

Nb – Hf – Ti Alloy C103 (UNS R04295)

Description of Product:

H.C. Starck Solutions produces additively manufactured C-103 niobium alloy using laser powder bed fusion (L-PBF). C103 niobium-hafnium titanium alloy is well-suited for rocket and jet propulsion applications utilized in spacecraft and launch vehicles. A key advantage of the niobium alloy is its high strength at temperatures up to 2700 °F (1482 °C), particularly in high performance rocket nozzle applications. H.C. Starck Solutions' C-103 niobium alloy also has excellent resistance to high frequency vibrations at cryogenic temperatures, as occur in many satellite applications, because of its low ductile-to-brittle transition temperature.

Chemical Characteristics ¹⁾

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

Chemical composition of finished parts can be supplied on request when Purchase Order is placed. The chemical composition of the starting powder shall conform to the following limits:

| | | |
|----|------------|--------|
| Nb | 88.0 min | % |
| Hf | 9.0 - 11.0 | % |
| Ti | 0.7 - 1.3 | % |
| Ta | 0.5 max | % |
| W | 0.5 max | % |
| Zr | 0.7 max | % |
| C | 150 | ppm wt |
| O | 500 | ppm wt |

Condition Parts will be supplied in the as-printed condition unless otherwise requested

Mechanical Properties ¹⁾ Tensile properties can be supplied on request when Purchase Order is placed

Typical Properties

| Test Condition | Print Orientation | Tensile Strength | Yield Strength 0.2% offset | Elongation |
|-----------------|-------------------|------------------|----------------------------|------------|
| | | MPa (ksi) | MPa (ksi) | % |
| 22°C (72°F) | Horizontal | 515 (75) | 425 (61) | 25 |
| 22°C (72°F) | Vertical | 525 (76) | 430 (62) | 25 |
| 1093°C (2000°F) | Horizontal | 195 (28) | 185 (27) | 22 |
| 1093°C (2000°F) | Vertical | 215 (31) | 205 (30) | 22 |

1) Information on testing methods on request.

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Physical Properties

Density 8.8 g/cm³
Relative Density 99+ %
Surface Roughness <10 μm

Hazards identification in Advertising (Directive 67/548/EEC Article 26 and Directive 1999/45/EC Article 13)
none.

Identification The material will be identified with appropriate specification number, ingot or lot number, and nominal size. Shipping containers will be marked with the name of the customer and the purchase order number.

Rejection H.C. Starck Solutions must receive written notification of rejected material with the reason for rejection. The right is reserved to inspect rejected material at customer plant for claim validation. The material may be returned only after proper authorization.

Applicable Standards ASTM WK77186 New Specification for Additive Manufacturing -- Finished Part Properties -- Specification for Niobium-Hafnium Alloy UNS R04295 via Laser Beam Powder Bed Fusion for Spaceflight Applications
ASTM E8/E8M Test Method for Tension Testing of Metallic Materials
ASTM E21 Standard Test Methods for Elevated Temperature Tension Tests of Metallic Materials
ASTM B311 Test Method for Density Determination for Powder Metallurgy (P/M) Materials Containing Less Than Two Percent Porosity

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