Material Data Sheet

Stainless Steel 15-5PH / 1.4545 / A564[1]

General

15-5PH is a stainless, martensitic, and hardenable Cr-Ni-Cu Steel with high strength and ductility as well as good weldability and forgeability. Typical fields of application are in medical, automotive, and aerospace areas. Through solution annealing and subsequent ageing, an increase in strength occurs. 15-5PH is applicable in a temperature range from -200 °C to 300 °C.

Material Structure

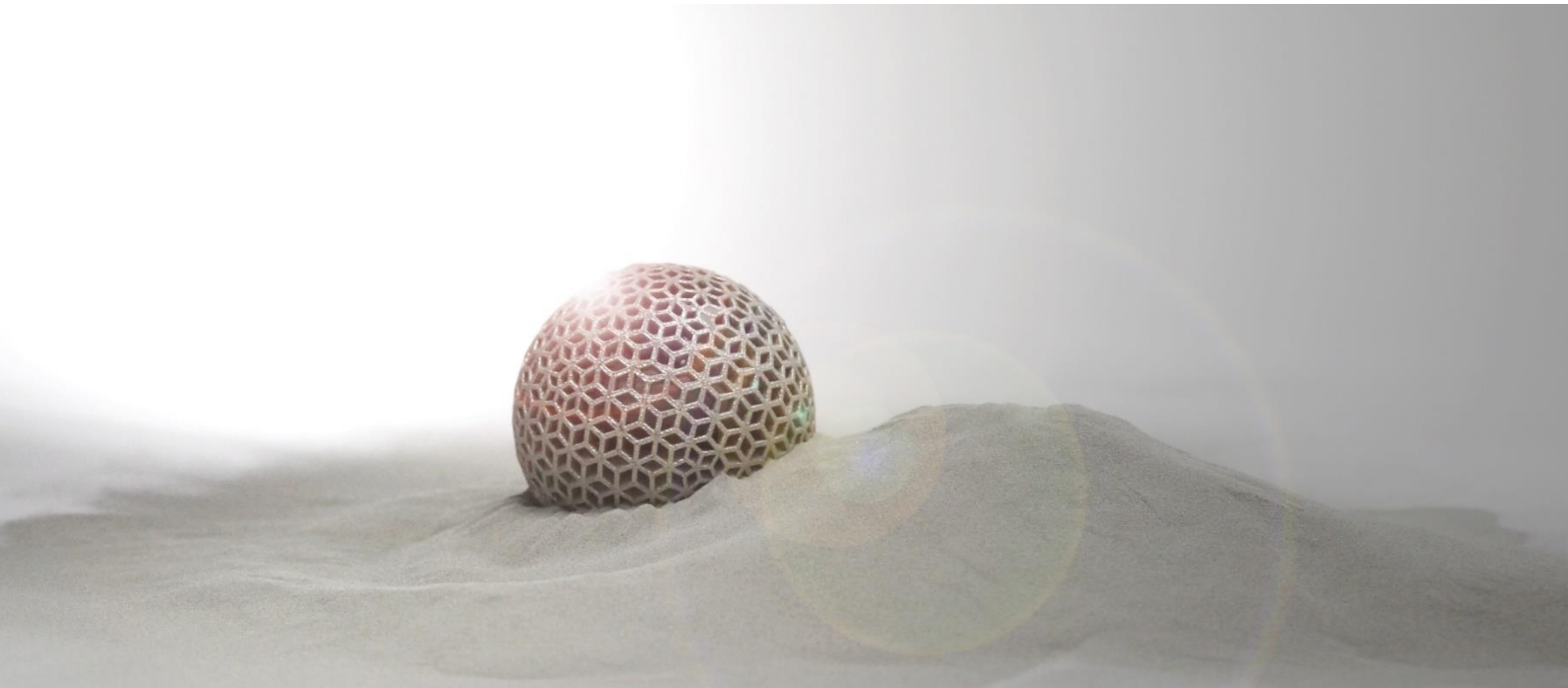
SLM®-processed components out of 15-5PH exhibit a homogeneous, nearly non-porous texture, with mechanical characteristic values in the range of material speci cations. Through subsequent post processing such as heat treatment (e.g. precipitation hardening), the components' properties can be adapted to meet specific requirements.

Chemical composition [Mass fraction in %][8]

Fe	Cr	Ni	Cu	Nb + Ta	Mn	Si	P	S	C	N	O
Balance	14.50 – 15.50	3.50 – 5.50	2.50 – 4.50	0.15 – 0.45	1.00	1.00	0.04	0.03	0.07	0.10	0.10

Powder properties

Particle size[8]	10 – 45 µm	Particle shape[9]	Spherical
Mass density[2]	7.8 g/cm³	Thermal conductivity	11 W/(m·K)



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Layer thickness 30 µm[3]	As-built	Heat-treated [13]

Build-up rate [7]	[cm³/h]	10.4 cm³/h
Component density[6]	[%]	> 99.5 %

Tensile test[10]			M	SD	M	SD
Tensile strength	R_m [MPa]	H	1237	6	1426	15
		V	1206	66	1426	17
Offset yield strength	$R_{p0,2}$ [MPa]	H	831	18	1244	58
		V	873	47	1289	13
Elongation at break	A [%]	H	17	1	14	1
		V	14	1	12	1
Reduction of area	Z [%]	H	57	2	37	1
		V	51	7	46	3
Young's modulus	E [GPa]	H	174	8	199	31
		V	182	15	188	7

Hardness test[11]		M	SD	M	SD
Vickers hardness	HV10	373	3	459	6

Roughness measurement[12]		As-built	
		M	SD
Roughness average	Ra [µm]	10	2
Mean roughness depth	Rz [µm]	62	11

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Layer thickness 50 µm[4]	As-built	Heat-treated [13]
Build-up rate [7]	[cm³/h]	15.3 cm³/h
Component density[6]	[%]	> 99.5 %

Tensile test[10]				M	SD	M	SD
Tensile strength	R_m	[MPa]	H	1263	7	1412	87
			V	1202	18	1485	4
Offset yield strength	$R_{p0,2}$	[MPa]	H	845	22	1281	43
			V	1003	21	1322	5
Elongation at break	A	[%]	H	17	1	12	1
			V	11	1	11	3
Reduction of area	Z	[%]	H	59	4	39	4
			V	41	18	37	13
Young's modulus	E	[GPa]	H	173	13	191	28
			V	191	9	209	9

Hardness test[11]		M	SD	M	SD
Vickers hardness	HV10	367	4	-	-

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

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Layer thickness 60 µm[5]		As-built	Heat-treated [13]
Build-up rate [7]	[cm³/h]	24.6 cm³/h	
Component density[6]	[%]	> 99.5 %	

Tensile test[10]			M	SD	M	SD
Tensile strength	R_m [MPa]	H	1247	12	1451	14
		V	1205	4	1466	6
Offset yield strength	$R_{p0,2}$ [MPa]	H	778	42	1290	22
		V	870	61	1315	10
Elongation at break	A [%]	H	14	1	8	3
		V	13	1	10	2
Reduction of area	Z [%]	H	37	1	19	12
		V	51	7	36	5
Young's modulus	E [GPa]	H	181	23	192	13
		V	182	19	195	6

Hardness test[11]		M	SD	M	SD
Vickers hardness	HV10	318	43	452	2

Roughness measurement[12]		As-built	
		M	SD
Roughness average	Ra [µm]	26	6
Mean roughness depth	Rz [µm]	157	41

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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.

[1] Material according to ASTM A564.

[2] Material density varies within the range of possible chemical composition variations.

[3] Material data file: 15-5PH_SLM_MBP3.0_30_CE2_400W_Stripes_V1.2

[4] Material data file: 15-5PH_SLM_MBP3.0_50_CE2_400W_Stripes_V1.2

[5] Material data file: 15-5PH_SLM_MBP3.0_60_CE2_400W_Stripes_V1.0

[6] Optical density determination by light microscopy.

[7] Theoretical build-up rate for each laser = layer thickness x scan speed x track distance.

[8] With respect to powder material.

[9] According to DIN EN ISO 3252:2001.

[10] Tensile test according to DIN EN ISO 6892-1:2017 B (DIN 50125:2016 – B6x30); orientation: 0°, 90°; testing machine: Zwick 1484; load range: 200 kN; testing speed: 0,008 1/s; testing temperature: room temperature; test laboratory: EWIS GmbH. Test samples were turned before tensile test.

[11] Hardness testing according to DIN EN ISO 6507-1:2018.

[12] Roughness measurement according to DIN EN ISO 4288:1998; λc = 0,8 mm.

[13] Heat Treatment: 1) Solution annealing: 1050 °C, 1 h; air quenching 2) Ageing: 450 °C, 1 h; air quenching.

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