



UR™ 317 LMN

UR™ 317 LMN: A 317 LMN modified Mo 4% austenitic stainless steel

UR™ 317 LMN is a Nitrogen alloyed austenitic stainless steel with a high Molybdenum content ($\geq 4\%$).

UR™ 317 LMN has an austenitic microstructure, free of deleterious carbide precipitations at grain boundaries. The grade contains some residual ferrite after solution annealing (1100 - 1150°C / 2012 - 2102°F) and water quenching. Because of its higher molybdenum content, this steel has a higher resistance to corrosion in chloride containing environments than standard grades (UR™ 316L / 316L). Nitrogen additions and a low silicon content have a stabilizing effect on the austenitic structure and reduce the precipitation of inter - metallic phases during welding. Nitrogen addition also increases the yield strength compared to UR™ 317L (317L).

Its main properties are:

- > high mechanical properties,
- > high ductility,
- > good weldability and excellent corrosion resistance.

PROPERTIES

STANDARDS

- > EURONORM: EN 1.4439 X2CrNiMoN 17.13.5
- > ASTM: A240TP 317LMN - UNS S31725/31726

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	Mo
0.02	17.5	13	≥ 4	0.15

PREN (%Cr + 3.3%Mo + 16%N) > 33

PHYSICAL PROPERTIES

Density: 8000 kg/m³

Temperature interval (°C)	Thermal expansion $\alpha \times 10^{-6} K^{-1}$	T (°C) (°F)	Resistivity ($\mu\Omega \cdot cm$)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	Specific heat ($J \cdot kg^{-1} \cdot K^{-1}$)	Young modulus E (GPa)	Shear modulus G (GPa)
20 - 100	16	20 (68)	80	14	500	200	77
20 - 200	16.5	100 (212)	87	15	500	194	75
20 - 300	17	200 (392)	94	16.5	520	186	71
20 - 400	17.5	300 (572)	100	18	530	179	68
20 - 500	18	400 (752)	105	19.5	540	172	65
		500 (932)	110	21	540	165	62

PROPERTIES

MECHANICAL PROPERTIES

Tensile properties after solution annealing heat treatment

°C	°F	YS 0.2%		YS 1%		UTS		Elongation
		MPa	ksi	MPa	ksi	MPa	ksi	%
20	68	285	42	315	46	590	86	40
100	212	225	33	255	37	530	77	35
200	392	185	27	210	31	480	70	30
300	572	165	24	190	28	460	67	30
400	752	150	22	175	25	450	65	25
500	932	135	20	160	23	440	64	25

Minimum guaranteed values following EN10088 hot rolled plates - The EN guaranteed values are valid for a thickness from 5 up to 75 mm.

Impact values

Temperature °C (°F)	- 196 (- 320)	+ 20 (+ 68)
KCV (J/cm ²) minimum	100	120

Industeel produces special 317 LMNN grades with high impact properties at - 269°C (- 452°F).

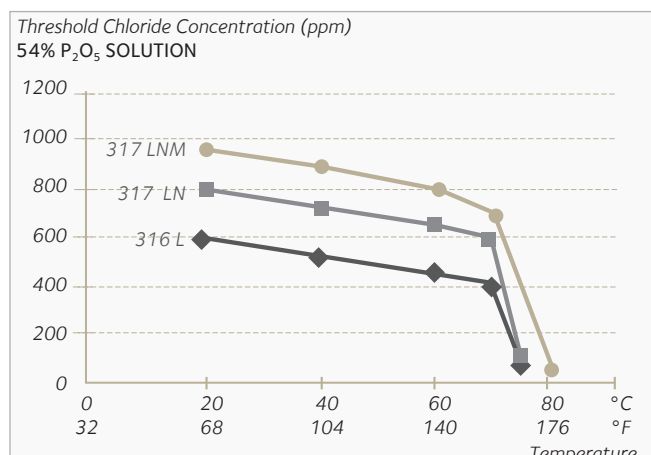
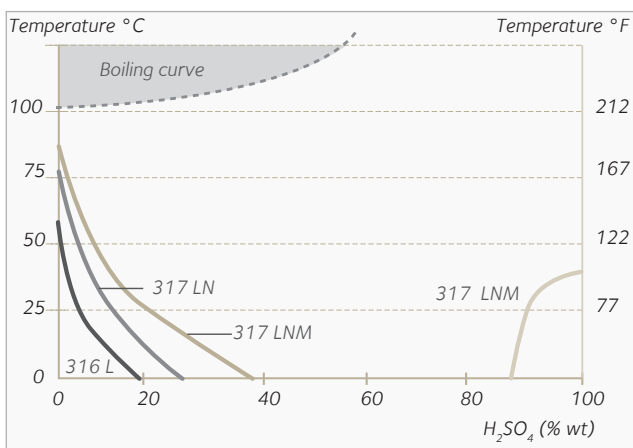
IN SERVICE CONDITIONS

CORROSION RESISTANCE

Standardized corrosion tests

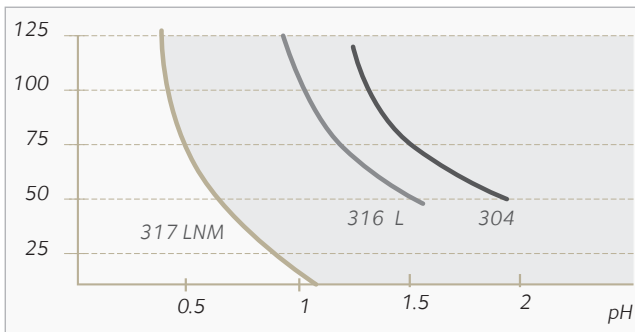
TEST	OTHER NAME	CORROSION	RESULTS
ASTM A 262 A		Intergranular	Step or dual structure
ASTM A 262 B	STREICHER	Intergranular	<1 mm/year
ASTM A 262 C	HUEY	Intergranular	<1 mm/year
ASTM A 262 E DIN 50914 RCCM	STRAUSS	Intergranular	No cracking after bending
ASTM G48A		Pitting	CPT ≥ 27.5°C - 82°F
ASTM G48B	ASTM G78	Crevice	CCT ≥ 15°C - 59°F

General corrosion resistance



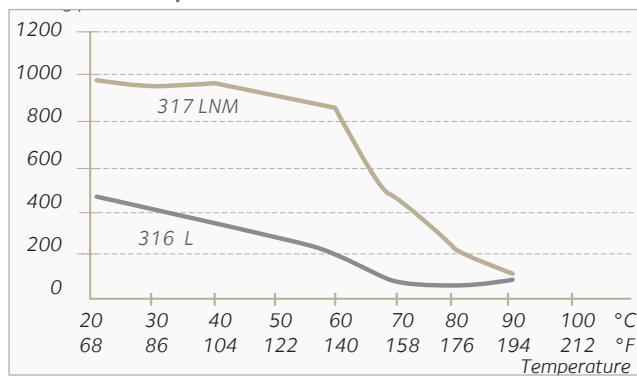
IN SERVICE CONDITIONS

Crevice corrosion resistance



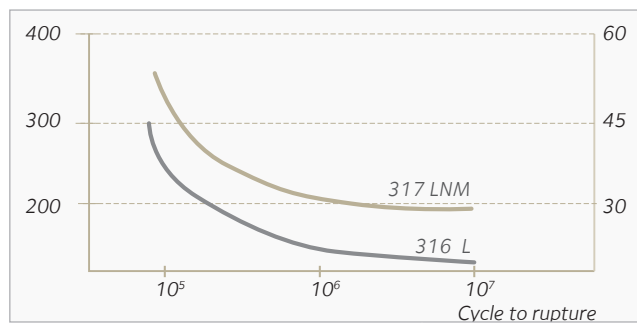
in a 30 g/l NaCl 20°C (68°F) solution

Effect of temperature

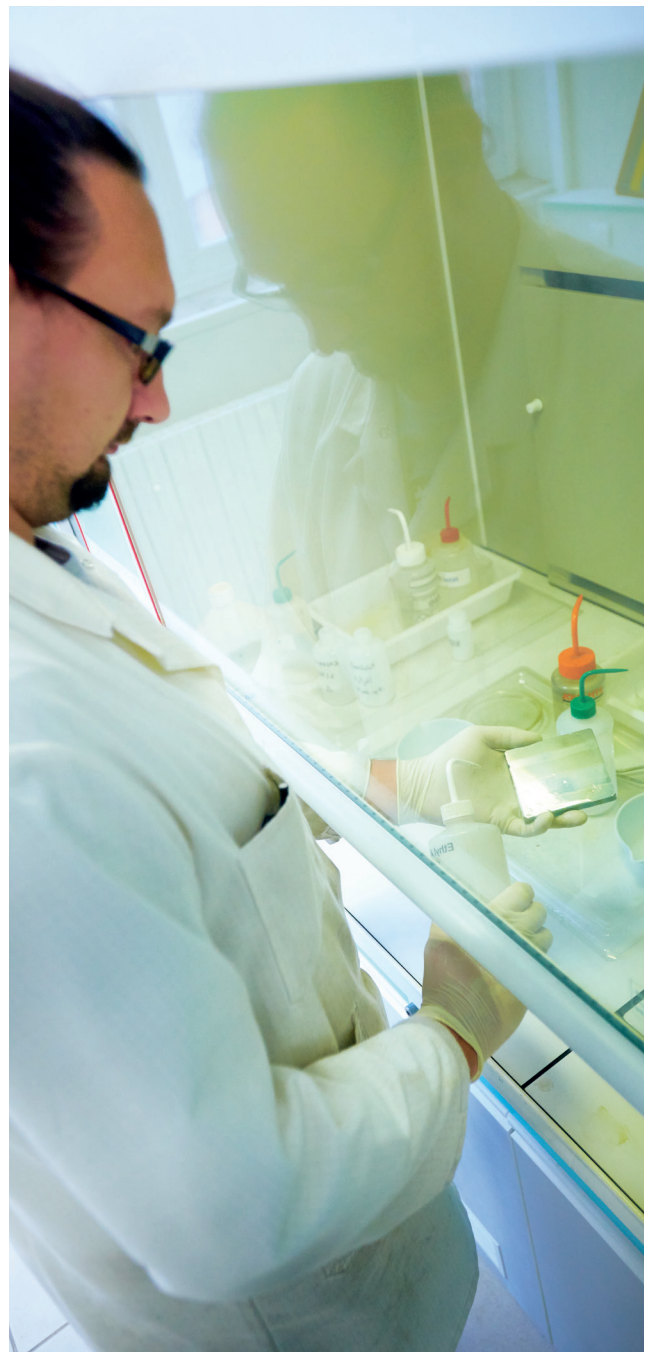


on the pitting potential in NaCl 30 g/l - ASTM G61

Fatigue corrosion resistance



Synthetic sawater rotating beam bending of smooth samples



DELIVERY CONDITIONS

SIZE RANGE

	Hot rolled plate	Clad plate
Thickness	5 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"	

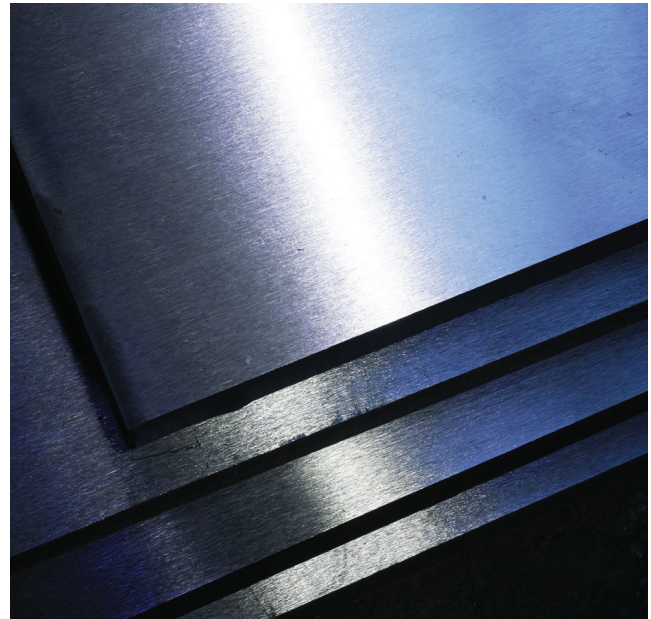
Indicative dimensional programme - *Width related to thickness, please consult for specific request.

HOT FORMING

Hot forming should be carried out in a temperature range of 900 - 1150°C (1652 - 2102°F). If the final forming temperature falls below 950°C (1742°F) a solution annealing (1080 - 1180°C / 1976 - 2156°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 for carbon steel (~50%). Quenching after forming must be fast.

COLD FORMING

Because of its high nitrogen content and of its work hardening properties, cold forming requires more power than structural steels or standard austenitic grades. UR™ 317 LMN has excellent ductility and can be cold formed without problem.



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 mm/t (inch/t)	Speed m/min (feet/min)	
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 mm/t (inch/t)	Speed m/min (feet/min)	
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 mm/t (inch/t)	Speed m/min (feet/min)
Milling profiling	High speed steel	Cutting oil			0.05 - 0.10 (0.002 - 0.004)	8 - 16 (26 - 52)

PICKLING

UR™ 317 LMN can be pickled in a standard pickling solution (10 - 20% HNO₃ + 1,5 - 5%HF) at 20°C - 60°C. Increasing the temperature will reduce the pickling time. A 10 - 20% H₂SO₄ + 1,5 - 5% HF solution can also be used. Rinse carefully after pickling.

CUTTING

- > **Thermal cutting (plasma, thermal sawing...).**
After cutting pickling or grinding are necessary to eliminate the oxide formed layer.
- > **Mechanical cutting (shearing, stamping, cold sawing...).**

WELDING

UR™ 317 LMN can be welded by TIG/GTAW, MIG/GMAW, MMAW, SAW and other usual processes. It has a good resistance to hot cracking but care must be exercised when using processes without filler, high energy processes or fully austenitic fillers. The filler metals can be E317L or ER317L type with a molybdenum content over 4% - 904L or overalloyed Ni - Cr - Mo alloys have been successfully used to weld 17 - 13 - 5LN. Preheating or postheating are not required nor recommended. After welding, the oxidized and heat tinted areas must be descaled carefully.

HEAT TREATMENT

UR™ 317 LMN has an austenitic microstructure with about 1 - 2% ferrite. The grade must be annealed at 1100 - 1150°C (2012 - 2102°F) and water quenched in order to avoid intermetallic phase precipitations which reduce the ductility and the corrosion resistance properties. Nitrogen additions improves structure stability.

APPLICATIONS

The alloy is corrosion resistant in:

- > Diluted sulfuric solutions at moderate temperature
- > Very diluted hydrochloric acid solutions at moderate temperature
- > Industrial phosphoric acid (30% P₂O₅ + 500ppm Cl - maximum at 70°C - 158°F)
- > Sulphurous acid solutions of sulphites and bisulphites at high temperature
- > Hot nitrogen sulphite solutions

Please consult for more data.

The main applications are:

- > **Flue gas desulfurization equipment**
- > **Chemical and pharmaceutical industries**
- > **Petrochemical industry**

YOUR CONTACTS

Didier Paul

Tel. +33 6 19 28 29 31

didier.r.paul@arcelormittal.com

<http://industeel.arcelormittal.com>

Industeel France

Le Creusot Plant

56 rue Clemenceau

F - 71202 Le Creusot Cedex

Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.