Material Data Sheet

Tool Steel 1.2709 / A646 / M300[1]

General

Tool steels such as 1.2709 are primarily used for manufacturing tools and molds. They are characterized by a high hardness combined with a high ductility. Their specific mechanical properties allow usage in high-stressed components due to its high wear resistance. The maximum operating temperatures can further reduce wear. An SLM®-specific bene t is the layerwise manufacturing, which allows to implement cooling channels into the component.

Material Structure

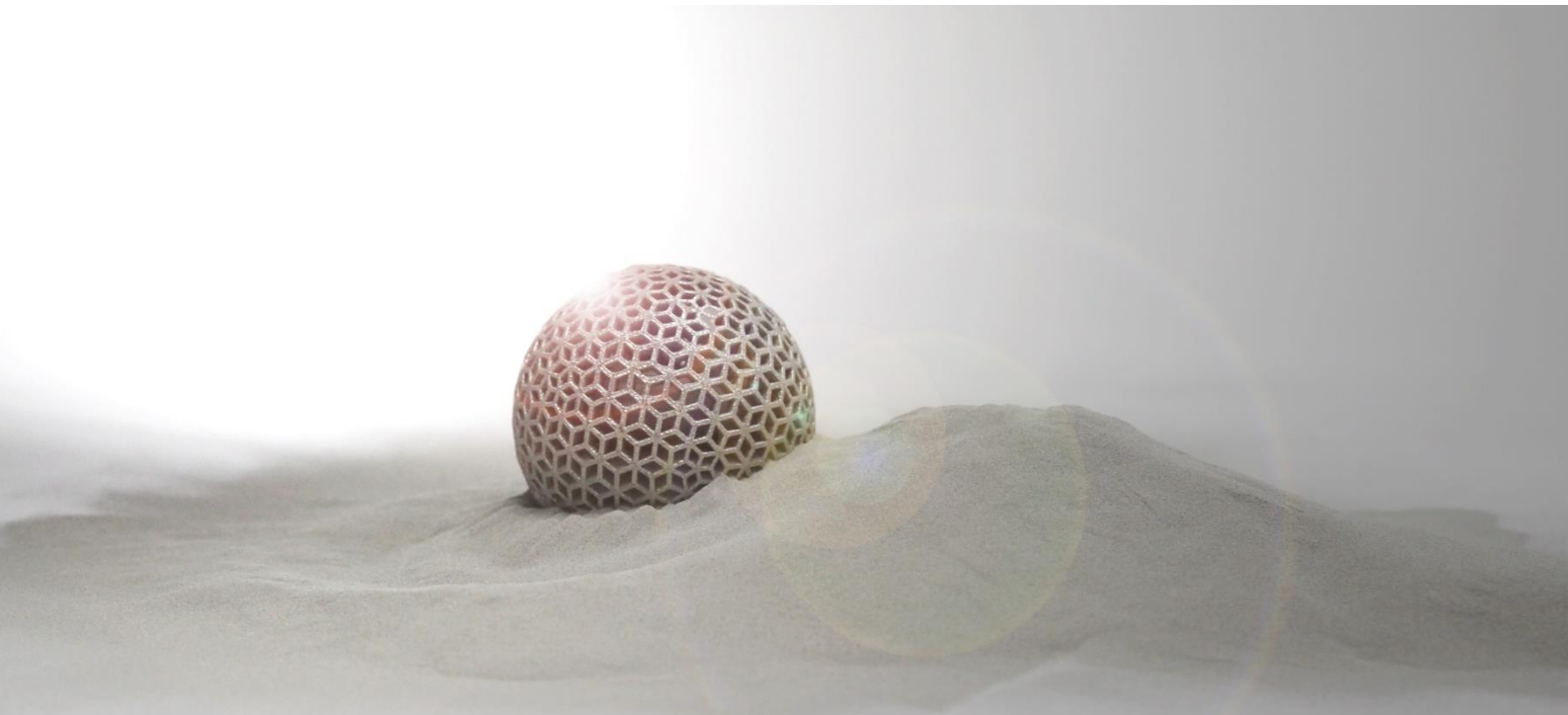
SLM®processed tool steel components exhibit a homogeneous, nearly non-porous texture, with mechanical characteristic values in the range of material specifications. Through subsequent processing such as heat treatment (e.g. precipitation hardening, soft annealing), the components' properties can be adapted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

Chemical composition [Mass fraction in %][8]

Fe	Ni	Co	Mo	Ti	Al	Mn	Si	P	S	C	O
Balance	18.00 – 19.00	8.50 – 9.50	4.70 – 5.20	0.50 – 0.80	0.05 – 0.15	0.10	0.10	0.01	0.01	0.03	/

Powder properties

Particle size[8]	10 – 45 µm	Particle shape[9]	Spherical
Mass density[2]	8.0 g/cm³	Thermal conductivity	14.2 W/(m·K)



Tool Steel 1.2709 / A646 / M300[1]

Layer thickness 30 µm[3]	As-built	Heat-treated[13]
Build-up rate[7] [cm³/h]	10.0 cm³/h	
Component density [6] [%]	≈ 99.5 %	

Tensile Test[10]			M	SD	M	SD
Tensile strength	R_m [MPa]	0°	1190	20	2038	20
		45°	1184	27	2107	20
		90°	1213	20	2111	20
Offset yield strength	$R_{p0,2}$ [MPa]	0°	999	8	1962	8
		45°	967	41	2023	15
		90°	1076	15	1937	17
Elongation at break	A [%]	0°	14	5	8	2
		45°	12	5	4	2
		90°	10	2	4	2
Reduction of area	Z [%]	0°	60	3	31	5
		45°	56	1	12	0
		90°	49	3	19	5
Young's modulus	E [GPa]	0°	168	4	192	4
		45°	173	6	201	14
		90°	181	2	203	4

Hardness Test[11]		M	SD	M	SD
Vickers hardness	HV10	654	8	608	5

Roughness measurement[12]			As-built		Corundum blasted	
			M	SD	M	SD
Roughness average	Ra	[µm]	7	1	6	2
Mean roughness depth	Rz	[µm]	45	5	41	4

Tool Steel 1.2709 / A646 / M300[1]

Layer thickness 50 µm[4]		As-built	Heat-treated[13]
Build-up rate[7]	[cm³/h]	10.0 cm³/h	
Component density [6]	[%]	≈ 99.5 %	

Tensile Test[10]			M	SD	M	SD
Tensile strength	R_m [MPa]	0°	1174	20	1940	34
		45°	1128	42	2040	14
		90°	1175	24	2021	28
Offset yield strength	$R_{p0,2}$ [MPa]	0°	965	25	1789	35
		45°	890	45	1971	14
		90°	970	32	1978	23
Elongation at break	A [%]	0°	14	5	6	2
		45°	10	2	5	2
		90°	12	2	5	2
Reduction of area	Z [%]	0°	55	11	28	4
		45°	56	2	8	1
		90°	57	5	22	7
Young's modulus	E [GPa]	0°	170	8	198	40
		45°	187	11	199	5
		90°	182	6	199	2

Hardness Test[11]		M	SD	M	SD
Vickers hardness	HV10	342	22	575	10

Roughness measurement[12]			As-built		Corundum blasted	
			M	SD	M	SD
Roughness average	Ra	[µm]	9	1	-	-
Mean roughness depth	Rz	[µm]	67	5	-	-

Tool Steel 1.2709 / A646 / M300[1]

Layer thickness 60 µm[5]		As-built	Heat-treated[13]
Build-up rate[7]	[cm³/h]	10.0 cm³/h	
Component density [6]	[%]	≈ 99.5 %	

Tensile Test[10]			M	SD	M	SD
Tensile strength	R_m [MPa]	0°	1168	20	1975	20
		45°	1073	29	2018	21
		90°	1091	36	1921	20
Offset yield strength	$R_{p0,2}$ [MPa]	0°	931	25	1894	2
		45°	896	59	1944	30
		90°	943	53	1921	17
Elongation at break	A [%]	0°	13	5	6	2
		45°	11	5	6	2
		90°	11	5	4	2
Reduction of area	Z [%]	0°	49	7	22	1
		45°	47	4	20	5
		90°	44	11	13	8
Young's modulus	E [GPa]	0°	172	11	190	9
		45°	167	13	186	10
		90°	167	10	185	8

Hardness Test[11]		M	SD	M	SD
Vickers hardness	HV10	-	-	552	6

Roughness measurement[12]			As-built		Corundum blasted	
			M	SD	M	SD
Roughness average	Ra	[µm]	10	2	5	2
Mean roughness depth	Rz	[µm]	61	10	35	11

Material Data Sheet

Tool Steel 1.2709 / A646 / M300[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 ASTM A646 Grade Marage 300.

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

[3] Material data file: 1.2709_SLM_MBP3.0_30_CE2_400W_Stripes_V1.2

[4] Material data file: 1.2709_SLM_MBP3.0_50_CE2_400W_Stripes_V1.3

[5] Material data file: 1.2709_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 ISO 6892-1:2017 B (DIN 50125:2016 – D6x30); testing machine: Zwick Z100; 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 = 0,8 mm.

(13) Heat treatment: aging 500 °C, 6 h; air-cooling.

SLM Solutions Group AG | Estlandring 4 | 23560 Lübeck | Germany
+49 451 4060 - 3000 | info@slm-solutions.com | slm-solutions.com

SLM Solutions Group AG | 191217-12709