GE Additive

13 Al

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

M2 Series 5 Aluminum AlSi7Mg

Base Parameters for Concept Laser M2 Series 5

Data in this material datasheet represents material built with a 30µm and 60µm layer thickness and 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 Base and Productivity Parameters for the Concept Laser M2 Series 5 are developed leveraging the performance of the previous M2 generations of AlSi7Mg parameters. The Base parameter is a 30 µm parameter 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. Both the Base and Productivity parameters can be used with either a rubber or steel recoater blade, depending on application needs.

M2 Series 5 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 30 and 60µm layer thickness and 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

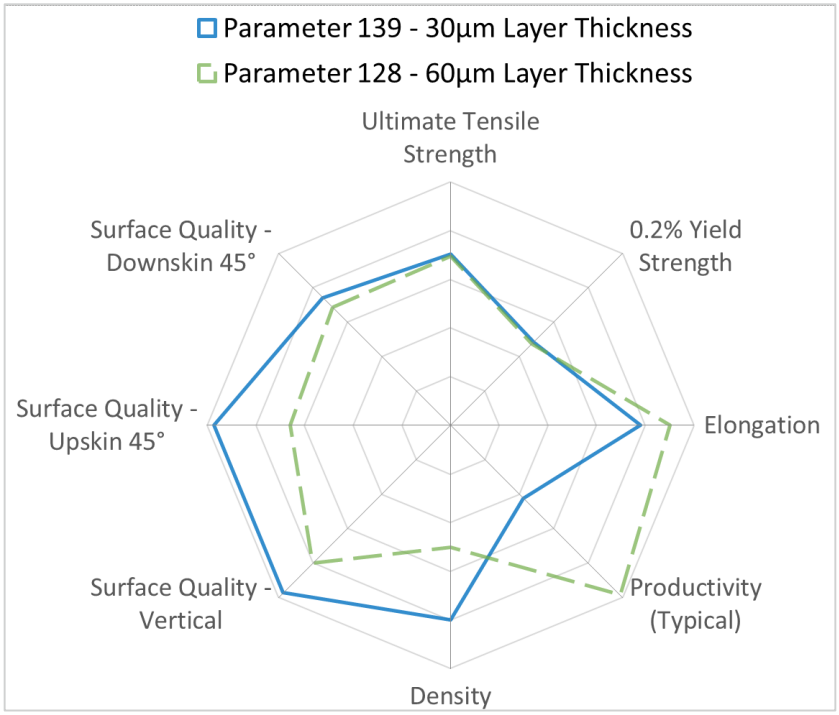
AVAILABLE PARAMETERS

- **Base Parameter 129** 30 µm layer thickness, rubber recoater
- **Base 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

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: 0-550 MPa, 0.2%YS: 0-450 MPa, Density: 99-100%, Elongation: 0-20%, Productivity: 5-30 cm³/hr, Surface Quality (all): 40-5 µm

TYPICAL BUILD RATE

Parameters 129 & 139

	(cm³/h)
Typical build rate[1] w/coating	13.6
Theoretical melting rate[2] bulk per Laser	19.4

[1]Measured by using standard Factory Acceptance Test layout
[2]Calculated (layer thickness x scan velocity x hatch distance)

PHYSICAL DATA AT ROOM TEMPERATURE

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

	Surface Roughness (µm)
H	16
V	6

	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

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	17.6	14.4	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--	--	--	--	--

Temperature: 150°C

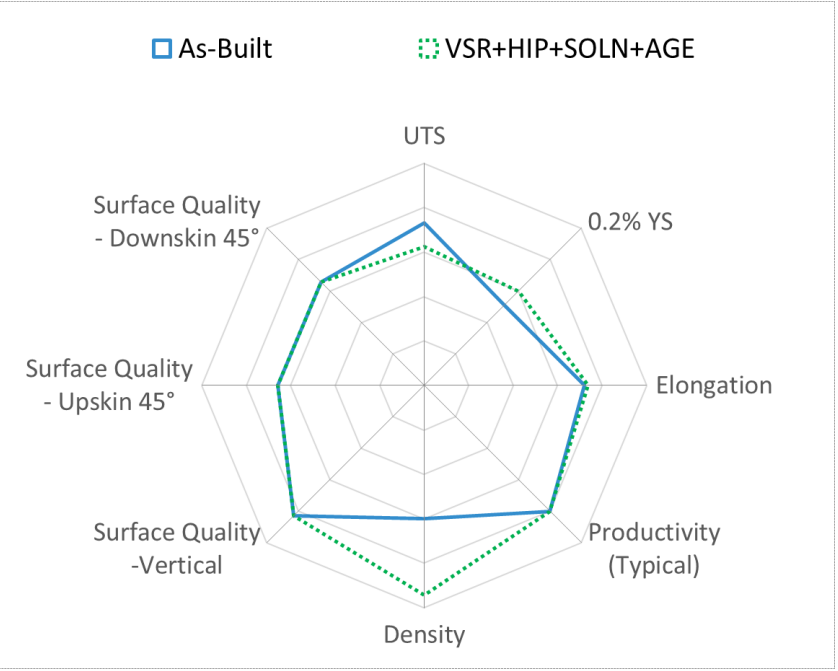
	Modulus of Elasticity (GPa)		0.2% YS (MPa)		UTS (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	--	--	--	--	--	--	--	--	--	--
VSR+HIP+SOLN+AGE	--	--	--	--	--	--	--	--	--	--

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.

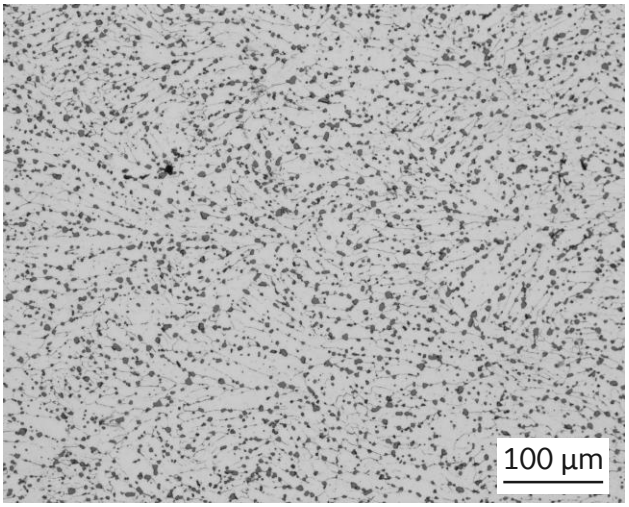
THERMAL STATE COMPARISON

Parameters 128 & 138

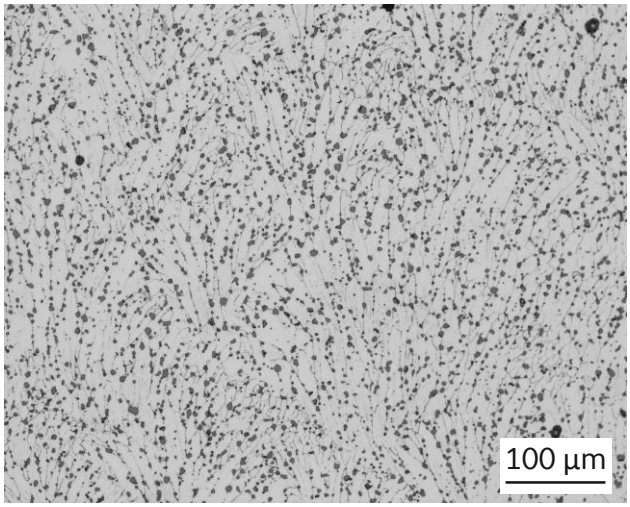


Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For **Aluminum Alloys,** the ranges are as follows: UTS: 0-550 MPa, 0.2%YS: 0-450 MPa, Elongation: 0-20%, Density: 99-100%, Productivity: 5-30 cm^3/hr, Surface Quality (all): 40-5 µm

TYPICAL MICROSTRUCTURE



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



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

TYPICAL BUILD RATE

	(cm³/h)
Typical build rate[1] w/coating	29.6
Theoretical melting rate[2] bulk per Laser	39.3

[1]Measured by using standard Factory Acceptance Test layout
[2]Calculated (layer thickness x scan velocity x hatch distance)

PHYSICAL DATA AT ROOM TEMPERATURE

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

	Surface Roughness (µm)
H	24
V	12

	Porosity (% Density)		Hardness (HV5)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.5	99.5	100	--	--	--
VSR+HIP+SOLN+AGE	99.94	99.94	--	--	0.352	--

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

VERTICAL	Thermal Conductivity	Coeff. Of Thermal Expansion	Thermal Diffusivity	Specific Heat
Thermal State	(W/m•K)	(mm/mm/K)	(m²/s)	(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

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	68	215	195	375	380	14.9	10.7	--	--
VSR+HIP+SOLN+AGE	67	68	270	255	340	325	11.8	11.9	28.4	27.2

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	55	56	215	210	250	245	15.8	14.7	39.9	38.3

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

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