

Forta 316plus

EN 1.4420, ASTM UNS S31655

General characteristics

Low-Ni and low-Mo cost efficient alternative for traditional molybdenum alloyed stainless grades.

Outokumpu 4420 austenitic stainless steel with its high chromium content delivers high strength, good formability and excellent weldability making it ideal for use in a variety of applications including heat exchangers, water treatment and piping as well as in architectural applications such as indoor and outdoor facades.

Outokumpu grade 4420 is an austenitic CrNiMo stainless steel with 21 wt.-% chromium and relatively low nickel and molybdenum content. Due to its high nitrogen content, grade 4420 has increased mechanical strength and shows a high degree of work hardening on mechanical deformation. Due to its high chromium content, grade 4420 offers similar or better corrosion resistance than austenitic CrNiMo standard grades in many corrosive environments.

Grade 4420 is used in applications where increased corrosion resistance and a combination of high mechanical strength and good formability are needed. Due to its tendency to work hardening, grade 4420 can absorb an increased amount of energy during deformation. It can be delivered in temper rolled condition with different strength levels.

Typical applications

- roofs & façade cladding
- street ware & outdoor furniture
- art & monuments
- swimming pools
- food & beverage industry
- pharmaceutical industry
- chemical industry
- textile finishing
- pulp & paper industry
- stack liners
- heat exchangers
- storage tanks
- tank containers
- process equipment
- piping
- low temperature equipment

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	0.70-5.00	50-1550	0.70-5.00	400-1550
2E	Cold rolled, heat treated, mech. desc. pickled	2.30-4.50	50-1550	2.30-4.50	600-1550
2K	Satin finish	0.70-4.00	50-1550	0.70-4.00	400-1550

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled	3.50-8.00	50-1550	3.50-8.00	600-1550
1E	Hot rolled, heat treated, mech. desc.	2.30-4.50	50-1550	2.30-4.50	600-1550

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	0.02		20.3	8.6	0.7	0.19	
ASTM A240	≤0.030	≤2.00	19.5-21.5	8.0-9.5	0.50-1.50	0.14-0.25	
EN 10028-7	≤0.030	≤2.00	19.5-21.5	8.0-9.5	0.50-1.50	0.14-0.25	

Corrosion resistance

Outokumpu grade 4420 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 diluted mineral acids depending on the temperature and concentration of the solution. Grade 4420 may suffer from uniform corrosion in strong mineral acids and hot strong alkaline solutions.

In aqueous solutions containing halogenides like 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. Due to its high chromium and nitrogen content, the pitting and crevice corrosion resistance of grade 4420 is on the same level or even better than the corrosion resistance of the austenitic CrNiMo standard grades 4401 and 4404 despite its lower molybdenum content. The presence of corrosion inhibiting or accelerating compounds like e.g. transition metal ions or organic compounds may influence the corrosion behaviour of grade 4420.

Grade 4420 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 for stress corrosion cracking.

Grade 4420 can be used for indoor and outdoor applications in urban and moderately corrosive industrial environments. When chloride contamination may be high like for instance in coastal areas, pitting and staining is possible. The best material performance is reached usually with the help of adequate design, correct post-weld treatment and regular cleaning during use (if applicable). For more information on corrosion resistance refer to the Outokumpu Corrosion Handbook or contact the Outokumpu corrosion experts.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	CPT	CCT
26	35	<0

PRE Pitting Resistant Equivalent calculated using the formula: $PRE = \%Cr + 3.3 \times \%Mo + 16 \times \%N$

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 in soft annealed condition at room temperature are given in the table below. 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 among 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)	380		700	45				
ASTM A240	≥ 310		≥ 635			≤ 100HRB	≤ 241	
EN 10028-7	≥ 350	≥ 380	650 - 850	≥ 35				

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)	390	400	710	45				
ASTM A240	≥ 310		≥ 635				≤ 241	
EN 10028-7	≥ 350	≥ 380	650 - 850	≥ 35				

Hot rolled quarto plate	R _{p0.2} MPa	R _{p1.0} MPa	R _m MPa	Elongation ¹⁾ %	Impact strength J	Rockwell	HB	HV
ASTM A240	≥ 310		≥ 635			≤ 100HRB	≤ 241	

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

Crystal structure is austenitic and therefore material is not ferromagnetic as soft annealed condition.

Md30 temperature is lower than -110°C which makes this material very stable against martensite transformation.

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	
7.9	200	16,0	15	500	0.73	No

Fabrication

The grade can be formed using typical forming processes like folding, bending, drawing, etc.

Higher strength values typically correspond to higher spring back after forming.

This grade has remarkably higher proof strength than standard austenitic stainless steel grade 316L / 1.4404 in combination with same degree of work hardening.

Due to the design of composition the Erichsen Index and LDR (Limiting Drawing Ratio) are matching with well-known austenitic type of stainless steels like 1.4307 or 1.4404.

These characteristics mean good deep-drawability and excellent stretch forming capabilities.

Welding

Grade 4420 has excellent weldability and is suited to a full range of conventional welding methods (like MMA, MIG, MAG, TIG, SAW, LBW or RSW), except gas welding. 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. Austenitic 19 12 3 L (316L) filler metals can be used to get matching corrosion resistance and 22 09 NL type duplex welding consumable to get matching strength. Shielding gases should be Ar/He based or contain up to 3 % nitrogen to minimize nitrogen drop. Typical heat input values for austenitic grades can be utilized. High nitrogen content tends to restrict grain growth during thermal cycle. Welds are not sensitized when normal welding procedures are followed.

Generally post weld heat treatment is not required. In special cases with high risks 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.

Standards & approvals

Forta 316^{plus} is a trademark of Outokumpu and its ASTM designation is UNS S31655 and EN number 1.4420*.

The grade is included in ASTM tube and pipe standards A249-15, A269-15, A358-15, A554-15 and A312-15.

Work is in progress for EN and ASME standardization.

Polarit Material Specification is available for this grade and it is applied when EN 1.4420 is wanted to be certified prior to EN standardization.

*Designation according to Stahl Eisen Liste (Register of European Steels)

Standard	Designation
ASTM A240/A240M	UNS S31655
EN 10028-7, PED 2014/68/EU	1.4420

Contacts & Enquiries

[Contact your nearest sales office](#)

www.outokumpu.com/contacts

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