Material Data Sheet

GRCop-42

Copper Alloy

A copper/chromium/niobium alloy developed by NASA specifically for use by spaceflight companies to manufacture components in rocket engines. The alloy exhibits high thermal conductivity combined with high strength at elevated temperatures and excellent creep resistance.

Typical Mechanical Properties

Ultimate tensile strength	545 MPa
Yield strength	334 MPa
Elongation at break	25%

Highlights

- High thermal conductivity & strength at elevated temperatures
- Suited to components requiring high thermal conductivity in high temperature environments such as liquid rocket engines
- Applications in space flight and satellite markets

Process Parameter

Quality — Balanced — Productivity

- Layer thickness: 40µm
- Density >99.9%
- Improved surface finish
- Dense/controlled thin walls <0.5mm

Process Readiness Level (PRL)

R&D			Foundation			Production		
1	2	3	4	5	6	7	8	9

Additive Industries

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Powder Chemistry[2,3]									
Composition	Cu	H	Si	Al	O	Fe	Nb	Cr	N
Min (wt%)	Bal.	Info Only	0	0	0	0	2.7	3.1	Info Only
Max (wt%)	-	-	0.035	0.06	0.07	0.025	3.0	3.4	-

Process details		
Layer thickness	40	[µm]
Build rate[8] (per laser)	10.8	[cm^3/hr]
Optical density [4]	≥ 99.8	[%]
Volumetric density [11]	-	[g/cm^3]

Mechanical properties [5]	Orientation	As-built (Mean)	As-Built Standard Dev.	Heat-treat (Mean)	As-Built Standard Dev.	Units
Ultimate tensile strength	Horizontal	545	5	-	-	[MPa]
	Vertical	528	5	-	-	[MPa]
Yield strength	Horizontal	334	5	-	-	[MPa]
	Vertical	295	5	-	-	[MPa]
Elongation at break	Horizontal	25	2	-	-	[%]
	Vertical	27	1	-	-	[%]
Youngs modulus	Horizontal	127	15	-	-	[GPa]
	Vertical	142	10	-	-	[GPa]
Vickers Hardness [6]		143	5	-	-	[HV10]

Surface Roughness [7]	Mean	Standard Deviation	Units
Vertical Surface Roughness (Ra)	-	-	[µm]
Vertical Surface Roughness (Rz)	-	-	[µm]
45° Surface Roughness (Ra)	-	-	[µm]
45° Surface Roughness (Rz)	-	-	[µm]

Notes

1. This data is only valid for Additive Industries released powder, machine and parameter sets. The material is processed under Nitrogen shielding atmosphere. The properties of the parts are measured on test coupons according to industry standards where available. These data are valid only under the tested conditions and correspond to our state of the art at the time of publication. They do not warrant any guarantee for printed parts, the producer or purchaser of these parts is responsible for checking the ultimate properties of the printed material. The listed data are subject to change without notice. We strive to continuously develop and improve the machine's performance and therefore the properties of the printed materials.
2. Powder Chemistry as per Additive Industries specification 08558 Rev. 1.0.
3. Additive Industries consolidated material is in compliance with industry specification (NASA).
4. Density measured by Optical Measurement Method as per internal process. This is the minimum guaranteed value that is achieved under standard processing conditions, manufactured using Additive Industries' qualification jobs.
5. Tensile test samples were produced as round blanks. These were machined to size and tested in accordance with ASTM E8m at a NADCAP approved supplier.
6. Hardness measured in accordance with DIN EN ISO6507-1:2018 as per internal process. Hardness values measured in XY and XZ planes from components manufactured using Additive Industries' qualification jobs.
7. Surface Roughness measured in as-printed condition in accordance with internal process. Roughness measurement conducted on specimens with varying unsupported manufacturing angle.
8. Build Rate stated is a typical value per laser. It is calculated using the formula: Layer Thickness x Laser Scan Speed x Hatch Distance.
9. Parameter released: GRCop42_40_BAL_MF1A64_INT_1.0.
10. Heat Treatment : NA
11. Volumetric density measured according to ASTM B962. This is a minimum volumetric density measurement achieved on samples manufactured using Additive Industries' qualification jobs.

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