

URANUS⁰ 52 N⁺

A 25 Cr Super Duplex stainless steel with PREN³ 40

URANUS 52N⁺ (UR 52N⁺) is a super duplex stainless steel with 25% Cr and a PREN value higher than 40. The minimum guaranteed yield strength is 550 MPa which allows the designer to reduce weight. The molybdenum and nitrogen additions have been optimized in order to obtain the best corrosion resistance properties even for heavy plates. High nitrogen content improves the structure stability particularly in HAZ. Its corrosion resistance is much better than UR B6/N08904 and roughly equivalent to 6 Mo super austenitic alloys.

Copper additions increase the corrosion resistance properties, particularly in sulphuric acid media.

URANUS 52N⁺ is a cost efficient grade designed for offshore, marine, phosphoric acid, sulphuric acid applications... as well as pollution control equipments.

STANDARDS

EURONORM 1. 4507 - X2 Cr Ni Mo Cu N 25.6.3
AFNOR Z3 CNDU 25.07 AZ
ASTM. UNS S32550/S32520

CHEMICAL ANALYSIS

Typical values (Weight %)

C	Cr	Ni	Mo	N	Others
< 0.030	25	6.5	3.5	0.25	Cu ≥ 1.5
PREN = [Cr %] + 3.3 [Mo %] + 16 [N %] ³ 40					

MECHANICAL PROPERTIES

Tensile properties - minimum values

°C	Rp 0.2 MPa	Rp 1.0 MPa	Rm MPa	°F	YS 0.2% KSI	YS 1.0% KSI	UTS KSI	EI %
20	550	570	770	68	78	83	111	25
100	485	500	700	212	70	72	102	25
250	400	420	640	500	57	61	92	25

Typical temperature range of use : -50°C/+ 270° C (-58°F /+518°F)
For lower temperature applications, please contact us.

Impact strength (KV typical values)

	-50°C (-58°F)	-20°C (-4°F)	0°C (32°F)	20°C (68°F)
KV plates (guaranteed)	> 70 J	> 85 J	> 90 J	> 95 J
KV weld metal (typical)	> 30 J	> 40 J	> 50 J	> 55 J

Impact values of welds are closely related to the microstructure (α / γ balance) and the control of chemical analysis (oxygen, nitrogen, nickel) which depend on welding processes and parameters. The best results are obtained for high austenite contents (75-60 %) and low oxygen levels. High nitrogen contents associated with high ferrite levels must be avoided. For more information, please contact us.

Hardness values - Typical values

HV₅ : 250 to 280

HRC < 28

PHYSICAL PROPERTIES

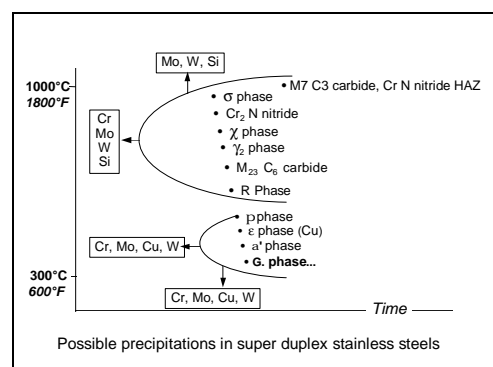
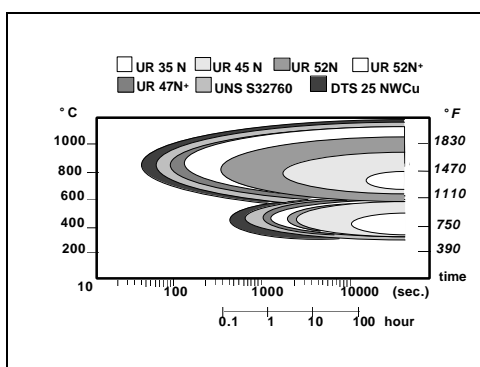
Density : 7,820 kg/m³ - 0.28 lb/in³

Interval Temper °C	Thermal expansion $\alpha \times 10^{-6} \text{K}^{-1}$	°C	°F	Resistivity ($\mu\text{W cm}$)	Thermal conductivity ($\text{W.m}^{-1}.\text{K}^{-1}$)	Specific heat ($\text{J.kg}^{-1}.\text{K}^{-1}$)	Young modulus E (GPa)	Shear modulus G (GPa)
20-200	13.5	20	68	85	17	450	200	75
20-300	14	100	392	95	18	500	190	73
20-500	14.5	200	392	100	19	530	180	70

STRUCTURE STABILITY

25 Cr super duplex grades are subject to intermetallic phase precipitations (σ , χ ...) particularly when improperly heat treated. Higher molybdenum and tungsten additions increase the sensitivity to sigma phase transformation. CLI equipments and heat treatments are optimised in order to control the composition, structure and properties of the products. We use a batch furnace to control time and temperature for each individual plate. This makes CLI duplex quality. The microstructure free of intermetallic phases contributes to an increase of both toughness properties and corrosion resistance properties.

Nitrogen additions have been increased compared to the former UR 52N grade (0.18→0.25%) in order to increase both corrosion resistance properties and structure stability, particularly in HAZ.



CORROSION RESISTANCE

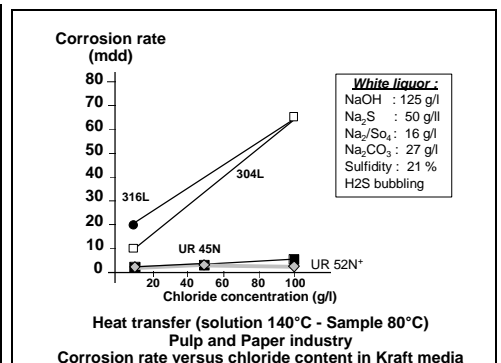
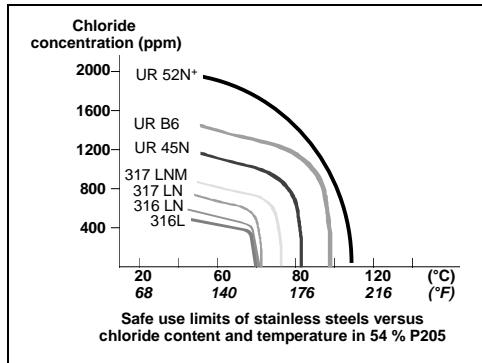
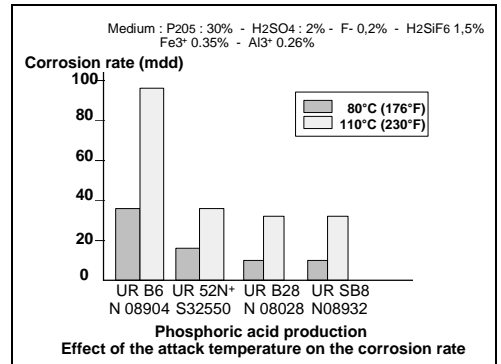
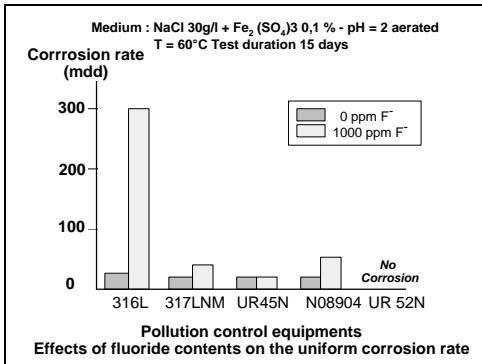
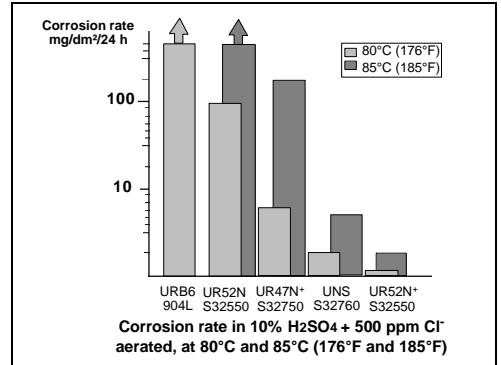
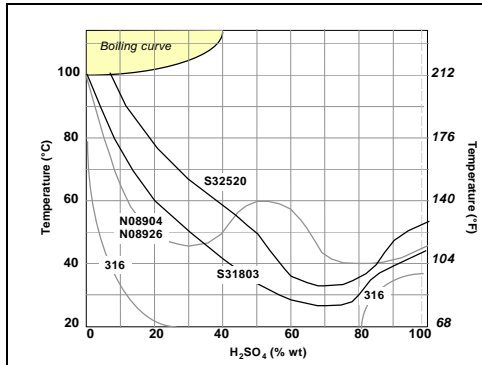
Heat treatment :

UR 52N⁺ is delivered in the solution annealed and water quenched conditions (1080/1120°C - 1976/2018°F). The chemical analysis and heat treatment are optimised in order to reach a 50% α / 50% γ microstructure.

General corrosion

UR 52N⁺ performs particularly well in sulphuric and phosphoric acid solutions, even in presence of chlorides. The duplex microstructure which provides high mechanical properties explains why the alloy behaves particularly well in abrasion-corrosion conditions (agitators, screws, rakes...).

Mixed acids are often associated with chlorides and in pollution control equipments. Due to high chromium, molybdenum and copper additions, UR 52N⁺ behaves well in scrubber systems. In Pulp and Paper industries, UR 52N⁺ is used in the most severe conditions encountered for example in digester (resistant to hot wall problems), chips presteaming vessels or in some bleaching equipments.

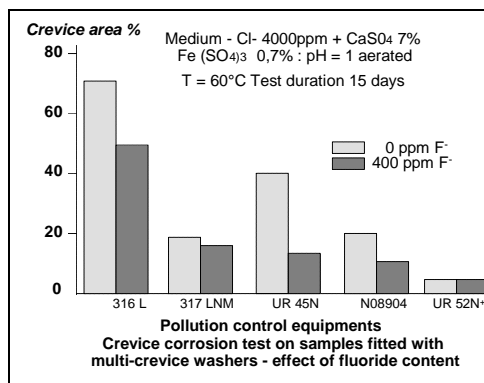
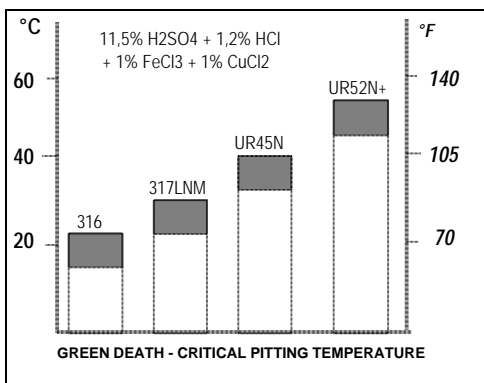
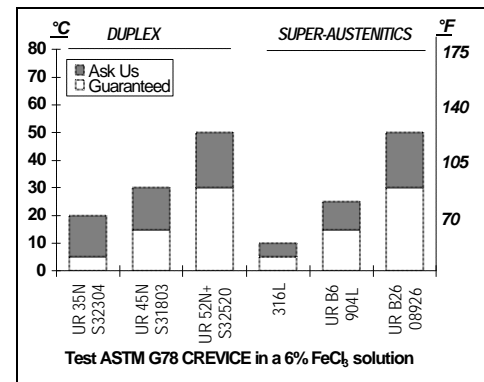
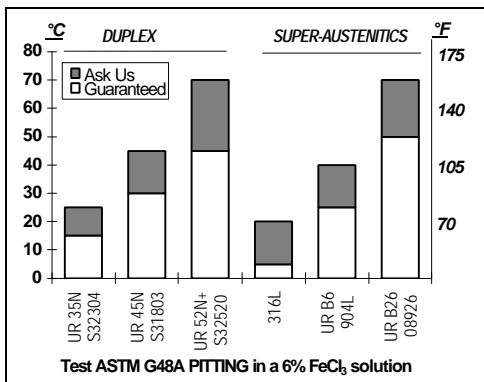
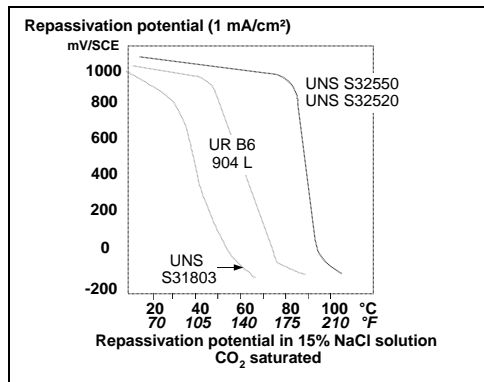
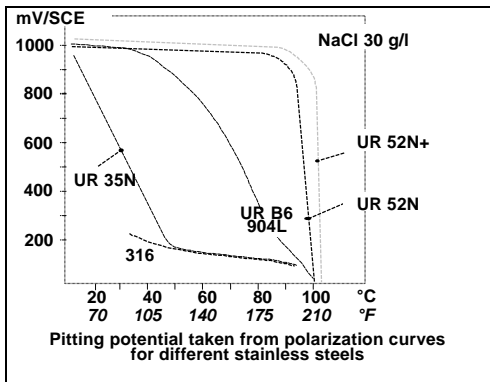


Chloride level		1 g/l			5 g/l			30 g/l			300 g/l		
F- (ppm)		0	400	1000	0	400	1000	0	400	1000	0	400	1000
pH	6	UR 45N+											
	4	UNS 31803 - PREN ≥ 35			UNS 32550/S32520 UR 52N+								
	2	UNS 32550/S32520 UR 52N+			UNS 08926 - UR B26								
	1				N06022 - H.C22			N10276 - H.C276					

MATERIAL GUIDE FOR USING IN FGD EQUIPMENTS - 60°C (140°F)
Based on extensive tests results

Pitting and crevice corrosion

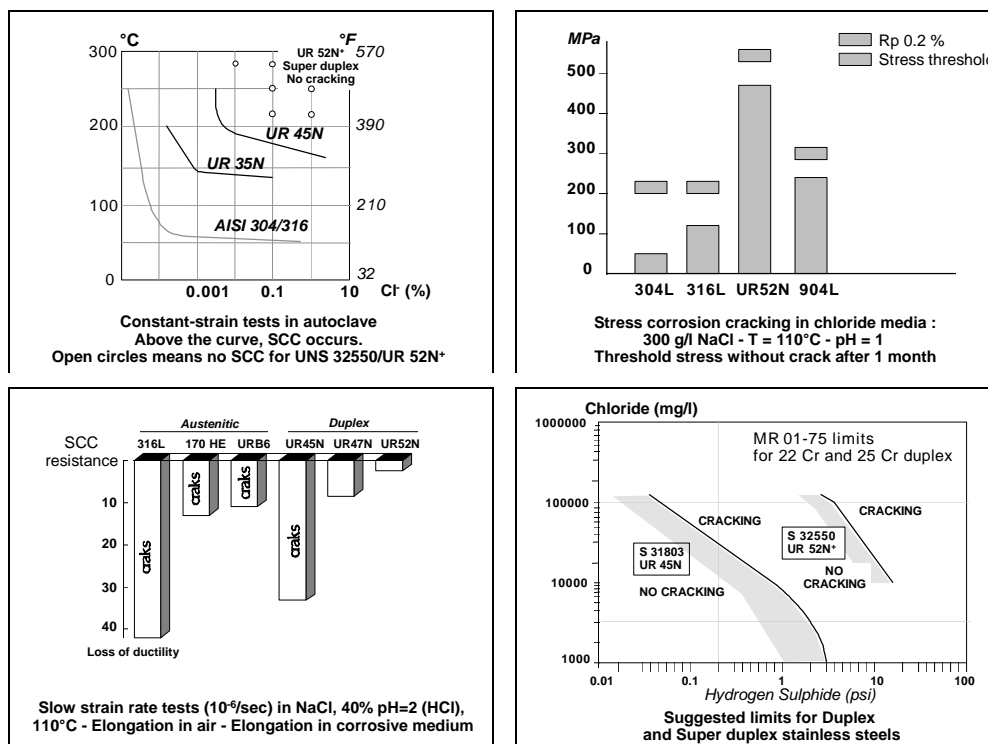
The minimum PREN value of 40 also explains why the alloy is highly resistant to pitting corrosion and crevice corrosion. The alloy behaves much better than 904L and is, for pitting corrosion resistance, nearly equivalent to 6 Mo super γ grade. In some cases, the crevice corrosion resistance is slightly higher than 6 Mo alloys due to the 25% Cr additions.



Stress corrosion cracking resistance

The stress corrosion resistance properties of URANUS 52N⁺ is excellent in high temperature chloride containing solutions as well as in sour gas applications.

FABRICATION



Cold forming

Due to its higher mechanical properties, the cold forming of UR 52N⁺ requires more strength than austenitic grades. For cold deformations higher than 20 %, an intermediate heat treatment is required (solution annealing 1080/1120°C (1976/2018°F) + water cooling).

Detailed guidelines for cold forming of unwelded and welded plates are available upon request.

Hot forming

Between 1150°C and 1000°C (2102 and 1832°F). After hot forming, a new solution annealing heat treatment in the range 1080/1120°C (1976/2018°F) + water cooling is necessary.

Pickling

Same conditions as for 316L grade, but the pickling time is at least twice that of 316L grade. An increase of the temperature of the pickling bath reduces the pickling time.

WELDING

URANUS 52N⁺ can be welded using the following processes : SMAW, GTAW (with filler), GMAW, PAW (with filler).

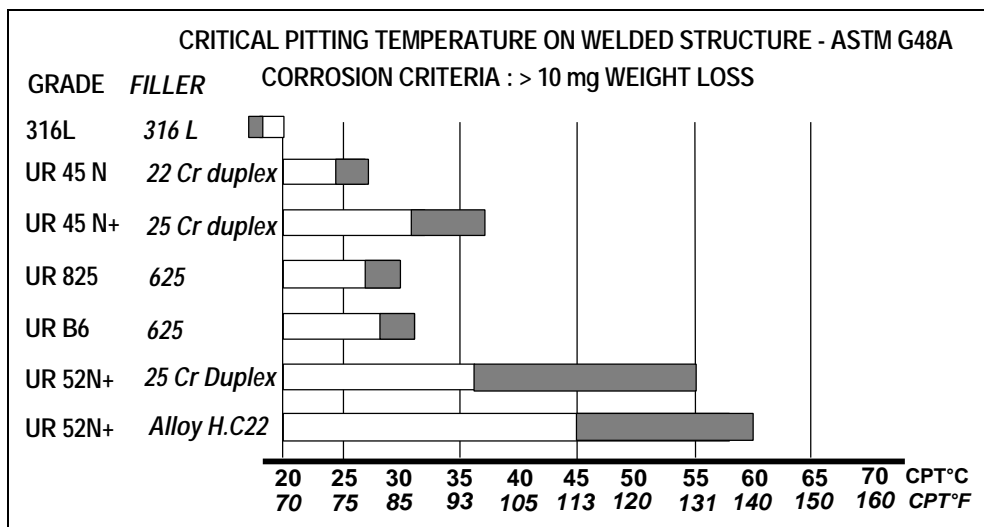
The welding procedures are similar to those of other duplex stainless steels :

- no pre-heating,
- heat input between 0.5 KJ/mm and 2 JK/mm is recommended (depending on the process and on the thickness of the plate). Precise welding parameters for each type of process and thicknesses are available on request.
- interpass temperature less than 150°C (302°F) and preferably less than 120°C (248°F)
- no PWHT, except solution annealing at 1080/1120°C (1976/2048°F) + water cooling.

As in welded conditions, the ferrite ratio in the heat affected zone should be lower than 70% between 20 to 60% for the weld metal ; for SMAW, FCAW and SAW weld metal aim for the lower part of the range (20 to 40%).

In order to control the structure and properties, over alloyed filler materials are recommended (nickel and/or nitrogen additions). Excessive dilutions must be avoided.

Filler materials and shielding gases guaranteeing PREN > 40 have been developed (wire, metallic cored wire, electrodes) - a list of tested filler materials is available on request.



Corrosion resistance properties of welded structures are very dependant on welding parameters and surface condition. Avoid oxyde scales or contaminations. Brushed or pickled welds perform better. The best results are obtained for solution annealed welds. The use of nickel based weld consumables allow to increase the corrosion resistance of welded structures (avoid 625 alloys but use Nb free grades like H.C22 or SG Ni Cr 23 Mo 16 or PHYWELD NCM (Nb free 625)).

DESIGN

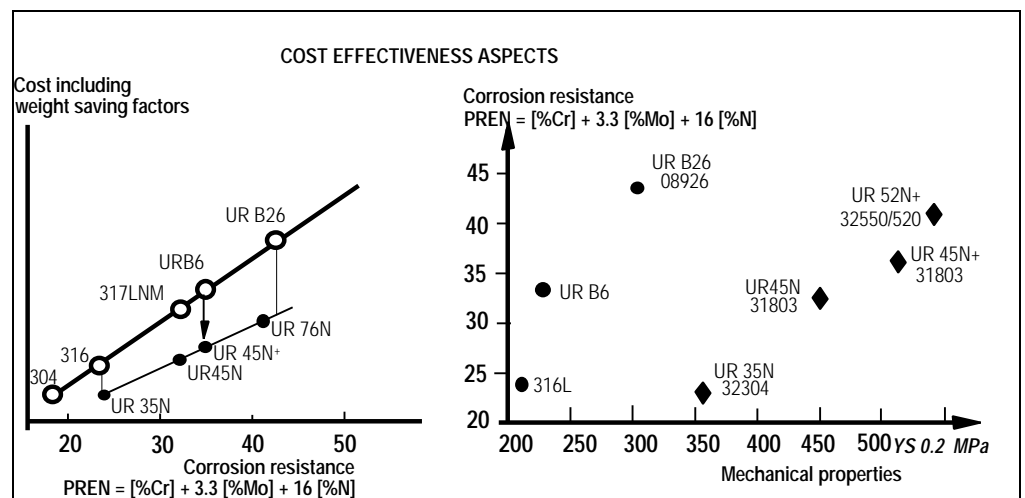
Cost factor considerations

Maximum allowable stresses given by several pressure vessel codes are shown here. The high mechanical properties of URANUS 52N⁺ allow thickness and, consequently, cost reductions..

We are happy to offer assistance in evaluating potential cost savings related to pressure vessel or structural design and the excellent corrosion resistance properties of UR 52N+.

Design stress values (Typical values)

Country	Code	Room temperature (MPa)				Saving factors UR52N ⁺ /URB6
		316	UR 45N 31803	UR B6 904L	UR 52N ⁺ 32550/520	
USA	ASME VIII, DIV1	108	155	123	190	35 %
F	CODAP 90, f.1	166	275	176	287	38 %
UK	BS 5500	128	289	173	294	42 %
D	ADW 2	128	300	167	327	49 %



APPLICATIONS

- Seawater systems and applications (diving spheres...),
- Oil and gas Industry including sour gas applications,
- Petrochemical industry including PVC strippers,
- Pulp and paper industry (digesters, bleaching towers...),
- Chemical industry including organic acid applications,
- Sulphuric acid plants,
- Phosphoric acid plants,
- Truck-lorries multipurpose containers,
- Pollution control equipments (scrubbers),
- ...

SIZE RANGE

	Hot rolled plates	Cold rolled plates	Clad plates
Thickness	5 to 150 mm 3/16" to 6"	2 to 14 mm 5/64" to 5/8"	6 to 150 mm 1/4" to 6"
Width	Up to 3300 mm Up to 130"	Up to 2300 mm Up to 90.5"	Up to 3300 mm Up to 130"
Length	Up to 12000 mm Up to 472"	Up to 8250 mm Up to 325"	Up to 14000 mm Up to 551"

Other sizes are available on request, including 4100mm (161,5")width plates

NOTE

This technical data and information represents our best knowledge at the time of printing. However, it may be subject to some slight variations due to our ongoing research programme on corrosion resistant grades. We therefore 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 is only for the purpose of description, and may only be considered as guarantees when our company has given written formal approval. Further information may be obtained from the following address.

For all information : CREUSOT-LOIRE INDUSTRIE, FAFER

56 Rue Clemenceau
71202 LE CREUSOT CEDEX - FRANCE
Sales Tel +33 3 85 80 52 16
 Fax +33 3 85 80 51 77

266, rue du Chatelet
B- 6030 MARCHIENNE AU PONT
Tel +32 71 44 18 78
Fax +32 71 44 19 59

Development Tel +33 3 85 80 55 03
CLI-FAFER Fax +33 3 85 80 59 66