SLM SOLUTIONS

H13

ASTM A681 / AMS 6408 / 1.2344

MATERIAL DATA SHEET

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MATERIAL

Hard, harder, H13. This hot working tool steel is the right choice for applications requiring very high wear resistance, especially against abrasive wear, such as die casting molds or shear knives. A heat treatment is not mandatory, as the SLM® process transforms H13 powder into fully functional, crack-free parts already. If additional ductility or hardness is required, a simple heat treatment can be performed. Looking for the ultimate hardness? After nitriding, a surface hardness of up to 72 HRC can be achieved.

CHEMICAL COMPOSITION

ASTM A681[1]									
	Fe	**Cr**	**Mo**	**Si**	**V**	**Mn**	**C**	**P**	**S**
Min.	Bal.	4.75	1.10	0.80	0.80	0.20	0.32		
Max.		5.50	1.75	1.25	1.20	0.60	0.45	0.03	0.03

POWDER PROPERTIES

Particle Size[1]	10 - 45 µm
Mass Density[2]	≈ 8.0 g/cm³
Particle Shape[3]	Spherical

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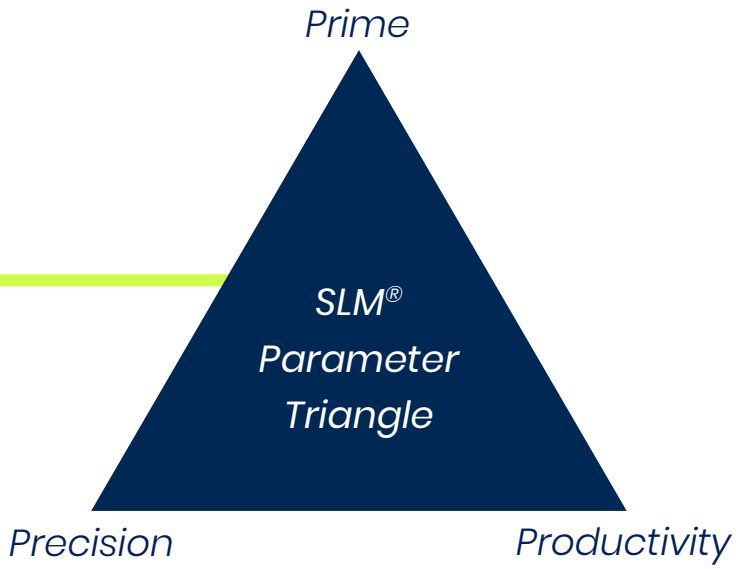
SLM® PARAMETERS

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 SLM® 280

Parameter Set	H13_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]	20.6 cm^3/h (Twin)
Minimum Relative Density[5,7]	99.8 %

Mechanical Properties[6]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

Non-heat-treated (NHT)

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1910	1720	1080	920	6	0
Vertical	1920	1670	990	780	6	1

Heat-treated (HARD)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1885	1785	1530	1400	9	4
Vertical	1890	1805	1540	1445	6	1

Hardness[9]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

	Vickers hardness HV10	
	M	**MIN**
NHT	570	540
HARD[8]	560	540

Surface Roughness[10]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	**MAX**	**M**	**MAX**
As built	6	12	40	85
Glass Blasting	4	9	30	65

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PRIME SLM® 280

Parameter Set	H13_SLM280_PRIM_MBP3_V1.0 (50 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]	32.8 cm^3/h (Twin)
Minimum Relative Density[5,7]	99.8 %

Mechanical Properties[6]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

Non-heat-treated (NHT)

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1875	1625	1030	825	5	0
Vertical	1890	1675	1030	790	5	1

Heat-treated (HARD)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1920	1690	1600	1415	10	6
Vertical	1955	1725	1610	1440	6	2

Hardness[9]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

	Vickers hardness HV10	
	M	**MIN**
NHT	560	505
HARD[8]	545	530

Surface Roughness[10]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	**MAX**	**M**	**MAX**
As built	6	8	35	50

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PRODUCTIVITY SLM® 280

Parameter Set	H13_SLM280_PROD_MBP3_V1.0 (90 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]	65.6 cm^3/h (Twin)
Minimum Relative Density[5,7]	99.7 %

Mechanical Properties[6]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

Non-heat-treated (NHT)

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1695	1355	925	725	3	0
Vertical	1610	1125	1085	785	2	0

Heat-treated (HARD)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1840	1750	1500	1415	9	5
Vertical	1815	1725	1495	1430	6	0

Hardness[9]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

	Vickers hardness HV10	
	M	**MIN**
NHT	550	535
HARD[8]	570	550

Surface Roughness[10]

M: Mean | MIN: Minimum (90 % population coverage / 90 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	**MAX**	**M**	**MAX**
As built	7	11	47	70
Glass Blasting	6	10	40	60

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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.

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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, ration 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 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. 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] Heat treatment: Hardening for 45 min at 1040 °C, followed by gas quenching, hold for 4 h at 550 °C and air-cooling.

[9] 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.

[10] 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.