COLIBRIUM ADDITIVE
a GE Aerospace company

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

L-PBF CuNi2SiCr

Parameters for Colibrium Additive's M2 Series 5

Copper CuNi2SiCr

CuNi2SiCr is a precipitation hardened copper-based alloy with excellent thermal and electrical conductivity in particular at elevated temperatures. This alloy features a high corrosion resistance as well as robust mechanical properties. It performs best in high temperature applications like heat sinks and heat exchangers. Beside it may also be used in parts within molding systems where wear resistance is desired.

M2 Series 5 CuNi2SiCr

The CuNi2SiCr parameter has recently been developed for the Colibrium Additive M2 Series 5 (1 kW) machine. The balanced parameter is a 50 µm parameter that produces surface roughness less than 10 µm without bead blast or shot peening, while delivering good productivity with dual lasers. Additionally, the parameter is capable to processes complex thin wall structures. In heat treated condition the additive manufactured CuNi2SiCr has an IACS (International Annealed Copper Standard) value of 40% IACS like conventionally processed material.

M2 Series 5 CuNi2SiCr

Machine Configuration

M2 Series 5 (1 kW) with Heat Exchanger

Dual-laser architecture

Nitrogen gas

Platform heating: 100°C

Powder Chemistry

CuNi2SiCr powder chemical composition according to C18000 (similar to CW111C, 2.0855)

Thermal States

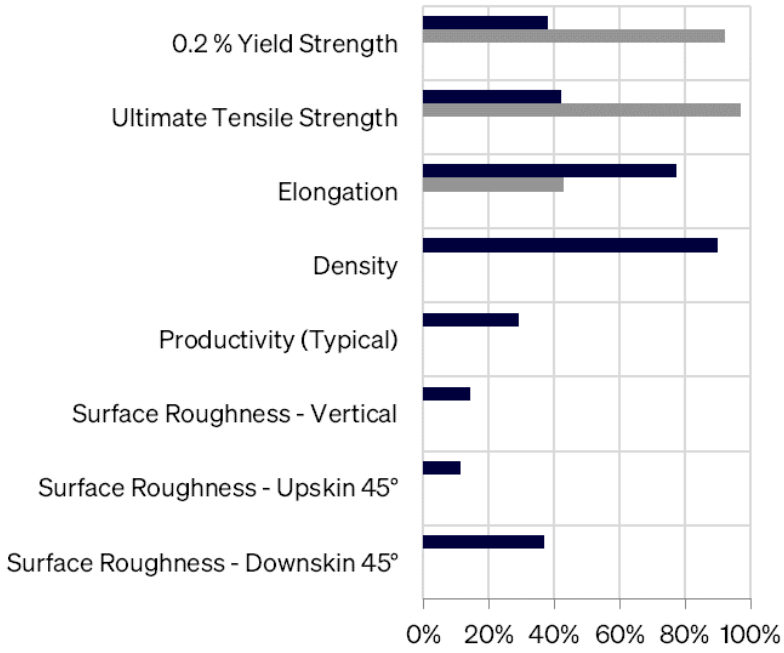
As-Built (AB)

Solution Heat Treatment + Aging (SOLN+AGE)

950°C for 0.5 hour in argon; water quenching; 540°C, 1.25 hours, air cooling

Parameter Availability and Thermal State Comparison

- Balanced Parameter 347 AB
  1 kW, 50 µm layer thickness, rubber recoater
- Balanced Parameter 347 SOLN+AGE
  1 kW, 50 µm layer thickness, rubber 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 copper-based alloys, the ranges are as follows: 0.2%YS: 0-500MPa UTS: 0-600 MPa, Elongation: 0-50%, Density: 99-100%, Productivity: 5-70 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 347 – 1 kW / 50 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	24.1
Theoretical melting rate bulk per laser[2]	23.9

[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	109	83	200	180	275	230
SOLN+AGE	116	98	485	435	620	545

Thermal State	Elongation (%)		Area Reduction (%)	
	H	V	H	V
As-Built	35.5	42.0	85	90
SOLN+AGE	18.0	25.0	46	68

Physical Properties at Room Temperature

	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	9	8	7
Downskin	18	13	9

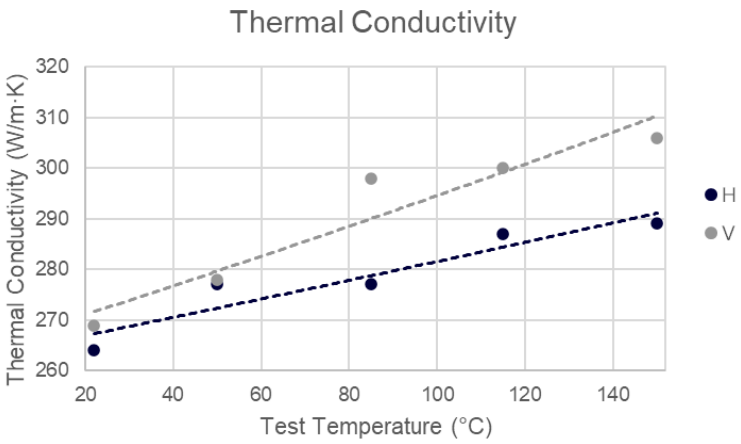
Surface Roughness, Ra (µm)	
H	23
V	10

Thermal State	Relative Density (%)		Hardness (HV5)
	H	V	H
As-Built	99.9	99.9	85
SOLN+AGE	---	---	201

Conductivity Data (SOLN+AGE)

Parameter 347

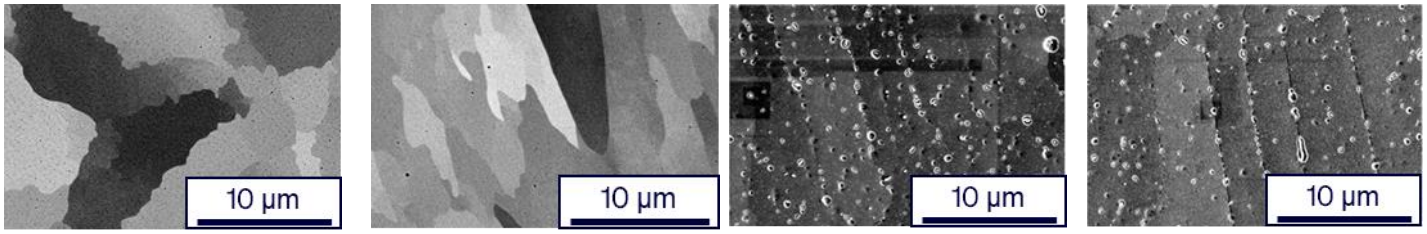
Test Temperature (°C)	Thermal Conductivity (W/m·K)	
	H	V
22	264	269
0	277	278
85	277	298
115	287	300
150	289	306



Test Temperature	Electrical Conductivity			
(°C)	(%IACS)		(MS/m)	
	H	V	H	V
22	40	40	23	23

Microstructure

As-Built		SOLN+AGE	
H	V	H	V



Scanning electron microscope images in As-Built and Solution Heat Treatment with Aging condition as defined previously.

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.

Thermal conductivity measurements have been performed according to ASTM E1004.
Electrical conductivity measurements have been performed according to ASTM E1461.