SLM SOLUTIONS

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

MATERIAL DATA SHEET

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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 B637[1]																			
	Fe	**Ni**	**Cr**	**Ta+Nb**	**Mo**	**Ti**	**Co**	**Al**	**Si**	**Mn**	**Cu**	**C**	**P**	**S**	**B**	**Nb**	**Pb**	**Bi**	**Se**
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

MATERIAL DATA SHEET

IN718

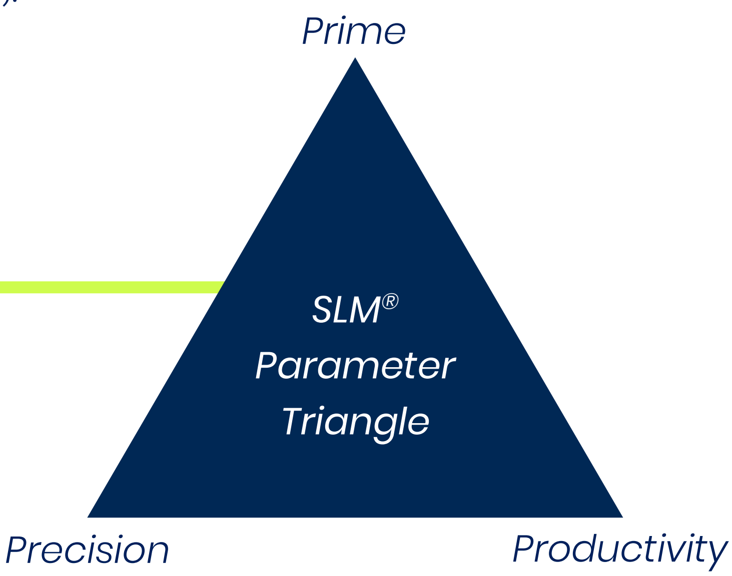
2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

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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IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

SLM SOLUTIONS

PRECISION SLM® 280

Parameter Set	IN718_SLM280_PREC_MBP3_V1.0 (30 µm)
Machine Compatibility	SLM® 280 2.0, SLM® 280 Production Series (400 W)
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	1065	1055	785	775	27	25
Vertical	975	950	655	635	32	28

Hardness[8]

M: Mean | MIN: Minimum (95 % PC / 95 % CL)[7]

	Vickers hardness HV10	
	M	MIN
As built	300	290

Surface Roughness[9]

M: Mean | MAX: Maximum (95 % PC / 95 % CL)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	6	11	32	59

MATERIAL DATA SHEET

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

SLM SOLUTIONS

PRIME SLM® 280

Parameter Set	IN718_SLM280_PRIM_MBP3_V1.0 (60 µm)
Machine Compatibility	SLM® 280 2.0, SLM® 280 Production Series (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	975	690	640	28	26
Vertical	930	895	600	580	36	31

Hardness[8]

M: Mean | MIN: Minimum (95 % PC / 95 % CL)[7]

	Vickers hardness HV10	
	M	MIN
As built	280	270

Surface Roughness[9]

M: Mean | MAX: Maximum (95 % PC / 95 % CL)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	9	11	55	73

MATERIAL DATA SHEET

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

SLM SOLUTIONS

PRECISION SLM® 500

Parameter Set	IN718_SLM500_PREC_MBP3_V1.0 (30 µm)
Machine Compatibility	SLM® 500 1.3 (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	1030	760	725	27	25
Vertical	970	955	660	630	33	29

Hardness[8]

M: Mean | MIN: Minimum (95 % PC / 95 % CL)[7]

	Vickers hardness HV10	
	M	MIN
As built	305	295

Surface Roughness[9]

M: Mean | MAX: Maximum (95 % PC / 95 % CL)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	6	8	31	47

MATERIAL DATA SHEET

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

PRIME SLM® 500

Parameter Set	IN718_SLM500_PRIM_MBP3_V1.0 (60 µm)
Machine Compatibility	SLM® 500 1.3 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	107.3 cm³/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	28	25
Vertical	940	915	610	590	35	30

Hardness[8]

M: Mean | MIN: Minimum (95 % PC / 95 % CL)[7]

	Vickers hardness HV10	
	M	MIN
As built	275	265

Surface Roughness[9]

M: Mean | MAX: Maximum (95 % PC / 95 % CL)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	6	9	32	48

MATERIAL DATA SHEET

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

SLM SOLUTIONS

PRECISION NXG XII 600

Parameter Set	IN718_NXG600_PREC_MBP3_V1.0 (30 µm)
Machine Compatibility	NXG XII 600
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	140.0 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
Horizontal	-	-	-	-	-	-
Vertical	970	940	655	630	31	25
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	940	910	620	575	34	29

Hardness[8]

M: Mean | MIN: Minimum (95 % PC / 95 % CL)[7]

	Vickers hardness HV10	
	M	MIN
As built	300	295

Surface Roughness[9]

M: Mean | MAX: Maximum (95 % PC / 95 % CL)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	6	9	37	55

MATERIAL DATA SHEET

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

SLM SOLUTIONS

PRIME NXG XII 600

Parameter Set	IN718_NXG600_PRIM_MBP3_V1.0 (60 µm)
Machine Compatibility	NXG XII 600
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[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	-	-	-	-	-	-
Vertical	930	890	585	550	34	26
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	915	890	580	545	34	28

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

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	-	-	-	-	-	-
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 % PC / 95 % CL)[7]

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

Surface Roughness[9]

M: Mean | MAX: Maximum (95 % PC / 95 % CL)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	8	12	46	70

MATERIAL DATA SHEET

IN718

2.4668 / ASTM B637 / AMS 2774 / ASTM F3055

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.

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

[6] Tensile testing was performed in accordance to DIN EN ISO 6892-1:2017 B and conducted at room temperature. Samples are machined before testing (geometry according to DIN 50125:2016-D6x30). 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 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 with a certain probability, e.g. the probability that 95 % of all samples will be above the stated minimum value (within a defined batch and tested according to mentioned specifications) is 95 %.

[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; $\lambda c = 2.5$ 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] HIP according to ASTM F3055 / ASTM F3301, followed by solution annealing + aging according to AMS 2774 (S1750DP).