



UR™ 31

UR™ 31: A high nickel super austenitic stainless steel

UR™ 31 is a super austenitic stainless steel with very high contents of nickel, chromium and molybdenum. The alloy is designed to give properties in-between super austenitic and nickel base alloys for very demanding applications from the corrosion aspect. The high content of chromium and molybdenum gives an excellent resistance to localized corrosion. The high nickel content gives a very good resistance to stress corrosion cracking. The overall performance of the alloy is better than 825 and could be considered for replacing Alloy 625 in sour gas service. The alloy composition also gives an excellent resistance to oxidizing as well as reducing environments.

PROPERTIES

STANDARDS

- > EURONORM: EN 1.4562
- > ASTM: UNS N08031

CHEMICAL ANALYSIS - WEIGHT %

UR™ 31 chemical composition (wt%) is according to EN 10088-2:2005. The pitting resistance equivalent number is UR™ 31 calculated as $[Cr]+3.3 \cdot [Mo]+16 \cdot [N]$.

Ni	Cr	Mo	N	C	Mn	Si	Cu	P	S
30 - 32	26 - 28	6 - 7	.15 - .25	< .015	< 2	< .3	1 - 1.4	.020	< .010

PREN \geq 48

PHYSICAL PROPERTIES

Density: 8.0 kg/dm³

Temperature interval °C (°F)	Thermal expansion ($\alpha \times 10^{-6} K^{-1}$)	T °C (°F)	Resistivity ($\mu\Omega \cdot cm$)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	Specific heat ($J \cdot kg^{-1} \cdot K^{-1}$)	Young modulus E (GPa)
		20 (68)	103	11.7	450	198
20 - 100 (68 - 212)	14.3	100 (212)	106	13.2	463	189
20 - 200 (68 - 392)	14.7	200 (392)	110	15	474	183
20 - 300 (68 - 572)	15.1	300 (572)	113	16.8	483	176
20 - 400 (68 - 752)	15.5	400 (752)	116	18.5	491	170
20 - 500 (68 - 932)	15.7	500 (932)	118	20.2	500	163

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	280	310	650	68	40.6	45	94.6	> 40%

STRUCTURE

UR™ 31 shows a completely austenitic microstructure due to its high nickel and nitrogen contents. The alloy is sensitive to precipitation of intermetallic phase in the temperature region 700 - 1100 °C. After the final solution heat treatment, it is recommended that the alloy be water quenched. The maximum recommended service temperature is 450 °C.

HEATING AND HEAT TREATMENT

Degrease, remove contaminants such as sulfur, low melting metals, Zn-rich paints etc. Heat to 1130 - 1180 °C (2066 - 2156 °F) followed by rapid cooling, preferably water quenching. The heat treatment should be performed in neutral or oxidizing atmosphere, free from sulfur.

IN SERVICE CONDITIONS

CORROSION RESISTANCE

The corrosion resistance of UR™ 31 in its solution annealed condition is very high. The resistance to pitting and crevice corrosion is better than for super austenitic grades such as UR™ 926 and comparable to UR™ 28 in many environments. The high nickel content contributes to an enhanced resistance to stress corrosion cracking. It can be used for a variety of very demanding applications.

Corrosion data for UR™ 31 in some typical test solutions.

Solution	Temperature (°C)
G48 (A), CPT	80
G48 (B), CCT	60
Green death*, CPT	65

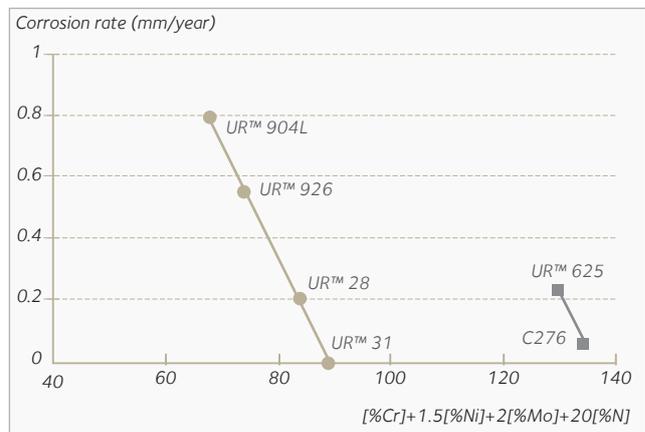
* Composition Green Death: 11.5% H₂SO₄ + 1.2% HCl + 1% FeCl₃ + 1% CuCl₂

Uniform Corrosion

UR™ 31 has a very good resistance to general corrosion at elevated temperatures in strong acids.

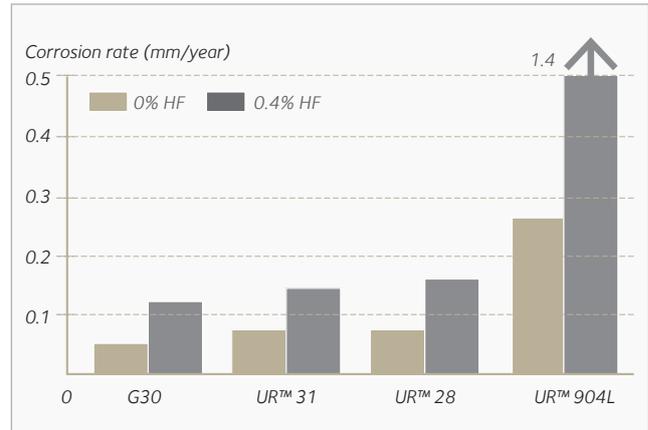
Solution	Corrosion rate
H ₂ SO ₄ 10% 80 °C deaerated	0 mm/y
HCl 35% 25 °C aerated	0.31 mm/y
H ₂ SO ₄ 10% + 500ppm Cl ⁻ deaerated 80 °C	0.45 mm/y

Uniform corrosion rate (mm/year) in 10wt% sulfuric acid at 80 °C. The alloy UR™ 31 showed no uniform corrosion in this medium.



IN SERVICE CONDITIONS

Influence of HF content on the uniform corrosion rate in 30% P₂O₅ + 2% H₂SO₄ + 1.5% H₂SiF₆ + 0.35% Fe³⁺ + 0.26% Al³⁺ + 1000ppm Cl⁻ containing solution at 110°C. UR™ 31 shows a corrosion rate comparable to that of UR™ 28 and the nickel base alloy G30. The environment is relevant to the production of industrial phosphoric acid. Increasing the hydrofluoric acid concentration has a strong influence on the dissolution rate for all alloys tested with the strongest effect on 904L.



DELIVERY CONDITIONS

SIZE RANGE

	Hot rolled plate	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.

PLATE PROCESSING

HOT FORMING

Same precautions as for heating. The workpiece should be placed into the furnace at temperature with a heating time of 0.5 - 1 min per mm thickness soaking time. The forming operations should be finished above 900°C.

COLD FORMING AND MACHINING

Similar to that of UR™ 904L (UNS N08904).

WELDING

The following processes can be used to weld UR™ 31: TIG/GTAW, PLASMA/PAW, MIG/GMAW, SMAW with covered electrodes. This grade must be welded with filler metal: welds without filler have lower ductility and a low corrosion resistance. Keep the dilution of parent metal below 50% (more filler metal than parent metal).

Welding conditions

Due to the fully austenitic structure, the following precautions must be taken:

- > Minimize 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 necessity for preheating or post weld heat treatment

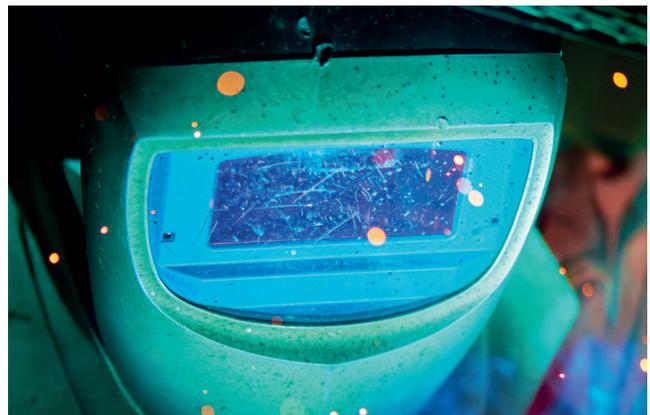


PLATE PROCESSING

- > Careful cleaning and degreasing of weld area. 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

Filler metals

UR™ 31 may be welded with:

- > ER NiCrMo-7 or EN NiCrMo 10 (AWS A5.14) wire
- > EL NiCrMo-7 or EL NiCrMo-10 (AWS A5.11) electrodes
- > SG NiCr20Mo-15 or SG NiCr23Mo-16 (DIN 1736) filler metals
- > EL NiCr23Mo-16 or EL NiCr19Mo-15 (DIN 1736) electrodes

Suitable electrodes and welding wire are available from a variety of manufacturers. Technical assistance is available on request.

APPLICATIONS

- > Flue gas cleaning systems
- > Bleaching stages for pulp production
- > Oil and gas: sour gas applications, separators
- > Equipment on offshore platforms in marine atmospheres
- > Chemical process industry



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