13 Al

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

M2 Series 5 Aluminum Al-Si10-Mg

Parameter for GE Additive's Concept Laser M2 Series 5

Data in this material datasheet represents material built with a 40 µm layer thickness and in a nitrogen atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine. Values listed are typical.

Aluminum Al-Si10-Mg

Al-Si10-Mg has a chemical composition according to ASTM F3318 and is an essential Aluminum alloy in the world of additive manufacturing. As good casting alloy for complex geometries, it combines light weight and excellent thermal conductivity. The alloy is ideally suited for part designs with thin walls such as ductwork or heat exchangers. Once post-processed, parts offer good strength and hardness superior to conventionally cast material, as well as good dynamic properties for industries in the aerospace, automotive, automation and tooling sectors. In summary this aluminum alloy holds great promises to bring additive manufacturing to high volume consumer applications.

M2 Series 5 Al-Si10-Mg

The Al-Si10-Mg parameter for the Concept Laser M2 Series 5 are developed leveraging the performance of the previous M2 generations. The parameter was developed using plasma atomized Al-Si10-Mg powder from AP&C. The balanced parameter is a 40 µm parameter that produces surface roughness less than 10 µm without bead blast or shot peening, while delivering good productivity with dual lasers. In particular the down- and upskin areas were further improved to ensure consistent high surface quality across different angles. Moreover, the mechanical properties succeed the limits specified in ASTM F3318 for additive manufactured parts in the as-built and stress relieved (SR1) state.

Design by TUfast

M2 Series 5 Aluminum Al-Si10-Mg

With appropriate approval* Al-Si10-Mg can be used for lightweight components in aerospace and industrial applications.

Data in this material datasheet represents material built 40 µm layer thickness and in a nitrogen atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine.
Values listed are typical.

POWDER CHEMISTRY

Aluminum Al-Si10-Mg powder chemical composition according to ASTM F3318.
For additional information on Al-Si10-Mg powder, visit https://www.advancedpowders.com/powders/aluminum/al-si10-mg.

MACHINE CONFIGURATION

- Concept Laser M2 Series 5 (single-laser or dual-laser)
- Nitrogen gas
- Rubber

AVAILABLE PARAMETER

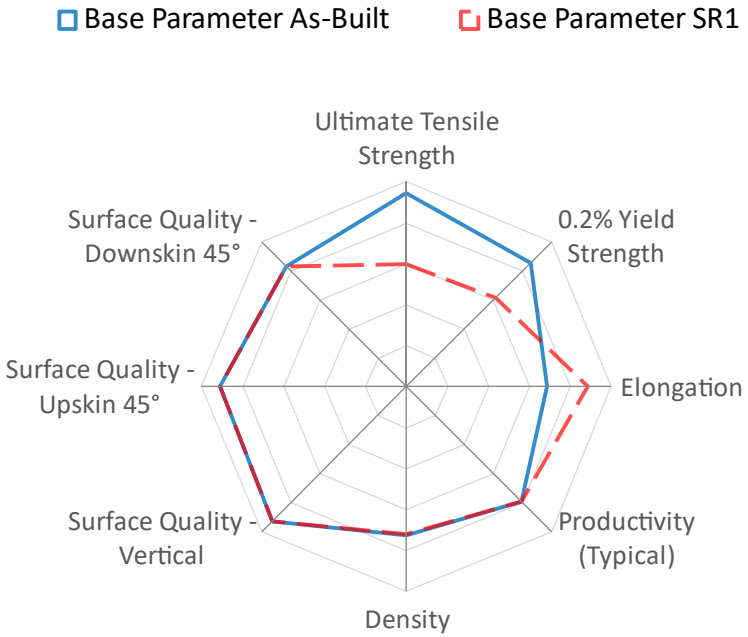
- **Base Parameter 258 / 281**** 40 µm layer thickness, rubber recoater

**Productivity optimized version (productivity bundle required)

THERMAL STATES

1. As-Built
2. Stress relief (SR1)
   Stress relief 295°C, 2 hours, cooled in air

THERMAL TREATMENT COMPARISON



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: 0-500 MPa, 0.2%YS: 0-300 MPa, Elongation: 0-20 %, Density: 99-100 %, Productivity: 5-30 cm³/h, Surface Quality (all): 40-5 µm

TYPICAL BUILD RATE

Base Parameter

	Standard (cm³/h)	Productivity optimized (cm³/h)
Typical build rate[1] w/coating	19.1	23.8
Theoretical melting rate[2] bulk per Laser	28.1	28.1

[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	9	7	6
Downskin	11	9	9

	Surface Roughness Ra** (µm)
H	19
V	8

	Relative Density (%)		Hardness (HV5)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.7	99.7	122	--	--	--
SR1	--	--	90	--	--	--

TENSILE DATA

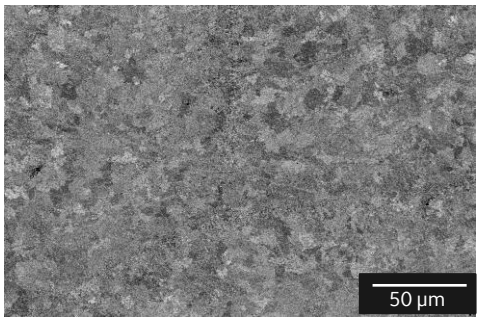
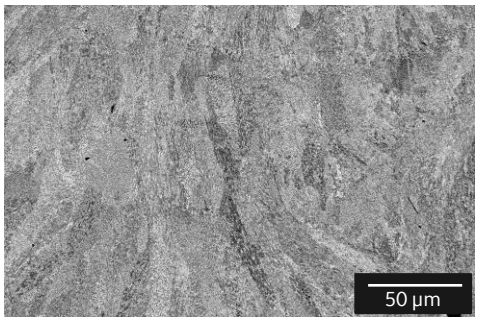
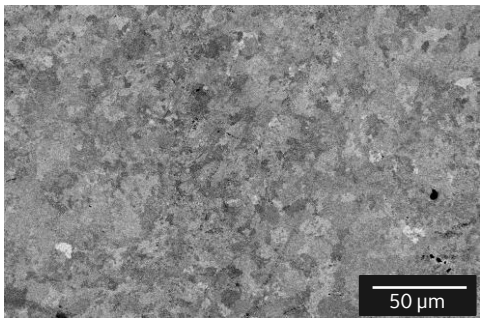
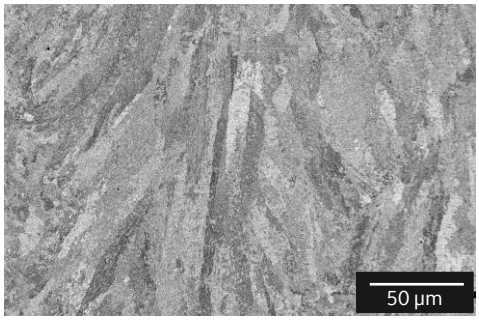
Tensile testing done in accordance with ASTM E8 and ASTM E21

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	70	68	270	240	465	475	9.0	6.0	10.0	6.5
SR1	66	62	185	180	295	300	15.5	12.0	40.5	33.0

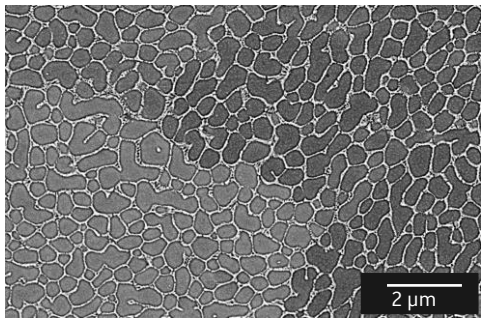
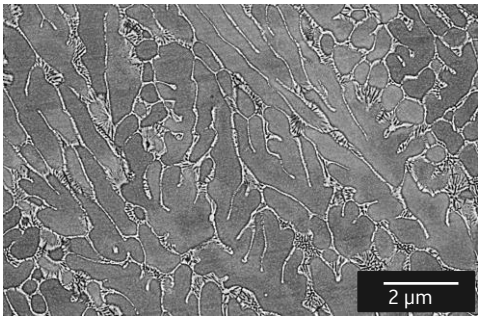
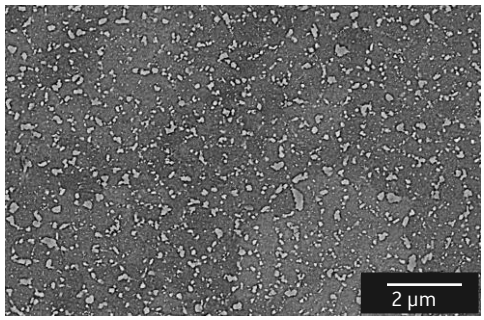
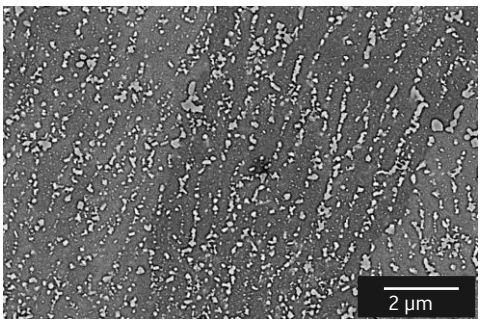
H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

* 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.

SEM IMAGES (low magnification)

	Horizontal	Vertical
As-Built		
SR1		

SEM IMAGES (high magnification)

	Horizontal	Vertical
As-Built		
SR1		

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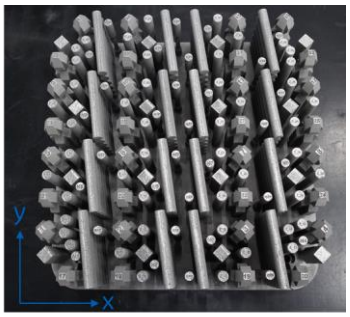
PLATFORM STABILITY

Base Parameter

The platform stability build evaluates porosity, roughness and tensile properties across different positions and orientations. To illustrate the position dependency of the M2 Series 5, the samples were homogenously distributed across the platform on 16 different positions. Regarding surface quality all sides of the specimen, so all orientations with respect to gas flow and optical system, are included in the analysis. Data shown below are dependent on part & print layout as well as batch chemistry variations and thus might deviate from “typical values” given on previous pages.

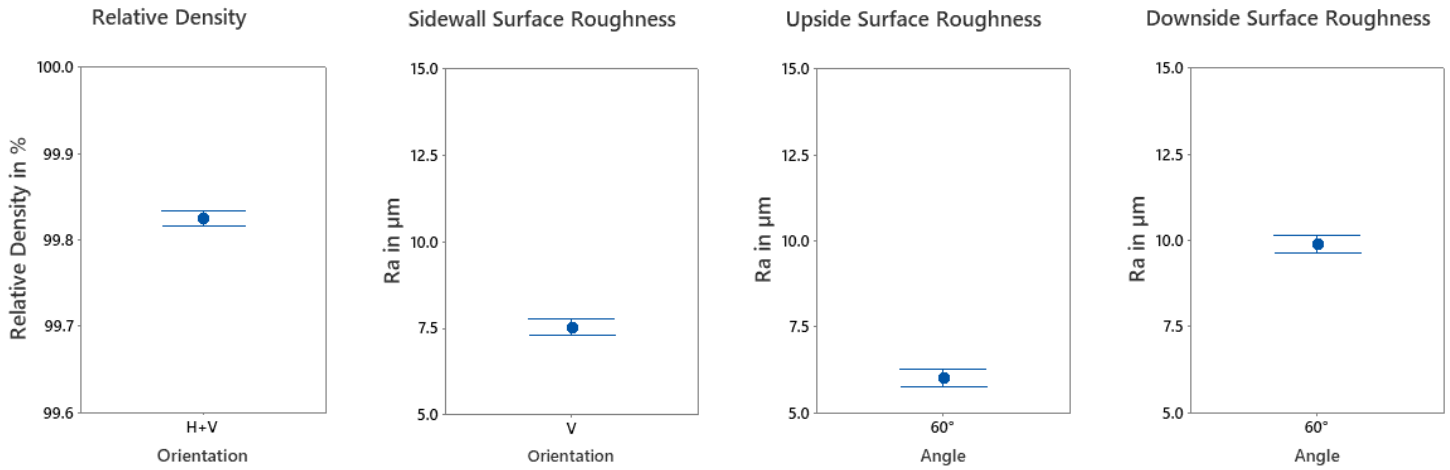
BUILD JOB DESIGN AND SUMMARIZED DATA (AS-BUILT)



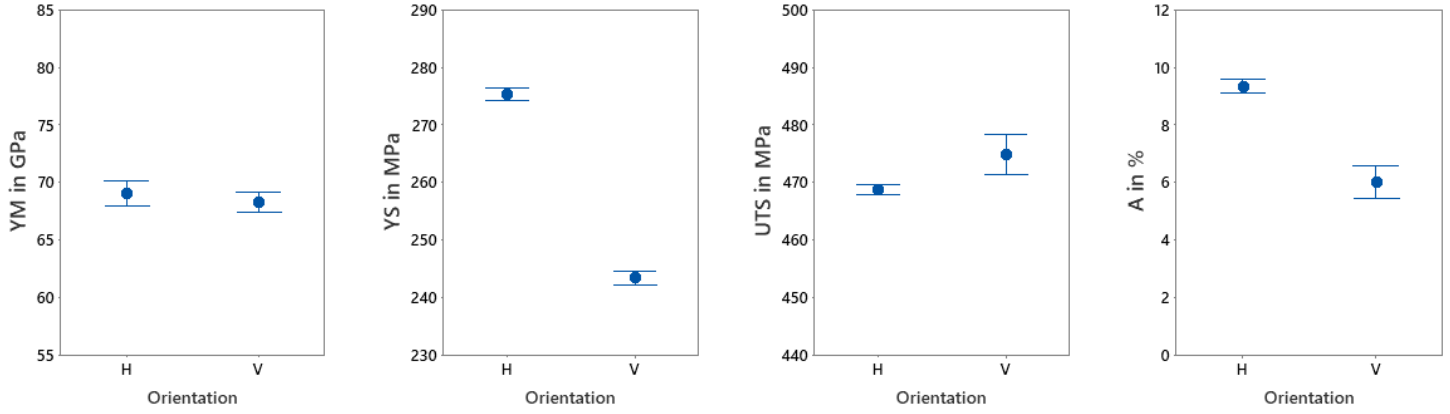
	Sample Size	Mean	St.Dev.
Rel. Density in %	32	99.83	0.03
Sidewall Roughness Ra in µm	64	8	1
Upside Roughness Ra in µm (60°)	64	6	1
Downside Roughness Ra in µm (60°)	64	10	1

	Sample Size	Mean	St.Dev.
YM in GPa (H/V)	16/16	69/68	2/2
YS in MPa (H/V)	16/16	275/243	2/2
UTS in MPa (H/V)	16/16	469/475	1/7
Elongation in % (H/V)	16/16	9.4/6.0	0.4/1.1

RESULTS – RELATIVE DENSITY AND SURFACE QUALITY



RESULTS - MECHANICAL PROPERTIES IN AS-BUILT CONDITION



Data points represent the mean value, intervals the 95% confidence level.

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