CuCr1Zr

CW106C (DIN CEN/TS 13388)

MATERIAL DATA SHEET

Nikon SLM SOLUTIONS

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MATERIAL

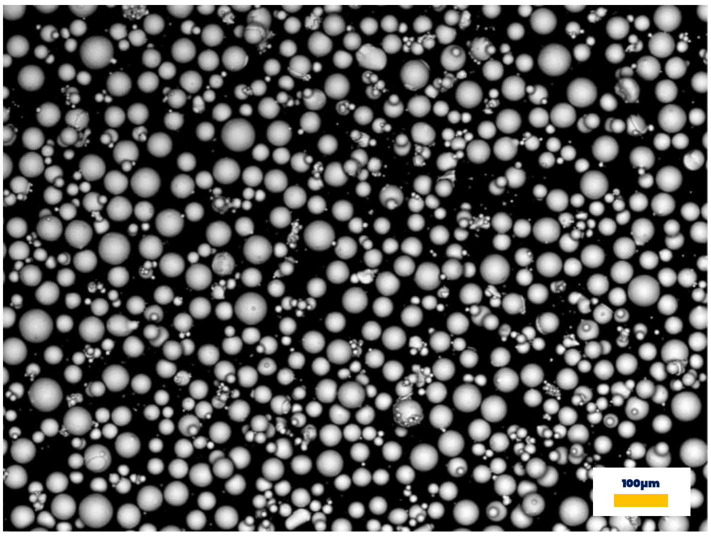
While pure copper reaches great thermal and electrical conductivities, it lacks strength for load-bearing or structural applications. Additional alloying elements can improve mechanical properties by means of precipitation hardening. CuCr1Zr is Nikon SLM Solutions' copper alloy with the lowest concentration of alloying elements and, therefore, brings an excellent balance of mechanical and conductive properties. With up to 90% 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

CW106C[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/cm^3
Particle Shape[3,4]	Spherical, typical batch morphology displayed below



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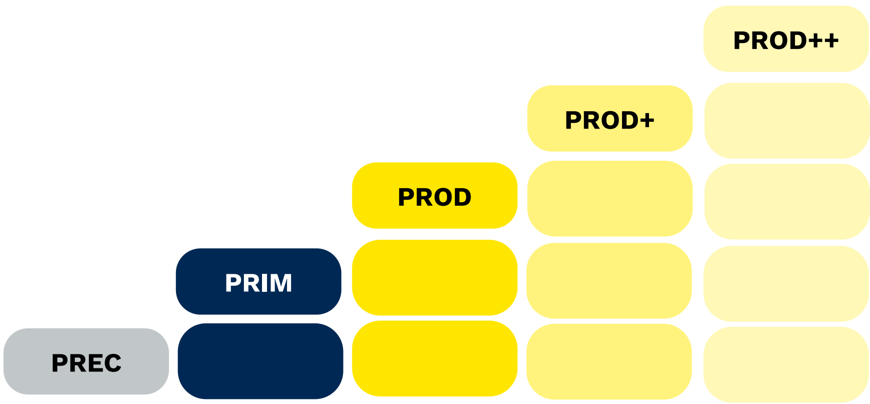
NIKON SLM® PARAMETERS

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

1. The **NIKON SLM® machine** fitting your needs,
2. The **metal powder** that defines the later purpose and functionality of a part,
3. Precisely engineered **NIKON 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 to you in the following categories: **Precision (PREC)** for high-resolution complex details, **Prime (PRIM)** for balanced properties with improved productivity and **Productivity (PROD)** for the highest build rates. Pushing boundaries is in our work culture, we can also offer a new dimension of productivity on selected materials with **Productivity+ (PROD+)** and **Productivity++ (PROD++)** parameters.



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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SLM® 280 PRECISION

Parameter Set	CuCr1Zr_PREC_MBP3_V1.0 (30 µm)
Machine Compatibility	SLM® 280 2.0, SLM® 280 Production System (700W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[5]	22.5 cm³/h (Twin)
Minimum Relative Density[6, 8]	99.4%

MECHANICAL PROPERTIES[7]

M: Mean | MIN: Minimum (95% population coverage / 95% confidence level)[8]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	265	255	190	180	41	37
Vertical	235	225	185	175	52	39

Heat-treated (ANN+AGED)[12]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	320	290	200	165	30	24
Vertical	280	260	180	150	32	25

HARDNESS[9]

M: Mean | MIN: Minimum (95% Population Coverage / 95% Confidence Level)[8]

	Vickers hardness HV5	
	M	MIN
NHT	80	75
ANN+AGED[12]	95	85

SURFACE ROUGHNESS[10]

M: Mean | MAX: Maximum (95% Population Coverage / 95% Confidence Level)[8]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	18	24	110	135
Corundum	9	-	50	-
Corundum + Glass bead	8	-	40	-

CONDUCTIVITY[11]

M: Mean | MIN: Minimum (95% population coverage / 95% confidence level)[8]

	Electrical conductivity [MS/m]		Electrical conductivity [%IACS]	
	M	MIN	M	MIN
NHT	15	11.5	26	20
ANN+AGED[12]	52	48.5	90	84

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SLM® 280 PRIME

Parameter Set	CuCr1Zr_PRIM_MBP3_V1.0 (60 µm)
Machine Compatibility	SLM® 280 2.0, SLM® 280 Production System (700 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[5]	39.9 cm³/h (Twin)
Minimum Relative Density[6, 8]	99.1%

MECHANICAL PROPERTIES[7]

M: Mean | MIN: Minimum (95% population coverage / 95% confidence level)[8]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	260	250	180	170	41	36
Vertical	225	215	175	165	50	36

Heat-treated (ANN+AGED)[12]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	340	300	220	180	27	22
Vertical	295	260	205	160	29	18

HARDNESS[9]

M: Mean | MIN: Minimum (95% Population Coverage / 95% Confidence Level)[8]

	Vickers hardness HV5	
	M	MIN
NHT	75	70
ANN+AGED[12]	95	85

SURFACE ROUGHNESS[10]

M: Mean | MAX: Maximum (95% Population Coverage / 95% Confidence Level)[8]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	23	27	130	160
Corundum	12	-	69	-
Corundum + Glass bead	10	-	56	-

CONDUCTIVITY[11]

M: Mean | MIN: Minimum (95% population coverage / 95% confidence level)[8]

	Electrical conductivity [MS/m]		Electrical conductivity [%IACS]	
	M	MIN	M	MIN
NHT	15	11.5	26	20
ANN+AGED[12]	52	48.5	90	84

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NXG PRIME

Parameter Set	CuCr1Zr_NXG600_PRIM_MBP3_V1 (60 µm)
Machine Compatibility	NXG XII 600, NXG 600E (1000 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[5]	314.2 cm^3/h (12 Lasers)
Minimum Relative Density[6, 8]	99.8 %

MECHANICAL PROPERTIES

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[8]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Vertical	215	205	160	145	60	45

HARDNESS[9]

M: Mean | MIN: Minimum (95% Population Coverage / 95% Confidence Level)[8]

	Vickers hardness HV5	
	M	**MIN**
NHT	79	70

SURFACE ROUGHNESS[10]

M: Mean | MAX: Maximum (95% Population Coverage / 95% Confidence Level)[8]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	**MAX**	**M**	**MAX**
As built	9	13	53	72

CONDUCTIVITY[11]

M: Mean | MIN: Minimum (95% population coverage / 95% confidence level)[8]

	Electrical conductivity [MS/m]		[%IACS]	
	M	**MIN**	**M**	**MIN**
NHT	13	11	23	19

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DISCLAIMER

The properties and mechanical characteristics apply to powder that is tested and sold by Nikon SLM Solutions, and that has been processed on Nikon SLM Solutions machines using the original Nikon 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 Nikon 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_2025-02.1_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 3252:2023.

[4] Secondary Electron Image of a typical powder batch.

[5] 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.

[6] 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. Population coverage: 99%, confidence level: 99%.

[7] Tensile testing was performed in accordance to DIN EN ISO 6892-1:2020 B and conducted at room temperature. Samples are either machined before testing (geometry according to DIN 50125:2016-D6x30 and DIN 50125:2016-C6x30). Samples labelled "Horizontal" correspond to a polar angle of $\theta = 90°$; samples labelled "vertical" correspond to a polar angle of $\theta = 0°$ (DIN EN ISO/ASTM 52921). 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.

[8] Minimum or maximum values are set by using tolerance interval method, which is a statistical approach based on the input of population coverage (PC) and confidence level (CL). Tolerance intervals ensure that a certain percentage of samples within a batch will be above the minimum value or below the maximum value with a certain probability, e.g. the probability that 95% of all samples will be above the minimum value or below the maximum value (within a defined batch and tested according to mentioned specifications) is 95%.

[9] Hardness testing according to DIN EN ISO 6507-1:2024. 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.

[10] Roughness measurement on vertical walls in alignment with DIN EN ISO 21920-3:2022; $\lambda c = 2.5$ 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.

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

[12] 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. Protective atmospheres shall be used as heating media unless parts will have sufficient surface material removed after heat treatment to eliminate high temperature atmospheric effects, such as oxidation or alloy depletion.