

## Certified GRCo-42 (A)

Certified GRCo-42 (A) is a copper alloy specifically designed for high-temperature, high-thermal transfer applications where high strength and creep properties are also a hard requirement. Parts in GRCo-42 can operate reliably up to a service temperature of approximately 750 °C.

3D Systems offers application development and part production using the integrated additive manufacturing (AM) workflow software, 3DXpert®, and the DMP Flex and DMP Factory 350 metal 3D printers. 3D Systems' Certified GRCo-42 parameters were developed, tested, and optimized on real heat management applications 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 GRCo-42, our Application Innovation Group (AIG) can support and accelerate application development.

### Typical Properties

DMP FLEX 350, DMP FACTORY 350 - LT 60 <sup>2</sup>	TEST METHOD	HEAT TREATMENT HIP <sup>3</sup>
Ultimate tensile strength (MPa   ksi)	ASTM E8	360   52
Yield strength Rp0.2% (MPa   ksi)		195   28
Elongation (%)		33
Electrical conductivity (% IACS1)	ASTM B193	>85

### Typical Applications

- Regeneratively cooled, liquid bi-propellant thrust chambers
- High-temperature aerospace components
- Advanced thermal management with high conductivity needs in temperatures up to 800°C
- High thermal transfer applications where pure Cu is too weak

1. IACS = International Annealed Copper Standard.

2. Samples printed with a layer thickness of 60 µm (LT60). Machined and tested according to ASTM E8 using round tensile test specimen type 4. Typical values, average of 10 vertical and 23 horizontal tensile coupons.

3. HIP = Hot Isostatic Pressing - 954°C for 3 hours at 103Mpa

### Material Description

Certified GRCo-42 is a copper-chrome-niobium alloy developed by NASA. The addition of Cr and Nb to the Cu matrix enables dispersion strengthening after HIP via Cr<sub>2</sub>Nb precipitates. These precipitates improve mechanical strength, creep resistance and low cycle fatigue life at high temperatures. At room temperature, electrical conductivity of over 85% IACS1 can be obtained.

Certified GRCo-42 (A) powder chemistry

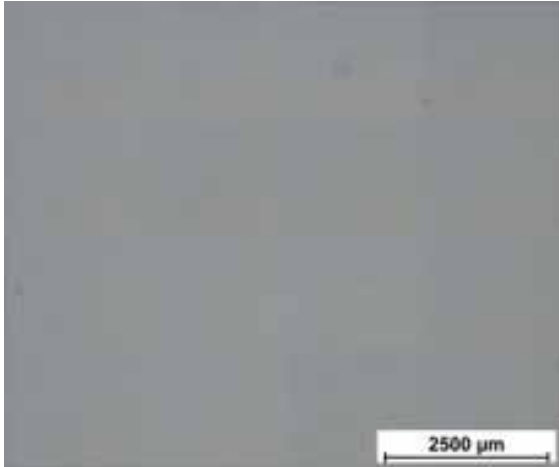
ELEMENT	WT%
Cr	3.1 - 3.4
Nb	2.7 - 3.0
Fe	< 250 ppm, target < 50 ppm
O	< 500 ppm, target < 250 ppm
Al	< 400 ppm
Si	< 350 ppm, target < 100 ppm
Cu	Balance

Source: NASA report AIAA-2019-4228

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. And with the DMP Factory 350 system, the powder handling can be done completely in an inert environment.



Layer thickness 60 relative density typically 99.8 - 99.9%4 after HIP



Typical Roughness Ra 8 - 10 µm

Typical Electrical Conductivity > 85% IACS<sup>1</sup>



### Application Focus:

#### SPACE - THRUST CHAMBERS

The high thermal conductivity of GRCo-42 greatly improves cooling of the chamber during operation. As a result, GRCo-42 allows combustion chambers to operate at higher temperatures which significantly increases efficiency. Moreover, GRCo-42 is an alloy specifically designed to meet the strength and creep requirements desired by the space industry. With a service temperature up to 750°C, GRCo-42 is therefore a go-to material for use in load-bearing high-temperature (typically 400-600°C) propulsion applications.

#### JUGGLE COMPLEXITY AND SIMPLIFY ASSEMBLY IN 3DXPERT

Benefit from the 3DXpert design features to generate 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.

Part height	260 mm
Print time	45 h (Batch size: 1)
Layer thickness	60 µm

4. Values based on a limited sample population (<15). Values shown are typical values from density test coupons, may deviate depending on specific part geometry.  
5. 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>

