Industeel

ArcelorMittal

UR™ 367

UR™ 367: A 6Mo high performance super austenitic stainless steel with PREN ≥ 43

UR™ 367 is a 25% Ni, 20% Cr, 6% Mo super austenitic stainless steel grade with a 0.2% nitrogen addition, particularly designed for high structural stability and high corrosion resistance. The 25% nickel and copper additions combined with chromium molybdenum improve the behaviour of the steel in many corrosive solutions encountered for example in chemical and petrochemical processes. The alloy behaves particularly well in sulphuric acid solutions and is well adapted for pollution control equipments (scrubbers...). The alloy is also seawater resistant and has extensively been used in offshore industry. The fully austenitic microstructure produced by the 25% nickel addition explains its high toughness at temperatures as low as -200°C (-328°F).

PROPERTIES

STANDARDS

> ASTM: UNS N08367

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	N	S	Cu
0.01	20.5	25.0	6.3	0.2	0.001	0.2

PREN = [Cr%] + 3.3 [Mo%] + 16 [N%] ≥ 43

PHYSICAL PROPERTIES

Typical values
Density: 8.1 kg/dm³ - 0.29 lb/in³

Temperature interval °C (°F)	Thermal expansion (αx10^{-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)	15.8	20 (68)	95	13	450	195	75
20 - 300 (68 - 572)	16.5	200 (392)	110	14	550	182	70
20 - 500 (68 - 932)	17.3	400 (752)	115	15	620	166	66

MECHANICAL PROPERTIES

Tensile properties - minimum values

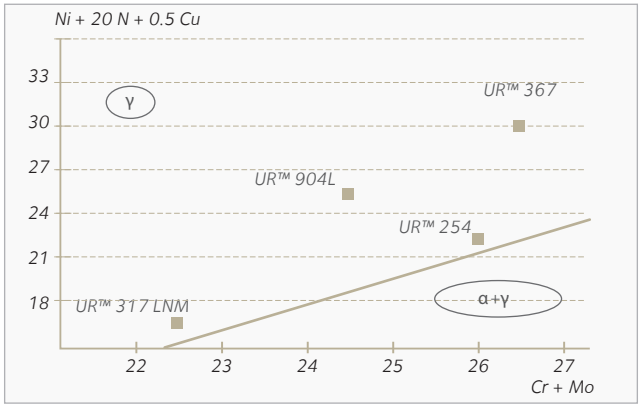
°C	$R_{p0.2}$	$R_{p1.0}$	R_m	°F	YS 0.2%	YS 1.0%	UTS	A/Elongation
	MPa				ksi			%
20	320	350	650	68	46	57	94	40
100	230	270	560	212	33	39	81	40
200	190	230	530	392	28	33	77	40
300	170	200	500	572	25	29	73	35
400	160	190	470	752	23	28	68	35

Impact: KCV > 100J/cm² (70 ft lbs) at -196°C (-319°F)

Hardness values: HV_{10}: [180-220]

STRUCTURE

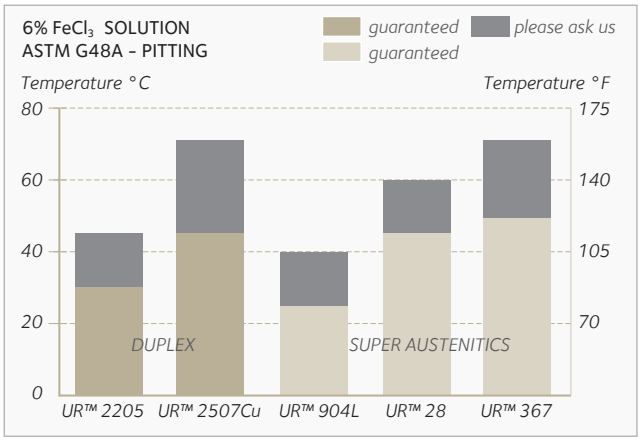
UR™ 367 chemical analysis (25Ni, 0.2N in order to increase its structure stability), is particularly well balanced, compared to other 6Mo super austenitic stainless steels. Ferrite islands may be observed at mid-thickness of the plates. The alloy remains very ductile down to -196°C (-321°F) (KCV>100 J/cm²). Due to the high chromium and molybdenum contents, the UR™ 367 alloy must be water-quenched to avoid intermetallic phase transformation which may occur in the 800 - 1100°C (1472/2012°F) temperature interval.

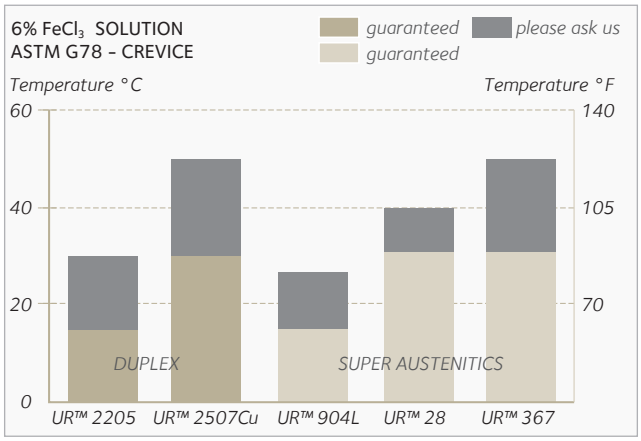


IN SERVICE CONDITIONS

CORROSION RESISTANCE

Pitting and crevice corrosion resistance





The high chromium, molybdenum and nitrogen contents of alloy UR™ 367 (PREN > 43) explain why the grade is very resistant to localized corrosion even in acidified oxidizing environments. The alloy has been used for seawater applications.

IN SERVICE CONDITIONS

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™ 2205+					UR™ 2507Cu						
	4												
	2	UR™ 2507Cu					UR™ 367						
	1	UR™ 22 - UR™ 276											

Selection grid for the selection of materials for FGD applications at 60 °C (140 °F) based on corrosion test results and cost effectiveness considerations.
With its well balanced composition consisting of a high nickel content and high chromium molybdenum and nitrogen additions, UR™ 367 is a typical multipurpose grade for very severe service conditions. It generally performs better than superduplex stainless steels and is less expensive than nickel base alloys. Moreover, the copper content increases its corrosion resistance in sulphuric acid solutions. It may be used in acidified solution polluted by very high chloride or fluoride additions as can be seen on the guide map of material selection for FGD applications shown above. It has also been successfully used in phosphoric acid plants and bleaching equipments in the pulp and paper industry.

DELIVERY CONDITIONS

SIZE RANGE

	Plates	Clad plates
Thickness	5 to 120 mm 3/16" to 4.7"	6 to 120 mm 1/4" to 4,7"
Width	Up to 3200 mm Up to 128"	Up to 3200 mm Up to 128"
Length	Up to 12000 mm Up to 472"	Up to 14000 mm Up to 551"

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

HOT FORMING

Furnace atmosphere must be slightly oxidising and free of sulphur compounds. 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 effects on structure.. Solution annealing is necessary after hot working:

- **> Temperature: 1120°C - 1170°C (2050°F - 2138°F)**
- **> Soaking time: 1 to 2 min per mm of thickness at annealing temperature**
- **> Cooling: water quench.**

COLD FORMING

The cold formability of UR™ 367 is excellent, but due to its high Mo content, the work hardening is higher than for 316L. Intermediate annealing treatment may be necessary. To remove forming stresses, or when SCC is possible (chloride or caustic media), an annealing heat treatment may be necessary (see hot forming).

PICKLING

The cleanliness of the surface is important to maintain the high corrosion resistance of this alloy.
The following solution is recommended:

- **> Nitric acid: 15 to 20% (weight)**
- **> Hydrofluoric acid: 2% to 5% (weight)**
- **> Temperature: 40 to 60°C (105 to 140°F).**

WELDING

UR™ 367 can be welded by the following processes: TIG/GTAW, MIG/GMAW, SMAW with covered electrodes.
This grade must be welded with filler metal: welds without filler have a low ductility and a low corrosion resistance.
Keep the dilution of parent metal below 50% (more filler metal than parent metal).
Due to the fully austenitic structure of UR™ 367, the following precautions must be taken:

- **> Minimise the heat input (string beads, no oscillation, diameter of covered electrodes limited to 3.2 mm). The heat input should preferably be limited to 1.2 kJ/mm.**
- **> Interpass temperature must be controlled to less than 120°C (248°F).**
- **> No preheating for PWHT.**
- **> Careful cleaning and degreasing of weld area and descaling and cleaning of finished weld are highly recommended. Carefully grind strike marks and other welding defects.**
- **> Use run-on and run-off plates and anti-spatter protection where possible.**
- **> Dry electrodes according to manufacturer's instructions.**

UR™ 367 must be welded with niobium free Ni base filler materials like:
PHYWELD NCW (Nb free 625 for PAW, GTAW, GMAW)
ER Ni.Cr.Mo-10 (AWS A5.14) wires and E.Ni.Cr.Mo-10 (AWS A 5.11) electrodes (alloy C22 type)
EL Ni.Cr.23.Mo-16 or SG - Ni.Cr.23 Mo-16 (DIN 1736) electrodes or filler metal (alloy 59 type) can be used

MACHINING

Operation	Tool	Lubrication	CONDITIONS			
			Depth of cut mm (inch)	Feed mm (inch)	Speed m/min (feet/min)	
					18/12Mo	UR™ 926
Turning	High speed steel	Cutting oil	6 (0.23)	0.5 (0.019)	11 - 16 (36.1 - 52.5)	6 - 11 (19.7 - 36.1)
			3 (0.11)	0.4 (0.016)	18 - 23 (59.1 - 75.5)	9 - 14 (29.5 - 45.9)
			1 (0.04)	0.2 (0.008)	25 - 30 (82 - 98.4)	15 - 20 (49.2 - 65.6)
	Carbide	Dry or cutting oil	6 (0.23)	0.5 (0.019)	70 - 80 (229.7 - 262.5)	25 - 35 (82 - 114.8)
			3 (0.11)	0.4 (0.016)	85 - 95 (278.9 - 312.7)	45 - 55 (147.6 - 180.4)
			1 (0.04)	0.2 (0.008)	100 - 110 (328.1 - 360.9)	65 - 70 (213.3 - 229.7)
			Blade width mm (inch)			
Parting off	High speed steel	Cutting oil	1.5 (0.06)	0.03 (0.0012)	17 - 22 (55.8 - 72.2)	10 - 13 (32.8 - 42.7)
			3 (0.11)	0.04 (0.0016)	18 - 23 (59.1 - 75.5)	11 - 14 (36.1 - 45.9)
			6 (0.23)	0.05 (0.0020)	19 - 24 (62.3 - 78.7)	12 - 15 (39.4 - 49.2)
			Drill Ø mm (inch)			
Drilling	High speed steel	Cutting oil	1.5 (0.06)	0.25 (0.0010)	10 - 14 (32.8 - 45.9)	6 - 10 (19.7 - 32.8)
			3 (0.11)	0.06 (0.0024)	11 - 15 (36.1 - 49.2)	7 - 11 (23 - 26.1)
			6 (0.23)	0.08 (0.0031)	11 - 15 (36.1 - 49.2)	7 - 11 (23 - 26.1)
			12 (0.48)	0.10 (0.0039)	11 - 15 (36.1 - 49.2)	7 - 11 (23 - 26.1)
Milling mm (inch)						
Milling profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.039)	10 - 20 (32.8 - 65.6)	10 - 20 (32.8 - 65.6)

APPLICATIONS

> Natural and treated seawater systems, desalination plants

> **Pollution control:** flue gas desulphurisation (absorbers, ducts)

> Bleaching equipment for pulp and paper industries (washers)

> **Fertilizer industries:** phosphoric acid production

> **Chemical industries:** chloride containing media; phosphoric acid, sulphuric acid - Fine chemical production

YOUR CONTACTS

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