LaserForm® AlSi7Mg0.6 (A)

AlSi7Mg0.6 (A) fine-tuned for use with DMP Flex / Factory 350 and DMP Flex 350 Triple metal printers to produce industrial parts with a combination of good mechanical properties and improved thermal conductivity.

AlSi7Mg0.6 (A) is formulated and fine-tuned 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 more than 1,000,000 challenging metal production parts in various materials year over year. Based on a multitude of test samples, the properties listed below provide high confidence to the user in terms of job-to-job and machine-to-machine repeatability. Using the LaserForm material enables the user to experience consistent and reliable part quality.

Material Description

AlSi7Mg0.6 (A) 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.

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[1,2,3,4]

MEASUREMENT	TEST METHOD	METRIC			U.S.		
		NHT	SR	DA	NHT	SR	DA
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[4]

MEASUREMENT	CONDITION	METRIC			U.S.		
		NHT	SR	DA	NHT	SR	DA
Thermal conductivity[5,6] (W/(m.K) | Btu.in/(h.ft².°F))	at 20°C / 68°F	120-140	180-190	150-170	70-80	105-110	85-100
CTE - Coefficient of thermal expansion[7] (µm/(m.°C) | µ inch/(inch.°F))	in the range of 20 to 100 °C	typical 21.4			typical 11.9		
Melting range[7] (°C | °F)		typical 557 - 613			typical 1035-1135		

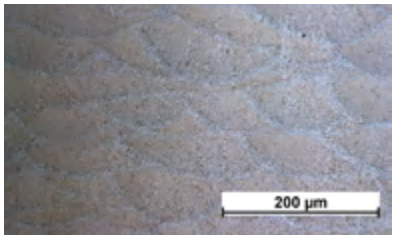
[1] Parts manufactured with standard parameters on a ProX DMP 320, Config B ; values also indicative for DMP Flex / Factory 350 and DMP Flex 350 Triple
[2] Values based on average and double standard deviation
[3] Surface condition of test samples: Horizontal samples (XY) tested in machined surface condition only, vertical (Z) tested in as-printed and machined surface condition
[4] NHT is non-heat treated sample condition; SR refers to a stress relief; DA refers to a direct ageing
[5] Thermal conductivity values are calculated via the Wiedemann-Franz law using the measured electrical resistivity values
[6] Results are based on limited sample size, not statistically representative
[7] Values based on literature

Electrical Properties[4,6,8]

MEASUREMENT	CONDITION	METRIC			U.S.		
		NHT	SR	DA	NHT	SR	DA
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

Physical Properties

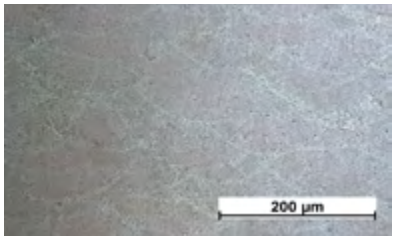
MEASUREMENT	TEST METHOD	METRIC	U.S.
Density			
Relative, based on pixel count[1,9,10] (%)	Optical method	> 99.2 tpical 99.8	> 99.2 tpical 99.8
Absolute theoretical[7] (g/cm^3 | lb/in^3)		2.67	0.096



Microstructure NHT

Surface Quality[1,11]

MEASUREMENT	TEST METHOD	METRIC	U.S.
Surface Roughness R_a			
Layer Thickness 30µm (µm | µin) Vertical side surface[12]	ISO 25178	typical 5-7	typical 200-280
Layer Thickness 60µm (µm | µin) Vertical side surface[12]		typical 10-20	typical 400-800

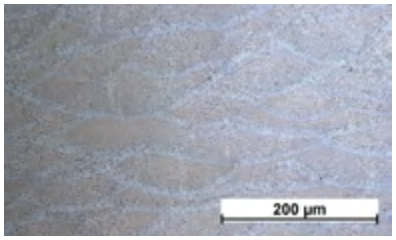


Microstructure after SR

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	6.5-7.5
Mg	0.50-0.70
Fe	≤0.15
Cu	≤0.03
Mn	≤0.10
Zn	≤0.07
Ti	≤0.18
Other (each)	≤ 0.03
Other (total)	≤ 0.10



Microstructure after DA

[8] Electrical resistivity measurements are based on the four point contact method according to ASTM B193
[9] Minimum value based on 95% confidence interval. Tested on typical density test coupons
[10] May deviate depending on specific part geometry
[11] Sand blasting performed with zirconia blasting medium at 2 bar
[12] Vertical side surface measurement along the building direction

To confirm the suitability of this material for your specific application, please contact the 3D Systems Application Innovation Group (AIG):
https://www.3dsystems.com/consulting/application-innovation-group