outokumpu
high performance stainless steel

Core 304LN/4311

EN 1.4311, ASTM TYPE 304LN / UNS S30453

General characteristics

Core 304LN/4311 is a low-carbon, higher nickel and nitrogen alloyed alternative to Core 304/4301 with improved strength and low-temperature toughness. Suitable for applications that require high tensile strength. is an austenitic stainless steel that belongs to the standard CrNi stainless steel family.

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 fully austenitic structure, Core 304LN/4311 is suitable for applications with low magnetic permeability requirements (μ < 1.005).

Typical applications

- Railroad cars
- Pressure vessels
- Chemical plant equipment(mild to medium corrosive environments)
- 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	0.40-6.00	30-1500	0.80-6.00	600-1530
2BB	Bright-pickled	0.80-3.00	30-1500	0.80-3.00	600-1530
2C	Cold rolled, heat treated	0.80-6.00	30-1500		
2D	Cold rolled, heat treated, pickled	0.80-6.00	30-1500	0.80-6.00	600-1530
2E	Cold rolled, heat treated, mech. desc. pickled	0.80-6.00	30-2050	0.80-6.00	600-2050
2G	Ground	0.80-3.00	30-1500	0.80-3.00	600-1530
2H	Work hardened	0.05-3.00	3-1500	0.80-3.00	600-1530
2J	Brushed or dull polished	0.80-3.00	30-1500	0.80-3.00	600-1530
2R	Cold rolled, bright annealed	0.05-3.00	3-1500	0.80-3.00	600-1530

Continous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled	4.00-12.70	800-2050	4.00-12.70	300-2050
1G	Ground	2.00-3.00	750-1530	2.00-3.00	750-1530
1U	Black hot rolled	2.00-8.00	750-1530		

Quarto plate products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled			5.00-50.00	400-3200

Chemical composition

The chemical composition may vary slightly between different product standards. The required standard will befully 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**		**18.5**	**9.2**		**0.14**	
ASME II A SA-240	≤0.030	≤2.00	18.0-20.0	8.0-12.0		0.10-0.16	
ASTM A240	≤0.030	≤2.00	18.0-20.0	8.0-12.0		0.10-0.16	
ASTM A666	≤0.030	≤2.00	18.0-20.0	8.0-12.0		0.10-0.16	
EN 10028-7	≤0.030	≤2.00	17.0-19.5	8.5-11.5		0.12-0.22	
EN 10088-2	≤0.030	≤2.0	17.5-19.5	8.5-11.5		0.12-0.22	
EN 10088-3	≤0.030	≤2.00	17.5-19.5	8.5-11.5		0.12-0.22	
EN 10088-4	≤0.030	≤2.0	17.5-19.5	8.5-11.5		0.12-0.22	
IS 6911	≤0.030	≤2.00	18.0-20.0	8.0-12.0	≤0.70	0.10-0.16	

Corrosion resistance

Core 304LN/4311 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 304LN/4311 may suffer from uniform corrosion in strong mineral acids and hot strong alkaline solutions. More detailed information on corrosion properties of Core 304LN/4311 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 halogenide concentration, temperature, pH-value, concentration of oxidizing compounds, and 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 304LN/4311. Due to its high nitrogen content, the resistance of Core 304LN/4311 against pitting and crevice corrosion is slightly increased compared to the basic austenitic CrNi standard grades 4301 and 4307.

Core 304LN/4311 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.

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
21	<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 in the 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 ,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)								
ASME II A SA-240	≥ 205		≥ 515				≤ 217	
ASTM A240	≥ 205		≥ 515			≤ 95HRB	≤ 217	
EN 10028-7	≥ 290	≥ 320	550 - 750	≥ 40				
EN 10088-2	≥ 290	≥ 320	550 - 750	≥ 40				
EN 10088-4	≥ 290	≥ 320	550 - 750	≥ 40				
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)	**355**	**410**	**665**	**50**				
ASME II A SA-240	≥ 205		≥ 515				≤ 217	
ASTM A240	≥ 205		≥ 515				≤ 217	
EN 10028-7	≥ 290	≥ 320	550 - 750	≥ 40				
EN 10088-2	≥ 290	≥ 320	550 - 750	≥ 40				
EN 10088-4	≥ 290	≥ 320	550 - 750	≥ 40				
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)	**310**	**350**	**640**	**55**				
ASME II A SA-240	≥ 205		≥ 515			≤ 95HRB	≤ 217	
ASTM A240	≥ 205		≥ 515			≤ 95HRB	≤ 217	
EN 10028-7	≥ 270	≥ 310	550 - 750	≥ 40				
EN 10088-2	≥ 270	≥ 310	550 - 750	≥ 40				
EN 10088-4	≥ 270	≥ 310	550 - 750	≥ 40				
IS 6911	≥ 205		≥ 515			≤ 95HRB	≤ 217	

Wire rod	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
Typical	**320**	**360**	**640**	**55**				

[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 304LN/4311 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.

Welding

Core 304LN/4311 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 304LN/4311 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. The recommended filler metal is 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.

Because of the austenitic structure, the welded joints are tough down to low temperatures even in the as-welded condition.

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 304LN / UNS S30453
ASTM A240/A240M	TYPE 304LN / UNS S30453
ASTM A666	TYPE 304LN / UNS S30453
EN 10028-7, PED 2014/68/EU	1.4311
EN 10088-2	1.4311
EN 10088-3	1.4311
EN 10088-4	1.4311
IS 6911, AMENDMENT NO. 2	ISS 304LN

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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