Material Data Sheet

Fe-Alloy 316L (1.4404)[1]

General

Components made of tool or stainless steels are known for great hardness with a high ductility. Through selective application of alloying elements, material properties can be precisely adjusted. This means that even corrosion-resistant steel alloys like 316L (1.4404) can be processed using SLM®. Applications for corrosion-resistant alloys are found in medical technologies, the automotive industry as well as in aerospace engineering. Tool steel is mainly used to produce tools and molds. Its layered structure enables components to be fitted with integrated cooling channels. The good mechanical characteristic values of stainless steel make it suitable for use in places that are exposed to heavy strain, because its high resistance to wear keeps abrasion to a minimum. Steel can also be used at high operating temperatures, which reduces the amount of wear on tools.

Material Structure

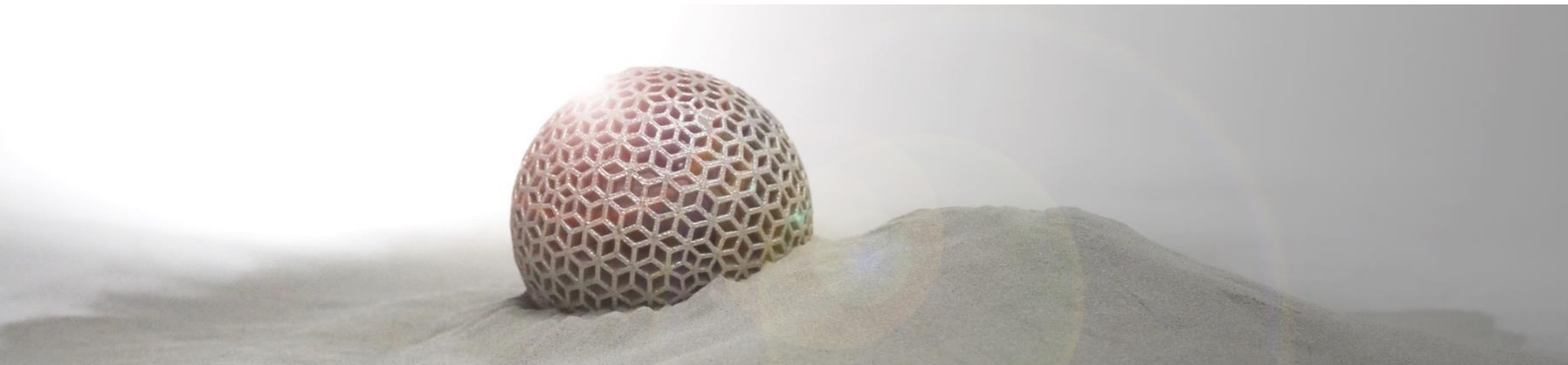
SLM®-processed stainless steel components exhibit a homogeneous, nearly non-porous texture, with mechanical characteristic values in the range of material specifications. Through subsequent processing such as heat treatment (e.g. solution annealing), the components' properties can be adapted to meet specific requirements.

Chemical composition [Mass fraction in %][8]

Fe	Cr	Ni	Mo	Nb + Ta	Mn	Si	P	S	C	N	O
Balance	16.00-18.00	10.00-14.00	2.00-3.00	\	2.00	1.00	0.045	0.030	0.030	0.10	\

Pulvereigenschaften

Particle size[8]	10-45 µm	Particle shape[9]	Spherical
Mass density[2]	≈ 7.9 g/cm³	Thermal conductivity	15 W/(m·K)



Fe-Alloy 316L (1.4404)[1]

30 µm / 400 W[3]				As-built	
Build-up rate [7]		[%]		10.4 cm³/h	
Component density[6]		[%]		≥ 99.5 %	

Tensile test[10]				M	SD
Tensile strength	R_m	[MPa]	H	692	4
			V	618	2
Offset yield strength	$R_{p0,2}$	[MPa]	H	591	16
			V	541	2
Elongation at break	A	[%]	H	39	1
			V	45	1
Reduction of area	Z	[%]	H	66	2
			V	72	2
Young's modulus	E	[GPa]	H	239	51
			V	178	9

Hardness test[11]		M	SD
Vickers hardness	HV10	221	4

Roughness measurement[12]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	8	2	6	2	5	1
Mean roughness depth	Rz	[µm]	68	10	40	6	30	5

Fe-Alloy 316L (1.4404)[1]

50 µm / 400 W[4]		As-built
Build-up rate[7]	[%]	15.3 cm³/h
Component Density [6]	[%]	≥ 99.5 %

Tensile test[10]				M	SD
Tensile strength	R_m	[MPa]	H	651	5
			V	640	8
Offset yield strength	$R_{p0,2}$	[MPa]	H	546	8
			V	529	14
Elongation at break	A	[%]	H	41	1
			V	43	1
Reduction of area	Z	[%]	H	70	2
			V	69	2
Young's modulus	E	[GPa]	H	181	29
			V	178	22

Hardness test[11]		M	SD
Vickers hardness	HV10	211	4

Roughness measurement[12]			As-built		Corundum blasted		Corundum- and Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	9	3	7	2	6	2
Mean roughness depth	Rz	[µm]	71	13	54	11	44	7

Fe-Alloy 316L (1.4404)[1]

60 µm / 400 W[5]		As-built
Build-up rate[7]	[%]	24.6 cm³/h
Component Density [6]	[%]	≥ 99.5 %

Tensile test[10]				M	SD
Tensile strength	R_m	[MPa]	H	674	5
			V	616	4
Offset yield strength	$R_{p0,2}$	[MPa]	H	556	12
			V	498	3
Elongation at break	A	[%]	H	40	1
			V	44	5
Reduction of area	Z	[%]	H	65	3
			V	66	7
Young's modulus	E	[GPa]	H	187	54
			V	173	12

Hardness test[11]		M	SD
Vickers hardness	HV10	214	5

Roughness measurement[12]			As-built		Corundum blasted		Corundum- and Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	12	5	10	3	9	2
Mean roughness depth	Rz	[µm]	83	18	63	7	57	6

Fe-Alloy 316L (1.4404)[1]

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 DIN EN 10088:2014, ASTM A276.

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

[3] Material data file: 316L_SLM_MBP3.0_30_CE2_400W_Stripes_V3.0

[4] Material data file: 316L_SLM_MBP3.0_50_CE2_400W_Stripes_V3.0

[5] Material data file: 316L_SLM_MBP3.0_60_CE2_400W_Stripes_V3.0

[6] Optical density determination at test specimens 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 – D6x30); testing machine: ZwickRoell ProLine; load range: 100 kN; testing speed: 0,008 1/s; testing temperature: room temperature. 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 = 2,5 mm. Glass-bead blasting is an additional post-processing step after corundum blasting.

SLM® is a registered trademark by SLM Solutions Group AG, Germany.