IN718

ASTM F3055 / ASTM B637 / AMS5664

MATERIAL DATA SHEET

Nikon SLM SOLUTIONS

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MATERIAL

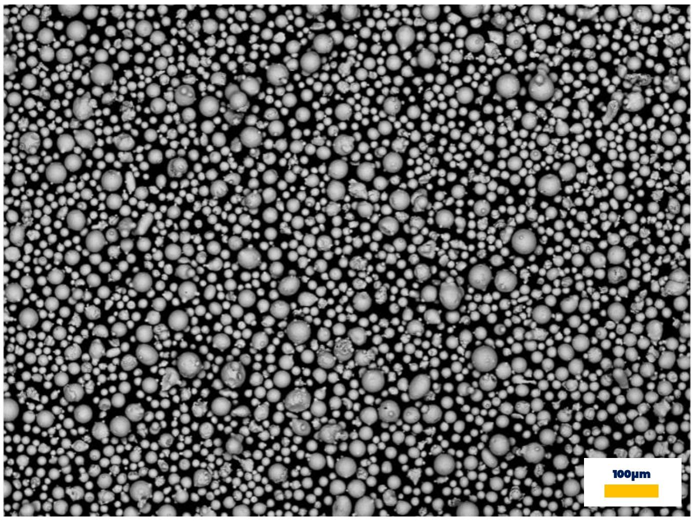
Nickel-based superalloys have been specifically designed to withstand extreme conditions in which other materials already fail. One of the most popular nickel-based superalloys is the precipitation-hardenable IN718. Whether it is static or dynamic loads, close to absolute zero or above 700 °C, corrosion, or creep – IN718 was made for this and brings a good weldability on top. This profile of properties makes IN718 an excellent choice for rocket and aircraft components, but also for stationary gas turbines or automotive exhaust systems.

CHEMICAL COMPOSITION

ASTM F3055 / ASTM B637 / AMS5664[1]															
	Fe	**Ni**	**Cr**	**Ta+Nb**	**Mo**	**Ti**	**Co**	**Al**	**Si**	**Mn**	**Cu**	**C**	**P**	**S**	**B**
Min.	Bal.	50.00	17.00	4.75	2.80	0.65		0.20							
Max.		55.00	21.00	5.50	3.30	1.15	1.00	0.80	0.35	0.35	0.30	0.08	0.015	0.015	0.006

POWDER PROPERTIES

Particle Size[1]	10 -45 µm
Mass Density[2]	≈ 8.2 g/cm³
Particle Shape[3]	Spherical



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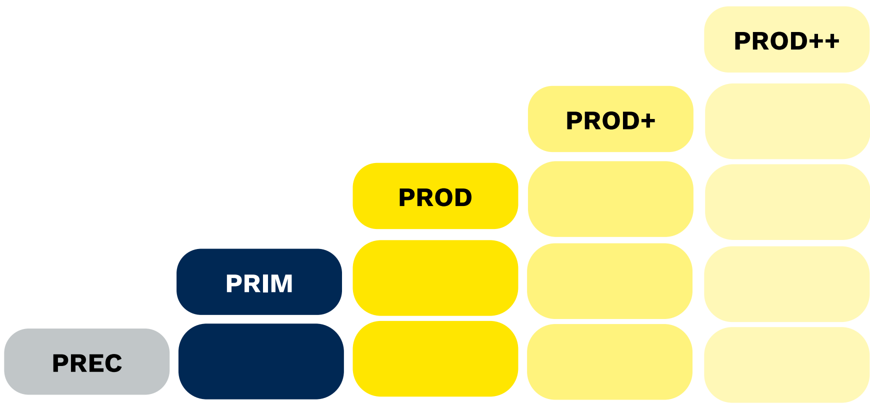
NIKON SLM® PARAMETERS

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	IN718_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]	23.3 cm³/h (Twin)
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

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**
Horizontal	1070	1055	785	775	28	26
Vertical	975	955	655	635	33	29

HARDNESS[8]

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

	Vickers hardness HV10	
	M	**MIN**
As built	300	285

SURFACE ROUGHNESS[9]

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	7	9	46	59

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SLM®280 PRIME

Parameter Set	IN718_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]	53.6 cm³/h (Twin)
Minimum Relative Density[5,7]	99.6 %

MECHANICAL PROPERTIES[6]

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
Horizontal	1010	980	690	640	29	27
Vertical	930	900	605	585	37	33

HARDNESS[8]

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

	Vickers hardness HV10	
	M	MIN
As built	280	275

SURFACE ROUGHNESS[9]

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	10	54	72

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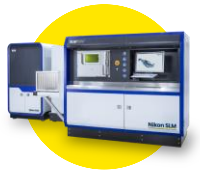

SLM®500 PRECISION

Parameter Set	IN718_SLM500_PREC_MBP3_V1 (30 µm)
Machine Compatibility	SLM®500 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	46.6 cm³/h (Quad)
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

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**
Horizontal	1055	1035	760	730	28	26
Vertical	975	955	660	630	34	30

HARDNESS[8]

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

	Vickers hardness HV10	
	M	**MIN**
As built	310	295

SURFACE ROUGHNESS[9]

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	5	8	31	52

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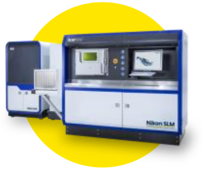

SLM®500 PRIME

Parameter Set	IN718_SLM500_PRIM_MBP3_V1 (60 µm)
Machine Compatibility	SLM®500 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	107.3 cm^3/h (Quad)
Minimum Relative Density[5,7]	99.7 %

MECHANICAL PROPERTIES[6]

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**
Horizontal	1010	990	700	670	30	26
Vertical	945	920	610	590	36	31

HARDNESS[8]

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

	Vickers hardness HV10	
	M	**MIN**
As built	280	265

SURFACE ROUGHNESS[9]

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	5	7	30	46

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NXG PRECISION

Parameter Set	IN718_NXG600_PREC_MBP3_V1 (30 µm)
Machine Compatibility	NXG XII 600, NXG 600E (1000 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	140 cm^3/h
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

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	970	945	655	635	32	26
Near-Net-Shape	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Vertical	940	910	620	575	34	29

HARDNESS[8]

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

	Vickers hardness HV10	
	M	**MIN**
As built	300	295

SURFACE ROUGHNESS[9]

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	5	8	36	54

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NXG PRIME

Parameter Set	IN718_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]	328.5 cm³/h
Minimum Relative Density[5,7]	99.7 %

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 [%]	
Machined	M	MIN	M	MIN	M	MIN
Vertical	930	890	585	555	35	26
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	915	890	580	545	34	28

Heat-treated (HIP + Solution Annealing + Aging)[10]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Vertical	1285	1270	985	955	24	17
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	1255	1215	985	945	21	11

HARDNESS[8]

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

	Vickers hardness HV10	
	M	MIN
As built	280	275
Heat-treated[10]	420	405

SURFACE ROUGHNESS[9]

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	7	11	45	69

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NXG PRODUCTIVITY

Parameter Set	IN718_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]	511.6 cm^3/h
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

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	930	895	570	550	30	18
Near-Net-Shape	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Vertical	895	885	550	520	25	20

HARDNESS[8]

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

	Vickers hardness HV10	
	M	**MIN**
As built	280	270

SURFACE ROUGHNESS[9]

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	14	47	80

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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_IN718_2024-06.1_EN

CONTACT

Headquarters

Nikon SLM Solutions AG
Estlandring 4
23560 Lübeck
Germany

Phone: +49 451 4060-3000

www.nikon-slm-solutions.com

NIKON-SLM-SOLUTIONS.COM

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 com-parable 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-D6x30 and DIN 50125:2022-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. 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] 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.

[9] 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.

[10] Hot isostatic pressing (HIP) acc. ASTM F3055-14 and ASTM F3301-18a:

Samples have been processed under argon atmosphere at 1000 -0/+50 bar at 1155 ± 10 °C (2111 ± 18 °F) for 180 min and cooled under inert atmosphere to below 425 °C (800 °F).

Solution annealing acc. ASTM F3055-14, ASTM F3301-18a and AMS2774 (Condition S1750DP):

Samples have been processed in vacuum at 954 ± 14 °C (1750 ± 25 °F) for 60 min with inert gas quench in nitrogen at a rate equivalent to or faster than air cooling. For guidance on soaking times, the holding time is commensurate to the section thickness acc. to AMS2774.

Aging acc. ASTM F3055-14, ASTM F3301-18a and AMS2774 (Condition S1750DP):

Samples have been processed in vacuum at 718 ± 8 °C (1325 ± 15 °F) for 8 hours followed by furnace cool to 621 ± 8 °C (1150 ± 15 °F) and additional soaking at 621 ± 8 °C (1150 ± 15 °F) for a total aging time of 18 hours with final inert gas quench in nitrogen at a rate equivalent to or faster than air cooling.