



## URANUS<sup>®</sup> 28

A high nickel super-austenitic stainless steel

URANUS<sup>®</sup> 28 (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 or 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. The alloy 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.

### Standard

**EURONORM:** EN 1.4563 - X1 Ni Cr Mo Cu 31.27.4

**ASTM:** UNS N 08028

### Chemical analysis

#### Typical values (weight %)

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

$$\text{PREN} = [\text{Cr \%}] + 3.3 [\text{Mo \%}] + 16 [\text{N \%}] \geq 39$$

### Mechanical properties

#### Tensile properties - minimum values

°C	R <sub>p0.2</sub> MPa	R <sub>p1.0</sub> MPa	R <sub>m</sub> MPa	°F	YS 0.2% KSI	YS 1.0% KSI	UTS KSI	A/EI%
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<sub>10</sub>: 250 - 310

**Impact properties - minimum guaranteed values:** UR 28 retains a very good impact strength at low temperature: -196°C (-319°F) > 100J/cm<sup>2</sup>

## Physical properties

**Density:** 8.0g/cm<sup>3</sup> - 0.29lb/in<sup>3</sup>

Temperature interval (°C) (°F)	Thermal expansion $\alpha \times 10^{-6} \text{ K}^{-1}$	T (°C) (°F)	Resistivity ( $\mu\Omega \text{ cm}$ )	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 (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

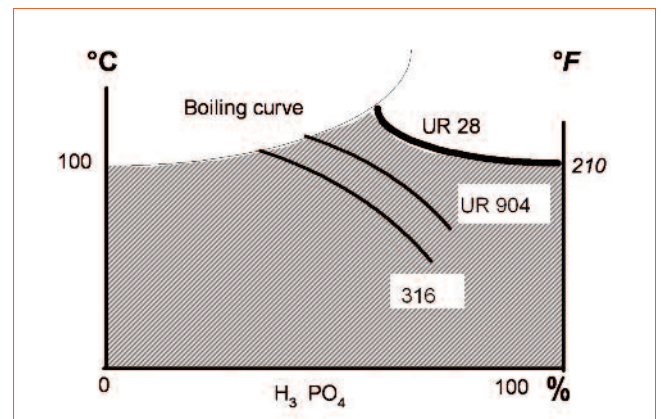
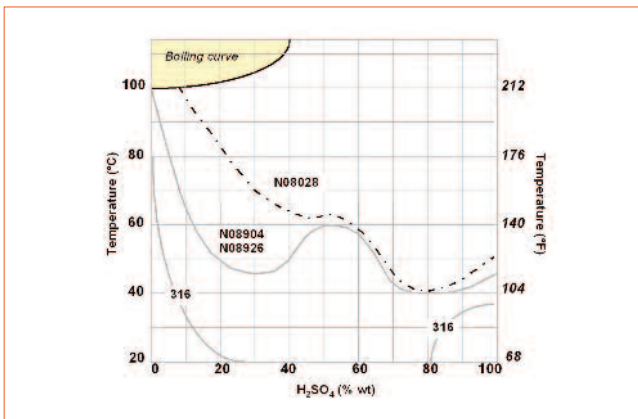
## Structure

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

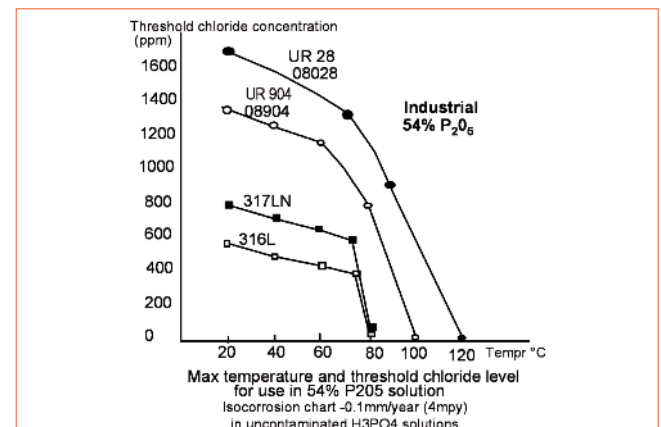
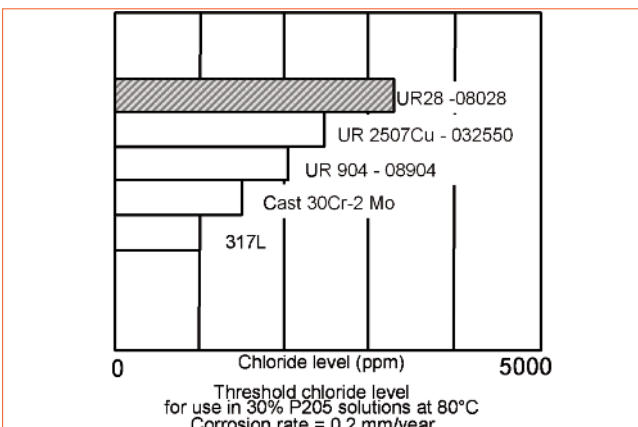
### General corrosion resistance



In most of the corrosive solutions, alloy UR 28 is more corrosion resistant than alloy UR 904 (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

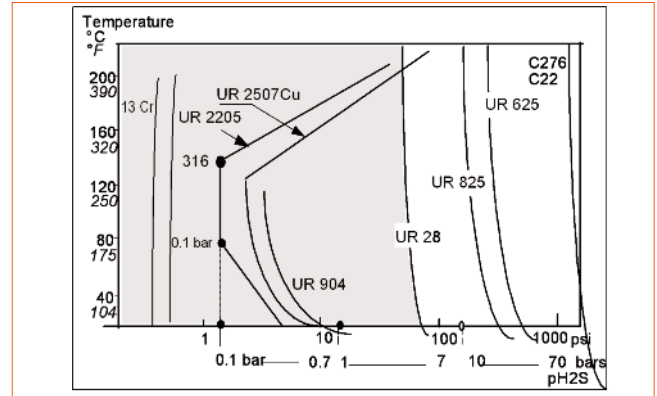
High chromium and moderate molybdenum additions contribute to improve the local corrosion resistance of UR 28 alloy. The grade performs much better than alloy 825 and better than alloy 08904 (UR 904) in acidic chloride containing solutions.



## 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 ( $140\text{--}400^\circ\text{C} = 284\text{--}752^\circ\text{F}$ ) and chloride containing environments.

UR 28 is particularly well designed for sour gas applications and has been successfully tested at  $230^\circ\text{C}$  ( $446^\circ\text{F}$ ) with 3 bars  $\text{H}_2\text{S}$  and 50 bar  $\text{CO}_2$  with high chloride levels.



## **Fabrication**

### Heating and heat treatment

Degrease, remove contaminants such as sulphur, low melting point metals, Zn rich paints, etc...

Heat at  $1100\text{--}1180^\circ\text{C}$  ( $2012/2156^\circ\text{F}$ ), 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  $< 120^\circ\text{C}$  ( $248^\circ\text{F}$ )

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.

### Hot forming

See precautions for heating.

Load into furnace at temperature ( $1100/1150^\circ\text{C} = 2012/2102^\circ\text{F}$ ) with 0.5 to 1 min/mm thickness soaking time - Finish forming above  $850^\circ\text{C}$  ( $1562^\circ\text{F}$ ).

Air or preferably activated air cooling after forming.

### Cold forming and machining

Similar to UR 904.

## Machining

Operation	Tool	Lubrication	CONDITIONS			
			Depth of cut (mm) (inch)	Feed (mm) (inch)	SPEED (m/min) SPEED (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
			6 0.23	0.5 0.019	70-80 229.7-262.5	25-35 82-114.8
	Carbide	Dry or cutting oil	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			
			1.5 0.06	0.03 0.0012	17-22 55.8-72.2	10-13 32.8-42.7
Parting off	High speed steel	Cutting oil	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 dia.			
			1.5 0.06	0.25 0.0010	10-14 32.8-45.9	6-10 19.7-32.8
	High speed steel	Cutting oil	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

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).

### For any information

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## Size range

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

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

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.