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 RocketPowder 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

Typical Volume Rate[1], cc/hour	36
Density, g/cc (lbs/cubic in)	8.79 (0.318)
Relative Density, percent	99+
Surface Finish[2], S_a, µm (µin)	<35 (1378)

Mechanical Properties[3] at Room Temperature

		After HIP[4]					
		Ultimate Tensile Strength, MPa		Yield (0.2% Offset), MPa		Elongation At Break, percent	
Powder	Sample Size	Mean-3σ	Mean	Mean-3σ	Mean	Mean-3σ	Mean
Praxair TruForm CU42-N30	148	378	389	187	192	28.9	33.3
Praxair TruForm CU42-P55	366	383	391	185	194	29.4	33.4

Thermal Conductivity after HIP[4]

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

1. Geometry-dependent. **2.** Depends on orientation and process selected; for angles >25° from horizontal. **3.** Mechanical & test samples printed in vertical orientation, machined to ASTM E8 (round specimen #3). **4.** HIP conditions: 1750 ± 25 F, 15 ± 0.5 ksi; 3 hours (+15/-0 min) in inert environment.

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Relative Density, percent	99+
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Mechanical Properties[3] at Room Temperature

		After HIP[4]		
		Ultimate Tensile Strength, MPa	Yield (0.2% Offset), MPa	Elongation At Break, percent
Powder	Sample Size	Mean	Mean	Mean
Carpenter CT-GRCop42-AAAA	43	365	176	36.6
KBM RocketPowder GRCU42015063ROC	22	364	181	35.5

Thermal Conductivity after HIP[4]

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

1. Geometry-dependent. **2.** Depends on orientation and process selected; for angles >25° from horizontal. **3.** Mechanical & test samples printed in vertical orientation, machined to ASTM E8 (round specimen #3). **4.** HIP conditions: 1750 ± 25 F, 15 ± 0.5 ksi; 3 hours (+15/-0 min) in inert environment.