Industeel

ArcelorMittal

UR™ 316LN

UR™ 316LN: A nitrogen containing 18Cr - 10Ni - 2 Mo austenitic stainless steel

UR™ 316LN is a nitrogen alloyed austenitic stainless steel with Mo addition. Its low carbon content avoids intergranular corrosion, even after welding. **UR™ 316LN** exhibits an austenitic microstructure, free of deleterious carbide precipitations. The grade contains residual ferrite after solution annealing (1050 - 1150°C /1922 - 2102°F) and water quenching. Higher Molybdenum content improves uniform and localized corrosion resistance. Nitrogen addition improves the structure stability and increases the yield strength compared to **UR™ 316L**. Main properties of **UR™ 316LN** are: high ductility, good weldability. Typical applications are food and beverage processing industry, chemical industry and chemical tankers. A ferrite free, non magnetic version of the grade has been developed for nuclear physics applications at 4°K.

PROPERTIES

STANDARDS

> EURONORM: EN 1.4429 X2CrNiMoN 17.13.3

> ASTM: A240TP 316LN - UNS S31653

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	N
< 0.030	17.5	13	> 2.5	0.18

PREN (%Cr + 3.3%Mo + 16%N) ≥ 29

PHYSICAL PROPERTIES

Density: 7950 kg/m³

Interval temperature (°C)	Thermal expansion (αx10^{-6} K^{-1})	T (°C) (°F)	Resistivity (µΩ.cm)	Thermal conductivity (W m^{-1} K^{-1})	Specific heat (J kg^{-1} K^{-1})	Young modulus E (GPa)	Shear modulus G (GPa)
20 - 100	16	20 (68)	75	15	500	200	77
20 - 200	16.5	100 (212)	77	16	500	194	75
20 - 300	17	200 (392)	84	17.5	520	186	71
20 - 400	17.5	300 (572)	91	19	530	179	68
20 - 500	18	400 (752)	97	20.5	540	172	65
		500 (932)	102	22	540	165	62

The alloy is non magnetic in the solution treated condition, very slightly ferromagnetic after cold work.

MECHANICAL PROPERTIES

Tensile properties - After solution annealing heat treatment

°C	°F	Minimum guaranteed values*							Typical values (10 mm plates)			
		YS 0.2%		YS 1%		UTS		Elongation	YS 0.2%		UTS	
		MPa	Ksi	MPa	Ksi	MPa	Ksi	%	MPa	Ksi	MPa	Ksi
20	68	280	40	320	47	580/780	85	45 (Typical 58)	355	51	637	93
100	212	211	30	246	36	520	76	35	240	34	540	79
200	392	167	24	198	29	460	67	30	190	27	500	73
300	572	145	21	175	26	440	65	30	160	23	480	71
400	752	135	20	164	24	435	64	25	150	22	460	68
500	932	128	19	158	23	430	63	25	140	21	440	64

** As per EN10088 hot rolled plates. The EN guaranteed values are valid for a thickness from 5 up to 75 mm. (0.20" up to 2.95")*

Impact values

Temperature °C (°F)	- 196°C (- 320°F)	20°C (68°F)
KCV (J/cm^2) guaranteed	125	187
KCV (J/cm^2) typical	250	325

Typical creep strength values

Temperature	600°C (1112°F)		650°C (1202°F)		700°C (1292°F)		750°C (1382°F)	
Time to rupture (h)	10^3	10^4	10^3	10^4	10^3	10^4	10^3	10^4
σR (MPa)	270	210	195	145	150	90	90	65

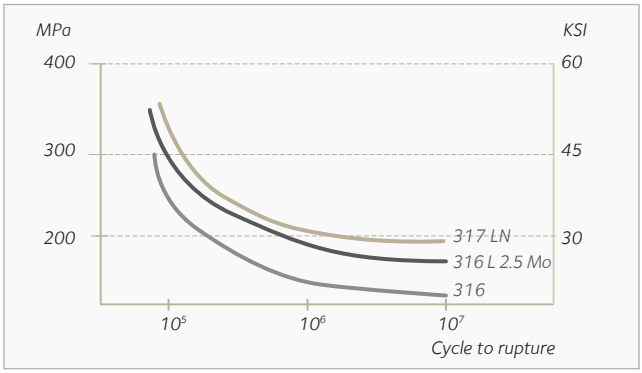
IN SERVICE CONDITIONS

CORROSION RESISTANCE

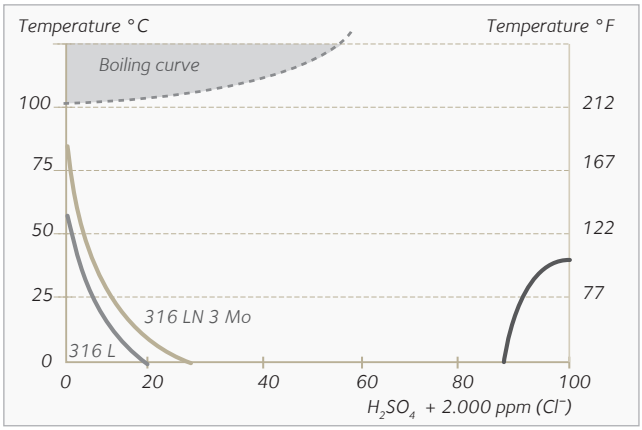
Standardized corrosion tests (special request may be discussed)

TEST	OTHER NAME	CORROSION	RESULTS
ASTM A262 A	-	Intergranular	Step or dual structure
ASTM A262 B	STREICHER	Intergranular	<1 mm/year (not sensitived)
ASTM A262 C	HUEY	Intergranular	< 0.6 mm/year
ASTM A262 E DIN 50914 RCCM	STRAUSS	Intergranular	No cracking after bending
ASTM G48A	-	Pitting	Not recommended (CPT< 15°C - 59°F)
ASTM G48B	ASTM G48	Crevice	Not recommended (CCT< 5°C - 41°F)

Synthetics seawater rotating beam bending of smooth samples



General corrosion in sulfuric and phosphoric acid



DELIVERY CONDITIONS

SIZE RANGE

	Quarto plates	Clad plates
Thickness	5 up to 150 mm 3/16" to 6"	Consult Industeel
Width	Up to 3800 mm* Up to 150"	
Length	Up to 16000 mm Up to 52.5"	

*Indicative dimensional programme - *Width related to thickness, please consult for specific request.*

PLATE PROCESSING

HOT FORMING

Hot forming should be carried out in a temperature range of 1150 - 850°C (2102 - 1562°F). If the final forming temperature falls below 950°C (1742°F) a solution annealing (1050 - 1150°C / 1922 - 2102°F) is necessary. The cleanliness of the surface is very important (avoid oil contamination). A neutral or slightly oxidising atmosphere is required. Due to the low thermal conductivity, the holding time of temperature may be longer than carbon steel (~ 50%). Quenching must be fast after forming.

COLD FORMING

The alloy can be cold formed without problem. It may require more powerful equipments than structural steel.

MACHINING

Due to its cold work hardening the alloy is less machinable than structural steel or than a 13%Cr martensitic stainless steel.

Operation	Tool	Lubrication	CONDITIONS		
			Depth of cut mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Turning	High speed steel	Cutting oil	6 (0.23)	0.5 (0.019)	9 - 13 (29 - 43)
			3 (0.11)	0.4 (0.016)	14 - 19 (46 - 62)
			1 (0.04)	0.2 (0.008)	20 - 25 (66 - 82)
	Carbide	Dry or cutting oil	6 (0.23)	0.5 (0.019)	55 - 65 (180 - 213)
			3 (0.11)	0.4 (0.016)	70 - 80 (229 - 262)
			1 (0.04)	0.2 (0.008)	80 - 90 (262 - 295)
			Blade width mm (inch)	Feed	Speed
Cutting	High speed steel	Cutting oil	1.5 (0.06)	0.03 - 0.05 (0.0012 - 0.0020)	13 - 17 (43 - 56)
			3 (0.11)	0.04 - 0.06 (0.0016 - 0.0024)	14 - 28 (46 - 92)
			6 (0.23)	0.05 - 0.07 (0.0020 - 0.0027)	15 - 19 (49 - 62)
			Drill Ø mm (inch)	Feed	Speed
Drilling	High speed steel	Cutting oil	1.5 (0.06)	0.02 - 0.03 (0.0008 - 0.0012)	8 - 11 (26 - 36)
			3 (0.11)	0.05 - 0.06 (0.0020 - 0.0024)	10 - 13 (33 - 43)
			6 (0.23)	0.08 - 0.09 (0.0031 - 0.0035)	10 - 13 (33 - 43)
			12 (0.48)	0.09 - 0.10 (0.0035 - 0.0039)	10 - 13 (33 - 43)
				Feed	Speed
Milling profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.004)	8 - 16 (26 - 52)

PICKLING

A nitric hydrofluoric acid bath (10 - 20% HNO_3 - 1.5 - 5% HF) at 20 - 60°C is used for the pickling treatment. A 10 - 20% H_2SO_4 - 1.5 - 5% HF pickling bath may also be used. Passivation - decontamination treatments may be performed with a 10 - 20% weight nitric acid solution.

CUTTING

> Thermal cutting (plasma, thermal sawing...)

> Mechanical cutting (shearing, stamping, cold sawing...)

After thermal cutting, pickling or grinding are necessary to eliminate the oxide formed layer.

WELDING

UR™ 316LN is readily weldable.
All welding processes can be used.

Filler materials

Electrode	E316L - 15 or E316L - 16 (ASME Sect II - Part C SFA5 - 4)
Wire	ER 316L (ASME Sect II - Part C SFA 5 - 9)

A post weld heat treatment is not necessary. Pre heating and post heating are not necessary. 200°C (392°F) is the maximum interpass temperature. Post weld pickling and rinsing is recommended.

APPLICATIONS

The alloy is corrosion resistant in:

- > Diluted sulfuric solutions at moderate temperature
- > Very diluted hydrochloric acid solutions at moderate temperature
- > Middle concentrated phosphoric solutions at low temperature
- > Organic acid solutions at moderate temperature
- > Very polluted urban media
- > Alkaline chloride solutions up to 70°C (158°F)
- > Industrial phosphoric acid (θ < 60°C/140°F, conc < 30% P_2O_5 and Cl^- < 300ppm) without abrasion

The main applications are:

- > Chemical industry
- > Food and beverage industry
- > Chemical tankers
- > Liquid gas production and storage vessels

YOUR CONTACTS

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