

Supra 444/4521

EN 1.4521, ASTM TYPE 444 / UNS S44400

General characteristics

Supra 444/4521 is a nickel-free, molybdenum alloyed ferritic stainless steel with very good corrosion resistance, good cold formability, and high strength. Supra 444/4521 allows for thinner walls in tanks and is not prone to stress-corrosion cracking.

Supra 444/4521 is a 2% molybdenum-alloyed ferritic stainless steel with medium chromium that can be used in many corrosive environments. As a ferritic stainless steel, it has high resistance to chloride-induced stress corrosion cracking. Because of its titanium alloying, Supra 444/4521 can be welded in all dimensions without becoming susceptible to intergranular corrosion.

Typical applications

- Hot water tanks
- Drinking water pipes

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	0.30-3.58	12-1620	0.30-3.58	18-1620
2BB	Bright-pickled	0.30-3.00	30-1350	0.30-3.00	350-1500
2C	Cold rolled, heat treated	0.80-3.00	30-1300		
2D	Cold rolled, heat treated, pickled	0.30-3.00	30-1350	0.30-3.00	350-1500
2E	Cold rolled, heat treated, mech. desc. pickled	0.33-3.58	12-1524	0.33-3.58	18-1524
2F	Cold rolled, heat treated, skin passed	0.33-3.58	12-1524	0.33-3.58	18-1524
2G	Ground	0.30-3.58	12-1524	0.30-3.58	18-1524
2J	Brushed or dull polished	0.30-3.00	30-1350	0.30-3.00	350-1300
2K	Satin finish	0.53-3.58	12-1524	0.53-3.58	18-1524
2R	Cold rolled, bright annealed	0.05-1.50	3-1250	0.30-1.50	350-1250

Continuous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1C	Hot rolled, heat treated, not descaled	2.80-6.00	750-1350		
1D	Hot rolled, heat treated, pickled			4.76-6.36	400-1524
1G	Ground	2.80-3.00	750-1303	2.80-3.00	750-1303
1M	Patterned	2.80-3.00	750-1303	2.80-3.00	750-1303
1U	Black hot rolled	2.80-6.00	750-1350		

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	0.02		18.0		2.0		Ti Nb
ASTM A240	≤0.025	≤1.00	17.5-19.5	≤1.00	1.75-2.50	≤0.035	
EN 10028-7	≤0.025	≤1.00	17.00-20.00		1.80-2.50	≤0.030	
EN 10088-2	≤0.025	≤1.0	17.0-20.0		1.8-2.5	≤0.030	
EN 10088-4	≤0.025	≤1.0	17.0-20.0		1.8-2.5	≤0.030	
IS 6911	≤0.025	≤1.00	17.5-19.5	≤1.00	1.75-2.50	≤0.035	

Corrosion resistance

Supra 444/4521 has very good corrosion resistance in solutions of many halogen-free organic and inorganic compounds over a wide temperature and concentration range. It can withstand many sufficiently diluted organic and mineral acids depending on the temperature and concentration of the solution. Supra 444/4521 may suffer from uniform corrosion in strong organic and mineral acids, as well as in hot concentrated alkaline solutions. More detailed information on the corrosion properties of Supra 444/4521 can be found in Outokumpu's Corrosion Tables published in the [Outokumpu Corrosion Handbook](#) and on www.outokumpu.com.

In aqueous solutions containing halogenides, e.g. chlorides or bromides, pitting and crevice corrosion may occur depending on the 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 Supra 444/4521. Due to its ferritic crystal structure, Supra 444/4521 is not prone to chloride-induced stress corrosion cracking.

Supra 444/4521 can be used for indoor and outdoor applications in rural areas and urban environments where chloride contamination is low. The best material performance is reached usually with the help of adequate design, correct post-weld treatment, and regular cleaning during use (if applicable).

Due to its titanium and niobium content, the risk of sensitization to intergranular corrosion is strongly reduced when compared to non-stabilized ferritic grades. Supra 444/4521 can be used in the temperature range in which chromium carbides would precipitate in non-stabilized ferritic grades. Its maximum service temperature in dry air is 850 °C. The presence of other corrosive compounds in the hot environment, like water or sulphur 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 experts.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	CPT	CCT
25	<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 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)	350	370	525	50				
ASTM A240	≥ 275		≥ 415			≤ 96HRB	≤ 217	
EN 10028-7	≥ 320		420 - 640	≥ 20				
EN 10088-2	≥ 300		420 - 640	≥ 20				
EN 10088-4	≥ 300		420 - 640					
IS 6911	≥ 275		≥ 415			≤ 96HRB	≤ 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)	380	420	450	32			85	
ASTM A240	≥ 275		≥ 415				≤ 217	
EN 10088-2	≥ 280		400 - 600	≥ 20				
EN 10088-4	≥ 280		400 - 600					
IS 6911	≥ 275		≥ 415			≤ 96HRB	≤ 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)	360	400	540	26				
ASTM A240	≥ 275		≥ 415				≤ 217	
EN 10028-7	≥ 300		420 - 620					
EN 10088-2	≥ 280		420 - 620	≥ 20				
EN 10088-4	≥ 300		420 - 620					
IS 6911	≥ 275		≥ 415			≤ 96HRB	≤ 217	

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

Data according to EN 10088

Density	Modulus of elasticity	Thermal exp. at 100 °C	Thermal conductivity	Thermal capacity	Electrical resistance	Magnetizable
kg/dm ³	GPa	10 ⁻⁶ /°C	W/m°C	J/kg°C	μΩm	
7.7	220	10,4	23	430	0.80	Yes

Fabrication

Forming

Supra 444/4521 can be formed using typical forming processes such as folding, bending, and drawing. It has higher minimum proof strength than a standard austenitic stainless steel like Core 304/4301 in combination with lower work hardening behavior. Due to the stabilization, the R-value is higher compared to non-stabilized ferritic stainless steels. These characteristics mean excellent deep-drawability.

Machining

Supra 444/4521 is relatively easy to machine. Compared to austenitic grades, it has lower tendency to form edges, which gives a larger machining window. Since the machinability is comparable to that of low-alloyed carbon steels, the same recommendations regarding choice of tool, cutting speed, and cutting feed apply.

Welding

Supra 444/4521 has good weldability and can be welded with common fusion and resistance welding methods. Conventional welding methods like MMA, MIG, MAG, TIG, SAW, LBW, or RSW, except gas welding, are applicable. Austenitic 19 12 3 L (316L) or 23 12 2 L (309MoL) filler metals can be used.

Low interstitial levels and added stabilizer have made enormous improvements to the welding characteristics of ferritic grades. Heat input should be minimized to reduce the grain growth in the HAZ. Dual-stabilization (Ti+Nb) of Supra 444/4521 improves autogenously welded joints by refining the grain structure in the weld metal. Stabilization prevents chromium carbide precipitation, which could otherwise lead to sensitization embrittlement. Consequently, the stabilized grades are practically immune to intergranular corrosion in the as-welded condition.

Shielding gases should be Ar/He based, mixed with a maximum of 2% oxygen to improve the arc stability. Hydrogen and nitrogen additions are forbidden.

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
ASTM A240/A240M	TYPE 444 / UNS S44400
EN 10028-7, PED 2014/68/EU	1.4521
EN 10088-2	1.4521
EN 10088-4	1.4521
IS 6911, AMENDMENT NO. 2	ISS 444

Contacts & Enquiries

[Contact your nearest sales office](#)

www.outokumpu.com/contacts

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