SLM SOLUTIONS

CuCr1Zr

C18150 / CW106C

MATERIAL DATA SHEET

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MATERIAL

While pure copper reaches great thermal and electrical conductivities, it lacks strength for load-bearing or structural applications. Additional alloying elements can improve mechanical properties by means of precipitation hardening. CuCr1Zr is SLM Solutions' copper alloy with the lowest concentration of alloying elements and, therefore, brings an excellent balance of mechanical and conductive properties. With up to 92 % IACS after heat-treatment, CuCr1Zr still features very high electrical conductivities at up to 300 MPa ultimate tensile strength. Chromium and zirconium help to maintain both high strength and hardness at elevated temperatures – ideal for rocket engines. Due to its sensitivity for oxygen pick-up, the maximum oxygen content during the process shall not exceed 200 ppm. Large exposure areas require the use of a metal recoater brush.

CHEMICAL COMPOSITION

C18150[1]						
	Cu	**Cr**	**Zr**	**Si**	**Fe**	**Total others**
Min.	Bal.	0.50	0.03			
Max.		1.20	0.30	0.10	0.08	0.20

POWDER PROPERTIES

Particle Size[1]	20 - 63 µm
Mass Density[2]	≈ 8.9 g/cm³
Particle Shape[3]	Spherical

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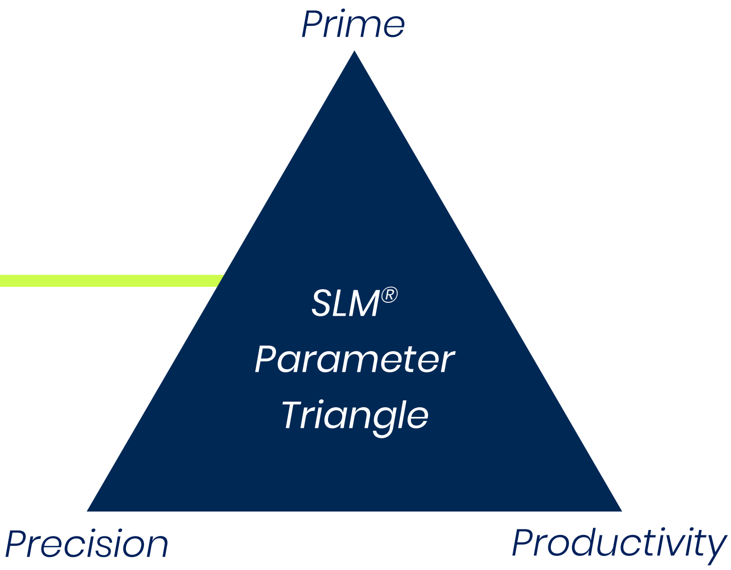
SLM® PARAMETERS

It only takes 3 tools to make you successful with metal additive manufacturing:

1. The **SLM® machine** fitting your needs,
2. The **metal powder** that defines the later purpose and functionality of a part,
3. Precisely engineered **SLM® parameters** as the missing link.

Our open parameters are the result of our vast experience in multi-laser technology and a diligent development and qualification procedure. They are key to produce fully functional parts with properties you can expect and rely on – whether you are new to AM or a large-scale production operator. We offer them in three categories to you: from high-resolution complex details (**Precision**) up to the highest build rates (**Productivity**) or right in between (**Prime**).



MATERIAL QUALIFICATION

As one of the inventors of the selective laser melting process, we impose the most comprehensive test procedures on ourselves: hundreds of samples, multiple systems, various powder batches, numerous heat-treatments, machined vs. near-net-shape tensile specimens, several surface roughness conditions and angles, fatigue behavior, corrosion investigation, creep testing... Did we miss anything? Get in touch with us!

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PRECISION

Parameter Set	CuCr1Zr_PREC_MBP3_V1.0 (30 µm, 700 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical Build Rate[4]	11.3 cm^3/h
Minimum Relative Density[5]	99.6 %

Mechanical Properties[6]

M: Mean | SD: Standard Deviation

Non-heat-treated (NHT)

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	SD	M	SD	M	SD
Horizontal	265	5	190	5	41	2
Vertical	235	5	185	5	59	5

Heat-treated (AGED)[7]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	SD	M	SD	M	SD
Horizontal	325	10	200	15	30	2
Vertical	280	10	180	15	32	3

Hardness[8]

M: Mean | SD: Standard Deviation

	Vickers hardness HV5	
	M	SD
NHT	80	5
AGED[7]	95	5

Surface Roughness[9]

M: Mean | SD: Standard Deviation

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	SD	M	SD
As built	21	2	119	10
Corundum	9	2	50	9
Corundum + Glass bead	8	1	40	4

Conductivity[10]

M: Mean | SD: Standard Deviation

	Electrical conductivity [MS/m]		[%IACS]	
	M	SD	M	SD
NHT	15	1	26	1
AGED[7]	52	1	90	1

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PRIME

Parameter Set	CuCr1Zr_PRIM_MBP3_V1.0 (60 µm, 700 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical Build Rate[4]	19.9 cm³/h
Minimum Relative Density[5]	99.1%

Mechanical Properties[6]

M: Mean | SD: Standard Deviation

Non-heat-treated (NHT)

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	SD	M	SD	M	SD
Horizontal	255	5	175	5	41	3
Vertical	225	10	170	5	54	11

Heat-treated (AGED)[7]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	SD	M	SD	M	SD
Horizontal	345	15	220	15	27	2
Vertical	300	15	205	15	29	5

Hardness[8]

M: Mean | SD: Standard Deviation

	Vickers hardness HV5	
	M	SD
NHT	75	5
AGED[7]	95	5

Surface Roughness[9]

M: Mean | SD: Standard Deviation

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	SD	M	SD
As built	23	2	130	12
Corundum	12	1	68	6
Corundum + Glass bead	11	1	56	5

Conductivity[10]

M: Mean | SD: Standard Deviation

	Electrical conductivity [MS/m]		[%IACS]	
	M	SD	M	SD
NHT	16	1	27	1
AGED[7]	53	1	92	1

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DISCLAIMER

The properties and mechanical characteristics apply to powder that is tested and sold by SLM Solutions, and that has been processed on SLM Solutions machines using the original SLM Solutions parameters in compliance with the applicable operating instructions (including installation conditions and maintenance). The part properties are determined based on specified procedures. More details about the procedures used by SLM Solutions are available upon request.

The specifications correspond to the most recent knowledge and experience available to us at the time of publication and do not form a sufficient basis for component design on their own. Certain properties of products or parts or the suitability of products or parts for specific applications are not guaranteed. The manufacturer of the products or parts is responsible for the qualified verification of the properties and their suitability for specific applications. The manufacturer of the products or parts is responsible for protecting any third-party proprietary rights as well as existing laws and regulations.

MDS_CuCr1Zr_2022-10.1_EN

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NOTES

[1] With respect to powder material. Compositions stated as mass or weight percent.

[2] Material density varies within the range of possible chemical composition variations.

[3] According to DIN EN ISO 3252:2001.

[4] Theoretical system build rate = layer thickness x scan speed x hatch distance x number of lasers. The value represents a comparable indicator but remains a theoretical value after all. It does expressively not reflect true build rates, which are influenced by part geometry, ratio between hatch and contour areas, area of exposure, recoating times, and more.

[5] Optical density determination at test specimens by light microscopy according to internal specification. Relative density may vary depending on part geometry, orientation, volume, and other process factors.

[6] Tensile testing was performed in accordance to DIN EN ISO 6892-1:2017 B and conducted at room temperature. Samples are either machined before testing or tested in near-net-shape without any surface finishing (geometry according to DIN 50125:2016-D6x30). Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.

[7] Heat treatment: Solution annealing for 15 min at 950 °C, followed by water quenching. Then artificial aging for 6 h at 500 °C, followed by cooling at a rate equivalent to air-cooling. Process parts under inert atmosphere during all thermal post-processing steps.

[8] Hardness testing according to DIN EN ISO 6507-1:2018. Measurement direction “2” according to VDI 3405 2.1. Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.

[9] Roughness measurement on vertical walls according to DIN EN ISO 4288:1998; λc = 2.5 mm. Glass bead blasting is an additional post-processing step after corundum blasting. Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.

[10] Electrical conductivity measurement according to DIN EN 2004-1, ASTM E1004.