Industeel

ArcelorMittal

UR™ 254

UR™ 254: A 6Mo cost savings super austenitic stainless steel with PREN ≥ 42

UR™ 254 is a 18% Ni, 20% Cr, 6% Mo super austenitic stainless steel grade with 0.2% nitrogen additions, particularly designed to be cost effective. The 18% nickel and 0.7% copper additions combined with the chromium and molybdenum additions enhance the performance of the steel in many corrosive solutions encountered for example in chemical and petrochemical processes or chloride containing solutions. The alloy is also seawater resistant and has extensively been used in offshore applications (It is not recommended for use in stagnant seawater applications with temperatures higher than 30°C (86°F). Thanks to the 18% Nickel and the 0.2 Nitrogen additions, the microstructure is austenitic.

PROPERTIES

STANDARDS

> EURONORM: EN 1.4547 X1 Cr Ni Mo Cu 20-18-7

> ASTM: UNS S31254

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	N	S	Others
0.01	20	18	6.1	0.2	0.001	Cu = 0.7

PREN = [Cr%] + 3.3 [Mo%] + 16 [N%] ≥ 42

PHYSICAL PROPERTIES

Typical values
Density: 8.0 kg/dm³ - 0.28 lb/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)	16.5	20 (68)	90	13	480	195	75
20 - 300 (68 - 572)	17	200 (392)	105	14.5	550	182	70
20 - 500 (68 - 932)	17.3	400 (752)	110	16	620	166	66

MECHANICAL PROPERTIES

Tensile properties - minimum values for plates th = 10 mm

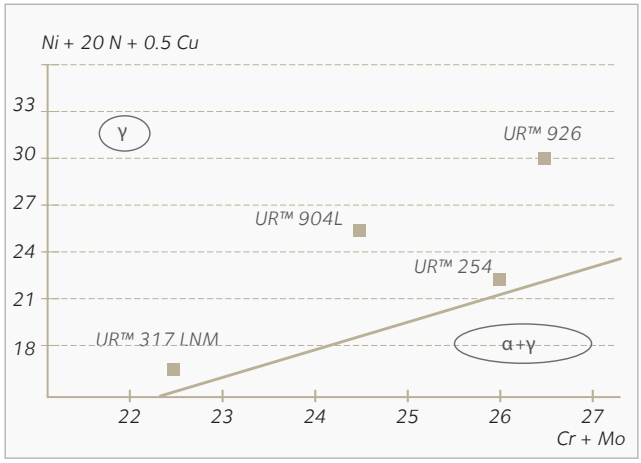
°C	$R_{p0.2}$	$R_{p1.0}$	R_m	°F	YS 0.2%	YS 1.0%	UTS	A/Elongation
	MPa				ksi			%
20	300	330	650	68	43	48	94	35
100	235	270	610	212	35	39	88	35
200	195	225	560	392	28	33	81	35
300	175	205	525	572	25	30	76	35
400	160	190	510	752	23	28	74	35

Impact toughness: KCV > 60J/cm² (70 ft lbs) at -196°C (-320°F)

Hardness values: HV_{10}: [190 - 230]

STRUCTURE

The UR™ 254 chemical analysis (18 Ni, 0.2 N) gives an austenitic microstructure. Ferrite islands may be observed at mid-thickness of the plates. The alloy remains ductile down to -196°C (320°F). Due to the high chromium and molybdenum contents, the UR™ 254 alloy must be water-quenched to obtain the optimum microstructure, and avoid phase precipitation during cooling. Phase precipitations may occur in the 700-1100°C (1292-2012°F) temperature range. The solution annealing heat treatment is typically performed in the 1120-1170°C (2048-2138°F) temperature range and followed by water quenching.

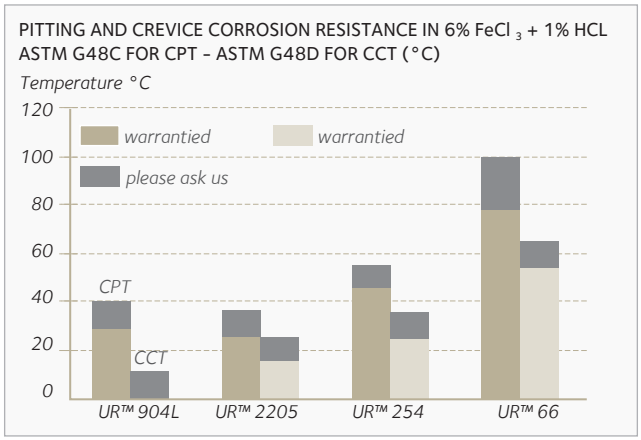


IN SERVICE CONDITIONS

CORROSION RESISTANCE

Pitting and crevice corrosion resistance

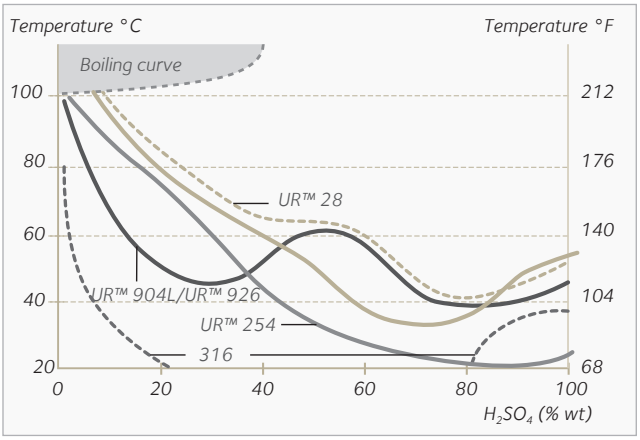
The high chromium, molybdenum and nitrogen contents of alloy UR™ 254 (PREN ≥ 42) explain why the grade is resistant to localized corrosion even in acidified oxidizing environments. The alloy has been successfully used for seawater applications.



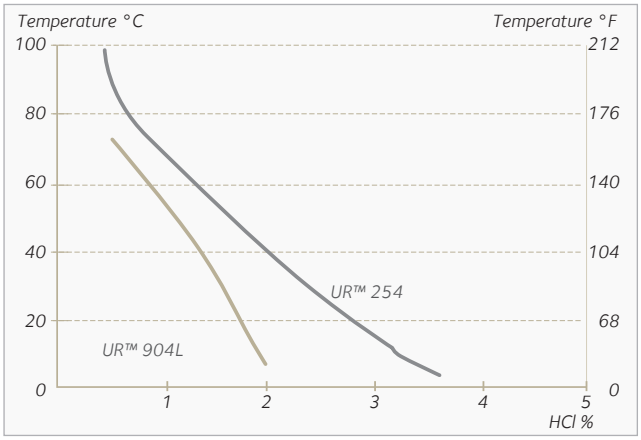
General corrosion resistance

Thanks to its well balanced composition with 18% nickel and high chromium molybdenum and nitrogen additions, UR™ 254 alloy is a typical multipurpose super austenitic grade for severe service conditions. It outperforms alloy UR™ 904L (UNS N08904) in most applications. Alloy UR™ 254 is not designed for concentrated sulfuric acid solutions. It contains 6% Mo but less nickel than the other grades of the 6 Mo family.

IN SERVICE CONDITIONS



Iso-corrosion diagram
Corrosion rate 0.1 mm/year in a H_2SO_4 solution



Iso-corrosion diagram
hydrochloric acid

DELIVERY CONDITIONS

SIZE RANGE

	Hot rolled plates	Clad plates
Thickness	5 to 120 mm 3/16" to 5"	6 to 150 mm 1/4" to 6"
Width	Up to 3300 mm Up to 130"	Up to 3300 mm Up to 130"
Length	Up to 12000 mm Up to 472"	Up to 14000 mm Up to 551"

Other sizes are available on request.

HOT FORMING

Furnace atmosphere must be slightly oxidizing and free of sulphur compounds Put 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™ 254 is excellent, but due to its high Mo content, the work hardening is higher than for 316L. Intermediate annealing may be necessary. To remove forming stress, or when there is risk for SCC in highly caustic media, an annealing may be necessary (see heat treatment).

PICKLING

The cleanliness of the surface is very important to maintain the high corrosion resistance of this alloy. Nitric, fluoric or sulfuric-fluoric baths can be used for pickling. The best results are obtained with a heated bath (40-60°C, 104-140°F).

WELDING

UR™ 254 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 40% (more filler metal than parent metal). Due to the fully austenitic structure of UR™ 254, 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™ 254 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.
Suitable electrodes and welding wire are available from various manufacturers. Technical support is available on request.

MACHINING

Operation	Tool	Lubrication	CONDITIONS			
			Depth of cut mm (inch)	Feed mm (inch)	Speed m/min (feet/min)	
					18/12Mo	UR™ 254
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 - 780.4)
			1 (0.04)	0.2 (0.008)	100 - 110 (328.1 - 360.9)	65 - 70 (273.3 - 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)	0.0025 (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 profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.0039)	10 - 20 (32.8 - 65.6)	10 - 20 (32.8 - 65.6)

APPLICATIONS

> Natural and treated seawater systems, desalination plants

> **Pollution control:** smelters (ductings, chimneys linings...)

> Bleaching equipment for pulp and paper industries (washers)

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

YOUR CONTACTS

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