Industeel

ArcelorMittal

CryElso™ 201LN

CryElso™ 201LN: A low nickel, high strength cryogenic stainless steel

CryElso™ 201LN is a low nickel austenitic stainless steel. Nitrogen and manganese used for nickel substitution increase the yield strength of the grade without impairing its ductility.

The main properties of CryElso™ 201LN are:

> high strength and excellent ductility

> good resistance to intergranular corrosion in the as - welded condition

> excellent fabrication properties

> low temperature toughness, and superior mechanical properties allowing its use for cryogenic applications

CryElso™ 201LN is austenitic in the solution annealed condition (1000 - 1100°C) (1832 - 2012°F). It contains a small amount of ferrite. CryElso™ 201LN is stable against martensitic transformations induced by deformation at low temperature. CryElso™ 201LN will usually provide weight savings in most structural or pressure vessels applications.

CryElso™ 201LN is certified by Bureau Veritas marine for the application to LNG tanks for ships.

PROPERTIES

STANDARDS

> EURONORM: EN 10028 - 7 - 1.4371 - X2CrMnNiN17 - 7 - 5

> ASTM A240: Type 201LN - UNS S20153

> ASME SA240: 16Cr - 4Ni - 6 Mn Type 201LN - UNS S20153 code case 2504
ASME VIII div 1 and 2 and ASME XII code case 2504

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mn	N	Others
.025	16.5	4.7	7	.15	-

PHYSICAL PROPERTIES

Density: 7.8 g/cm³
Melting temperature: liquidus 1420°C (2588°F)

T (°C)	Resistivity (µΩ.cm)	Thermal conductivity (W m⁻¹ K⁻¹)
20	0.70	15

Specific heat (J kg⁻¹ K⁻¹)	Young modulus E (GPa)	Magnetic permeability at 0.8 kA/m DC or AC
500	200	1.05

Thermal expansion

Temperature interval (°C)	Thermal expansion x10⁻⁶ K⁻¹	T (°C)
20 - 100	17.0	100
20 - 200	17.5	200
20 - 400	18.5	300

MECHANICAL PROPERTIES

Tensile properties after solution annealing heat treatment
Minimum guaranteed values as per EN 10028 - 7 quarto plates

Temperature		YS 0.2%		YS 1%		UTS		Elongation
°C	°F	MPa	ksi	MPa	ksi	MPa	ksi	%
-196*	-320	500	73	600	87	1350	196	
-150*	-238	430	62	500	73	1300	189	
20	68	300	44	370	54	650	94	45
100	212	205	30	240	35	490	71	
200	392	127	18	157	23	430	62	
300	572	110	16	135	20	410	44	

** informative values*
The EN guaranteed values are valid for thicknesses from 5 up to 75 mm. Note: for thickness > 40 mm, please consult us.

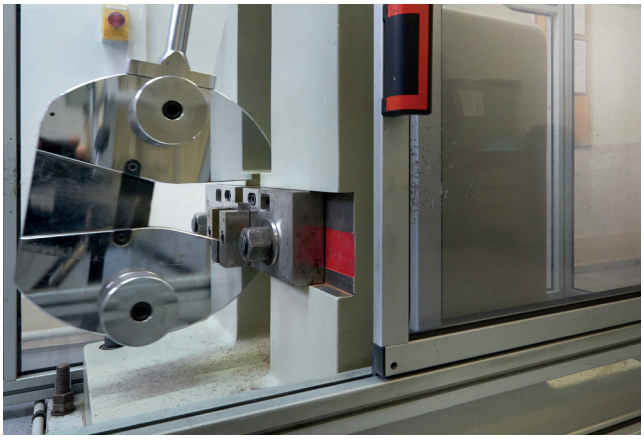
Guaranteed values as per ASTM A240, ASME SA240

Temperature		YS 0.2%		UTS		Hardness max		Elongation
°C	°F	MPa	ksi	MPa	ksi	HBW	HRB	%
20	68	310	45	655	95	241	100	45

Guaranteed Impact value

Temperature		KCV Transverse		KCV Longitudinal	
°C	°F	J/cm²	Ft.lb	J/cm²	Ft.lb
- 196	- 320	60	35		
+20	+ 68	60	35	100	59

Lateral expansion > 0.38 mm at - 196°C (- 320°F). Like other austenitic steels (e.g. 304), CryElso™ 201LN maintains excellent impact strength at low temperature down to - 196°C (- 320°F) and increases in tensile properties with decreasing temperature.



IN SERVICE CONDITIONS

CORROSION RESISTANCE

CryElso™ 201LN has a good resistance to common types of corrosion in mild environments, it is nearly equivalent to 304L (1.4307).

DELIVERY CONDITIONS

SIZE RANGE

	Plates
Thickness	6.35 mm up to 40 mm 1/4" to 1.6"
Width*	Up to 3200 mm Up to 126"
Length	Up to 12000 mm Up to 472"

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

PLATE PROCESSING

HOT FORMING

Hot forming should be carried out at temperatures between 1150 and 750°C (2102 - 1382°F). Solution annealing is not required if hot forming has been performed above 900°C (1652°F) followed by rapid cooling in air or water.
The cleanliness of the surface is very important and contaminations should be avoided. A neutral or slightly oxidizing atmosphere is required. Due to the low thermal conductivity, the holding time of temperature may need to be longer than for carbon steel (about 50% longer).

COLD FORMING

CryElso™ 201LN can be cold formed without difficulty. Thanks to the nitrogen addition, it is less susceptible to martensitic transformation than cold formed 304 or 321. Cryelso™ 201LN may require more powerful equipments than structural steel because of its work hardening properties and its higher mechanical properties.

CUTTING

> Plasma or other high power thermal cutting methods can be used

> Mechanical cutting is also suitable (shearing, stamping, cold sawing...)

After cutting, pickling or grinding are necessary to eliminate the oxide layer scale and tinting that has formed.

PICKING

A nitric - hydrofluoric acid bath (10 - 20% HNO_3 - 1.5 - 5% HF) at 20 - 60°C (68 - 142°F) may be used for pickling for example.
Decontamination treatments may be performed with a 10 - 20% weight nitric acid solution. Efficient rinsing with fresh water is necessary after pickling.

WELDING

The alloy is not sensitive to cold cracking phenomenon. All welding processes can be used, including processes without filler. The alloy has a good resistance to hot cracking.

a) For non cryogenic applications CryElso™ 201LN is readily welded using the same methods as 304L.

Recommended filler metal:

> Austenitic: Welds using 308L/316L filler materials are generally sufficient to guarantee the same mechanical properties as the base metal for thin plates (< 12 mm - 0.47"). For thicker plates, use 316LMN filler materials in order to increase tensile properties in weld metal

> Duplex: For higher tensile properties of the welding joint, use duplex filler material 2209. Consult in case of doubt.

200°C (390°C) is the maximum interpass temperature. A post weld heat treatment is not necessary.
Post weld pickling is necessary to restore the corrosion resistance of the joints.
b) For cryogenic applications filler material is selected according to the thickness and the welding process so that the welded joint conforms to the requirements of the construction codes.

Welding processes	Recommended filler metals		Shielding gas/Flux
	Thicknesses (mm)	Filler material** Wire/Rod	
P.A.W. G.T.A.W. G.M.A.W.	e ≤ 12	ER 308 L (1) - W/G 19 9 L ER 31 6 L - W/G 1 9 12 3 L ER 316LMn - W/G 20 16 3 Mn N L	**P.A.W./G.T.A.W.** Argon (I1) (3) - Argon + Helium (I3) **G.M.A.W.** Argon (I1) Argon + 2% Co2 (M12)
	e > 12 or if PWHT* required	ER NiCrMo 3 - E Ni 6625	
S.A.W.	e ≤ 12	ER 308 L / S 19 9 L ER 316 L - S 19 12 3 L ER 31 6 LMn/S 20 16 3 Mn N L	'See filler materials suppliers' recommendations
	e > 12 or if PWHT* required	ER NiCrMo-3 - E Ni 6625 OE 2016NC + OP79 Flux	
S.M.A.W.	e ≤ 12	E 308 L - 15/E199LB42 ER 308 L- 16/E 19 9 L R 3 2 E 316 L - 15/E 19 12 3 L B 4 2 E 316 L - 16/E19 123 LR 3 2	
	e > 12 or if PWHT* required	E NiCrMo-3 E Ni 6625	

** PWHT = Post Weld Heat Treatment*
*** AWS A5.9 or AWS A5.11 - EN ISO 14343 or EN ISO 14172 - EN 439*

APPLICATIONS

The main applications are:

> Liquid gas production and storage vessels

> Tanks and containers for cryogenic transportation

YOUR CONTACTS

Didier Paul
Tel. +33 6 19 28 29 31
didier.r.paul@arcelormittal.com

https://industeel.arcelormittal.com

Industeel Belgium
266, rue de Châtelet
B - 6030 Marchienne-au-Pont