

GRCop-42 Copper

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Material & Process Capability

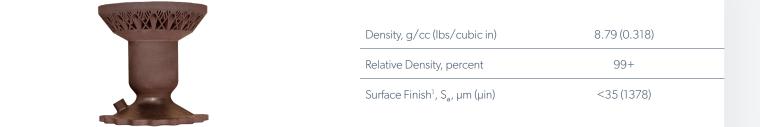
GRCop-42 is a copper-chromium-niobium alloy. The alloy was developed by NASA to additively manufacture parts in need of high-strength dispersion and high conductivity. It retains strength at high temperature, due to the use of chromium and niobium in the alloy. Velo3D has developed processes that maintain high density in the printed part. GRCop-42 also has excellent creep resistance, and a low cycle fatigue life.

All of these properties are particularly valuable for rocket engine components such as fuel injector faces and combustion chamber linings with regenerative cooling.

General Process

Velo3D has successfully printed dense components with GRCop-42 using its fully integrated additive manufacturing process. This data sheet specifies the expected mechanical properties and characteristics of this alloy when manufactured on a Velo3D Sapphire System. All data is based on parts built using Velo3D standard 50 µm layer thickness parameters, using Praxair TruForm™ CU42-N30, CU42-P55, Carpenter CT-GRCop42-AAAA and KBM GRCU42015063ROC, all Velo3D-approved powders. Parts built from GRCop-42 on a Sapphire System can be heat treated like those manufactured by other methods.

Powders: Praxair TruForm CU42-N30 and TruForm CU42-P55



Mechanical Properties² at Room Temperature

				After HIP⁴					
				Ultimate Tensile Strength, MPa (ksi)		Yield (0.2% Offset), MPa (ksi)		Elongation At Break, percent	
Powder	Process Recipe	TBR (cc/h) ³	Sample Size	Mean-3 0	Mean	Mean-3 0	Mean	Mean-3 0	Mean
Praxair TruForm CU42-N30	1114/50	32	148	378 (55)	389 (56)	187 (27)	192 (28)	28.9	33.3
Praxair TruForm CU42-P55	- 1kW/50μm		366	383 (56)	391 (57)	185 (27)	194 (28)	29.4	33.4

Thermal Conductivity after HIP⁴

		Thermal Conductivity W/mK			
Powder	Sample Size	Temperature	Mean		
		25°C	323		
Praxair TruForm CU42-N30	6	260°C	317		
		537.8°C	303		

1. Depends on orientation and process selected; for angles >25° from horizontal. 2. Mechanical & test samples printed in vertical orientation, machined to ASTM E8 (round specimen #3). 3. TBR: Theoretical Build Rate (TBR) is a per-laser build rate calculated from the process conditions of bulk core as *scan speed x hatch spacing x layer thickness*. This value represents a single laser only and is reported for comparison purposes across different materials and recipes, but does not correspond to true build rate, which is dependent on geometry and system characteristics (i.e. number of lasers, recoat times, etc.) 4. HIP conditions: 1750 ± 25 °F, 15 ± 0.5 ksi; 3 hours (+15/-0 min) in inert environment.

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Powders: Carpenter CT-GRCop42-AAAA and KBM GRCU42015063ROC



8.79 (0.318)
99+
<35 (1378)

Mechanical Properties² at Room Temperature

					After HIP ⁴	
				Ultimate Tensile Strength, MPa (ksi)	Yield (0.2% Offset), MPa (ksi)	Elongation At Break, percent
Powder	Process Recipe	TBR (cc/h) ³	Sample Size	Mean	Mean	Mean
Carpenter CT-GRCop42-AAAA	3004/50	20	43	365 (53)	176 (26)	36.6
KBM GRCU42015063ROC	- 1kW/50 μm	29	22	364 (53)	181 (26)	35.6

Thermal Conductivity after HIP⁴

		Thermal Conductivity W/mK			
Powder	Sample Size	Temperature	Mean		
Carpenter CT-GRCop42-AAAA		25°C	347		
	2	260°C	322		
		537.8°C	306		
		25°C	351		
KBM GRCU42015063ROC	3	260°C	327		
		540°C	321		

1. Depends on orientation and process selected; for angles >25° from horizontal. 2. Mechanical & test samples printed in vertical orientation, machined to ASTM E8 (round specimen #3). 3. TBR: Theoretical Build Rate (TBR) is a per-laser build rate calculated from the process conditions of bulk core as *scan speed x hatch spacing x layer thickness*. This value represents a single laser only and is reported for comparison purposes across different materials and recipes, but does not correspond to true build rate, which is dependent on geometry and system characteristics (i.e. number of lasers, recoat times, etc.) 4. HIP conditions: 1750 ± 25 °F, 15 ± 0.5 ksi; 3 hours (+15/-0 min) in inert environment.

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