COLIBRIUM ADDITIVE
a GE Aerospace company

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

L-PBF Aluminum A205

Parameters for Colibrium Additive's M2 Series 5 use of A20X™* Alloy

Aluminum A205

A20X™ is the registered trademark for aluminum alloy A205. 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 state. Additionally, A205 demonstrates excellent thermal stability, stress corrosion resistance, and comparatively superior fatigue properties to other AlSi-based additively manufactured alloys. These superior properties make this material an excellent choice for additively manufactured applications.

M2 Series 5 Aluminum A205

Colibrium Additive developed a novel A205 parameter for use with the M2 Series 5 machine. The balanced 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 balanced parameter can be used with either a rubber or steel recoater blade, depending on application needs.

*A20X™ is a registered trademark of ECKART GmbH. Colibrium Additive is not affiliated with ECKART GmbH.

M2 Series 5 Aluminum A205

Machine Configuration

M2 Series 5

Single- or dual-laser architecture

Nitrogen gas

Powder Chemistry

A20X™ powder chemical composition according to AMS 7033 as provided by ECKART GmbH.

Particle size: 10-53 µm

Thermal States

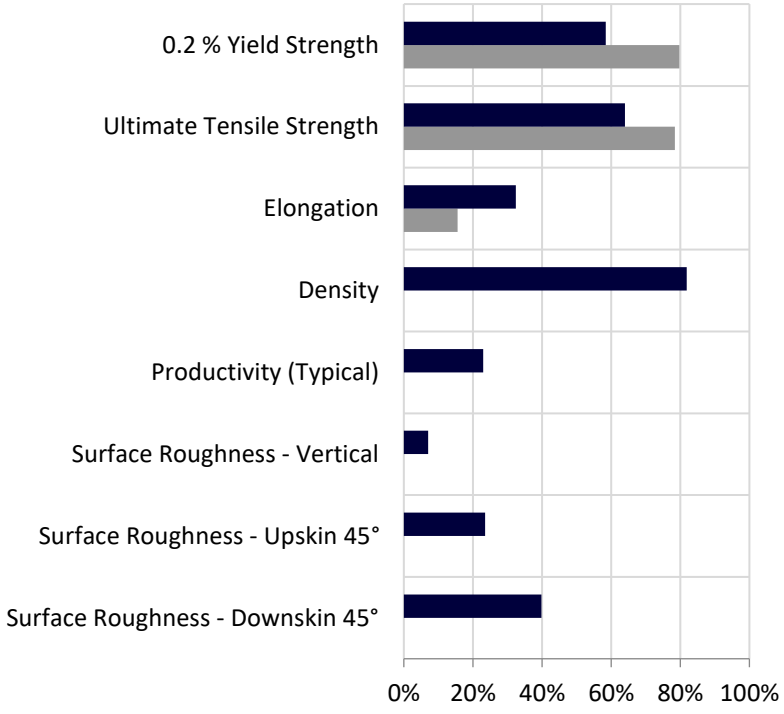
As-Built (AB)

T7 Solution Annealed + Age (T7 SOLN + AGE)

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

Parameter Availability and Thermal State Comparison

- Balanced Parameter 177/179 AB
  400 W, 40 µm layer thickness,
  rubber/ steel recoater
- Balanced Parameter 177/179
  T7 SOLN+AGE
  400 W, 40 µm layer thickness,
  rubber/ steel recoater



Bar plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For high strength aluminum-based alloys, the ranges are as follows: 0.2%YS: 0-500 MPa UTS: 0-600 MPa, Elongation: 0-50%, Density: 99-100%, Productivity: 5-60 cm^3/h, Surface Quality (all): 5-40 µm. 0% in the bar plot indicates the lower range value, 100% indicates the upper range value

Balanced Parameter 177/179 - 400 W / 40 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	17.6
Theoretical melting rate bulk per laser[2]	25.2

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

Tensile Performance at Room Temperature

Thermal State	Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)	
	H	V	H	V	H	V
As-Built	75	75	315	275	385	385
T7 SOLN+AGE	74	75	395	400	465	470

Thermal State	Elongation (%)	
	H	V
As-Built	17.5	14.0
T7 SOLN+AGE	9.0	6.5

Physical Properties at Room Temperature

Parameter 177/179

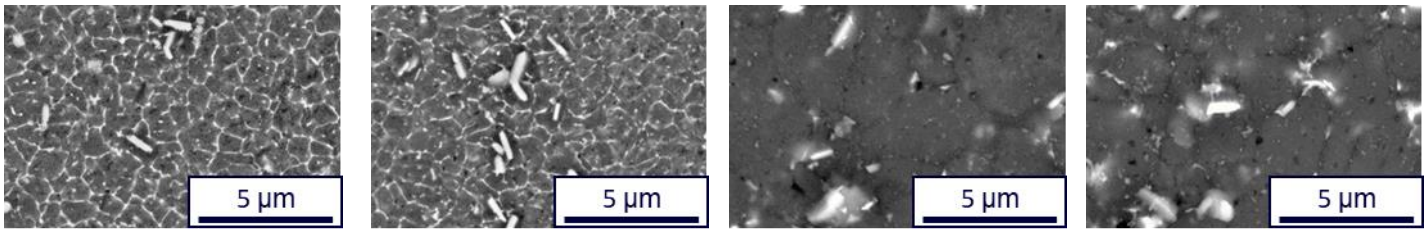
	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	14	12	10
Downskin	20	12	8

Surface Roughness, Ra (µm)	
H	20
V	8

Thermal State	Relative Density (%)		Hardness (HV5)
	H	V	H
As-Built	99.8	99.8	107

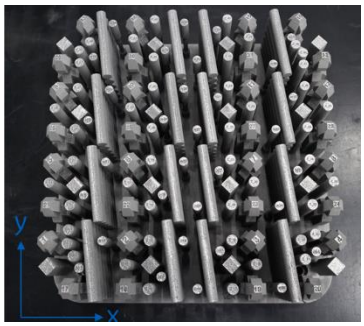
Microstructure

As-Built		T7 SOLN+AGE	
H	V	H	V



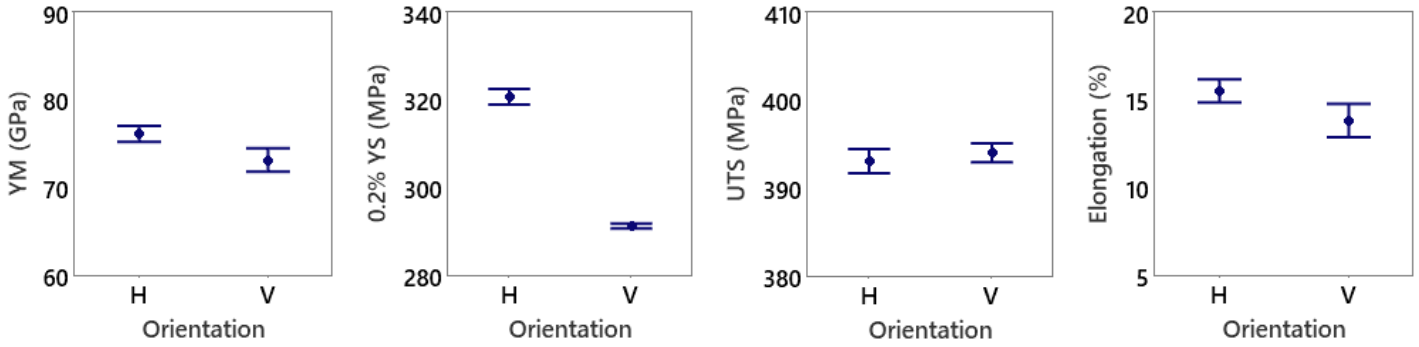
Scanning electron microscope images in As-Built and T7 Solution Annealed + Age condition as defined previously.

The platform stability build evaluates relative density, 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.

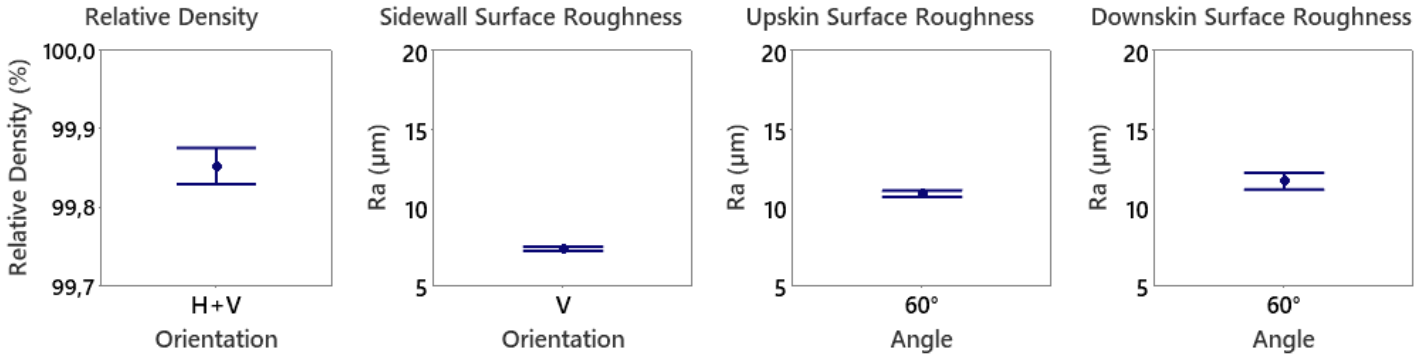


	Sample Size	Mean	Std. Dev.		Sample Size	Mean	Std. Dev.
YM (GPa) H/V - AB	16/16	76/73	2/3	Rel. Density (%)	30	99.85	0.06
0.2% YS (MPa) H/V - AB	16/16	321/291	3/1	Sidewall Roughness Ra (µm)	128	7.3	0.8
UTS (MPa) H/V - AB	16/16	393/394	3/2	60° Upskin Roughness Ra (µm)	128	10.8	1.2
Elongation (%) H/V - AB	16/16	15.5/13.8	0.3/0.5	60° Downskin Roughness Ra (µm)	128	11.7	3.0

Results Platform Stability: Mechanical properties in As-built condition



Results Platform Stability: Relative Density and Surface Quality



Data Sheet Nomenclature and Notation

H: Horizontal, perpendicular to build direction.
V: Vertical, parallel to build direction.
Other angles are measured from horizontal.

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.

Tensile evaluations were performed according to ASTM E8 or E21, depending on test temperature.