



# Certified C-103 (A)

Certified C-103 (A) is a niobium alloy with hafnium and titanium alloying elements. It is a refractory material specifically designed for high-temperature and high-corrosive operating applications. Parts in C-103 can operate reliably up to a service temperature of approximately 1480°C. For example, at a temperature of 1093°C, C-103 has more than double the strength of Ni718 or Ni625.

3D Systems offers application development and part production using the integrated additive manufacturing (AM) workflow software, 3DXpert®, and the DMP Flex/Factory 350 metal 3D printers. 3D Systems' Certified C-103 parameters were developed, tested, and optimized in cooperation with our AS9100/ISO9001 part production facilities, which have the unique distinction of printing more than 1,000,000 challenging metal production parts in various materials, year over year.

For companies looking to develop new applications and processes with Certified C-103, our Application Innovation Group (AIG) can support and accelerate this development.

## Material description

Certified C-103 is a niobium-hafnium-titanium alloy. C-103 was used for the first time in the Apollo manned lunar module rocket engine in 1965. It has since been adopted for various ultra-high temperature applications, such as rocket nozzles, jet propulsion, and thrust augments flaps.

3D Systems offers this standard alloy now as a solution for additive manufacturing. The extremely low oxygen environment of the DMP Flex and Factory 350 vacuum chamber architecture minimizes oxygen pickup, ensuring the best conductivity properties. In effect, the DMP Flex and Factory 350 Architecture allows indefinite storage of C-103 powder under low oxygen conditions. Moreover, with the DMP Factory 350 system, the entire powder handling cycle can be done under an inert environment.

Finally, the 3D Systems build volume reducer accessory for the DMP Flex or Factory 350 DMP systems reduces the required amount of powder to load in the printer and allows for cost-efficient pilot application development and pilot production.

## Typical Properties<sup>1,2,3</sup>

DMP FLEX/FACTORY 350 – LT 60	TEST METHOD	TEST CONDITION	NON HEAT TREATED (NHT)
Ultimate tensile strength (MPa   ksi)	ASTM E8	Room Temp 22°C	574   83
Yield strength Rp0.2% (MPa   ksi)			461   67
Elongation (%)			28
Ultimate tensile strength (MPa   ksi)	ASTM E21	Elevated Temp 1093°C	269   39
Yield strength Rp0.2% (MPa   ksi)			216   31
Elongation (%)			13

<sup>1</sup> Parts manufactured with a standard parameters and protocols on DMP Flex/Factory 350 using layer thickness 60 µm (LT60)

<sup>2</sup> Sampled machined and tested according to ASTM E8 using round tensile test specimen type 4

<sup>3</sup> Typical values, average of 3 vertical tensile coupons

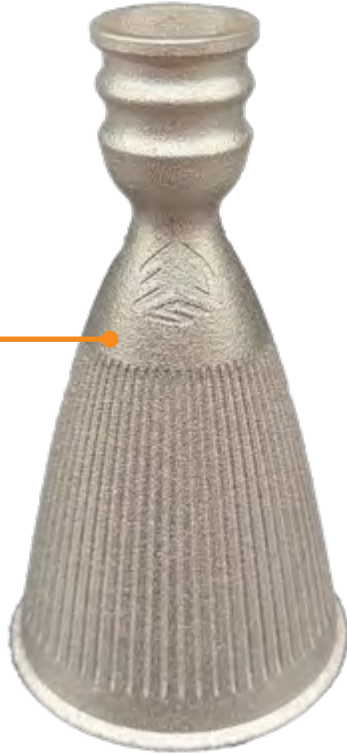
## Typical Applications

- High temperature (aero) space propulsion and satellite components
- Steering nozzles, high-thrust nozzles
- Thrust chambers, turbine blades, jet engine afterburner flap sections
- Burst disks test stands components

Layer thickness: 60µm  
Typical relative density<sup>4</sup>: 99.6-99.7%



Roughness Ra<sup>5</sup>  
8-12 µm



Satellite Truster

PART HEIGHT	57 mm
PRINT TIME	6 h
LAYER THICKNESS	60 µm

## Application Focus:

### SPACE - NOZZLES AND THRUST CHAMBERS

C-103 has a high service temperature between 1200°C and 1400°C. It is capable of withstanding high stresses at these elevated temperatures, rendering it particularly suited for use in propulsion systems. In addition, Because of its low ductile-to-brittle transition temperature, C-103 has excellent resistance to high-frequency vibrations at cryogenic temperatures, as occurs in many satellite or space applications.

### JUGGLE COMPLEXITY AND SIMPLIFY ASSEMBLY IN 3DXPERT

Benefit from the 3DXpert design features to generate surface lattice and cooling channels with unlimited complexity. Analyze your design inside the same software environment. Leverage the power of additive manufacturing to simplify assemblies by integrating additional functions such as structural elements and fixtures into a single part.

<sup>4</sup>Values based on a limited sample population (<15). Values shown are typical values from density test coupons, may deviate depending on specific part geometry

<sup>5</sup>No surface treatment applied, measured in as printed condition according with a Keyence microscope. Values based on a limited sample population (<5)



To confirm the suitability of this material for your specific application, please contact the 3D Systems Application Innovation Group (AIG): <https://www.3dsystems.com/consulting/application-innovation-group>



3D Systems works with C-103 powders sourced from H.C. Starck Solutions  
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