13 Al
22 Ti | 24 Cr | 26 Fe | 27 Co | 28 Ni | 29 Cu

M2 Series 5 Aluminum AlSi7Mg

Parameters for GE Additive’s Concept Laser M2 Series 5

Data in this material datasheet represent material built with a 30 and 60 µm layer thicknesses in an argon atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine and requires build plate heating. Values listed are typical.

Aluminum

Lightweight aluminum alloys for additive manufacturing are traditionally used in many industrial, aerospace and automotive applications. They possess high strength-to-weight ratios, and they also demonstrate good resistance to metal fatigue and corrosion. Due to the geometrically complex structures possible with additive manufacturing, further weight reduction is often possible with little or no compromise in strength and overall performance. One key advantage of aluminum alloy powders is that they typically offer better build rates than other metal powders.

M2 Series 5 AlSi7Mg

The parameters for the Concept Laser M2 Series 5 are developed leveraging the performance of the previous M2 generations of AlSi7Mg parameters. The surface parameter has a 30 µm layer thickness that produces surface roughness less than 10 µm without bead blast or shot peening, while delivering good productivity with dual lasers. The productivity parameter is a 60 µm parameter that provides double the productivity, with the trade off of double the surface finish. All parameters can be used with either a rubber or steel recoater blade and succeed the minimum tensile properties specified in AMS 4289 in the heat-treated state.

M2 Series 5 Aluminum AlSi7Mg

With appropriate approval* AlSi7Mg can be used for lightweight components in aerospace and industrial applications.

Data in this material datasheet represents material built with a 30 and 60 µm layer thicknesses in an argon atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine and requires build plate heating. Values listed are typical.

POWDER CHEMISTRY

Aluminum AlSi7Mg powder chemical composition according to AMS 4289. For additional information on AlSi7Mg powder, visit AP&C.

MACHINE CONFIGURATION

- Concept Laser M2 Series 5 (single-laser or dual-laser)
- Argon gas
- Stainless steel or rubber recoater blade

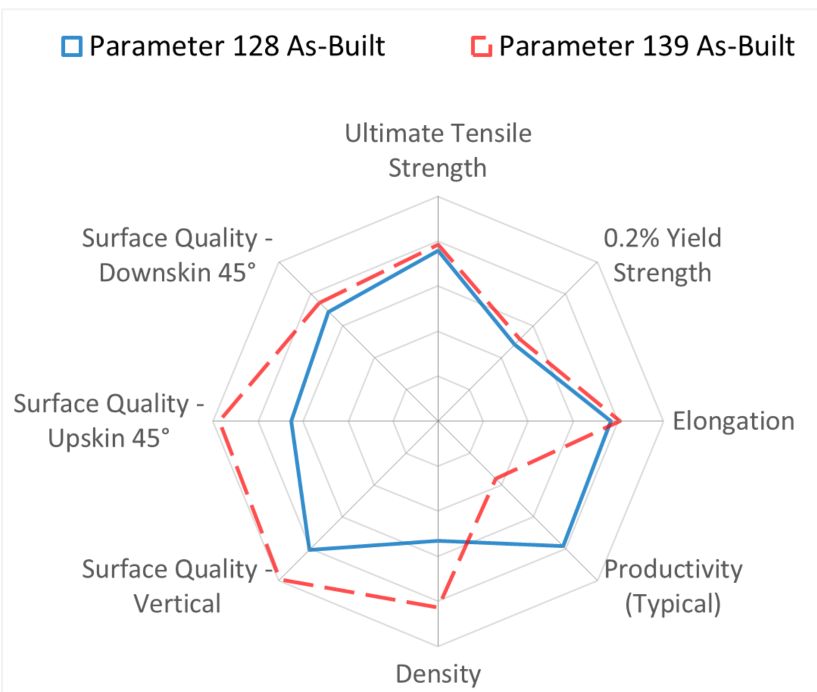
AVAILABLE PARAMETERS

- **Surface Parameter 129** 30 µm layer thickness, rubber recoater
- **Surface Parameter 139** 30 µm layer thickness, steel recoater
- **Productivity Parameter 128** 60 µm layer thickness, steel recoater
- **Productivity Parameter 138** 60 µm layer thickness, rubber recoater
- **Hybrid Parameter 182** 30/60 µm layer thickness, rubber recoater

THERMAL STATES

1. As-Built
2. Vacuum Stress Relief + Hot Isostatic Press + Solution + Age (VSR+HIP+SOLN+AGE)
   VSR: 440°C, 1 hour in vacuum, HIP: 538°C, 8 hours at 100MPa, SOLN: 543°C, 8 hours, rapid quench, AGE: 160°C, 8 hours

PARAMETER COMPARISON (THERMAL STATE AS-BUILT)



Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical) against a range defined for each material family. For **Aluminum Alloys,** the ranges are as follows: UTS: 0-500 MPa, 0.2%YS: 0-425 MPa, Density: 99-100 %, Elongation: 0-30 %, Productivity: 5-35 cm³/h, Surface Quality (all): 40-5 µm

TYPICAL BUILD RATE

	(cm^3/h)
Typical build rate[1] w/coating	13.6
Theoretical melting rate[2] bulk per Laser	19.4

[1]Using standard Factory Acceptance Test layout and 2 lasers
[2]Calculated (layer thickness x scan velocity x hatch distance)

PHYSICAL DATA AT ROOM TEMPERATURE

	Surface Roughness Ra**- Overhang (µm)		
	45°	60°	75°
Upskin	7	6	5
Downskin	17	8	6

	Surface Roughness Ra** (µm)
H	16
V	6

	Relative Density (%)		Hardness (HV5)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.8	99.8	105	--	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--

HORIZONTAL

Thermal State	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (mm/mm/K)	Thermal Diffusivity (m^2/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN+AGE	154.0	13.7×10^{-6}	6.3×10^{-5}	917

VERTICAL

Thermal State	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (mm/mm/K)	Thermal Diffusivity (m^2/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN+AGE	154.0	13.7×10^{-6}	6.3×10^{-5}	917

TENSILE DATA

Tensile testing done in accordance with ASTM E8 and ASTM E21

Test Temperature: RT

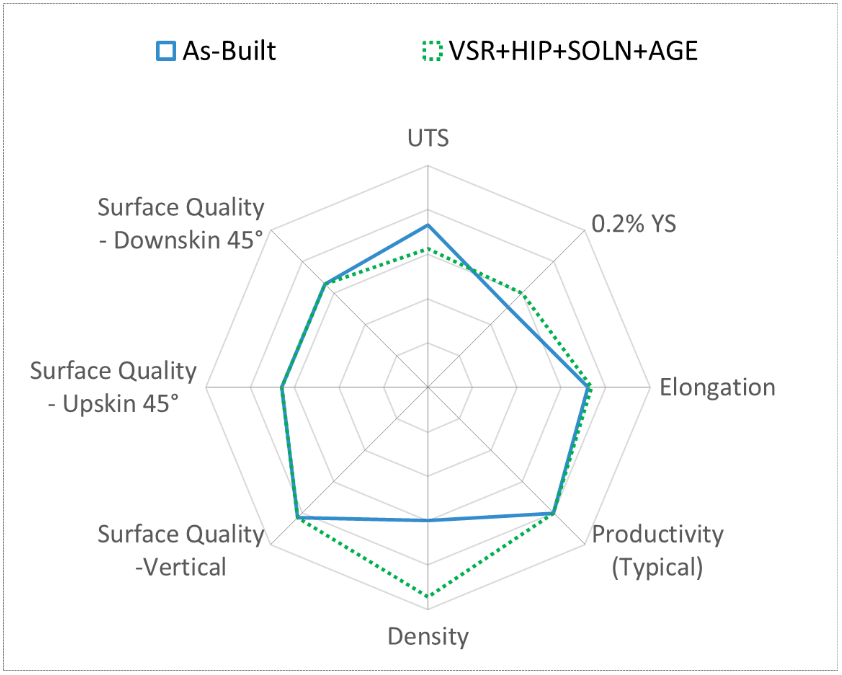
	Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	72	68	225	200	385	390	17.5	14.0	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--	--	--	--	--

Test Temperature: 150°C

	Modulus of Elasticity (GPa)		0.2% YS (MPa)		UTS (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	--	--	--	--	--	--	--	--	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--	--	--	--	--

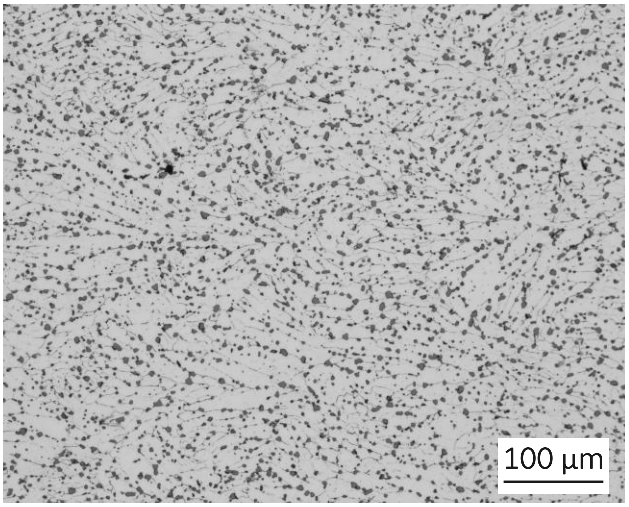
H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

* All of the figures contained herein are approximate only. The figures provided are dependent on a number of factors, including but not limited to, process and machine parameters, and the approval is brand specific and/or application specific. The information provided on this material data sheet is illustrative only and cannot be relied on as binding.
** Roughness measurements have been performed according to DIN EN ISO 4287 and DIN EN ISO 4288. In general analysis of the surface quality is strongly dependent on the methodology used and therefore deviations might be observed depending on methodology used. Vertical and horizontal sidewalls have been characterized using a tactile system, overhangs using an optical system.

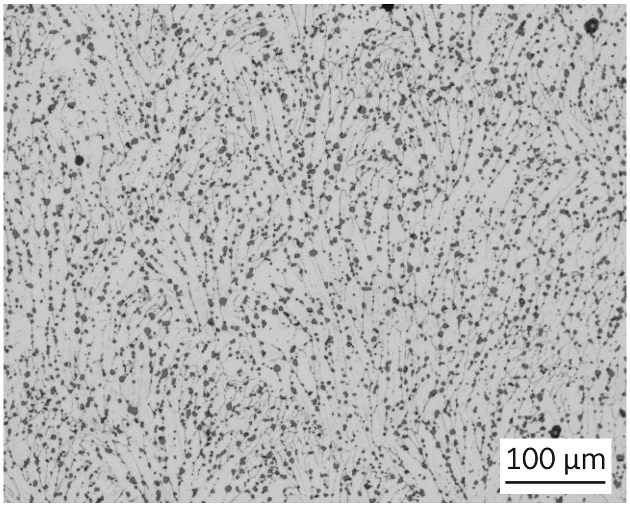


Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For **Aluminum Alloys,** the ranges are as follows: UTS: 0-550 MPa, 0.2%YS: 0-450 MPa, Elongation: 0-20%, Density: 99-100%, Productivity: 5-30 cm³/h, Surface Quality (all): 40-5 µm

TYPICAL MICROSTRUCTURE



200X, VSR+HIP+SOLN+AGE, HORIZONTAL



200X, VSR+HIP+SOLN+AGE, VERTICAL

H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

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TYPICAL BUILD RATE

	(cm^3/h)
Typical build rate[1] w/coating	29.6
Theoretical melting rate[2] bulk per Laser	39.3

[1]Using standard Factory Acceptance Test layout and 2 lasers
[2]Calculated (layer thickness x scan velocity x hatch distance)

PHYSICAL DATA AT ROOM TEMPERATURE

	Surface Roughness Ra** - Overhang (μm) 45°	60°	75°
Upskin	17	14	13
Downskin	16	11	10

	Surface Roughness Ra** (μm)
H	24
V	12

Thermal State	Relative Density (%) H	V	Hardness (HV5) H	V	Poisson's Ratio H	V
As-Built	99.5	99.5	100	--	--	--
VSR+HIP+SOLN+AGE	99.9	99.9	--	--	0.352	--

HORIZONTAL

Thermal State	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (mm/mm/K)	Thermal Diffusivity (m^2/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN+AGE	154.0	13.7×10^{-6}	6.3×10^{-5}	917

VERTICAL

Thermal State	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (mm/mm/K)	Thermal Diffusivity (m^2/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN+AGE	154.0	13.7×10^{-6}	6.3×10^{-5}	917

TENSILE DATA

Tensile testing done in accordance with ASTM E8 and ASTM E21

Test Temperature: RT

Thermal State	Modulus of Elasticity (GPa) H	V	0.2% YS (MPa) H	V	UTS (MPa) H	V	Elongation (%) H	V	Reduction of Area (%) H	V
As-Built	70	68	215	195	375	380	14.5	10.5	--	--
VSR+HIP+SOLN+AGE	67	68	270	255	340	325	11.5	11.5	28.0	27.0

Test Temperature: 150°C

Thermal State	Modulus of Elasticity (GPa) H	V	0.2% YS (MPa) H	V	UTS (MPa) H	V	Elongation (%) H	V	Reduction of Area (%) H	V
As-Built	--	--	--	--	--	--	--	--	--	--
VSR+HIP+SOLN+AGE	55	56	215	210	250	245	15.5	14.5	39.5	38.0

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TYPICAL BUILD RATE

	(cm³/h)
Typical build rate[1] w/coating	13.9 *(13-35)*[3]
Theoretical melting rate[2] bulk per Laser	36.5

[1]Using standard Factory Acceptance Test layout and 2 lasers
[2]Calculated (layer thickness x scan velocity x hatch distance)
[3]The hybrid parameter build rate is strongly dependent on application design, in particular wall thickness. For this parameter, a larger increase in productivity (faster build rate) can be expected for parts having high volume/surface ratios.

PHYSICAL DATA AT ROOM TEMPERATURE

	Surface Roughness Ra** - Overhang (µm)		
	45°	60°	75°
Upskin	6	5	5
Downskin	17	7	5

	Surface Roughness Ra** (µm)
H	20
V	6

	Relative Density (%)		Hardness (HV5)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.6	99.6	103	--	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--

HORIZONTAL **Thermal State**	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (mm/mm/K)	Thermal Diffusivity (m²/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN+AGE	154.0	13.7×10^{-6}	6.3×10^{-5}	917

VERTICAL **Thermal State**	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (mm/mm/K)	Thermal Diffusivity (m²/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN+AGE	154.0	13.7×10^{-6}	6.3×10^{-5}	917

TENSILE DATA

Tensile testing done in accordance with ASTM E8 and ASTM E21

Test Temperature:

RT	Modulus of Elasticity (GPa)		0.2% YS (MPa)		UTS (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	70	69	220	200	380	380	14.0	10.0	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--	--	--	--	--

H: HORIZONTAL (XY) orientation
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