SLM
SOLUTIONS

15–5PH

ASTM A564 / 1.4545

MATERIAL DATA SHEET

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MATERIAL

15-5PH stainless steel is based on the chemistry of 17-4PH, but with slight modifications leading to minimal contents of delta ferrite leading to improved toughness and ductility. It is hardenable and withstands temperatures above 300 °C, while still offering a good corrosion resistance. 15-5PH covers a wide range of applications: it is suitable for high-pressure applications such as pumps, valves, and hydraulic drives all the way to structural components in aerospace.

CHEMICAL COMPOSITION

ASTM A564[1]										
	Fe	Cr	Ni	Cu	Mn	Si	Nb	C	P	S
Min.	Bal.	14.00	3.50	2.50			0.15			
Max.		15.50	5.50	4.50	1.00	1.00	0.45	0.07	0.04	0.03

POWDER PROPERTIES

Particle Size[1]	10 - 45 µm
Mass Density[2]	≈ 7.8 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**).

Prime

*SLM®
Parameter
Triangle*

Precision   *Productivity*
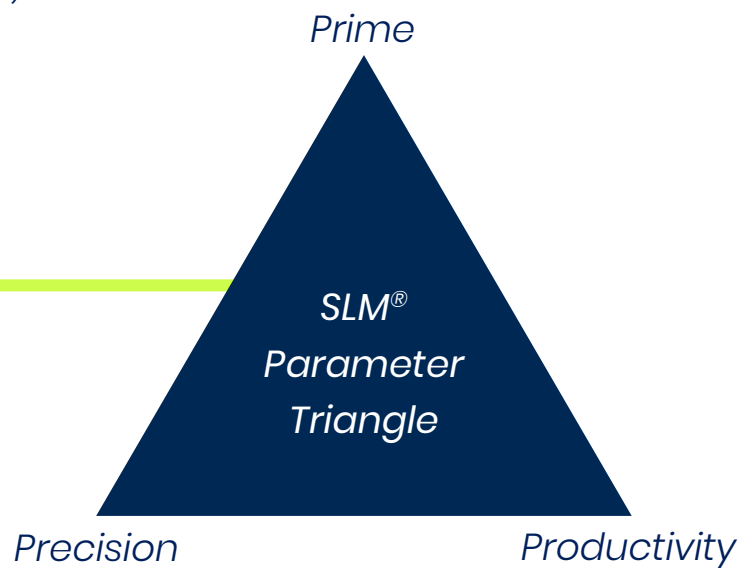
MATERIAL QUALIFICATION

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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S O L U T I O N S

PRECISION

Parameter Set	15-5PH_PREC_MBP3_V1.0 (30 µm, 400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical Build Rate[4]	10.4 cm³/h
Minimum Relative Density[5]	99.8 %

Mechanical Properties[6]

M: Mean | SD: Standard deviation

Non-heat-treated (NHT)

Machined	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
	M	SD	M	SD	M	SD
Horizontal	1235	10	830	20	17	1
Vertical	1215	20	875	25	14	1

Heat-treated (SOL+AGE)[7]

Machined	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
	M	SD	M	SD	M	SD
Horizontal	1430	15	1245	30	14	1
Vertical	1430	20	1285	15	12	1

Hardness[8]

M: Mean | SD: Standard Deviation

	Vickers hardness HV10	
	M	SD
NHT	373	3
SOL+AGE[7]	459	6

Surface Roughness[9]

M: Mean | SD: Standard Deviation

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	SD	M	SD
As built	10	2	62	11

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PRIME

Parameter Set	15-5PH_PRIM_MBP3_V1.0 (50 μm, 400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical Build Rate[4]	15.3 cm³/h
Minimum Relative Density[5]	99.6 %

Mechanical Properties[6]

M: Mean | SD: Standard deviation

Non-heat-treated (NHT)

Machined	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
	M	SD	M	SD	M	SD
Horizontal	1260	10	845	25	17	1
Vertical	1200	20	1000	25	11	1

Heat-treated (SOL+AGE)[7]

Machined	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
	M	SD	M	SD	M	SD
Horizontal	1450	40	1285	30	12	1
Vertical	1485	5	1320	5	11	3

Hardness[8]

M: Mean | SD: Standard Deviation

	Vickers hardness HV10	
	M	SD
NHT	364	4
SOL+AGE[7]	452	2

Surface Roughness[9]

M: Mean | SD: Standard Deviation

	Roughness average Ra [μm]		Mean roughness depth Rz [μm]	
	M	SD	M	SD
As built	12	5	65	26

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PRODUCTIVITY

Parameter Set	15-5PH_PROD_MBP3_V1.0 (60 µm, 400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical Build Rate[4]	24.6 cm³/h
Minimum Relative Density[5]	99.3 %

Mechanical Properties[6]

M: Mean | SD: Standard deviation

Non-heat-treated (NHT)

Machined	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
	M	SD	M	SD	M	SD
Horizontal	1245	15	780	45	14	1
Vertical	1200	5	885	20	13	2

Heat-treated (SOL+AGE)[7]

Machined	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
	M	SD	M	SD	M	SD
Horizontal	1450	15	1290	25	8	3
Vertical	1465	10	1315	10	10	3

Hardness[8]

M: Mean | SD: Standard Deviation

	Vickers hardness HV10	
	M	SD
NHT	318	43
SOL+AGE[7]	452	2

Surface Roughness[9]

M: Mean | SD: Standard Deviation

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	SD	M	SD
As built	26	6	157	41

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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 build rate = layer thickness x scan speed x hatch distance. 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.

[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.

[7] Heat treatment: Solution annealing for 1 h at 1050 °C, followed by air-cooling. Then aging for 1 h at 450 °C, followed by air-cooling.

[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; λc = 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.