GE Additive

13 Al

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

M2 Series 5 Aluminum A205

Parameters for GE Additive's Concept Laser M2 Series 5

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

High-strength aluminum alloy A205

A205 is a lightweight aluminum alloy derived from the aerospace-approved A20X™ alloy. Due to a unique solidification mechanism, this material exhibits a highly refined microstructure leading to exceptional high strength, exceeding e.g. the yield strength of AlSi10Mg by more than 150 MPa (+60%) in the T7 or T6 state, respectively. Additionally, A205 demonstrates excellent thermal stability, stress corrosion resistance, and comparatively superior fatigue properties to other AlSi-based additively manufactured alloys. These superior properties – achieved through high cooling rates to create a high-density, crack-free, and finely scaled cellular microstructure – make A205 an excellent choice for additively manufactured applications.

M2 Series 5 A205

The novel A205 parameter has recently been developed for the M2 Series 5 machine. The base parameter is a 40 µm parameter that produces surface roughness less than 10 µm without bead blasting or shot peening, while delivering good productivity with dual lasers. The high density of the parts leads to extraordinary elongation, superior to castings of the same alloy (AMS4471) and reaching the same strength level. The base parameter can be used with either a rubber or steel recoater blade, depending on application needs.

M2 Series 5 A205

With appropriate approval*, A205 can be used for lightweight components in aerospace and industrial applications.

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

POWDER CHEMISTRY

Aluminum A205 powder chemical composition according to AMS 4471.

MACHINE CONFIGURATION

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

AVAILABLE PARAMETERS

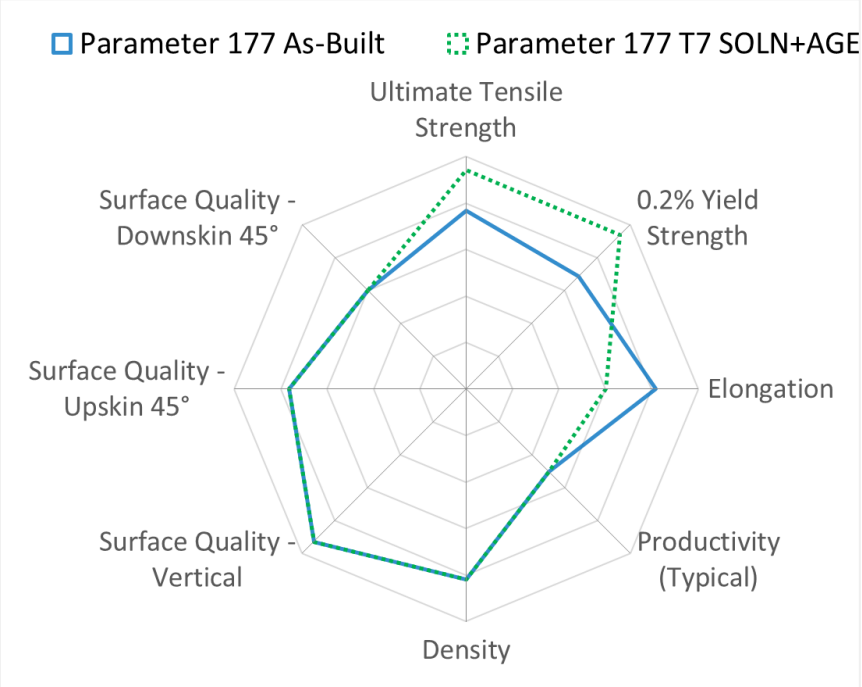
- **Base Parameter 177** – 40 µm layer thickness, rubber recoater
- **Base Parameter 179** – 40 µm layer thickness, steel recoater

THERMAL STATES

1. As-built
2. T7 solution + age (T7 SOLN + AGE)

Please contact GE Additive for more details regarding the heat treatment.

HEAT TREAT COMPARISON



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: 0-20%, Productivity: 5-30 cm³/hr, Surface Quality (all): 5-40 µm.

TYPICAL BUILD RATE

Base Parameter

	(cm³/h)
Typical build rate[1] w/coating	17.6
Theoretical melting rate[2] bulk per Laser	25.2

[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[3]

		Surface Roughness Ra** - Overhang (µm)		
		45°	60°	75°
Upskin	Mean	14.0	11.5	9.5
	St.Dev.	1.1	0.9	0.9
Downskin	Mean	19.3	12.0	7.3
	St.Dev.	2.1	1.1	0.6

		Surface Roughness Ra** (µm)
H	Mean	19.5
	St.Dev.	1.9
V	Mean	7.7
	St.Dev.	1.0

Thermal State		Relative Density (%)		Hardness (HV5)		Poisson's Ratio	
		H	V	H	V	H	V
As-Built	Mean	99.87	99.86	106.9	--	--	--
	St.Dev.	0.06	0.06	1.3			
T7 SOLN + AGE	Mean	99.87	99.86	--	--	--	--

[3] The physical data at room temperature have been generated using one (1) powder lot and one (1) Series 5 machine and three (3) FAT builds and minimum 24 tests per angle or orientation in the as-built state.

TENSILE DATA[4]

Tensile testing done in accordance with ASTM E8 and ASTM E21

Temperature: RT

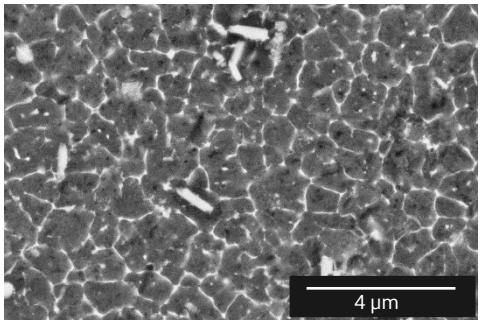
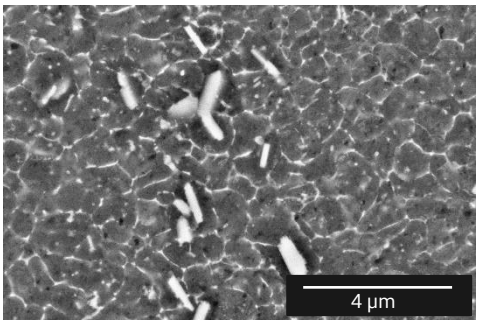
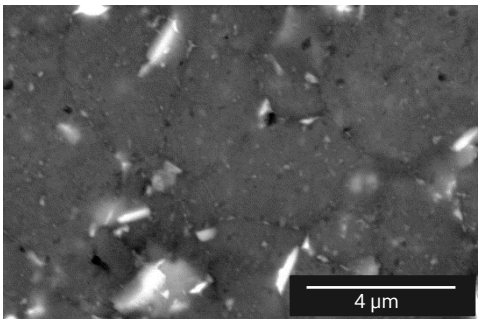
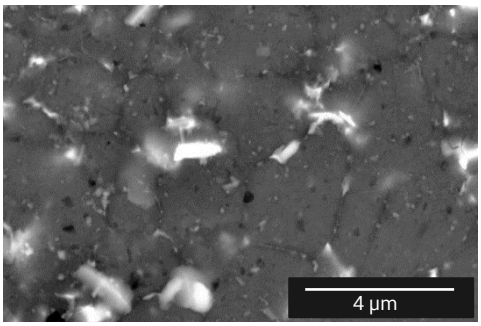
Thermal State		Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)		Elongation (%)	
		H	V	H	V	H	V	H	V
As-Built	Mean	75	75	319	277	388	388	17.7	14.3
	St.Dev.	2	5	10	7	3	3	1.5	1.5
T7 SOLN + AGE	Mean	74	75	395	400	465	470	9.0	6.6

[4] The tensile data at room temperature have been generated using one (1) powder lot and one (1) Series 5 machine and five (5) FAT builds and minimum 36 tests per orientation in the as-built state.

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

*Industry-specific certifications and/or approvals rely on a number of factors. Customer cannot rely on any data presented herein as binding or as a guarantee of repeatability.
** 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

	Horizontal	Vertical
As-Built		
T7 SOLN + AGE		

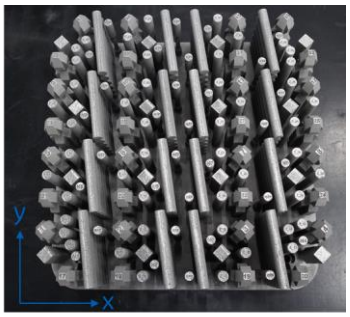
H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

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.

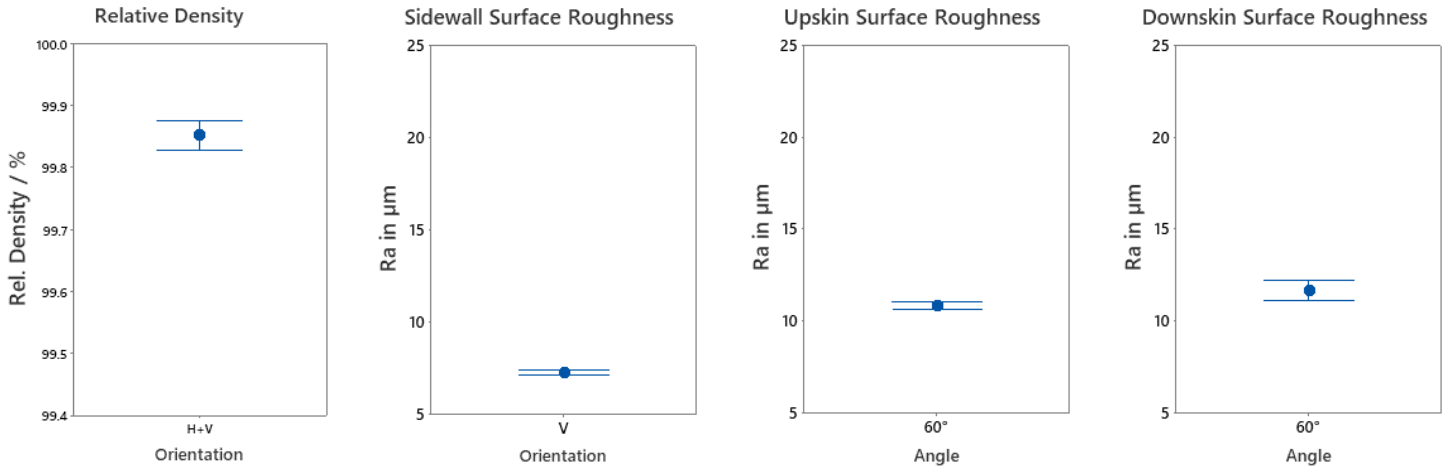
BUILD JOB DESIGN AND SUMMARIZED DATA (AS-BUILT)



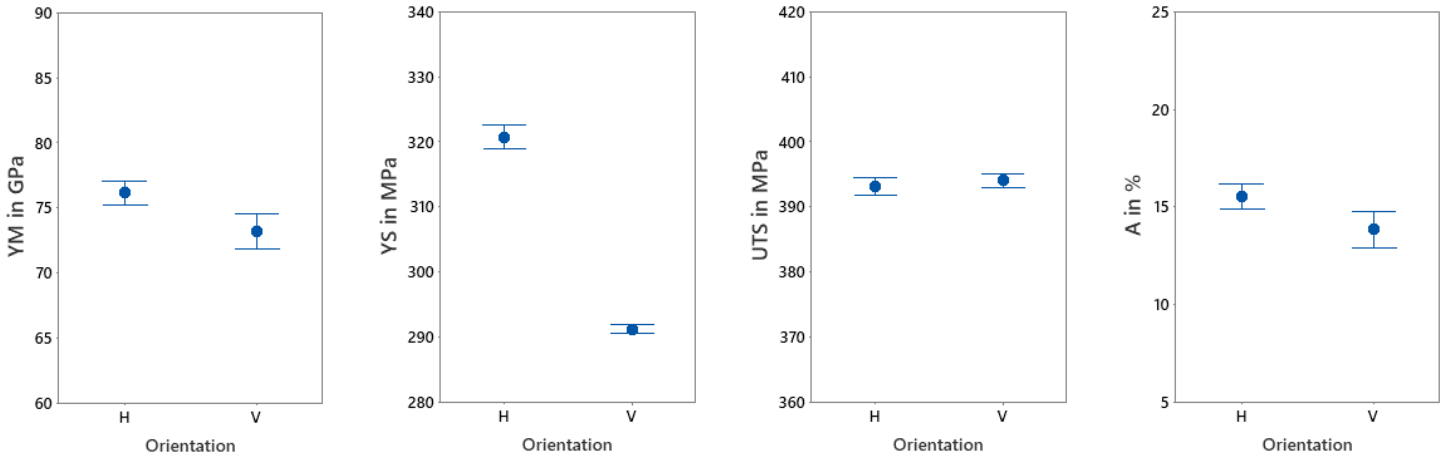
	Sample Size	Mean	St.Dev.
Rel. Density in %	30	99.85	0.06
Sidewall Roughness Ra in µm	128	7	1
Upside Roughness Ra in µm (60°)	128	11	1
Downside Roughness Ra in µm (60°)	128	12	3

	Sample Size	Mean	St.Dev.
YM in GPa (H/V)	16/16	76/73	2/3
YS in MPa (H/V)	16/16	321/291	3/1
UTS in MPa (H/V)	16/16	393/394	3/2
Elongation in % (H/V)	16/16	15.5/13.8	1.2/1.8

RESULTS – RELATIVE DENSITY AND SURFACE QUALITY



RESULTS - MECHANICAL PROPERTIES IN AS-BUILT CONDITION



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

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