LaserForm® AlSi7Mg0.6 (A)

AlSi7Mg0.6 fine-tuned for use with ProX® DMP 320 and DMP Flex and Factory 350 metal printer 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 Flex and Facotry 350 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 E8M						
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
Impact toughness[4], typical (J | ft-lb)	ASTM E23	8 ± 2	14 ± 9	3 ± 2	6 ± 1	10 ± 7	2 ± 1

Thermal Properties

MEASUREMENT	CONDITION	METRIC			U.S.		
		AS BUILT	AFTER STRESS RELIEF	AFTER DIRECT AGEING	AS BUILT	AFTER STRESS RELIEF	AFTER DIRECT AGEING
Electrical resistivity[5] (Ω.m) [10^{-8}]	ASTM B193 at 20°C | 68°F	5.2-5.8	3.8-4.0	4.2-4.6	5.2-5.8	3.8-4.0	4.2-4.6
Thermal conductivity[6] (W/(m.K) | Btu/(h.ft².°F))	at 25 °C | 77 °F	120-140	180-190	150-170	830-970	1250-1320	1040-1180
CTE - Coefficient of thermal expansion[7] (µm/(m.°C) | µ inch/(inch . °F))	in the range of 20 to 100 °C		21.4			11.9	
Melting range[7] (°C | °F)			557 - 613			1035-1135	

[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] Tested with Charpy V-notch impact test specimens
[5] Electrical resistivity measurements are based on the four point contact method according to ASTM B193.
[6] Thermal conductivity values are calculated via the Wiedermann-Franz law using the measured electrical resistivity values.
[7] Values based on literature

LaserForm® AlSi7Mg0.6 (A)

Physical Properties

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

Surface Quality[2]

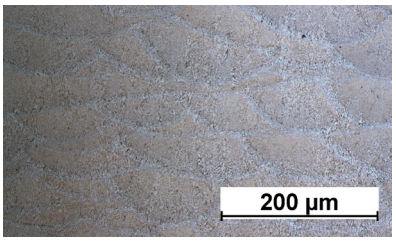
MEASUREMENT	METRIC		U.S.	
	AS BUILT	SAND BLASTED	AS BUILT	SAND BLASTED
Surface Roughness R_a				
Layer Thickness 30µm (µm | µin)				
Horizontal direction - XY Vertical direction - Z	5 ± 1 6 ± 1	5 ± 1 6 ± 1	200 ± 40 240 ± 40	200 ± 40 240 ± 40
Layer Thickness 60µm (µm | µin)				
Horizontal direction - XY Vertical direction - Z	15 ± 4 16 ± 4	15 ± 3 14 ± 3	590 ± 160 630 ± 160	590 ± 120 550 ± 120

Chemical Composition

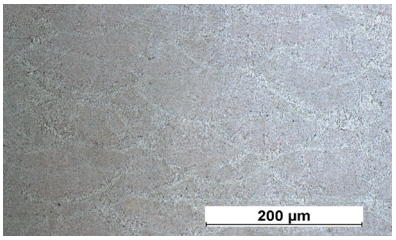
The chemical composition of LaserForm AlSi7Mg0.6 (A) conforms to the requirements EN AC 43100, and is indicated in the table below in wt%.

ELEMENT	% OF WEIGHT
Al	Balance
Si	6.50-7.50
Mg	0.50-0.70
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)	≤0.05
Other (total)	≤0.15

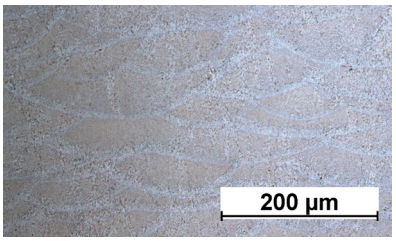
[1] Values based on literature
[2] Values based on average and double standard deviation



Microstructure as built



Microstructure after stress relief



Microstructure after direct ageing

3D SYSTEMS

www.3dsystems.com

PN 10116A 10-18