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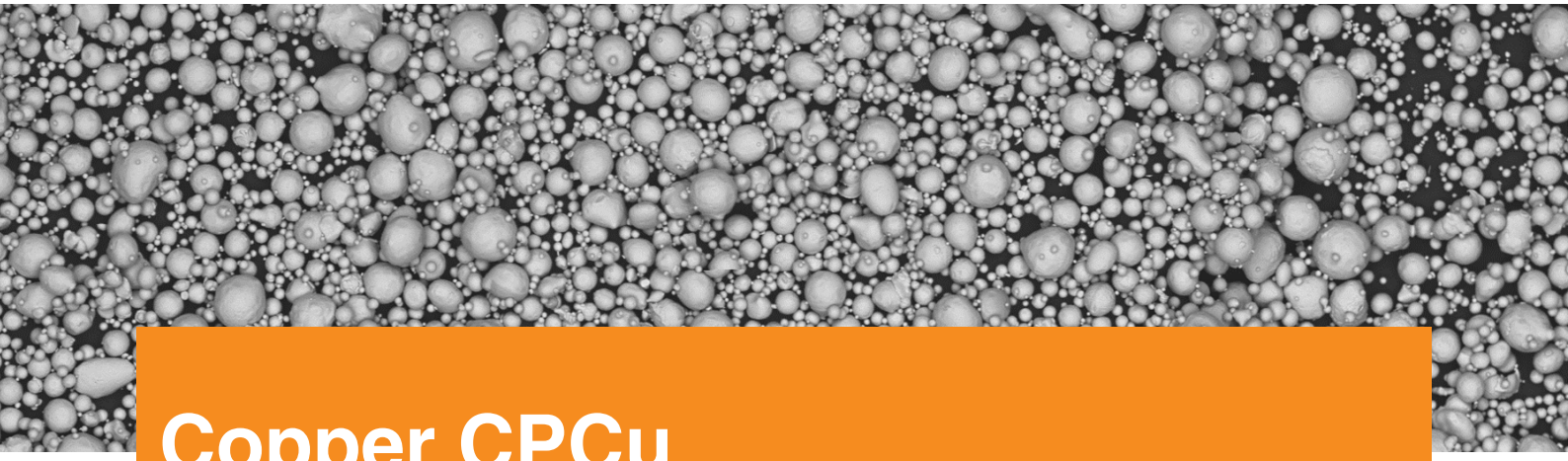

Copper CPCu

Parameter set options

Layer thickness	Optimised for	Laser mode	Page
30 µm	Single laser per part	Continuous wave	4

To download the latest material files, visit **www.renishaw.com/softwarelicensing.**

Material description

Commercially Pure Copper (CPCu) is composed of >99.5% purity copper with trace amounts of oxygen and phosphorus.

Parts made using commercially pure copper have extremely high electrical and thermal conductivity, making them well suited for applications in electronics and heat transfer. CPCu also has good corrosion resistance due to the protective oxide layer that forms on its surface.

Material properties

- Very high thermal conductivity
- Very high electrical conductivity
- Good corrosion resistance
- Responds well to post process finishing

Applications

- Electronics cooling and components
- Automotive
- Aerospace and defence
- Consumer goods
- Heat exchangers

Disclaimer

The mechanical property data featured in this document were obtained from tests performed in Renishaw's laboratories and they indicate the mechanical properties that can be achieved. The data is not intended as a guaranteed minimum specification.

Glossary of terms

Term	Definition
Scan strategy	Determines the path the laser will take to melt the cross-sectional area of the parts featured in each layer of the build process.
Meander	A scan strategy that takes the form of a straight-line vector path that bounces back and forth from each side of the part border. Meander strategy is quick and ideal for parts with a small XY cross section.
Stripe	A scan strategy where the area within the part border is split into strips and a meander technique is used within each strip. Stripe is ideal for parts with a large XY cross section.

Generic material data

NOTE: Due to the ease of copper oxidising, the following considerations should be followed for best results:

- Keep the machine inert when not in use
- Clean-down the machine only when bed temperature is at <30°C
- When using an external sieve, sieve powder under argon

Typical wrought material properties

Material property	Wrought material value
Density	8.95 g/cm^3
Electrical conductivity	58.1 MS/m (100% IACS)
Thermal conductivity	391 W/mK to 401 W/mK
Melting temperature	1 000 °C to 1 090 °C
Coefficient of thermal expansion [1]	16.5×10-6 K-1

[1] In the range of 20 °C to 100 °C.

Recommended composition of powder

Element	Mass (%)
Copper	99.5
Oxygen	≤ 0.2
Phosphorus	≤ 0.5

Recommended powder size distribution: 20 µm to 63 µm.

The values shown in this table are representative of a general composition powder. Contact your powder supplier for more detailed information about specific powders.

Please contact Renishaw for further information about specifications or if you require support in qualifying non-Renishaw powders.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
30 µm	Single laser per part	Continuous wave	190 m^3/h	One laser: 6.05 cm^3/h	Four lasers: N/A

Material files: CPCu_500S_B30_M_01_A (meander scan strategy)
CPCu_500S_B30_S_01_A (stripe scan strategy)

Properties of additively manufactured components

NOTE: This parameter set is optimised for bulk density. The material properties in this table are indicative only. Further modification of the material file may be required to suit your application.

		As built	Heat treated [1]
Bulk density [2]		≥ 96.1% ±0.8%	≥ 96.1% ±0.8%
Ultimate tensile strength [3]	Horizontal (XY)	212 MPa ±4 MPa	201 MPa ±3 MPa
	Vertical (Z)	139 MPa ±12 MPa	153 MPa ±6 MPa
Yield strength [3]	Horizontal (XY)	155 MPa ±3 MPa	80 MPa ±2 MPa
	Vertical (Z)	123 MPa ±8 MPa	71 MPa ±2 MPa
Elongation after fracture [3]	Horizontal (XY)	20% ±2%	38% ±2%
	Vertical (Z)	7% ±3%	71% ±2%
Hardness (Vickers) [4]	Horizontal (XY)	75 HV0.5 ±6 HV0.5	57 HV0.5 ±5 HV0.5
	Vertical (Z)	73 HV0.5 ±6 HV0.5	56 HV0.5 ±5 HV0.5
Electrical conductivity [5]	Horizontal (XY)	91% IACS ±1% IACS	94% IACS ±2% IACS
	Vertical (Z)	87% IACS ±1% IACS	56% IACS ±5% IACS
Thermal conductivity [6]	Horizontal (XY)	321 W/mK ±1 W/mK	294 W/mK ±3 W/mK
	Vertical (Z)	333 W/mK ±7 W/mK	318 W/mK ±3 W/mK
Surface roughness [7]	Vertical (Z) (Median Ra)	17 µm ±1 µm	17 µm ±1 µm

Mechanical test samples were created using one laser, one laser per sample and with no downstream processing. Meander scan strategy was used for vertical samples. Stripe scan strategy was used for horizontal samples.

1 Heat treatment method used for testing: Under vacuum, heat at 10°C/min to 650 °C ±20 °C, then hold temperature for 4 hours. Furnace cool to room temperature with argon. Heat treatment will result in outgassing.

2 Measured optically on 10 mm × 10 mm × 10 mm samples at 75× magnification.

3 Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 12 samples.

4 Tested to ASTM E384-11 after polishing.

5 Tested to ASTM E1004. Values based on 5 samples.

6 Tested to ASTM E1461. Values based on 5 samples.

7 Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601 2001 (ISO 4287:1997).

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