ 95HRB	≤ 217	
ASTM A240	≥ 205		≥ 515			≤ 95HRB	≤ 217	
EN 10028-7	≥ 200	≥ 240	500 - 700	≥ 40				
EN 10088-2	≥ 200	≥ 240	500 - 700	≥ 40				
EN 10088-4	≥ 200	≥ 240	500 - 700	≥ 40				
IS 6911	≥ 205		≥ 515			≤ 95HRB	≤ 217	
RM 2/1039-02	≥ 200	≥ 240	500 - 700	≥ 40				
RM 2/1077-02	≥ 200	≥ 240	500 - 700	≥ 40				

Wire rod	R _{p0.2} MPa	R _{p1.0} MPa	R _m MPa	Elongation ¹⁾ %	Impact strength J	Rockwell	HB	HV
Typical	250	290	570	55				

¹⁾Elongation according to EN standard:

A₈₀ for thickness below 3 mm.

A for thickness = 3 mm.

Elongation according to ASTM standard A₂ or A₅₀.

Physical properties

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

These grades can be readily formed and fabricated by the full range of cold forming operations. They can be used in heading, drawing, and bending. Any cold forming 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.

Hot forming

Hot forming can be carried out in the 850–1150 °C temperature range. For maximum corrosion resistance, forgings should be annealed at 1050 °C and rapidly cooled in air or water after hot forming operations.

Welding

Austenitic Core 321/4541 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 321/4541 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.

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 321 / UNS S32100
ASTM A240/A240M	TYPE 321 / UNS S32100
EN 10028-7, PED 2014/68/EU	1.4541
EN 10088-2	1.4541
EN 10088-4	1.4541
GOST 5632-72	08X18H10T; 12X18H10T
GOST 5632-72 Chemical analysis only	08X18H10T; 12X18H10T
IDESA RM 2/1077-02 Rev. 0	1.4541
IS 6911, AMENDMENT NO. 2	ISS 321
RM 2/1039-02 Rev 0	1.4541
Siemens AG spec. TLV 9360 02	1.4541

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.

Information given in this brochure may be subject to alterations without notice. Care has been taken to ensure that the contents of this publication are accurate but Outokumpu and its affiliated companies do not accept responsibility for errors or for information which is found to be misleading. Suggestions for or descriptions of the end use or application of products or methods of working are for information only and Outokumpu and its affiliated companies accept no liability in respect thereof. Before using products supplied or manufactured by the company the customer should satisfy himself of their suitability



outokumpu.com
steelfinder.outokumpu.com