



UR™ S1

UR™ S1: A 4% Si, austenitic stainless steel resistant to nitric acid solutions

Research carried out in about the last 20 years in Industeel Research Center shows that a strong addition of silicon to austenitic stainless steels of the 18/10 type has a favourable influence on resistance to transpassive intergranular corrosion. This type of corrosion develops particularly in very concentrated nitric environments (> 90%) up to boiling point, also in strongly oxidizing nitric environments (oxidizing ions present such as: hexavalent chromium, pentavalent vanadium - ferritic salts etc...). Our UR™ S1 steel grade puts in a concrete form the results of our research in this domain.

PROPERTIES

STANDARDS

- > EURONORM: EN 1.4361 X1 Cr Ni Si 18 - 15 - 4
- > ASTM: UNS S30600

CHEMICAL ANALYSIS - WEIGHT %

Typical values

| C | Cr | Ni | Mo | N | Others |
|--------|----|------|----|---|--------|
| ≤ .015 | 17 | 14.5 | | - | Si = 4 |

$$\text{PREN} [\text{Cr}\%] + 3.3 [\text{Mo}\%] + 16 [\text{N}\%] \geq 17$$

PHYSICAL PROPERTIES

Density: 7.7 kg/dm³

| Interval temperature (°C) | Thermal expansion ($\alpha \times 10^{-6} \text{ K}^{-1}$) | T (°C (°F)) | Resistivity ($\mu\Omega \cdot \text{cm}$) | Thermal conductivity ($\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$) | Specific heat ($\text{J} \cdot \text{kg}^{-1} \cdot \text{K}^{-1}$) | Young modulus E (GPa) | Shear modulus G (GPa) |
|---------------------------|--|-------------|---|---|---|-----------------------|-----------------------|
| 20 - 100 | 16.5 | 20 (68) | 75 | 15.1 | 500 | 200 | 77 |
| 20 - 300 | 18 | 200 (392) | - | - | 520 | 186 | 71 |
| 20 - 500 | 19 | 400 (752) | | | 540 | 172 | 65 |

MECHANICAL PROPERTIES

Tensile properties

| °C | °F | Y.S. 0.2% | | Y.S. 1% | | UTS | | Elongation % |
|-----|-----|-----------|-----|---------|-----|-----|-----|--------------|
| | | MPa | ksi | MPa | ksi | MPa | ksi | |
| 20 | 68 | 240 | 35 | 260 | 38 | 540 | 78 | 45 |
| 100 | 212 | 185 | 27 | 210 | 31 | 490 | 71 | 45 |
| 200 | 392 | 140 | 21 | 175 | 25 | 450 | 65 | 45 |
| 300 | 572 | 125 | 18 | 155 | 22 | 420 | 61 | 40 |
| 400 | 752 | 115 | 17 | 150 | 22 | 400 | 58 | 40 |

Minimum guaranteed values.

CORROSION PERFORMANCES

Pickling

This can be carried out using the following process: nitrohydrofluoric bath HNO₃ 15% (volume) HF (3%) volume water immersion for a few hours at 20°C - 30 mins at 60° C careful rinsing in water.

Decontamination - Passivation

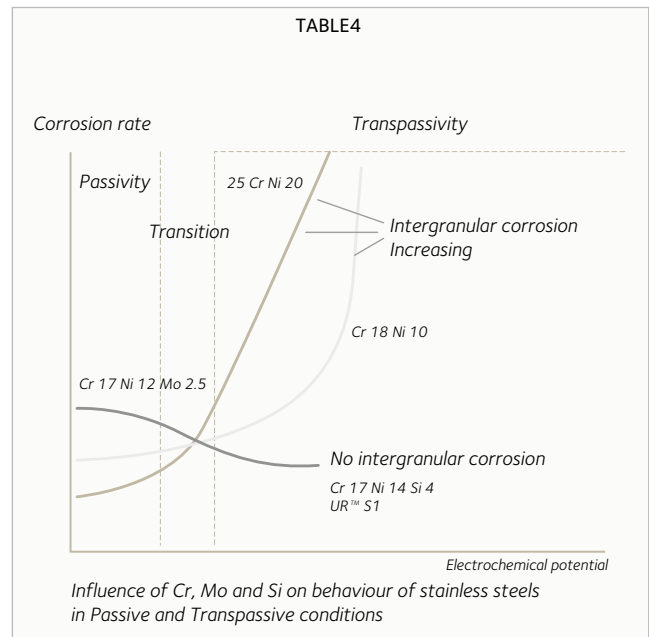
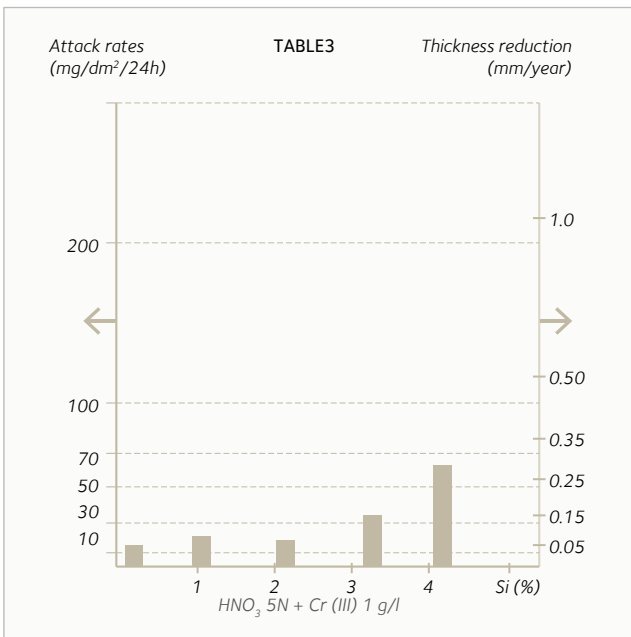
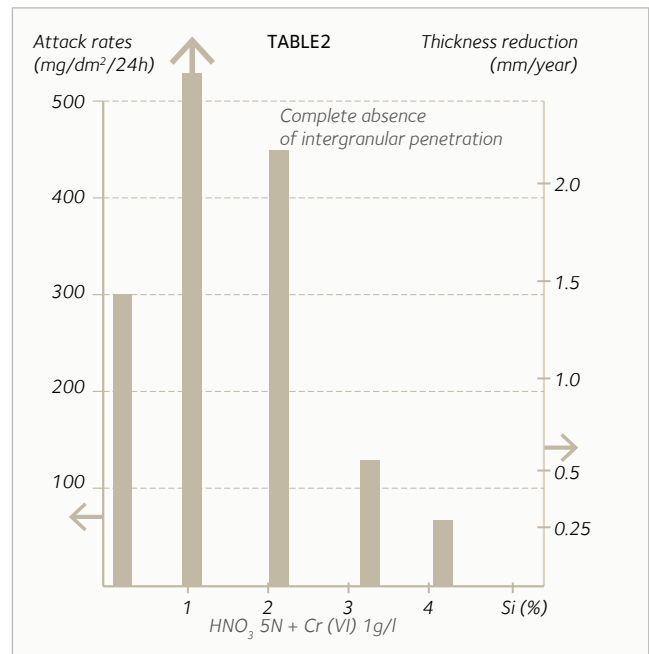
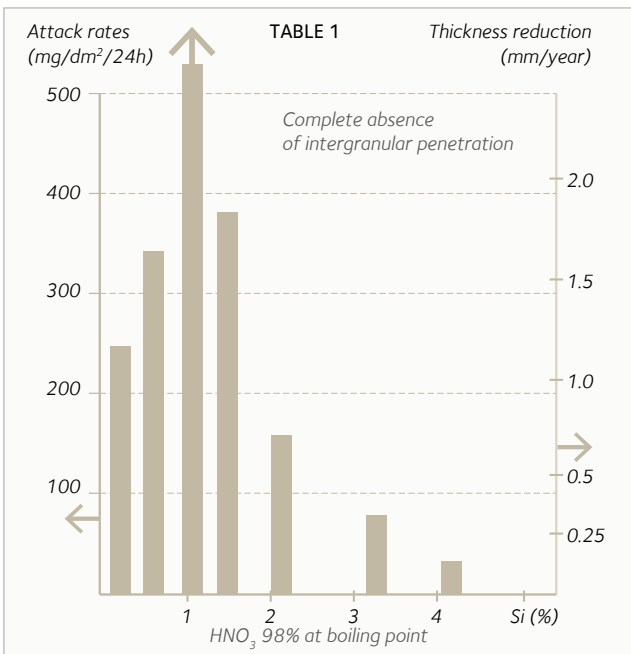
Nitric bath HNO₃ 25% in volume for 30 mins at 20° C (or 10 min. at 50° C) washing in water.

Resistance to corrosion

UR™ S1 has a chemical composition adapted to work in the transpassive zone. It resists perfectly to intergranular corrosion.

| Acid nitric | General corrosion rate |
|--|---|
| 98% at room temperature | Practically non existent |
| 98% boiling | ≤ 0.20 mm/year (Table 1) |
| 28% boiling + 1 g/l of hexavalent chrome | ≤ 0.30 mm/year (Table 2) |
| 28% boiling + 1 g/l of trivalent chrome | < 0.30 mm/year (Table 3) with no trace of intergranular corrosion |

The graphs beside (Tables 1 to 3) show the influence of silicon content for a Cr 16% Ni, the content increasing from 0.1 to 4.2%. Table 4 schematizes UR™ S1 behaviour in passive and transpassive conditions compared to some other grades.



DELIVERY CONDITIONS

SIZE RANGE

| | Hot rolled 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 39 ft | Up to 14000 mm Up to 46 ft |

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

PLATE PROCESSING

HOT FORMING

Forming temperature 1150 - 900°C (2100 - 1650°F)
(removal of grease in oxidising environment necessary)
in order to avoid all risks of recarburation.

COLD FORMING

Easy with all current methods: bending, profiling,
stamping.

HEAT TREATMENT

Solution annealing at 1100 - 1150°C (2010 - 2100°F)
- cooling in water (holding time 1 to 2 min. per mm of
plate thickness oxidising environment).

CUTTING

All classical mechanical or thermal processes for
stainless steels.

WELDING

UR™ S1 can be weld by experimented welder with GTAW or GMAW under inert gas such as Argon with dedicated welding consumables (ISO 14343-A S Z 19 13 Si N L). SMAW is also possible.

Our general recommendations:

- No preheating or postheating, low interpass temperature < 100 °C and heat input < 1,5 kJ/mm, no PWHT
- Low welding speed < 15 cm/mn for GTAW and 35 cm/mn for GMAW
- Sufficient wire feed to reduce dilution with base metal and avoid hot cracking
- Finish welding with decreasing current to eliminate crater (decaying arc)
- No grinding before crossing beads to reduce reheating of weld metal
- Liquid penetrant inspection of the weld is necessary before performing backing run and after finishing the weld
- Finishing: pickling + passivation treatment



APPLICATIONS

- > Mineral chemistry
Production of concentrated HNO_3
- > Organic chemistry
Use of concentrated HNO_3 (nitration)
- > Nuclear industry
Evaporator working in nitric environment, to concentrate products of fusion
- > Metallurgical industry
Tanks - equipment destined for nitrogen sulphite mixtures
- > Chemical industry
Chrome sulphite mixtures, very oxyding solutions
- > Explosive industry
- > Aerspatial industry
Rocket tanks
- > Galvanotechnology



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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.