Aluminium AlSi10Mg

Aluminium AlSi10Mg is an aluminium alloy in fine powder form which has been specially optimised for processing on INT M systems.
This document provides information and data for parts built using Aluminium AlSi10Mg Powder.

Description

AlSi10Mg is a typical casting alloy with good casting properties and is typically used for cast parts with thin walls and complex geometry. It offers good strength, hardness and dynamic properties and is therefore also used for parts subject to high loads. Parts in Aluminium AlSi10Mg are ideal for applications which require a combination of good thermal properties and low weight. They can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required.
Conventionally cast components in this type of aluminium alloy are often heat treated to improve the mechanical properties, for example using the T6 cycle of solution annealing,
quenching and age hardening. The laser-sintering process is characterized by extremely rapid melting and re-solidification. This produces a metallurgy and corresponding mechanical properties in the as-built condition which is similar to T6 heat-treated cast parts. Therefore such hardening heat treatments are not recommended for laser-sintered parts, but rather a stress relieving cycle of 2 hours at 300 °C (572 °F). Due to the layerwise building method, the parts have a certain anisotropy, which can be reduced or removed by appropriate heat treatment – see Technical Data for examples.

Technical data	
General process and geometrical data	
Typical achievable part accuracy [1]	± 100 µm
Smallest wall thickness [2]	approx. 0.3 – 0.4 mm approx. 0.012 – 0.016 inch
Surface roughness, as built, cleaned [3]	Ra 6 - 10 µm, Rz 30 - 40 µm Ra 0.24 – 0.39 x 10-³ inch, Rz 1.18 – 1.57 x 10-³ inch
- After micro shot-peening	Ra 7 - 10 µm, Rz 50 - 60 µm Ra 0.28 – 0.39 x 10-³ inch, Rz 1.97 – 2.36 x 10-³ inch
Volume rate [4]	7.4 mm³/s (26.6 cm³/h) 1.6 in³/h

[1] Based on users' experience of dimensional accuracy for typical geometries. Part accuracy is subject to appropriate data preparation and post-processing, in accordance with training.
[2] Mechanical stability dependent on the geometry (wall height etc.) and application
[3] Due to the layerwise building, the surface structure depends strongly on the orientation of the surface, for example sloping and curved surfaces exhibit a stair-step effect. The values also depend on the measurement method used. The values quoted here given an indication of what can be expected for horizontal (up-facing) or vertical surfaces.
[4] The volume rate is a measure of the building speed during laser exposure. The overall building speed is dependent on the average volume rate, the time required for coating (depends on the number of layers) and other factors, e.g. DMLS settings.

Physical and chemical properties of the parts	
Material composition	Al (balance) Si (9.0 – 11.0 wt-%) Fe (≤ 0.55 wt-%) Cu (≤ 0.05 wt-%) Mn (≤ 0.45 wt-%) Mg (0.2 – 0.45 wt-%) Ni (≤ 0.05 wt-%) Zn (≤ 0.10 wt-%) Pb (≤ 0.05 wt-%) Sn (≤. 0.05 wt-%) Ti (≤ 0.15 wt-%)
Relative density	approx. 99.85 %
Density	2.67 g/cm³ 0.096 lb/in³

Mechanical properties of the parts		
	As built	Heat treated [8]
Tensile strength [5]		
- in horizontal direction (XY)	460 ± 20 MPa 66.7 ± 2.9 ksi	345 ± 10 MPa 50.0 ± 1.5 ksi
- in vertical direction (Z)	460 ± 20 MPa 66.7 ± 2.9 ksi	350 ± 10 MPa 50.8 ± 1.5 ksi
Yield strength (Rp 0.2 %) [5]		
- in horizontal direction (XY)	270 ± 10 MPa 39.2 ± 1.5 ksi	230 ± 15 MPa 33.4 ± 2.2 ksi
- in vertical direction (Z)	240 ± 10 MPa 34.8 ± 1.5 ksi	230 ± 15 MPa 33.4 ± 2.2 ksi
Modulus of elasticity		
- in horizontal direction (XY)	75 ± 10 GPa 10.9 ± 0.7 Msi	70 ± 10 GPa 10.2 ± 0.7 Msi
- in vertical direction (Z)	70 ± 10 GPa 10.2 ± 0.7 Msi	60 ± 10 GPa 8.7 ± 0.7 Msi
Elongation at break [5]		
- in horizontal direction (XY)	(9 ± 2) %	12 ± 2%
- in vertical direction (Z)	(6 ± 2) %	11 ± 2%
Hardness [6]	approx.119 ± 5 HBW	
Fatigue strength [7]		
- in vertical direction (Z)	approx. 97 ± 7 MPa approx. 14.1 ± 1.0 ksi	

[5] Mechanical strength tested as per ISO 6892-1:2009 (B) annex D, proportional specimens, specimen diameter 5 mm, initial measured length 25 mm.
[6] Hardness test in accordance with Brinell (HBW 2.5/62.5) as per DIN EN ISO 6506-1. Note that measured hardness can vary significantly depending on how the specimen has been prepared.
[7] Fatigue test with test frequency of 50 Hz, R = -1, measurement stopped on reaching 5 million cycles without fracture.
[8] Stress relieve: anneal for 2 h at 300 °C (572 °F).

Thermal properties of parts		
	As built	Heat treated [8]
Thermal conductivity (at 20 °C)		
- in horizontal direction (XY)	approx. 103 ± 5 W/m°C	approx. 173 ± 10 W/m°C
- in vertical direction (Z)	approx. 119 ± 5 W/m°C	approx. 175 ± 10 W/m°C
Specific heat capacity		
- in horizontal direction (XY)	approx. 920 ± 50 J/kg°C	approx. 890 ± 50 J/kg°C
- in vertical direction (Z)	approx. 910 ± 50 J/kg°C	approx. 910 ± 50 J/kg°C

Notes

The data are valid for the combinations of powder material, machine and parameter sets referred to on page 1, when used in accordance with the relevant Operating Instructions (including Installation Requirements and Maintenance) and Parameter Sheet. Part properties are measured using defined test procedures. Further details of the test procedures are available on request.

The data correspond to our knowledge and experience at the time of publication. They do not on their own provide a sufficient basis for designing parts. Neither do they provide any agreement or guarantee about the specific properties of a part or the suitability of a part for a specific application. The producer or the purchaser of a part is responsible for checking the properties and the suitability of a part for a particular application. This also applies regarding any rights of protection as well as laws and regulations. The data are subject to change without notice as part of continuous development and improvement processes.