



High Performance Metal Solutions

# ***ULTRA 76* Tantalum for Corrosive Resistant Applications**

H.C.Starck 

High Performance Metal Solutions

# High Performance Materials for Demanding Corrosive Resistant Applications

H.C. Starck Solutions is a worldwide supplier of corrosion resistant refractory metals such as tantalum, niobium, molybdenum, and tungsten. We provide engineered material solutions for a wide range of industries where corrosion resistance is critical for improved performance. Applications include linings for piping, tubing for heat exchangers, and cladding for vessels.

Corrosion resistant tantalum alloys have been used in various process industries involving aggressive, hazardous chemicals. These tantalum alloys have been proven to provide the optimum cost-effective, long service-life for critical components in severe corrosive environments.

## **ULTRA 76 (Ta 2.5 % W + PGM)**

H.C. Starck Solutions' new tantalum alloy, **ULTRA 76** has significant improvements in corrosion resistance in hydrochloric and sulfuric acid applications (HCl and H<sub>2</sub>SO<sub>4</sub> acids) using higher temperatures and concentrations. Hydrogen embrittlement is minimized as hydrogen pickup is reduced by two magnitudes over standard NRC® 76 material with up to 100 times lower in HCl acid and 10 times lower in H<sub>2</sub>SO<sub>4</sub> acid.

**ULTRA 76** will help extend equipment life, reduce downtime and allow operations in more demanding environments compared to alternative materials.

The **ULTRA 76** alloy eliminates the need for separate "Platinum Spot welding" application steps to protect against hydrogen embrittlement and maintains all the excellent mechanical properties of NRC® 76. There is a potential for increased operating temperatures in both HCl and H<sub>2</sub>SO<sub>4</sub> acids and should allow simplified fabrication, avoid inconvenient repairs and production losses, and ensure reliable, long service-life.

A high strength alloy for corrosion applications is needed in all applications where tantalum's physical properties are desired at a higher strength level than pure tantalum and better corrosion resistance in HCl and H<sub>2</sub>SO<sub>4</sub> acids.

## **ULTRA 76 can be used as corrosive resistance material in:**

- > **Bayonet Heaters, single and multi-tube types for use in steam heating in corrosive atmospheres**
- > **Heat Exchangers, Condensers and Coils**
- > **Thermocouple Protection Sheaths, loose line or machined from solid**
- > **Pumps, Bodies or Cases, Shafts and Impellers, for corrosive chemical solutions**
- > **Paddle Stirrers and Agitators, solid or covered (loose-lined)**
- > **Distillation Columns, Boilers and Condensers**
- > **Tantalum Clad Dip Pipes, Heaters and Chemical Plant Equipments**
- > **Repair Kits, for tanks, vats and other glass-lined containers**
- > **Crucibles, in standard and special shapes and sizes**
- > **Furnaces and Furnace Parts, for use at temperatures up to 1371°C (2500 °F) in controlled atmospheres**

## CHEMICAL CHARACTERISTICS<sup>1)</sup>

(Mass fraction in % [cg/g]; ppm [µg/g])

| Element | ppm (max)    | Element | ppm (max)     |
|---------|--------------|---------|---------------|
| C       | 50           | Ti      | 40            |
| O       | 100          | Ni      | 50            |
| N       | 50           | Mo      | 200           |
| H       | 10           | Si      | 25            |
| Nb      | 0.1 % (1000) | W       | 2.0 – 3.5 Wt% |
| Fe      | 50           | PGM*    | 1000 – 2000   |
| Ta      | Balance      |         |               |

\* Platinum Group Metals

1) Information on testing methods available upon request

## MECHANICAL PROPERTIES

(Design Minimum)

| Temp °C | Yield Strength<br>0.2 % offset MPa | Tensile<br>Strength (MPa) | Elongation % |
|---------|------------------------------------|---------------------------|--------------|
| 21      | 244.8                              | 344.7                     | 20           |
| 100     | 210.2                              | 331.0                     | 15           |
| 200     | 188.9                              | 289.6                     | 10           |
| 250     | 175.7                              | 275.8                     | 10           |

| Temp °F | Yield Strength<br>0.2 % offset KSI | Tensile<br>Strength (KSI) | Elongation % |
|---------|------------------------------------|---------------------------|--------------|
| 70      | 35.5                               | 50                        | 20           |
| 210     | 30.5                               | 48                        | 15           |
| 390     | 27.4                               | 42                        | 10           |
| 480     | 25.5                               | 40                        | 10           |

With comparable mechanical properties to those of conventional Tantalum alloys, **ULTRA 76** can be easily adopted to the same processing and fabrication techniques.

## PHYSICAL PROPERTIES

|  |                      |                              |                      |                    |
|--|----------------------|------------------------------|----------------------|--------------------|
| Density  | 16.6                 | g/ml                         | 0.602                | Lb/in <sup>3</sup> |
| Melting Point                                  | 2996                 | °C                           |                      |                    |
| Coefficient of Thermal Expansion (20 – 500 °C) | $6.6 \times 10^{-6}$ | 1/K                          | $3.6 \times 10^{-6}$ | °F <sup>-1</sup>   |
| Specific Heat at 100 °C                        | 0.14                 | J/g K                        | 0.0336               | BTU/Lb °F          |
| Thermal Conductivity (20 – 100 °C)             | 0.575                | W/cm K                       | 32                   | BTU/Hr-Ft °F       |
| Electrical Resistivity (20 °C)                 | 0.13                 | ((Ohm × mm <sup>2</sup> )/m) | 14.7                 | Microhm-cm         |
| Typical Ultimate Tensile Strength at 20 °C     | 310 – 380            | MPa                          | 45 – 55              | KPSI               |
| Typical Yield Strength at 20 °C                | 240 – 310            | MPa                          | 35 – 45              | KPSI               |
| Modulus of Elasticity                          | $1.86 \times 10^5$   | MPa                          | $27 \times 10^6$     | PSI                |
| Hardness as Annealed (Typical) Vickers         | 115 – 160            |                              |                      |                    |
| Hardness as Annealed (Typical) Rockwell B      | 50 – 80              |                              |                      |                    |

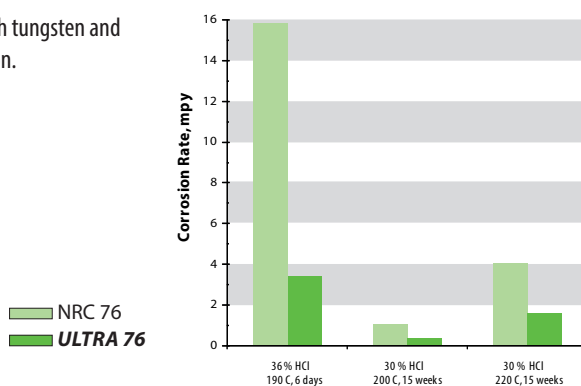
## Metallurgical Characteristics

Material is single-phase tantalum with tungsten and platinum group metals in solid solution.

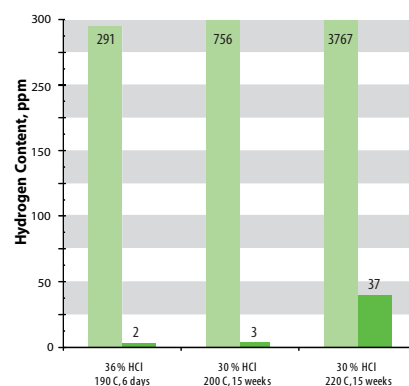
Stress relieve at 1093 °C (2000 °F)

Re-crystallize at 1316 °C (2400 °F)

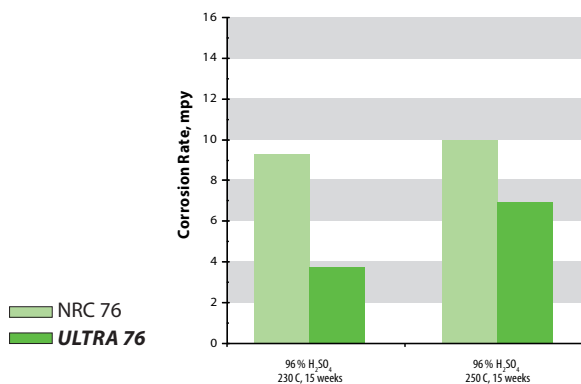
### HYDROCHLORIC ACID - CORROSION RATES



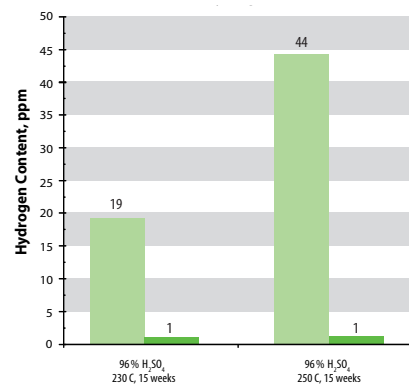
### HYDROCHLORIC ACID - HYDROGEN EMBRITTLEMENT



### SULFURIC ACID - CORROSION RATES



### SULFURIC ACID - HYDROGEN EMBRITTLEMENT



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