COLIBRIUM ADDITIVE
a GE Aerospace company

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

L-PBF Cobalt Chrome Balanced

Parameters for Colibrium Additive's M2 Series 5

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.

M2 Series 5 Cobalt Chrome

This is the machine and parameter developed for the fuel nozzle and other aerospace applications. We have worked closely together with our customers optimizing around speed and productivity, part to part and machine to machine consistency, reliability, uptime and quality control. Thousands of development hours and rigorous testing resulted in unprecedented productivity while offering excellent surface finish, feature resolution, mechanical strength, fatigue capability, and buildability. This parameter is delivering the best balance between productivity and performance.

M2 Series 5 Cobalt Chrome

Machine Configuration

M2 Series 5

Single- or dual-laser architecture

Nitrogen gas

Platform heating: 80°C

Powder Chemistry

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

Particle size: 5 - 45 µm

Thermal States

As-Built (AB)

Vacuum Stress Relief + Hot Isostatic Press + Solution (VSR+HIP+SOLN)

VSR: 1052°C for 2 hours in vacuum
HIP: 1204°C for 3-5 hours, 100 MPa minimum
SOLN: 1190°C for 1 hour in vacuum

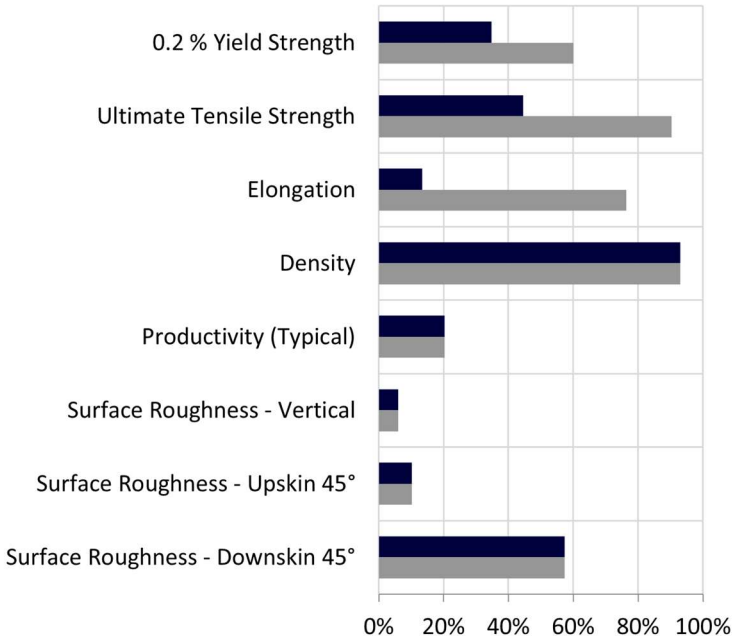
Parameter Availability and Thermal State Comparison

Balanced Parameter 86 AB

400 W, 50 µm layer thickness, steel recoater

Balanced Parameter 86 VSR+HIP+SOLN

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-based 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.

Premium Balanced Parameter 86 - 400 W / 50 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	16.2
Theoretical melting rate bulk per laser[2]	18.0

[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	---	185	---	795	---	1290
VSR+HIP+SOLN	230	225	695	685	1320	1300

Thermal State	Elongation (%)		Area Reduction (%)	
	H	V	H	V
As-Built	---	16.0	---	---
VSR+HIP+SOLN	45.0	46.0	34.0	35.0

Tensile Performance at 1000°F (538 °C)

Thermal State	Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)	
	H	V	H	V	H	V
VSR+HIP+SOLN	180	175	375	365	1200	1185

Thermal State	Elongation (%)		Area Reduction (%)	
	H	V	H	V
VSR+HIP+SOLN	50.0	51.0	37.0	37.0

Physical Properties at Room Temperature

	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	9	7	7
Downskin	26	15	7

Surface Roughness, Ra (µm)	
H	---
V	8

Thermal State	Relative Density (%)		Hardness (HV10)
	H	V	H
As-Built	99.9	99.9	408

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.

HCF testing done in accordance with ASTM E466 – Test Frequency: 60 Hz