



## UREA™ 310Mo LN

### UREA™ 310Mo LN: A 310L modified - Low Si, high N, Stainless Steel for Urea Plants

Industeel UREA™ 310Mo LN chemical composition has been optimised for specific uses in urea plants. It is a 310L modified austenitic stainless steel with low carbon, low silicon and high nitrogen content in order to stabilize and strengthen the austenitic phase. The alloy is designed to obtain a fully austenitic stainless steel free of intermetallic phases as intergranular carbide precipitations which affect drastically the corrosion resistance properties of the alloy in urea containing solutions. The ferrite level is kept under 0.5% in the solution annealing and water quenched conditions. The alloy is particularly designed for improved corrosion resistance properties in urea carbonate environments including strippers. The grade is also well designed for resistance in wet corrosive conditions due to its high contents of chromium, molybdenum and nitrogen (PREN ≥ 33).

#### PROPERTIES

#### STANDARDS

- > EURONORM:            EN 1.4466            X1 Cr Ni Mo N 25 - 22 - 2
- > ASTM:                    310 MoLN            UNS S31050

#### CHEMICAL ANALYSIS - WEIGHT %

##### Typical values

C	Cr	Ni	Mo	N	Others
< .02	25	22	2.1	.12	Si < .4 - Mn < 2

#### PHYSICAL PROPERTIES

Density: 7.9 kg/dm<sup>3</sup>

Interval temperature (°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)	95	14	500	200	75
20 - 300	16.5	200 (392)	105	16	580	185	70
20 - 500	17.5	400 (752)	115	18	650	170	64

## MECHANICAL PROPERTIES

Typical tensile properties after solution annealing heat treatment

°C	°F	Y.S. 0.2%		Y.S. 1%		UTS		Elongation
		MPa	ksi	MPa	ksi	MPa	ksi	%
20	68	260	38	290	42	550	80	40
100	212	220	32	250	36	520	75	40
200	392	180	26	200	29	490	71	40
300	572	160	23	180	26	450	65	40
400	752	140	20	150	22	430	62	40

Impact value:

KCV ≥ 120 J/cm<sup>2</sup> (room temperature)

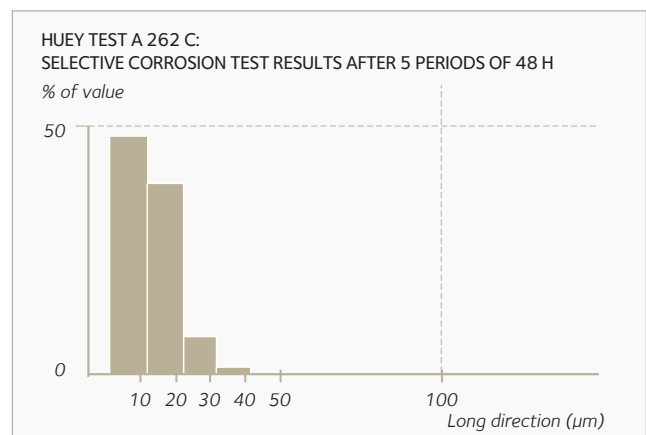
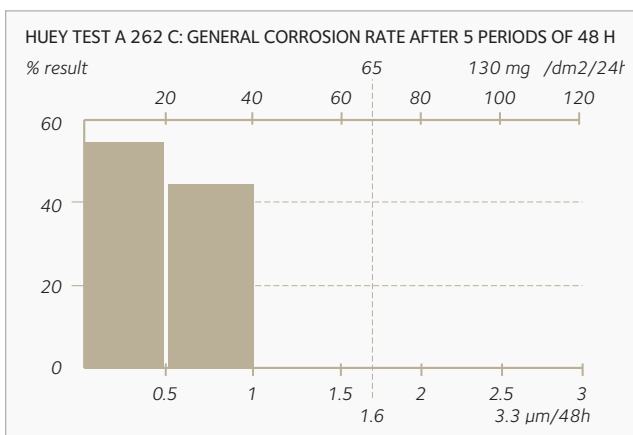
## STRUCTURE

Alloy UREA™ 310Mo LN is a fully austenitic stainless steel which ferrite content is guaranteed lower than 0.5% after solution annealing heat treatment (1140 - 1180°C / 2084 - 2156°F) and water quenching. The grain size is generally obtained between 3 and 6. The grain boundaries are free of intermetallic phases or carbide precipitations. The melting practice is optimised in order to improve the cleanliness properties of the steel.

## IN SERVICE CONDITIONS

### CORROSION RESISTANCE

The UREA™ 310Mo LN grade is particularly designed for urea applications. The corrosion resistance properties are enhanced thanks to the low carbon level and silicon level and complementary additions of nitrogen. Typical maximum corrosion results required following different specifications for the 310Mo LN grade after 5 periods of 48 h following ASTM A 262 - C practice are: maximum general corrosion: 1,6 µm/48 h or 65 mg/dm<sup>2</sup> per hour with a maximum depth of microcracks of 100 µm in the long direction of rolling. Industeel UREA™ 310Mo LN modified grade behaves much better than those maximum values as indicated on the following graph where about 100 tests results obtained on 2 years production period have been reported:



Industeel UREA™ 310Mo LN is delivered in accordance with last revisions of STAMICARBON or SNAM PROGETTI specifications.

## DELIVERY CONDITIONS

### SIZE RANGE

	Hot rolled plates
Thickness	5 to 150 mm 3/16" to 6"
Width	Up to 3300 mm Up to 130"
Length	Up to 12000 mm Up to 39 ft

Other sizes are available on request, including 4100 mm (161.4") width plate.

## PLATE PROCESSING

### HOT FORMING

Hot forming should be carried out in a temperature range of 1200 – 950°C (2732 – 1742°F) after the piece has been uniformly heat treated. Final full annealing temperature is required to obtain the requested microstructure. It will be performed at 1140° – 1180°C (2084 – 2156°F) followed by water quenching.

### COLD FORMING

Due to its fully austenitic microstructure, the alloy can be cold formed without any problem. The higher molybdenum content and cold hardening behaviour of the steel explains that it may require more powerful equipments than 304 stainless steel.

### PICKLING

The UREA™ 310Mo LN grade must be used in the as pickled and passivated conditions. Pickling treatment may be performed with a nitro - hydrofluoric acid bath (10 – 20% HNO<sub>3</sub> - 1.5 – 5% HF) at 40 – 60°C (104 – 140°F). A 10 – 20% H<sub>2</sub>SO<sub>4</sub> - 1.5 – 5% HF pickling bath may also be used.

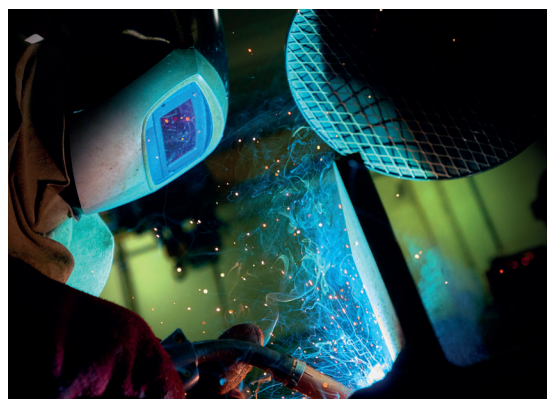
### WELDING

Alloy Industeel UREA™ 310Mo LN can be welded with most of the welding processes: TIG, Plasma, MIG welding, as well as SMAW, SAW or FCAW processes. The alloy is sensitive to hot cracking phenomenon due to its fully austenitic microstructure. Weld should be performed in order to obtain extra - low ferrite contents, no carbide or nitride precipitations, low silicon contents as well as no intermetallic phase precipitations. Higher manganese content products should be considered.

Typical chemistry of filler materials to be used is as follow:

C	Si	Cr	Ni	Mo	Mn	N
< .03	.3	24 - 25	22 - 23	2.0 - 2.2	5 - 6	.12 - .15

Use basic coated electrodes or fluxes in order to decrease the hot cracking susceptibility. The heat input should be limited to 1.5 kJ/mm and interpass temperature kept below 150°C (302°F)



## MACHINING

Operation	Tool	Lubrication	CONDITIONS		
			Blade width mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Parting off	High speed steel	Cutting oil	1.5 (0.06)	0.03 (0.0012)	10 - 13 (32.8 - 42.7)
			3 (0.11)	0.04 (0.0016)	11 - 14 (36.1 - 45.9)
			6 (0.23)	0.05 (0.0020)	12 - 15 (39.4 - 49.2)
			Drill Ø mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Drilling	High speed steel	Cutting oil	1.5 (0.06)	0.025 (0.0010)	6 - 10 (19.7 - 32.8)
			3 (0.11)	0.06 (0.0024)	7 - 11 (23 - 26.1)
			6 (0.23)	0.08 (0.0031)	7 - 11 (23 - 26.1)
			12 (0.48)	0.10 (0.0039)	7 - 11 (23 - 26.1)
				Feed mm/t (inch/t)	Speed m/min (feet/min)
Milling profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.0039)	10 - 20 (32.8 - 65.6)

## APPLICATIONS

The steel Industeel UREA™ 310Mo LN is designed for the fabrication of lining interiors in urea units or complementary products (pipes, fittings...). The grade can be used for urea strippers.

## YOUR CONTACTS

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*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.*