Industeel

ArcelorMittal

UREA 25.22.2

A 310L modified - Low Si, high N, Stainless Steel for Urea Plants

Industeel UREA 25.22.2 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 additions 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 $\geq$ 33).

Standards

EURONORM	1.4466 X1 CrNiMoN 25-22-2
ASTM	310 MoLN

Chemical analysis

Typical values (% weight)

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

Mechanical properties

Typical tensile properties after solution annealing heat treatment

C°	F°	Y.S. 0.2%		Y.S. 1%		UTS		El%
		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 $\geq$ 120 J/cm² (room temperature)

Physical properties

Density : 7.9 kg/dm³

Interval temperature	Thermal expansion	°C	°F	Resistivity	Thermal conductivity	Specific heat	Young modulus E	Shear modulus G
°C	α x10^{-6}K^{-1}			μΩ cm	W.m^{-1}.K^{-1}	J.kg^{-1}.K^{-1}	GPa	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

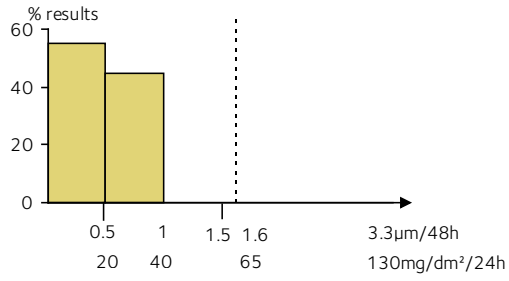
Structure

Alloy UREA 25.22.2 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.

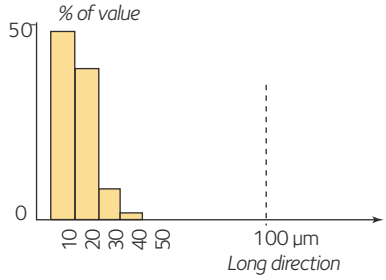
Corrosion resistance

The UREA 25.22.2 grade is particularly designed for urea applications. The corrosion resistance properties are enhanced thanks to the low carbon level, low silicon level and complementary additions of nitrogen.
Typical maximum corrosion results required following different specifications for the 25.22.2 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/dm² per hour with a maximum depth of microcracks of 100 μm in the long direction of rolling.

Industeel UREA 25.22.2 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:



Huey test A 262 C
General corrosion rate after 5 periods of 48 hours



Huey test A 262 C
Selective corrosion test results after 5 periods of 48 hours

Industeel UREA 25.22.2 is delivered in accordance with last revisions of STAMICARBON or SNAM PROGETTI specifications.

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 uniformely 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 powerfull equipments than 304 stainless steel.

Pickling

The UREA 25.22.2 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_3 - 1.5-5% HF) at 40-60°C (*104-140°F*).
A 10-20% H_2SO_4 - 1.5-5% HF pickling bath may also be used.

Welding

Alloy Industeel UREA 25.22.2 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	Blade width - in	Feed - mm/t	Feed - in/t	Speed - m/min	Speed - ft/min
Parting off	High speed steel	Cutting oil	1.5 3 6	*.06* *.11* *.23*	.03 .04 .05	*.0012* *.0016* *.0020*	10-13 11-14 12-15	*32.8-42.7* *36.1-45.9* *39.4-49.2*
			Drill Ø mm	Drill Ø in	Feed - mm/t	Feed - in/t	Speed - m/min	Speed - ft/min
Drilling	High speed steel	Cutting oil	1.5 3 6 12	*.06* *.11* *.23* *.48*	.025 .06 .08 .10	*.0010* *.0024* *.0031* *.0039*	6-10 7-11 7-11 7-11	*19.7-32.8* *23-26.1* *23-26.1* *23-26.1*
					Feed - mm/t	Feed - in/t	Speed - m/min	Speed - ft/min
Milling Profiling	High speed steel	Cutting oil			.05-.10	*.002-.0039*	10-20	*32.8-65.6*

Applications

The steel Industeel UREA 25.22.2 is designed for the fabrication of lining interiors in Urea units or complementary products (pipes, fittings...).
The grade can be used for urea strippers.

Size range

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

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

For any information, please contact :

Industeel France
Le Creusot Plant
56 rue Clemenceau
F-71201 Le Creusot Cedex
Tel +33 (0)3 85 80 55 31
Fax +33 (0)3 85 80 54 11

Industeel Belgium
266 rue de Chatelet
B-6030 Marchienne au Pont
Tel +32 71 44 16 99
Fax +32 71 44 19 56

www.industeel.info
www.arcelormittal.com

transforming tomorrow