

Ti6Al4V Grade 23 ELI

ASTM B348 / ASTM F136 / ASTM F3001

MATERIAL DATA SHEET

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MATERIAL

Titanium and its alloys typically have a high strength-to-density ratio and a high corrosion resistance. This material, Grade 23 ELI, is alloyed aluminum and vanadium, which leads to formation of metastable α and β phases. It is very similar to Grade 5, but has extra low interstitial (ELI) elements, meaning the amount of the interstitial elements oxygen and iron are reduced to improve both ductility and fracture toughness. Ti6Al4V Grade 23 ELI is commonly used in medical implants due to its biocompatibility, but also in aerospace and automotive applications and others.

CHEMICAL COMPOSITION

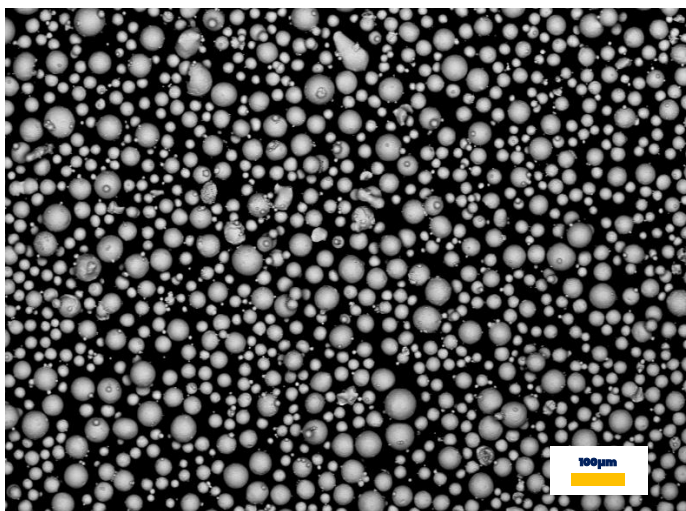
ASTM B348 ¹											
	Ti	Al	V	Fe	O	C	N	H	Y	Total each	Total others
Min.	Bal.	5.50	3.50								
Max.	Bal.	6.50	4.50	0.25	0.13	0.08	0.03	0.0125	-	0.10	0.40

ASTM F136 ¹											
	Ti	Al	V	Fe	O	C	N	H	Y	Total each	Total others
Min.	Bal.	5.50	3.50								
Max.	Bal.	6.50	4.50	0.25	0.13	0.08	0.05	0.012	-	-	-

ASTM F3001 ¹											
	Ti	Al	V	Fe	O	C	N	H	Y	Total each	Total others
Min.	Bal.	5.50	3.50								
Max.	Bal.	6.50	4.50	0.25	0.13	0.08	0.05	0.012	0.005	0.10	0.40

POWDER PROPERTIES

Particle Size ¹	20 - 63 μm
Mass Density ²	$\approx 4.43 \text{ g/cm}^3$
Particle Shape ³	Spherical, typical batch morphology displayed below



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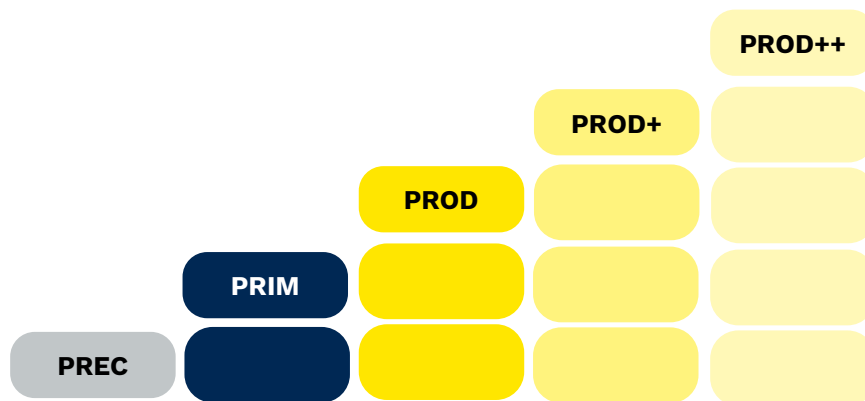
ASTM B348 / ASTM F136 / ASTM F3001

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.



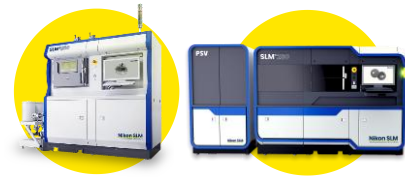
MATERIAL QUALIFICATION

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	Ti6Al4V_SLM280_PREC_MBP3_V1 (30 µm)
Machine Compatibility	SLM®280 2.0, SLM®280 Production System (400W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	37.6 cm ³ /h (Twin)
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1240	1200	1085	880	8	5
Vertical	1295	1225	1190	1115	9	5

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1080	1030	1000	950	16	13
Vertical	1075	1030	1025	970	16	12

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	370	354

SURFACE ROUGHNESS¹⁰

M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	9	15	60	94

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SLM® 280 PRIME

Parameter Set	Ti6Al4V_SLM280_PRIM_MBP3_V1 (60 µm)
Machine Compatibility	SLM®280 2.0, SLM®280 Production System (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	64.8 cm ³ /h (Twin)
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1270	1250	1145	1070	7	5
Vertical	1280	1200	1180	1000	9	4

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1085	1080	995	970	16	12
Vertical	1045	990	925	800	12	7

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	365	335

SURFACE ROUGHNESS¹⁰

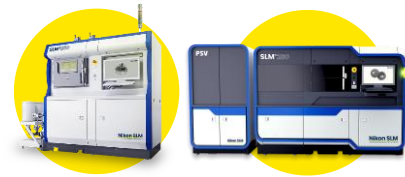
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	15	28	87	167

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SLM® 280 PRODUCTIVITY

Parameter Set	Ti6Al4V_SLM280_PROD_MBP3_V1 (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 ⁴	81.0 cm ³ /h (Twin)
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1260	1230	1150	1090	8	5
Vertical	1245	1215	1155	1075	8	6

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1095	1060	1000	940	15	12
Vertical	1100	1085	1035	1020	15	9

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	360	290

SURFACE ROUGHNESS¹⁰

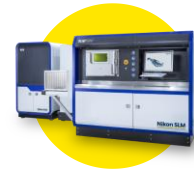
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	12	21	73	142

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SLM® 500 PRECISION

Parameter Set	Ti6Al4V_SLM500_PREC_MBP3_V1 (30 µm)
Machine Compatibility	SLM®500 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	75.2 cm³/h (Quad)
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1290	1250	1130	1030	9	6
Vertical	1305	1220	1200	1130	9	5

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1070	1020	995	910	16	13
Vertical	1085	1045	1035	995	16	14

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	375	285

SURFACE ROUGHNESS¹⁰

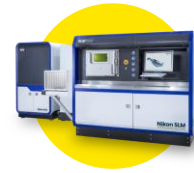
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	9	16	61	106

MATERIAL DATA SHEET

Ti6Al4V Grade 23 ELI

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SLM® 500 PRIME

Parameter Set	Ti6Al4V_SLM500_PRIM_MBP3_V1 (60 µm)
Machine Compatibility	SLM®500 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	129.6 cm³/h (Quad)
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1300	1285	1155	1080	6	5
Vertical	1295	1250	1195	1145	8	5

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1105	1095	1020	980	14	12
Vertical	1105	1090	1045	1020	15	12

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	380	360

SURFACE ROUGHNESS¹⁰

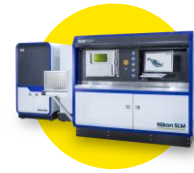
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	10	14	66	91

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ASTM B348 / ASTM F136 / ASTM F3001



SLM® 500 PRODUCTIVITY

Parameter Set	Ti6Al4V_SLM500_PROD_MBP3_V2 (90 µm)
Machine Compatibility	SLM®500 (700 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	220 cm ³ /h (Quad)
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1270	1255	1135	1090	6	5
Vertical	1250	1135	1165	1045	10	7
Near-Net-Shape	M		M		M	
Vertical	1290	1185	1150	1095	7	2

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1110	1095	1015	1000	13	12
Vertical	1120	1105	1050	1030	16	14

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	375	355
Heat-treated ⁸	362	350

SURFACE ROUGHNESS¹⁰

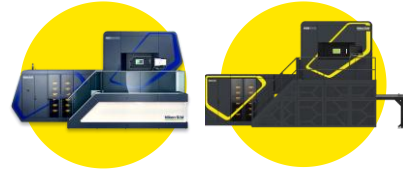
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	9	14	61	85

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NXG PRIME

Parameter Set	Ti6Al4V_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 ⁴	421.2 cm ³ /h
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	1245	1200	1090	1045	8	6
Vertical	1215	1165	1095	1035	7	2
Near-Net-Shape						
Vertical	1185	1170	1055	1000	7	4

Heat-treated (ANN)⁸

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Vertical	1025	1015	955	935	15	11

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	357	346
Heat-treated ⁸	316	308

SURFACE ROUGHNESS¹⁰

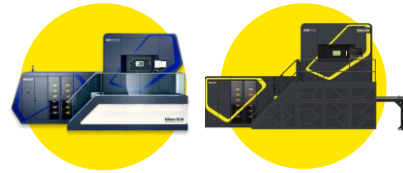
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	8	11	51	66

MATERIAL DATA SHEET

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NXG PRODUCTIVITY

Parameter Set	Ti6Al4V_NXG600_PROD_MBP3_V1 (90 µm)
Machine Compatibility	NXG XII 600, NXG 600E (1000 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	1020 cm ³ /h
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

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	1160	1120	1030	980	4	1
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	1110	1085	925	880	4	1

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
As built	355	340

SURFACE ROUGHNESS¹⁰

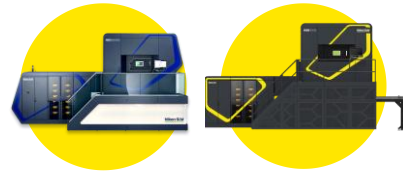
M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	8	11	51	70

MATERIAL DATA SHEET

Ti6Al4V Grade 23 ELI

ASTM B348 / ASTM F136 / ASTM F3001



NXG PRODUCTIVITY+

Parameter Set	Ti6Al4V_NXG600_PROD+_MBP3_V1 (120 µm)
Machine Compatibility	NXG XII 600, NXG 600E (1000 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁴	1254 cm ³ /h
Minimum Relative Density ^{5,7}	99.9 %

MECHANICAL PROPERTIES⁶

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Vertical	1145	1120	1035	980	7	1
Near-Net-Shape						
Vertical	1215	1085	1050	880	5	1

Heat-treated (HIP+ANN)¹¹

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Vertical	935	925	825	805	15	13
Near-Net-Shape						
Vertical	970	955	865	845	14	12

HARDNESS⁹

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁷

	Vickers hardness HV10	
	M	MIN
NHT	345	335
Heat-treated	305	295

SURFACE ROUGHNESS¹⁰

M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)⁷

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	10	14	61	88

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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.

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MDS_Ti6Al4V_2025-11.1_EN

CONTACT

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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 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. Population coverage: 99%, confidence level: 99%.

⁶ Tensile testing was performed in accordance to DIN EN ISO 6892-1:2020 (method A / method 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 50125:2022-08 D6x30 and DIN 50125:2022-08 C6x30). Samples labelled "Horizontal" correspond to a polar angle of $\theta = 90^\circ$; samples labelled "vertical" correspond to a polar angle of $\theta = 0^\circ$ (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. Population coverage: 95%, confidence level: 95%.

⁷ 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%.

⁸ Heat treatment: Annealing in vacuum at 800 °C +/- 14 °C for 2 h, cooling in air or furnace cooling.

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.

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¹⁰ Roughness measurement on vertical walls according to 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 Hot Isostatic Pressing (HIP) in an inert atmosphere (Ar) at a pressure of $105\text{MPa} \pm 5\text{MPa}$ and temperature of $920^\circ\text{C} \pm 10^\circ\text{C}$. A soaking time of 2 hours minimum, 2 hours +15 mins maximum), cool in the autoclave to 420°C or below and cool from 420°C at any rate. Anneal at $704 \pm 14^\circ\text{C}$ in a vacuum. Hold at temperature for 2 hours minimum, and cool under vacuum, or argon quenching to 420°C or below and cool from 420°C in air or argon till room temperature. Parts must not be exposed to air at a temperature above 420°C .