

Aluminium AlSi10Mg

Parameter set options

Layer thickness	Optimised for	Laser mode	Page number
30 µm	Single laser per part	Modulated	4
30 µm	Single laser per part	Continuous wave	5
60 µm	Single laser per part	Continuous wave	6
60 µm	Multiple lasers per part	Continuous wave	7

To download the latest material files, visit www.renishaw.com/softwarelicensing.

Material description

AlSi10Mg-0403 alloy comprises aluminium alloyed with silicon of mass fraction up to 10%, small quantities of magnesium and iron, along with other minor elements. The presence of silicon makes the alloy both harder and stronger than pure aluminium due to the formation of Mg_2Si precipitate.

Due to the natural formation of an oxide layer on the surface of the aluminium alloy, the material has good corrosion resistance.

Material properties

- Low density (ideal for lightweight components)
- High specific strength (strength to mass ratio)
- High thermal conductivity
- Very high electrical conductivity
- Responds well to post process finishing

Applications

- Automotive
- Aerospace and defence
- Electronics cooling
- Consumer goods

Disclaimer

The mechanical property data featured in this document were obtained from tests performed in Renishaw's laboratories and they indicate the mechanical properties that can be achieved. The data is not intended as a guaranteed minimum specification.

Glossary of terms

Term	Definition
Scan strategy	Determines the path the laser will take to melt the cross-sectional area of the parts featured in each layer of the build process.
Meander	A scan strategy that takes the form of a straight-line vector path that bounces back and forth from each side of the part border. Meander strategy is quick and ideal for parts with a small XY cross section.
Stripe	A scan strategy where the area within the part border is split into strips and a meander technique is used within each strip. Stripe is ideal for parts with a large XY cross section.

Typical wrought material properties

Material property	Wrought material value
Density	2.7 g/cm ³
Thermal conductivity	130 W/mK to 190 W/mK
Melting temperature	570 °C to 590 °C
Coefficient of thermal expansion ¹	20×10 ⁻⁶ K ⁻¹ to 21×10 ⁻⁶ K ⁻¹

¹ In the range of 20 °C to 100 °C.

Recommended composition of powder

Element	Mass (%)
Aluminium	Balance
Silicon	9.00 to 11.00
Magnesium	0.25 to 0.45
Iron	≤ 0.25
Nitrogen	≤ 0.20
Oxygen	≤ 0.20
Titanium	≤ 0.15
Zinc	≤ 0.10
Manganese	≤ 0.10
Nickel	≤ 0.05
Copper	≤ 0.05
Lead	≤ 0.02
Tin	≤ 0.02
Residual elements	≤ 0.05 each, ≤ 0.05 total

Recommended powder size distribution: 20 µm to 63 µm.

The values shown in this table are representative of a general composition powder. Renishaw powders are supplied to a tighter specification to minimise batch-to-batch variations. Results quoted in this data sheet are from samples produced using Renishaw's tighter-specification powder. To purchase powder from Renishaw, visit the online store at www.renishaw.com/shop.

Please contact Renishaw for further information about specifications or if you require support in qualifying non-Renishaw powders.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
30 µm	Single laser per part	Modulated	190 m ³ /h	One laser: 17.5 cm ³ /h	Four lasers: 70 cm ³ /h

Material files: AISi10Mg_500QS_A30_M_01_B (meander scan strategy)
 AISi10Mg_500QS_A30_S_01_B (stripe scan strategy)

Properties of additively manufactured components

NOTE: This parameter set is optimised for bulk density. The material properties in this table are indicative only. Further modification of the material file may be required to suit your application.

		As built	Stress relieved ¹
Bulk density ²		≥ 99.8%	≥ 99.8%
Ultimate tensile strength ³	Vertical (Z)	428 MPa ±11 MPa	315 MPa ±3 MPa
Yield strength ³	Vertical (Z)	262 MPa ±5 MPa	212 MPa ±3 MPa
Elongation after fracture ³	Vertical (Z)	4% ±1%	14% ±2%
Modulus of elasticity ³	Vertical (Z)	69 GPa ±4 GPa	73 GPa ±7 GPa
Hardness (Vickers) ⁴	Horizontal (XY)	124 HV0.5 ±4 HV0.5	-
	Vertical (Z)	119 HV0.5 ±5 HV0.5	-

Mechanical test samples were created using four lasers, one laser per sample and with no downstream processing. Meander scan strategy was used for vertical samples.

- ¹ Stress relieving method used for testing: Under argon at 15 L/min flow rate, heat at 3 °C/min to 275 °C ±10 °C, then hold temperature for 2 hours. Air cool to room temperature.
- ² Measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.
- ³ Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.
- ⁴ Tested to ASTM E384-11 after polishing.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
30 µm	Single laser per part	Continuous wave	190 m ³ /h	One laser: 19.44 cm ³ /h	Four lasers: 77.76 cm ³ /h

Material files: AISi10Mg_500QS_B30_M_01_A (meander scan strategy)
AISi10Mg_500QS_B30_S_01_A (stripe scan strategy)

Properties of additively manufactured components

NOTE: This parameter set is optimised for bulk density. The material properties in this table are indicative only. Further modification of the material file may be required to suit your application.

		As built	Stress relieved ¹
Bulk density ²		≥ 99.8%	≥ 99.8%
Ultimate tensile strength ³	Horizontal (XY)	424 MPa ±4 MPa	311 MPa ±2 MPa
	Vertical (Z)	442 MPa ±9 MPa	316 MPa ±3 MPa
Yield strength ³	Horizontal (XY)	283 MPa ±4 MPa	207 MPa ±2 MPa
	Vertical (Z)	263 MPa ±8 MPa	207 MPa ±3 MPa
Elongation after fracture ³	Horizontal (XY)	10% ±1%	19% ±1%
	Vertical (Z)	6% ±1%	16% ±2%
Modulus of elasticity ³	Horizontal (XY)	72 GPa ±2 GPa	72 GPa ±2 GPa
	Vertical (Z)	70 GPa ±5 GPa	68 GPa ±5 GPa
Hardness (Vickers) ⁴	Horizontal (XY)	128 HV0.5 ±5 HV0.5	95 HV0.5 ±2 HV0.5
	Vertical (Z)	119 HV0.5 ±6 HV0.5	95 HV0.5 ±2 HV0.5
Surface roughness ⁵	Vertical (Z) (Median Ra)	15 µm ±2 µm	-
	Vertical (Z) (Median Rz)	111 µm ±10 µm	-

Mechanical test samples were created using four lasers, one laser per sample and with no downstream processing. Stripe scan strategy was used for all samples.

- ¹ Stress relieving method used for testing: Under argon at 15 L/min flow rate, heat at 3 °C/min to 275 °C ±10 °C, then hold temperature for 2 hours. Air cool to room temperature.
- ² Measured optically on a 10 mm × 10 mm × 10 mm sample at 75x magnification.
- ³ Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.
- ⁴ Tested to ASTM E384-11 after polishing.
- ⁵ Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601-2001 (ISO 4287:1997).

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
60 µm	Single laser per part	Continuous wave	190 m ³ /h	One laser: 48.6 cm ³ /h	Four lasers: 194.4 cm ³ /h

Material files: AISi10Mg_500QS_B60_M_01_A (meander scan strategy)
 AISi10Mg_500QS_B60_S_01_A (stripe scan strategy)

Properties of additively manufactured components

NOTE: This parameter set is optimised for bulk density. The material properties in this table are indicative only. Further modification of the material file may be required to suit your application.

		As built	Stress relieved ¹
Bulk density ²		≥ 99.7%	≥ 99.7%
Ultimate tensile strength ³	Horizontal (XY)	418 MPa ±14 MPa	281 MPa ±1 MPa
	Vertical (Z) – Meander	430 MPa ±13 MPa	294 MPa ±2 MPa
	Vertical (Z) – Stripe	396 MPa ±12 MPa	262 MPa ±2 MPa
Yield strength ³	Horizontal (XY)	268 MPa ±9 MPa	173 MPa ±1 MPa
	Vertical (Z) – Meander	264 MPa ±4 MPa	179 MPa ±3 MPa
	Vertical (Z) – Stripe	230 MPa ±3 MPa	157 MPa ±4 MPa
Elongation after fracture ³	Horizontal (XY)	8% ±1%	18% ±1%
	Vertical (Z) – Meander	5% ±1%	12% ±3%
	Vertical (Z) – Stripe	6% ±1%	14% ±1%
Modulus of elasticity ³	Horizontal (XY)	71 GPa ±7 GPa	74 GPa ±4 GPa
	Vertical (Z) – Meander	69 GPa ±5 GPa	75 GPa ±7 GPa
	Vertical (Z) – Stripe	70 GPa ±5 GPa	67 GPa ±6 GPa
Hardness (Vickers) ⁴	Horizontal (XY)	119 HV0.5 ±7 HV0.5	80 HV0.5 ±1 HV0.5
	Vertical (Z)	113 HV0.5 ±11 HV0.5	78 HV0.5 ±2 HV0.5
Surface roughness ⁵	Vertical (Z) (Median Ra)	14 µm ±2 µm	–
	Vertical (Z) (Median Rz)	102 µm ±14 µm	–
Plastometrex ultimate tensile strength ⁶	Horizontal (XY)	–	302 MPa ±5 MPa
Plastometrex yield strength ⁶	Horizontal (XY)	–	136 MPa ±5 MPa

Mechanical test samples were created using four lasers, one laser per sample and with no downstream processing. The scan strategy for vertical samples is indicated in the table above. Stripe scan strategy was used for horizontal samples.

¹ Stress relieving method used for testing: Under argon at 15 L/min flow rate, heat at 3 °C/min to 275 °C ±10 °C, then hold temperature for 2 hours. Air cool to room temperature.

² Measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.

³ Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.

⁴ Tested to ASTM E384-11 after polishing.

⁵ Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601-2001 (ISO 4287:1997).

⁶ Plastometrex's standard indentation procedure was used to generate this data. Indents were carried out on 10 mm × 10 mm × 10 mm samples. Values are based on six indents from three samples.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate
60 µm	Multiple lasers per part	Continuous wave	190 m ³ /h	Four lasers: 194.4 cm ³ /h

Material files: AISi10Mg_500QS_C60_S_02_A (stripe scan strategy)

Properties of additively manufactured components

NOTE: This parameter set is optimised for bulk density. The material properties in this table are indicative only. Further modification of the material file may be required to suit your application.

		As built	Stress relieved ¹
Bulk density ²		≥ 99.7%	≥ 99.7%
Ultimate tensile strength ³	Horizontal (XY)	392 MPa ±6 MPa	299 MPa ±2 MPa
	Vertical (Z)	394 MPa ±10 MPa	290 MPa ±2 MPa
Yield strength ³	Horizontal (XY)	244 MPa ±3 MPa	186 MPa ±1 MPa
	Vertical (Z)	228 MPa ±3 MPa	168 MPa ±1 MPa
Elongation after fracture ³	Horizontal (XY)	8% ±1%	15% ±3%
	Vertical (Z)	8% ±1%	12% ±2%
Modulus of elasticity ³	Horizontal (XY)	73 GPa ±5 GPa	75 GPa ±3 GPa
	Vertical (Z)	70 GPa ±4 GPa	74 GPa ±3 GPa
Hardness (Vickers) ⁴	Horizontal (XY)	116 HV0.5 ±6 HV0.5	90 HV0.5 ±2 HV0.5
	Vertical (Z)	109 HV0.5 ±9 HV0.5	86 HV0.5 ±3 HV0.5
Surface roughness ⁵	Vertical (Z) (Median Ra)	12 µm ±1 µm	–
	Vertical (Z) (Median Rz)	80 µm ±8 µm	–

Mechanical test samples were created using four lasers, multiple lasers per sample and with no downstream processing. Stripe scan strategy was used for all samples.


- ¹ Stress relieving method used for testing: Under argon at 15 L/min flow rate, heat at 3 °C/min to 275 °C ±10 °C, then hold temperature for 2 hours. Air cool to room temperature.
- ² Measured optically on a 10 mm × 10 mm × 10 mm sample at 75x magnification.
- ³ Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.
- ⁴ Tested to ASTM E384-11 after polishing.
- ⁵ Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601-2001 (ISO 4287:1997).

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