Industeel

ArcelorMittal

UR™ 66

UR™ 66: A high strength super austenitic stainless steel with PRENW = 55

Research carried out these last years has shown that combined additions of chromium, tungsten, molybdenum, nitrogen and copper, make it possible to design a super austenitic stainless steel with mechanical properties equivalent to the alloy 625 and with very high corrosion resistance properties. Due to 22% Ni and 0.4% N additions, the new **UR™ 66** alloy exhibits a very stable microstructure, less prone to intermetallic phase precipitations than the other highly alloyed austenitic stainless steels. The **UR™ 66** alloy has improved corrosion resistance properties compared to 6 Mo grades particularly in sea water and chlorinated sea water. Due to the optimum "cocktail" of alloying elements, the grade can be used in most very severe corrosive environments where it behaves almost equivalent or better than alloy 625.

PROPERTIES

STANDARDS

> EURONORM: EN 1.4659 X1Cr Ni Mo Cu N W 24-22-6

> ASTM: UNS S31266

CHEMICAL ANALYSIS - WEIGHT %

Typical values

Ni	Cr	Mo	W	Mn	N	Others
22	24	6	2	3	> .4	Cu = 1.5

PRENW = [Cr%] + 3.3 ([Mo%] + 0.5 [W%]) + 16 [N%] = 55

PHYSICAL PROPERTIES

Density: 8.2 kg/dm³ - 0.29lb/in³

Temperature interval °C (°F)	Thermal expansion (α x10^{-6} K^{-1})	T °C (°F)	Resistivity (µΩ.cm)	Thermal conductivity (W m^{-1} K^{-1})	Specific heat (J kg^{-1} K^{-1})	Young modulus E (GPa)	Shear modulus G (GPa)
20 - 100 (68 - 212)	15	20 (68)	100	12	450	195	75
20 - 300 (68 - 572)	16	200 (392)	115	13	550	180	70
20 - 500 (68 - 932)	16.5	400 (752)	125	14	620	165	66

MECHANICAL PROPERTIES

Tensile properties - Guaranteed values

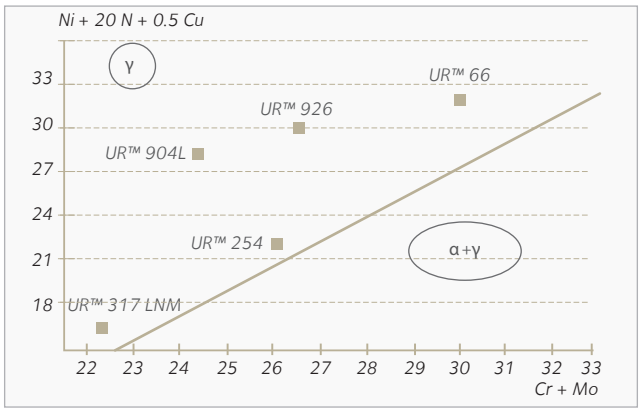
°C	$R_{p0.2}$	$R_{p1.0}$	R_m	°F	YS 0.2%	YS 1.0%	UTS	A/Elongation
	MPa				ksi			%
20	420	440	750	68	61	64	109	50
100	350	380	730	212	51	55	106	50
200	300	330	670	392	44	48	97	50
300	280	310	630	572	41	45	91	50

Impact values: >100J/cm² (70ft lbs) at -196°C (-320°F)

Hardness values: HV_{10}: [220-260]

STRUCTURE

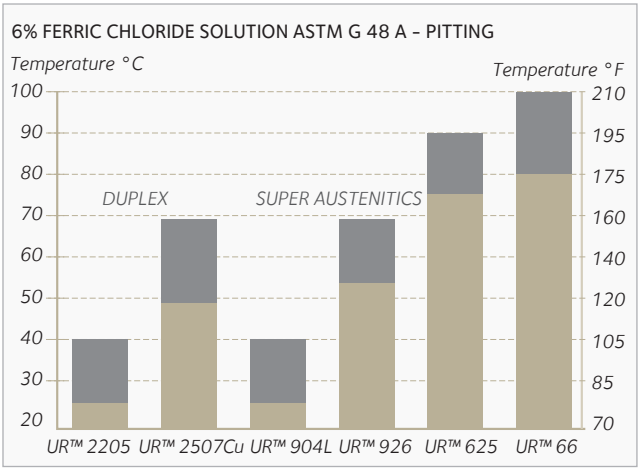
UR™ 66 chemical analysis (22%Ni, 0.4%N) is optimised in order to obtain a fully austenitic structure. The synergetic effects of nitrogen and tungsten additions result in drastic decrease of the gamma to sigma phase kinetic of transformation compared to high molybdenum low nitrogen grades. As a result, very thick products may be produced without intermetallic phase precipitations. Due to the high chromium and molybdenum additions, the alloy must be water-quenched from 1150°C (2100°F).

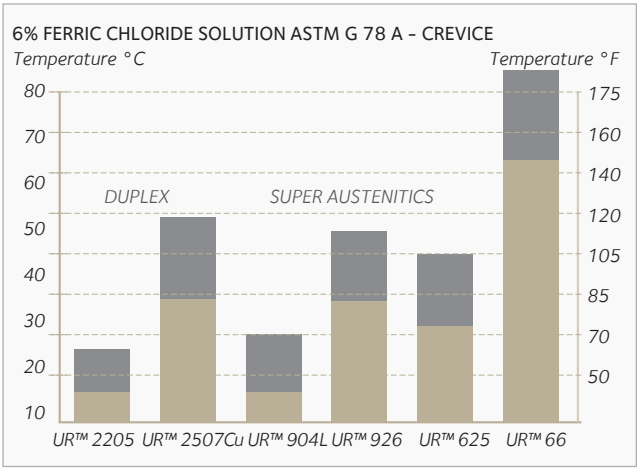


IN SERVICE CONDITIONS

CORROSION RESISTANCE

Pitting and crevice corrosion resistance

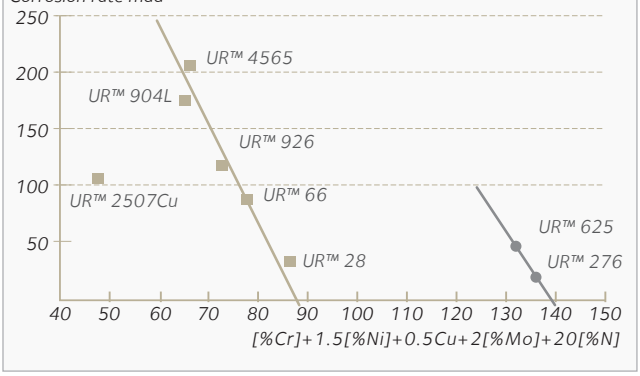




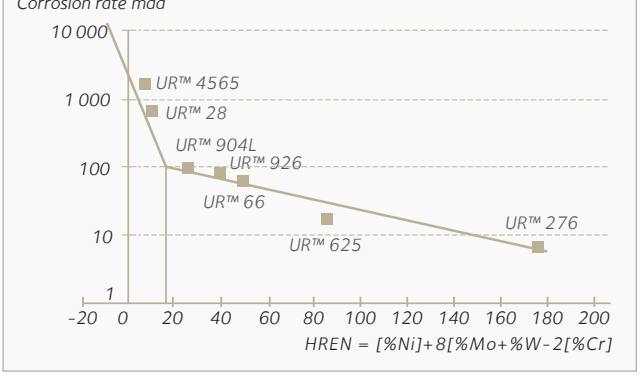
The high chromium, molybdenum and nitrogen contents of alloy UR™ 66 (PREN ≥ 50) explains why the grade is very resistant to localised corrosion even in acidified oxidizing conditions. The alloy can be used for sea-water applications (natural treated and re-use).

IN SERVICE CONDITIONS

CORROSION RATE IN DEAERATED 10% H_2SO_4 AT 80°C



CORROSION RATE IN AERATED 35% HCl AT 25°C



Simulated wet FGD environment			
Grade	0 ppm Br -	1.000 ppm Br -	5000 ppm Br -
N08904	Pitting	Pitting	Pitting
S31254	No pit	No pit	Pitting
S34565	No pit	No pit	Pitting
N06625	No pit	No pit	No pit
S31266	No pit	No pit	No pit

DELIVERY CONDITIONS

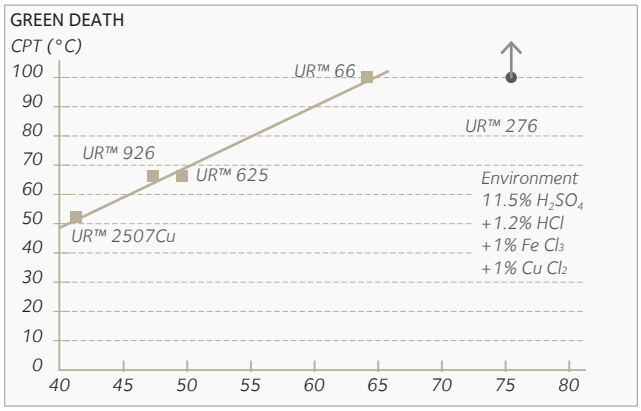
SIZE RANGE

	Plates	
Thickness	5 to 50 mm 3/16" to 6"	
Width	Up to 3300 mm Up to 130"	
Length	For thickness > 9 mm	Up to 12000 mm Up to 472"
	For thickness < 9 mm	Up to 8000 mm Up to 315

Other sizes are available on request, including 4100 mm (161,4") width plates.

DESIGN

In most of the very severe media, the alloy UR™ 66 behaves much better than 6 Mo super austenitic grades and exhibits equivalent, or better corrosion resistance proper-ties to nickel based alloys (625...). The alloy is particularly well designed for pollution control equipments (FGD) even in abrasion-corrosion conditions. The alloy is also designed for pulp and paper applications and chemical industry where mixed polluted acids and temperature are encountered together.



HOT FORMING

Furnace atmosphere must be slightly oxidising and free of sulphur contaminations. Charge the plate in the furnace at specified temperature. Temperature range for hot forming: 1200°C to 900°C (2190°F to 1650°F).
Reheat as often as necessary to reduce hardening and structural effects.
Solution annealing is necessary after hot working:

> Temperature: 1140°C - 1210°C (2084°F - 2210°F)

> Soaking time: 1 to 2 min per mm of thickness at annealing temperature

> Cooling: water quench.

COLD FORMING

The cold formability of UR™ 66 is excellent, but due to its high Mo content, the work hardening rate is higher than for 316 L. Intermediate annealing treatment may be necessary. Remove forming stresses by annealing heat treatment.

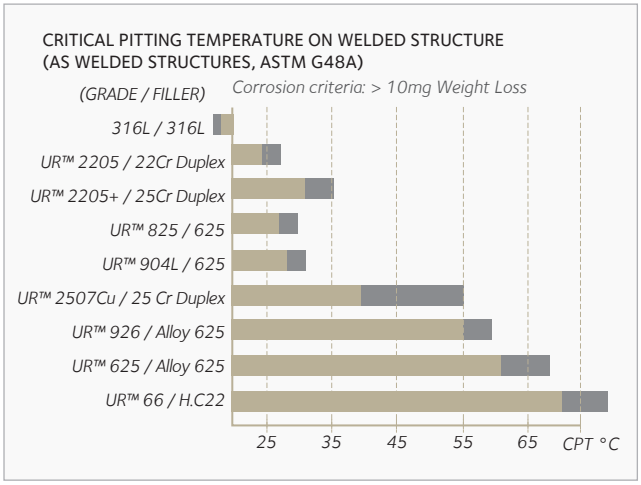
PICKLING

The cleanliness of the surface is very important to maintain the high corrosion resistance properties of this alloy. Use 6 Mo super austenitic pickling conditions. Pickling time will be higher.

WELDING

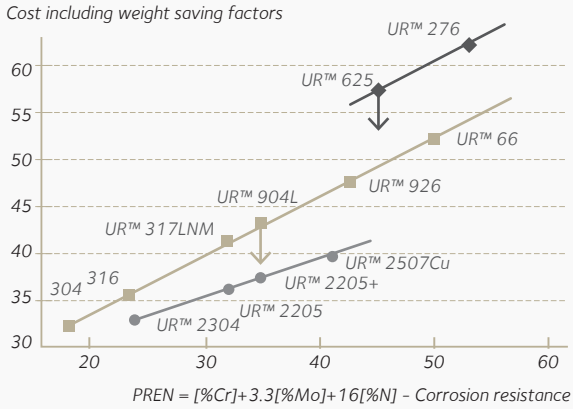
UR™ 66 can be welded by the following processes: TIG/GTAW, MIG/GMAW, SMAW with covered electrodes. Typical electrodes or filler metal to be used are alloy C22 or alloy 59 The weldability is at least equivalent to 6 Mo super austenitic grades and in fact the higher structure stability makes it possible to avoid phase transformations. Welding without filler metal is also possible for UR™ 66 grade, particularly when a solution annealing heat treatment can be done after welding.

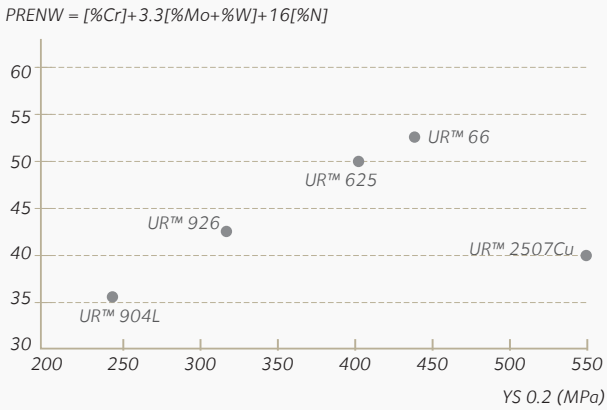
For other welding aspects, take the same precautions as for 6 Mo super austenitic grades.



UR™ 66 has a unique position in the stainless steel family when comparing the combined PRENW value and mechanical properties. The use of the high mechanical properties allows the designer to reduce the costs. Another cheaper way to design vessels is the use of cladded UR™ 66 grade.

Cost effectiveness aspects





APPLICATIONS

- > Natural treated seawater systems and water re-use
- > **Pollution control equipments:** FGD absorbers and ducts
- > **Pulp and paper industry:** bleaching equipments
- > **Chemical industries:** Chloride containing media, heated solutions ...
- > Geothermal, hydrometallurgy

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