



## UR™ 825

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UR™ 825 is an austenitic Ni - Fe - Cr - Mo - Cu nickel based alloy developed to resist corrosion in aggressive media. The high level of nickel, molybdenum and copper induces an improvement of the corrosion resistance in reducing environment compared to standard stainless steels. This grade presents an excellent resistance to stress corrosion cracking.

## PROPERTIES

### STANDARDS

- > EURONORM: EN 2.4858 Ni Cr21 Mo
- > ASTM: UNS N08825

Specification

- > ASTM: B 424
- > ASME: SB 424

### CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Mn	Si	Cr	Ni	Mo	Cu	Ti
< 0.030	0.3	0.3	23	40	3	2.0	< 1

### PHYSICAL PROPERTIES

Density: 8.14 kg/dm<sup>3</sup> - 0.294lb/in<sup>3</sup>

Melting range: 1370 - 1400 °C (2500 - 2550 °F)

Permeability at 20 °C/68 °F (RT): 1.004

Magnetic Permeability: < 1.02

Interval temperature °C (°F)	Thermal expansion ( $\alpha \times 10^{-6} \text{ K}^{-1}$ )	T °C (°F)	Resistivity ( $\mu\Omega \cdot \text{cm}$ )	Thermal conductivity ( $\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$ )	Young modulus E (GPa)	Shear modulus G (GPa)
0 - 100 (32 - 212)	14.0	20 (68)	112	11	195	75
0 - 200 (32 - 392)	14.9	100 (212)	114	12	191	73
0 - 400 (32 - 762)	15.9	200 (392)	118	14	185	70

## MECHANICAL PROPERTIES

### Tensile properties - Minimum values

°C	Rp 0.2 MPa	Rm MPa	°F	YS 0.2% ksi	UTS ksi	Elongation %
20	300	640	68	43	93	42
100	260	585	212	38	85	40
200	230	560	392	33	81	40
300	219	552	572	32	80	40
400	205	545	752	30	79	40
600	180	460	1112	26	67	40

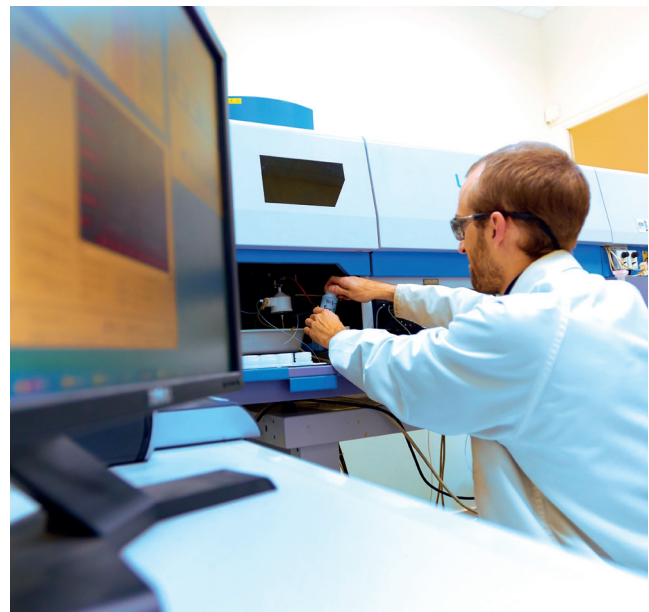
ISO V - notch impact toughness. Average values at RT: longitudinal  $\geq 150 \text{ J/cm}^2$  - transverse  $\geq 100 \text{ J/cm}^2$

## IN SERVICE CONDITIONS

### CORROSION RESISTANCE

#### Uniform corrosion in acids

- > Sulfuric acid: UR™ 825 is highly resistant to sulfuric acid (all concentrations) at temperatures below 65°C (150°F) and until boiling temperature for concentration to 40%. Its corrosion resistance is enhanced by the presence of oxidizing salts.
- > Phosphoric acid: UR™ 825 well resists to pure phosphoric acid until boiling temperature for concentrations up to 85%.
- > Nitric acid: UR™ 825 has a good behavior in nitric acid to concentrations up to 65%. This behavior is lower in the presence of fluorhydric acid.
- > Chlorhydric acid: UR™ 825 is susceptible to corrosion when the chlorhydric acid concentration is higher than 20%.



#### Stress corrosion cracking

The high nickel content of UR™ 825 provides the material with excellent stress corrosion cracking resistance in halide-containing solutions such as  $\text{CaCl}_2$  and  $\text{NaCl}$ . It also exhibits very good cracking resistance in environments containing  $\text{CO}_2$  and  $\text{H}_2\text{S}$  mainly encountered in the oil & gas industry. That is why UR™ 825 is today widely used in oil & gas production systems for a variety of applications.

#### Localized corrosion

The chromium and molybdenum content of 825 provides a pitting corrosion resistance higher than that of the austenitic UR™ 316L. For this reason this alloy can be utilized in high chloride environments such as seawater. However, in such applications, UR™ 825 does not provide the same levels of resistance as 6%Mo grades and UR™ 625. UR™ 825 has a limited resistance to crevice corrosion.

## DELIVERY CONDITIONS

### SIZE RANGE

	Hot rolled plates	Clad plates
Thickness	5 to 120 mm 3/16" to 4.7"	10 to 90 mm 0.4" to 3.5"
Width	Up to 3000 mm Up to 126"	Up to 3000 mm Up to 126"
Length	Up to 12000 mm Up to 472"	Up to 13000 mm Up to 511"

Other sizes are available on request.

## PLATE PROCESSING

### HOT FORMING

Hot forming operations can be performed between 1180 and 850°C (2150 – 1560°F). After hot forming, a stabilization heat treatment at about 950°C (1740°F) is recommended. It has to be followed by a water cooling or rapid air cooling.

### COLD FORMING

UR™ 825 alloy can be cold formed by classical methods: folding, profiling, stamping, fluoturning, drawing. Its work hardening rate is less than for austenitic stainless steels. An intermediate heat treatment (annealing) can be necessary during cold forming operations to restore the ductility of the material.

### HEAT TREATMENT

To optimize corrosion resistance behavior, and particularly to avoid any intergranular corrosion risk, softening and stabilizing treatments has to be done about 950 – 970°C (1740 – 1780°F). Cooling has to be as rapid as possible (water or rapid air cooling).

### WELDING

UR™ 825 has improved weldability. It has low sulfur and phosphorus contents in order to improve the hot cracking resistance of its heat affected zone. UR™ 825 can be readily welded by conventional processes (SMAW, GMAW, FCAW, GTAW and SAW). Preheating is not required and interpass temperature must be limited to 140°C (284°F). The heat input must be controlled (below 15 kJ/cm) and post - heating is not needed. Post welding heat treatment is not necessary and can be detrimental for the material properties if the temperature or cooling rate is too low. For submerged arc welding process (SAW), it is recommended to use small wire diameter (1.6 to 2.4 mm) to limit the heat input.

**Filler materials to be used have a similar chemical composition to UR™ 625:**

- > E NiCrMo - 3 (AWS A5.11) for electrodes
- > ER NiCrMo - 3 (AWS A5.14) for wires

Basic electrodes and fluxes shall be used.



## MACHINING

UR™ 825 alloys can be machined as well as other Nickel based alloys. The following table gives some indications about capabilities:

Type of machining	Tool	Lubrication	CUTTING PARAMETERS		
			Depth of cut mm	Feed mm	Speed mn
Turning	High speed steel type AFNOR 2 - 9 - 1 - 8 or 9 - 3 - 3 - 10	Soluble or entire cutting oil	6	0.5	13 - 18
			3	0.4	20 - 25
			1	0.2	26 - 31
	Carbide type ISO P10 or P30	Dry or cutting oil	6	0.5	75 - 85
			3	0.4	90 - 100
			1	0.2	110 - 120
			Width cut mm	Feed mm	Speed mn
Cutting	High speed steel type AFNOR 2 - 9 - 1 - 8 or 9 - 3 - 3 - 10	Soluble or entire cutting oil	1.5	0.03 - 0.005	20 - 25
			3	0.04 - 0.06	21 - 26
			6	0.05 - 0.07	22 - 27
			Drill dia. (mm)	Feed mm	Speed mn
Drilling	High speed steel type AFNOR 6 - 5 - 2 - 5 or 9 - 3 - 3 - 10 or 2 - 9 - 1 - 8	Soluble or entire cutting oil	1.5		
			3		
			6		
			12		
			Feed per tooth (mm per rev.)	Speed (mm per mn)	
Milling profiling	High speed steel type AFNOR 2 - 9 - 1 - 8	Soluble or entire cutting oil	0.005-0.10	12-22	

## APPLICATIONS

This grade is mainly used for construction vessels, tubes, forgings or sheets used in seawater, sulphuric and nitric acids (particularly for pickling vessels), phosphoric acid and other aggressive media.

## YOUR CONTACTS

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*Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we 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 are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.*