LaserForm® AlSi7Mg0.6 (A)

AlSi7Mg0.6 fine-tuned for use with ProX® DMP 320 and DMP 350 metal printers to produce industrial parts with a combination of good mechanical properties and improved thermal conductivity.

LaserForm AlSi7Mg0.6 (A) is formulated and fine-tuned specifically for 3D Systems DMP 320 and DMP 350 series metal 3D printers to deliver high part quality and consistent part properties. The print parameter database that 3D Systems provides together with the material has been extensively developed, tested and optimized in 3D Systems' part production facilities that hold the unique expertise of printing 500,000 challenging metal production parts in various materials year over year. And for 24/7 production 3D Systems' thorough Supplier Quality Management System guarantees consistent, monitored material quality for reliable results.

Material Description

AlSi7Mg0.6 combines silicon and magnesium as alloying elements, which results in good mechanical properties. Due to the very rapid melting and solidification during Direct Metal Printing, LaserForm AlSi7Mg0.6 (A) in as-printed condition shows a fine microstructure and obtains a good combination of strenght and ductility. Lower silicon content improves electrical and thermal conductivity properties compared to AlSi10Mg while the increased magnesium content maintains mechanical properties similar to AlSi10Mg. Heat treatment allows electrical and thermal conductivity to be fine-tuned to the needs of the application. Additionally, the lower silicon content improves the anodization quality as well as the corrosion resistance.

LaserForm AlSi7Mg0.6 (A)'s low material density is well suited for the aerospace and automotive industry. Innovative applications such as mold design and specific heat exchanger applications make use of the high thermal conductivity of this alloy.

Mechanical Properties[1,2,3]

MEASUREMENT	CONDITION	METRIC			U.S.		
		AS-BUILT	AFTER STRESS RELIEF	DIRECT AGEING	AS-BUILT	AFTER STRESS RELIEF	DIRECT AGEING
Young's modulus (GPa | ksi)	ASTM E1876						
Horizontal direction - XY Vertical direction - Z		NA 70-72	NA 75-76	NA 73-74	NA 10100-10500	NA 10800-11000	NA 10600-10900
Ultimate strength (MPa | ksi)	ASTM E8M						
Horizontal direction - XY Vertical direction - Z		410 ± 20 390 ± 40	280 ± 20 290 ± 50	430 ± 20 430 ± 30	59 ± 3 56 ± 6	41 ± 3 42 ± 7	62 ± 3 62 ± 5
Yield strength Rp0.2% (MPa | ksi)	ASTM E8M						
Horizontal direction - XY Vertical direction - Z		240 ± 30 210 ± 30	160 ± 40 180 ± 40	310 ± 20 280 ± 20	35 ± 5 30 ± 5	23 ± 6 26 ± 6	45 ± 3 40 ± 3
Plastic elongation (%)	ASTM E8M						
Horizontal direction - XY Vertical direction - Z		14 ± 4 11 ± 5	18 ± 3 11 ± 6	10 ± 3 5 ± 3	14 ± 4 11 ± 5	18 ± 3 11 ± 6	10 ± 3 5 ± 3
Hardness, Rockwell B (HRB)	ASTM E18	60 ± 3	39 ± 10	69 ± 2	60 ± 3	39 ± 10	69 ± 2

Thermal Properties

MEASUREMENT	CONDITION	METRIC			U.S.		
		AS BUILT	AFTER STRESS RELIEF	AFTER DIRECT AGEING	AS BUILT	AFTER STRESS RELIEF	AFTER DIRECT AGEING
Thermal conductivity[4,5] (W/(m.K) | Btu/(h.ft.°F))	at 20°C / 68°F	120-140	180-190	150-170	70-80	105-110	85-100
CTE - Coefficient of thermal expansion[6] (µm/(m.°C) | µ inch/(inch.°F))	in the range of 20 to 100 °C	typical 21.4			typical 11.9		
Melting range[6] (°C | °F)		typical 557 - 613			typical 1035-1135		

Electrical Properties[5,7]

MEASUREMENT	CONDITION	METRIC			U.S.		
		AS BUILT	AFTER STRESS RELIEF	AFTER DIRECT AGEING	AS BUILT	AFTER STRESS RELIEF	AFTER DIRECT AGEING
Electrical conductivity (10^6 S/m)	ASTM B193 at 20°C / 68°F	17-19	25-27	22-24	17-19	25-27	22-24

[1] Parts manufactured with standard parameters on a ProX DMP 320, Config B
[2] Values based on average and double standard deviation
[3] Surface condition of test samples: Horizontal samples (XY) tested in machined surface condition only, vertical (Z) tested in as-printed and machined surface condition
[4] Thermal conductivity values are calculated via the Wiedemann-Franz law using the measured electrical resistivity values
[5] Results are based on limited sample size, not statistically representative
[6] Values based on literature
[7] Electrical resistivity measurements are based on the four point contact method according to ASTM B193

LaserForm® AlSi7Mg0.6 (A)

Physical Properties

MEASUREMENT	CONDITION	METRIC	U.S.
Density			
Relative, based on pixel count[1,2,4] (%)	Optical method	> 99.2 tpical 99.8	> 99.2 tpical 99.8
Absolute theoretical[3] (g/cm^3 | lb/in^3)		2.67	0.096

Surface Quality[4,5]

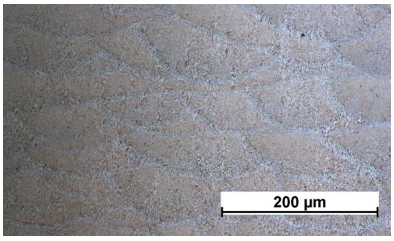
MEASUREMENT	CONDITION	SAND BLASTED METRIC	SAND BLASTED U.S.
Surface Roughness R_a	ISO 25178		
Layer Thickness 30µm (µm | µin)			
Vertical side surface[6]		typical 5-7	typical 200-280
Layer Thickness 60µm (µm | µin)			
Vertical side surface[6]		typical 10-20	typical 400-800

Chemical Composition

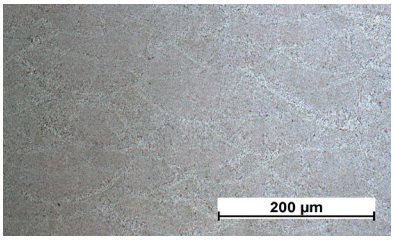
The chemical composition of LaserForm AlSi7Mg0.6 (A) conforms to the requirements EN AC-42200, and is indicated in the table below in wt%.

ELEMENT	% OF WEIGHT
Al	Balance
Si	6.50-7.50
Mg	0.45-0.70
Fe	≤0.15
Cu	≤0.03
Mn	≤0.10
Ni	≤0.05
Zn	≤0.07
Pb	≤0.05
Sn	≤0.05
Ti	≤0.18
Other (each)	≤ 0.03
Other (total)	≤ 0.10

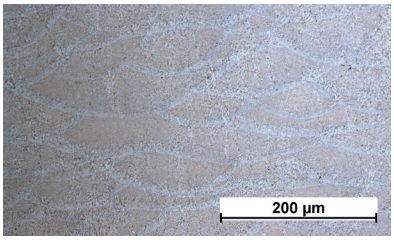
[1] Minimum value based on 95% confidence interval. Tested on typical density test coupons
[2] May deviate depending on specific part geometry
[3] Values based on literature
[4] Parts manufactured with standard parameters on a ProX DMP 320, Config B
[5] Sand blasting performed with zirconia blasting medium at 2 bar
[6] Vertical side surface measurement along the building direction



Microstructure as built



Microstructure after stress relief



Microstructure after direct ageing

3D SYSTEMS®

www.3dsystems.com

PN 10116B 07-20