Industeel

ArcelorMittal

UR™ 28

UR™ 28: A high nickel super austenitic stainless steel

UR™ 28 is a super austenitic stainless steel with very high nickel (31%) and chromium (27%) contents. The molybdenum content is about 3.5%. The alloy is designed for specific purposes, including sulphuric and phosphoric acid applications. It behaves particularly well in sulphuric and phosphoric acid environments, even when contaminated by chlorides and fluorides species.
The high nickel content improves its stress corrosion cracking resistance. The combined chromium and molybdenum additions contribute to drastically increase the localized corrosion resistance. **UR™ 28** behaves much better than alloy 825 and could be considered in some applications (sour gas) to replace the more expensive 625 grade.
The alloy is extensively used in chemical and offshore applications including very sour gas fields.

PROPERTIES

STANDARDS

> EURONORM: EN 1.4563 X1 Ni Cr Mo Cu 31-27-4

> ASTM: UNS N08028

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	N	Others
< 0.020	27	31	3.5	0.05	Cu = 1

PREN = [Cr%] + 3.3 [Mo%] + 16 [N%] ≥ 39

PHYSICAL PROPERTIES

Density: 8.0 kg/dm³ - 0.29lb/in³

Interval temperature °C (°F)	Thermal expansion ($\alpha \times 10^{-6} K^{-1}$)	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 - 200 (68 - 392)	15.8	20 (68)	100	12	450	195	75
20 - 300 (68 - 572)	16.5	100 (212)	-	-	-	182	70
20 - 500 (68 - 932)	17.3	400 (752)	-	-	-	166	166

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	220	250	500	68	32	36	72	40
100	190	220	460	212	28	32	67	40
200	160	190	430	392	23	28	62	40
300	150	180	400	572	22	26	58	35
400	135	165	380	752	19	24	55	35

Hardness:

HV_{10}: 250 - 310

Impact properties - minimum guaranteed values:

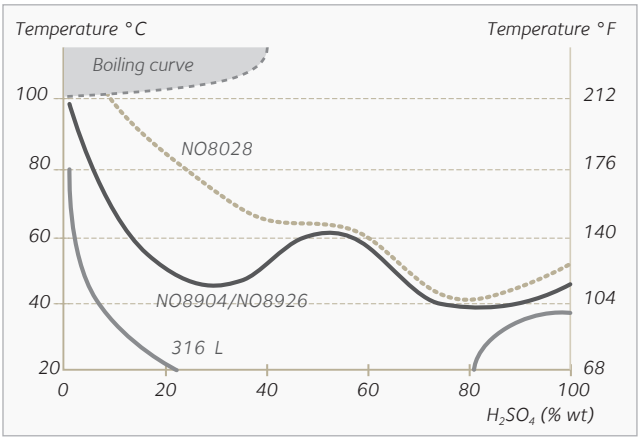
UR™ 28 retains a very good impact strength at low temperature: - 196°C (- 319°F) > 100J/cm^2

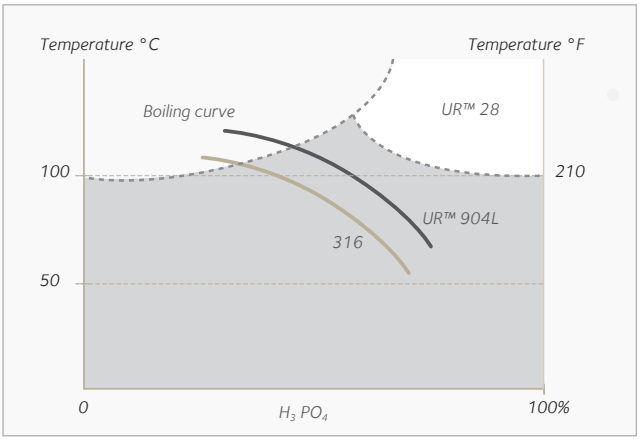
STRUCTURE

UR™ 28 has an entirely austenitic structure due to its very high nickel content. The alloy is sensitive to intermetallic phase precipitation when heat treated between 700 and 1100°C (1292 and 2012°F). The alloy must be water quenched after final solution annealing treatment. The alloy is designed for a maximum service temperature of about 450°C (842°F).

CORROSION RESISTANCE

General corrosion resistance

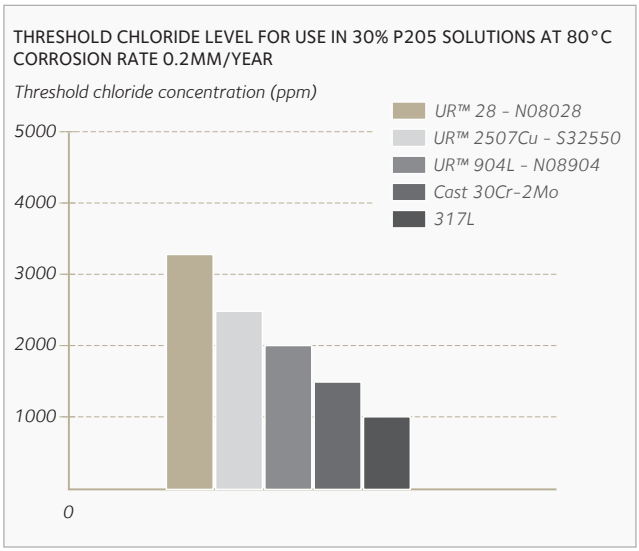


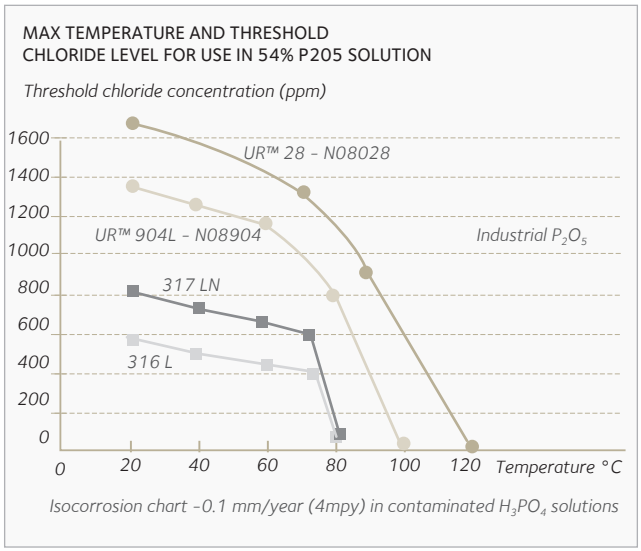


In most of the corrosive solutions, alloy UR™ 28 is more corrosion resistant than alloy UR™ 904L (N08904). The alloy is extensively used in phosphoric acid applications and some sulphuric solutions. Alloy UR™ 28 may also be used in caustic solutions since its molybdenum content remains low comparing with the nickel and chromium additions.

Pitting and crevice corrosion resistance

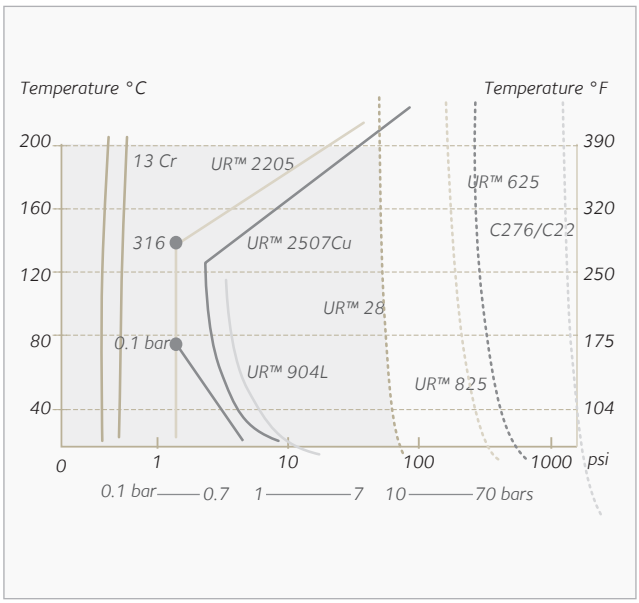
High chromium and moderate molybdenum additions contribute to improve the local corrosion resistance of UR™ 28 alloy. The grade performs much better than alloy 825 and better than alloy N08904 (UR™ 904L) in acidic chloride containing solutions.

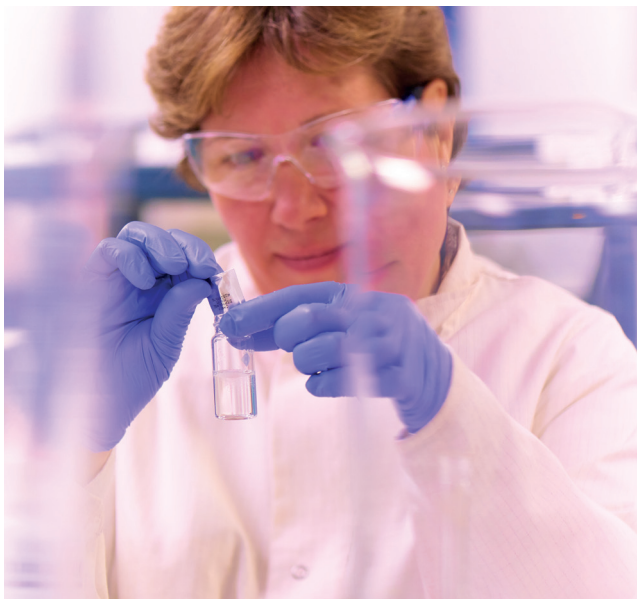




Pitting and crevice corrosion resistance

The high nickel and molybdenum contents give UR™ 28 an excellent resistance to stress corrosion cracking phenomena. This is particularly the case for high temperature applications (140 - 400°C = 284 - 752°F) and chloride containing environments. UR™ 28 is particularly well designed for sour gas applications and has been successfully tested at 230°C (446°F) with 3 bars H_2S and 50 bar CO_2 with high chloride levels.





DELIVERY CONDITIONS

SIZE RANGE

	Plates	Clad plates
Thickness	5 to 150 mm 3/16" to 6"	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, including 4100 mm (161,4") width plates.

PLATE PROCESSING

HOT FORMING

See precautions for heating. Load into furnace at temperature (1100 - 1150°C = 2012 - 2102°F) with 0.5 to 1 min/mm thickness soaking time - Finish forming above 850°C (1562°F). Air or preferably activated air cooling after forming.

COLD FORMING AND MACHINING

Similar to UR™ 904L.

HEATING AND HEAT TREATMENT

Degrease, remove contaminants such as sulphur, low melting point metals, Zn rich paints, etc... Heat at 1100 - 1180°C (2012 - 2156°F), followed by rapid cooling - water preferable - (soaking time = 1 - 2 min/mm thickness). A neutral or oxidizing sulphur free atmosphere is preferred.

WELDING

UR™ 28 is readily welded by GMAW, GTAW, SMAW. Due to its austenitic primary solidification, precautions must be taken when welding UR™ 28 to prevent the risk of "hot cracking".

> no preheat

> low heat input, stringer bead

> interpass temperature < 120°C (248°F)

Filler metal: SANDVIK 27.31.4.L Cu wire. Over matching filler materials such as ER Ni Cr Mo.3 or E Ni Cr Mo.3 (AWS) or PHYWELD NCM (Nb free 625) can also be used.

MACHINING

Operation	Tool	Lubrication	CONDITIONS			
			Depth of cut mm (inch)	Feed mm (inch)	Speed m/min (feet/min)	
					18/12Mo	UR™ 28
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)	0.02 (0.0008)	10 - 14 (32.8 - 45.9)	6 - 10 (19.7 - 32.8)
			3 (0.11)	0.05 (0.0020)	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)	0.09 (0.0035)	11 - 15 (36.1 - 49.2)	7 - 11 (23 - 26.1)
Milling profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.004)	10 - 20 (32.8 - 65.6)	10 - 20 (32.8 - 65.6)

APPLICATIONS

UR™ 28 alloy has been used with success in the following applications:

> Production, concentration and use of phosphoric acid reactors tanks, impellers, piping systems, cyclone evaporators, surface coolers, circulation pumps, agitators, superphosphoric acid storage, shell/tubes for heat exchangers

> **Production and use of sulphuric acid:** heating equipments, reactor tanks, agitators, inlet pipe in reactors...

> **Oil and gas production:** sour gas application, tubing, separators...

> Several offshore platform equipments

> Chemical industry (acetic acid, vinyl chlorides)

YOUR CONTACTS

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