

EOS Aluminium AlSi10Mg

Lot: Z 602322

Trade name	EOS Aluminium AlSi10Mg	Manufacturing method	Gas atomized
Product no.	9011-0024	Date of manufacturing	09.02.2024
Manufacturer	Electro Optical Systems Finland Oy Lemminkäisenkatu 36 FI-20520 Turku Finland	Supplier	EOS GmbH Robert-Stirling-Ring 1 D-82152 Krailling Germany
	Tel.: +358 (0)20 765 91 40		Tel.: +49 89 893 36 0

Declaration of conformance

Powder lot conforms to EOS requirements to be used in EOS M Systems.

Sampling and test sample preparation done according to ASTM B215. Analysis sample quantity 0.5 kg. Chemistry Analysis (External ISO 17025 accredited laboratory). Powder properties determined by EOS Oy in Turku, Finland

Date: 09.02.2024

Approved by:

Vaja Sz

Saija Syväjärvi

QA Specialist

Electro Optical Systems Finland Oy

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Analyses of Powder (see page 6 for analysis details)



Cleanliness of Powder

Powder is visually free from foreign materials and uniform in condition. Powder shall be predominantly spherical with low levels of agglomerates, satellites, needle-shaped particles, entrapped porosity and deformed particles.

Property	Detailed property	Test Method	Limits	Result	✓/×
Water content	[ppm]	Coulometric KF titration	≤ 126	74	V
Skeletal density	[g/cc]	Inert gas displacement	≥ 2.604	2.648	V
Morphology	Sphericity Symmetry Aspect ratio	Dynamic image analysis	≥ 0.871 ≥ 0.899 ≥ 0.786	0.910 0.927 0.861	 ✓ ✓ ✓
PSD	d10 [μm] d50 [μm] d90 [μm]	Laser diffraction	20 - 33 38 - 53 63 - 80	24 45 73	 ✓ ✓ ✓
	<u>X_{Cmin} 10 [μm]</u> X _{Cmin} 50 [μm] X _{Cmin} 90 [μm]	Dynamic image analysis	n/a n/a n/a	22 39 61	n/a n/a n/a
	<u>> 90 µm [wt%]</u>	Laboratory sieving	<u>≤ 0.5</u> Balance	0.2 Balance	
	Si [wt%] Fe [wt%]	ICP-OES	9.0 - 11.0 ≤ 0.55	9.9 0.09	 ✓ ✓
	<u>Mn [wt%]</u> <u>Mg [wt%]</u>	ICP-OES	≤ 0.45 0.20 - 0.45	<0.01	
Chemical Composition	Zn [wt%]	ICP-OES	≤ 0.13 ≤ 0.10	<0.01	<u> </u>
·	Sn [wt%] Cu [wt%]		≤ 0.05 ≤ 0.05	<0.01	
	Ni [wt%] Pb [wt%]	ICP-OES	≤ 0.05 ≤ 0.03	<0.01	
	OE, each [wt%] OE, total [wt%]	ICP-OES	<u>≤ 0.05</u> ≤ 0.15	<0.05 <0.15	<u> </u>

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restimethou	Limits	Result	✓/×
ASTM B527	1.4 – 1.8	1.6	V
ASTM B417	1.10 – 1.50	1.33	V
	ASTM B527 ASTM B417	ASTM B527 1.4 – 1.8 ASTM B417 1.10 – 1.50	ASTM B527 1.4 – 1.8 1.6 ASTM B417 1.10 – 1.50 1.33

Additional powder behavior data

About powders

Powder behaviour can change due to processing in AM machine, sieving an/or vacuum conveying, but factors such as aging, electrostatic build-up and ferromagnetism are excluded from the quality control metrics due to the facts that these do not exist in fresh powders. The main factors that influence the part properties are namely chemical composition, skeletal density, water content, powder morphology (particle shape) and particle size distribution.



When a shift in manufacturing process happens, the effect is visible in one or several of these. Failing to meet set criteria for these parameters can lead to poor part quality.

About Part Properties (EOS M290)

Typical part properties for EOS Aluminium AlSi10Mg shown in table below.

Property	Expected (T99)	Min AlSi10Mg requirement	
Toperty		in quality control	
Yield Strength, Rp0.2	≥ 217 MPa	90 MPa	
Ultimate tensile strength, Rm	≥ 439 MPa	180 MPa	
Elongation at break, A ₂₅	≥ 3.2 %	2.5 %	
Solid part density	≥ 2.67 g/cc*	2.66 g/cc	
*Europeted regult of TOE			

*Expected result of T95



Long term process capability predicts following number of fails (out-of-specification) per million opportunities (DPPMO):

Property	DPMO	Failrate
Yield Strength, Rp0.2	0	0.00 %
Ultimate tensile strength, Rm	0	0.00 %
Elongation at break, A ₂₅	436	0.04 %
Solid part density	598	0.06 %

Actual long-term data for EOS Aluminium AlSi10Mg is presented in the following graphs with calculated tolerance interval. T99 tolerance interval means that 99% of the possible results are expected to be higher than declared lower bound. Sample size (N) for different metrics is in the graph.









EOS M290 400W system with AlSi10Mg_030_FlexM291 process used for the long term process capability data. Heat treatment: As-manufactured. Number of lots 91 (N=497 tensile samples, N=67 density).

You've got a question(s) or request(s) on the content of this document?

Don't hesitate to email us at <u>Quality Control FINLAND@eos.info</u>

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Information on Analysis Methods

Internal powder analyses done using qualified and calibrated (where applicable) analysis equipment. Calibration/operational checks performed on predetermined intervals according to internal procedures and/or procedures recommended by the manufacturer. Daily operational checks for equipment where applicable using traceable reference materials (if available) or internal reference materials. Conditions during testing are 19-23C rH max 45%.

Sampling and sample preparation: According to ASTM B215. Analysis sample(s) for sieve analysis, laser diffraction analysis and powder densities prepared using spinning rifflers.

Cleanliness of powder and powder morphology: Visual examination of powder according to internal procedure using optical microscope Olympus BX41 or GX51 to investigate powder monolayer and mounted, polished samples. Terminology in accordance with ASTM B243.

Particle size distribution: Laser diffraction analysis and sample preparation according to ASTM B822 and ISO 13320 with Microtrac S3500 or HelosRodos according to ISO 13320. Dynamic image analysis according to ISO 13322-2 with CAMSIZER XT.

Sieve analysis: Sieve analysis based on ASTM B214. Retsch AS200 Digit sieving system is used. Sieves according to ASTM E11.

Powder density: Tap density analysis according to ASTM B527. Apparent density analysis according to ASTM B212 or ASTM B417 or ASTM B329. Skeletal density analysis according to ASTM B923 by Quantachrome UltraPyc 1200e gas pycnometer (He). Skeletal density is the ratio of the mass of solid material to the sum of the volumes of the solid material and closed (or blind) pores within the material (ASTM D3766)

Powder water content: Water content determination according to internal procedure using coulometric Karl Fischer titrator C30s with InMotion KF Flex oven autosampler.

Powder chemistry: Elemental composition determined in ISO 17025 certified laboratory with following test methods: ICP-OES analyses according to ASTM E3061 (analysis device according to E1479). All methods ISO 17025 accredited. The chemical composition is in accordance with standard DIN EN 1706 (EN AC-43000). Powder analyses without surface removal. Bal. = balance. OE= Other Elements.

The data correspond to our knowledge and experience at the time of publication. They do not on their own represent a sufficient basis for any part design, neither do they provide any agreement about or guarantee the specific properties of a product or part or the suitability of a product or part for a specific application. It is the responsibility of the producer or customer of a part to check its properties as well as its suitability for a particular purpose. This also applies to consideration of possible intellectual property rights as well as laws and regulations. The data are subject to change without notice as part of EOS' continuous development and improvement processes. EOS has not FDA cleared this product for medical device manufacturers to use this material in FDA sensitive applications.