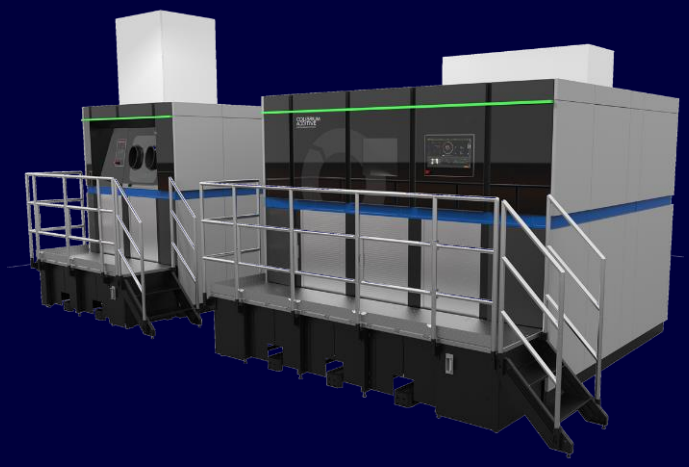
COLIBRIUM ADDITIVE
a GE Aerospace company

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

L-PBF Cobalt Chrome

Parameter for Colibrium Additive's M Line



Cobalt Chrome

Parts are fabricated from cobalt chrome alloys like ASTM F75 CoCr when excellent resistance to high temperatures, corrosion and wear is critical. It is an appropriate selection where nickel-free components are required, such as in orthopedic and dental applications due to the hardness and bio-compatibility necessary for long-term performance. Cobalt chrome alloys are used in additive manufacturing to print parts that often benefit from hot isostatic pressing (HIP), which combines high temperatures and pressures to induce a complex diffusion process that strengthens grain structures, producing fully dense metal parts.

M Line Cobalt Chrome

The CoCr parameters for the Colibrium Additive M Line are developed leveraging the performance of the previous machine generations. The base parameters deliver good surface quality while maintaining a very good density. The parameter has been optimized for use of steel blade recoater.

M Line Cobalt Chrome

Machine Configuration

M Line

Quad-laser architecture

Nitrogen gas

Powder Chemistry

Cobalt Chrome (CoCrMo) powder chemical composition according to ASTM F75

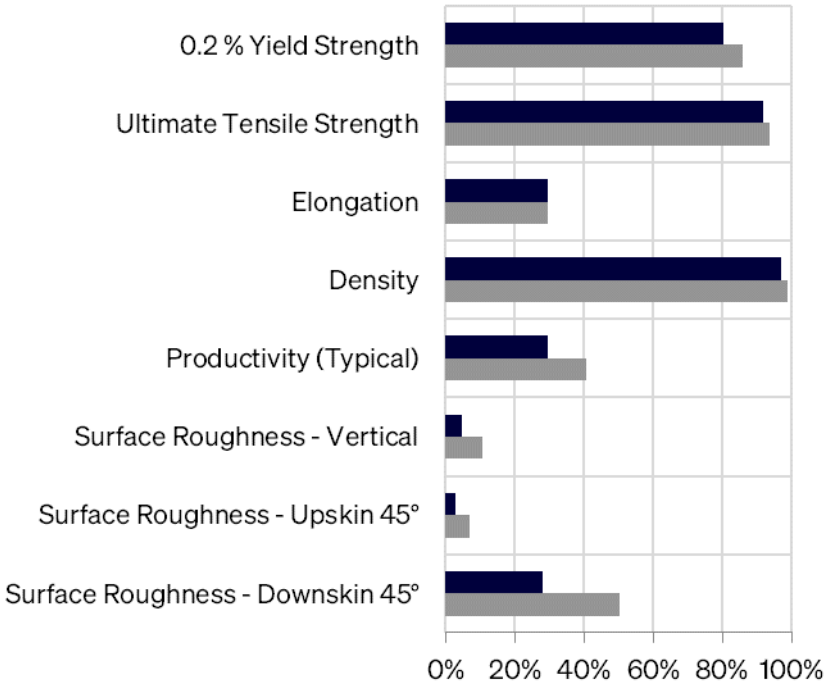
Particle Size: 5-45 µm

Thermal States

As-Built (AB)

Parameter Availability and Thermal State Comparison

- Base Parameter 190 AB
  400 W, 50 µm layer thickness, steel recoater
- Base Parameter 320 AB
  400 W, 50 µm layer thickness, 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 Cobalt alloys, the ranges are as follows: 0.2% YS: 0-1150 MPa, UTS: 0-1450 MPa, Elongation: 0-60 %, 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.

Base Parameter 190 - 400 W / 50 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	21.2
Theoretical melting rate bulk per laser[2]	14.6

[1] Using standard Factory Acceptance Test layout and 4 lasers
[2] Calculated (layer thickness × scan velocity × hatch distance)

Tensile Performance at Room Temperature

Thermal State	Sample Size	YM (GPa)	0.2% YS (MPa)	UTS (MPa)	Elongation (%)	Area Reduction (%)
As-Built H	32	219	1035	1385	16.5	14
As-Built H – ST	31	215	1035	1385	14.0	14
As-Built V	47	161	815	1275	20.0	18

Physical Properties at Room Temperature

	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	6	5	4
Downskin	14	7	5

Surface Roughness, Ra (µm)	
H	---
V	7

Thermal State	Relative Density (%)		Hardness (HV10)
	H	V	H
As-Built	99.9	99.9	402

Base Parameter 320 - 400 W / 50 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	27.4
Theoretical melting rate bulk per laser[2]	32.8

[1] Using standard Factory Acceptance Test layout and 4 lasers
[2] Calculated (layer thickness × scan velocity × hatch distance)

Tensile Performance at Room Temperature

Thermal State	Sample Size	YM (GPa)	0.2% YS (MPa)	UTS (MPa)	Elongation (%)	Area Reduction (%)
As-Built H	8	218	1080	1400	14.5	15
As-Built H – ST	8	222	1080	1400	15.0	15
As-Built V	24	175	890	1315	20.5	18

Physical Properties at Room Temperature

	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	7	6	5
Downskin	22	15	7

	Surface Roughness, Ra (µm)
H	---
V	9

Thermal State	Relative Density (%)		Hardness (HV10)
	H	V	H
As-Built	99.9	99.9	405

Data Sheet Nomenclature and Notation

H: Horizontal, X or Y.
V: Vertical, Z.
Other angles are measured from horizontal.

ST: Stitched, parts built by multiple optical systems

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.