

Al-Alloy AlSi10Mg^[1]

General

AlSi10Mg is a hardenable aluminum-based alloy with a density of circa 2.67 g/cm³ [2]. It is applicable for thin-walled components and parts with complex geometries. AlSi10Mg is highly suitable for processing and characterized by a good resistance in corrosive atmospheres as well as a high electrical conductivity. The combination of achievable high strengths while maintaining dynamic load capacity enable it to be used for highly stressed parts. With this profile of properties, AlSi10Mg is currently the most common aluminum-based alloy. Components made of AlSi10Mg are ideal to use in areas such as aerospace engineering and the automotive industry.

Material Structure

SLM[®] processed aluminum-based alloy 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, the components' properties can be adapted to meet specific requirements. Due to high solidification rates, a typical heat treatment of aluminum alloys (T6) is not necessary for SLM[®] parts. Therefore, only a stress relief heat treatment at 300 °C for 2 h is recommended after the SLM[®] process.

Chemical composition [Mass fraction in %]^[8]

Al	Si	Fe	Cu	Mn	Mg	Zn	Ti	Ni	Pb	Sn	Other total
Balance	9.00 – 11.00	0.55	0.05	0.45	0.20 – 0.45	0.10	0.15	0.05	0.05	0.05	0.15

Pulvereigenschaften

Particle size ^[8]	20 – 63 µm	Particle shape ^[9]	Sphärisch
Mass density ^[2]	≈ 2.67 g/cm ³	Thermal conductivity ^[6]	130 – 150 W/(m·K)



Al-Alloy AlSi10Mg^[1]

30 μm / 400 W ^[3]		As-built	Heat-treated ^[13]
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Build-up rate ^[10]	[cm ³ /h]	24.5 cm ³ /h	
Component density ^[11]	[%]	≥ 99.5 %	

Tensile test ^[12]			M	SD	M	SD
Tensile strength	R _m [MPa]	H	454	5	276	16
		V	474	5	280	14
Offset yield strength	R _{p0.2} [MPa]	H	297	7	166	12
		V	271	7	158	7
Elongation at break	A [%]	H	8	1	19	3
		V	6	1	17	2
Reduction of area	Z [%]	H	9	1	36	4
		V	7	2	31	3
Young's modulus	E [GPa]	H	73	4	62	16
		V	74	2	66	7

Hardness test ^[13]		M	SD	M	SD
Vickers hardness	HV5	124	7	82	1

Roughness measurement ^[17]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	R _a [μm]		8	2	5	1	4	1
Mean roughness depth	R _z [μm]		55	13	34	6	26	4

Al-Alloy AlSi10Mg^[1]

60 µm / 400 W ^[4]		As-built	Heat-treated ^[13]
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Build-up rate ^[10]	[cm ³ /h]	35.6 cm ³ /h	
Component density ^[11]	[%]	≥ 99.0 %	

Tensile test ^[12]			M	SD	M	SD
Tensile strength	R _m [MPa]	H	443	6	264	5
		V	432	28	273	5
Offset yield strength	R _{p0,2} [MPa]	H	277	7	151	8
		V	259	5	154	6
Elongation at break	A [%]	H	8	1	19	3
		V	5	1	14	3
Reduction of area	Z [%]	H	7	2	30	5
		V	4	1	19	6
Young's modulus	E [GPa]	H	72	5	57	14
		V	71	3	58	14

Hardness test ^[13]		M	SD	M	SD
Vickers hardness	HV5	127	4	80	1

Roughness measurement ^[17]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	R _a [µm]		13	2	8	1	5	1
Mean roughness depth	R _z [µm]		80	13	49	7	30	4

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60 µm / 700 W ^[5]		As-built	Heat-treated ^[13]
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Build-up rate ^[10]	[cm ³ /h]	67.9 cm ³ /h	
Component density ^[11]	[%]	≥ 99.0 %	

Tensile test ^[12]			M	SD	M	SD
Tensile strength	R _m [MPa]	H	421	4	261	12
		V	424	10	270	11
Offset yield strength	R _{p0,2} [MPa]	H	251	6	141	13
		V	235	5	142	10
Elongation at break	A [%]	H	8	1	16	3
		V	6	1	13	2
Reduction of area	Z [%]	H	7	1	20	3
		V	6	1	17	3
Young's modulus	E [GPa]	H	72	5	59	14
		V	72	3	57	8

Hardness test ^[13]		M	SD	M	SD
Vickers hardness	HV5	123	7	76	1

Roughness measurement ^[17]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra [µm]		16	4	9	3	7	1
Mean roughness depth	Rz [µm]		96	22	52	18	41	7

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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.

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- ^[1] Material according to DIN EN 1706:2013, EN AC-43000, EN AC-AlSi10Mg(a).
- ^[2] Material density varies by $\pm 0,01$ g/cm³ within the range of possible chemical composition variations.
- ^[3] Material data file: AlSi10Mg_SLM_MBP3.0_30_CE2_400W_Stripes_V1.2
- ^[4] Material data file: AlSi10Mg_SLM_MBP3.0_60_CE2_400W_Stripes_V1.3
- ^[5] Material data file: AlSi10Mg_SLM_MBP3.0_60_CE2_700W_Stripes_V1.3
- ^[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; $\lambda_c = 2,5$ mm. Glass-bead blasting is an additional post-processing step after corundum blasting.
- ^[13] Heat treatment: 2 h at 300 °C, air quenching.

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