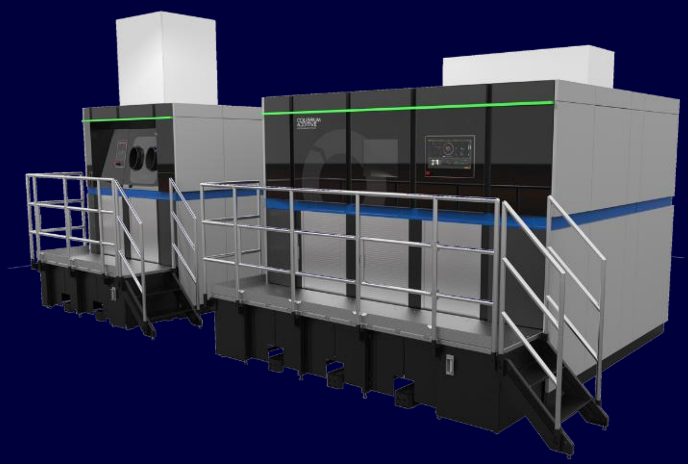
COLIBRIUM ADDITIVE
a GE Aerospace company

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

L-PBF Nickel 718

Parameter for Colibrium Additive's M Line

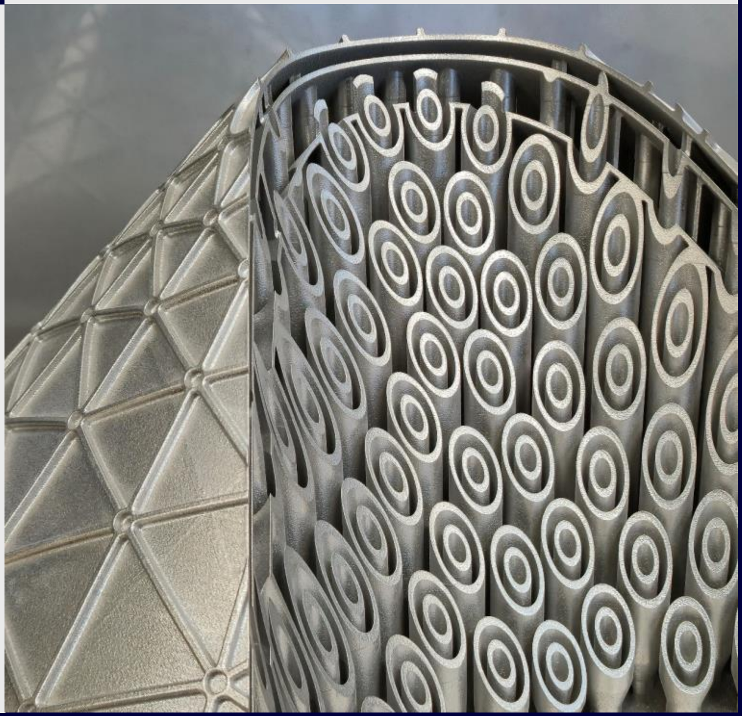


Nickel 718

Nickel chromium superalloys like Nickel 718 are often used in high-stress and high-temperature environments. The excellent high temperature strength and creep resistance derive from precipitation hardening of finely dispersed precipitates. Next to that Nickel 718 is a metal that is also highly resistant to the corrosive effects of hydrochloric acid and sulfuric acid. The favorable weldability of Nickel 718 makes this alloy suitable for additive manufacturing as well. Typical applications are high-quality components designed for thermally challenging environments such as rocket engines, gas-turbine hot sections, and heat exchangers.

M Line Nickel 718

The Nickel 718 parameter for the Colibrium Additive M Line using 1kW lasers are developed for productivity. The productivity parameter provides good density and tensile properties while also producing adequate surface quality. Parameter #423 meets the minimum tensile properties specified in ASTM F3055 for additive manufactured parts in the heat-treated state.



M Line Nickel 718

Machine Configuration

M Line

1kW Quad-laser architecture

Nitrogen gas

Powder Chemistry

Nickel 718 powder chemical composition according to ASTM B 637 UNS N07718.

Particle Size: 15-53 µm

For additional information on Nickel 718 powder, visit: www.advancedpowders.com

Thermal States

As-Built (AB)

Solution + Age (SOLN+AGE)

SOLN: 980 °C, 1 hour in argon; AGE: 720 °C, 8 hours, furnace cooling down to 620 °C, 8 hours, cooling in air

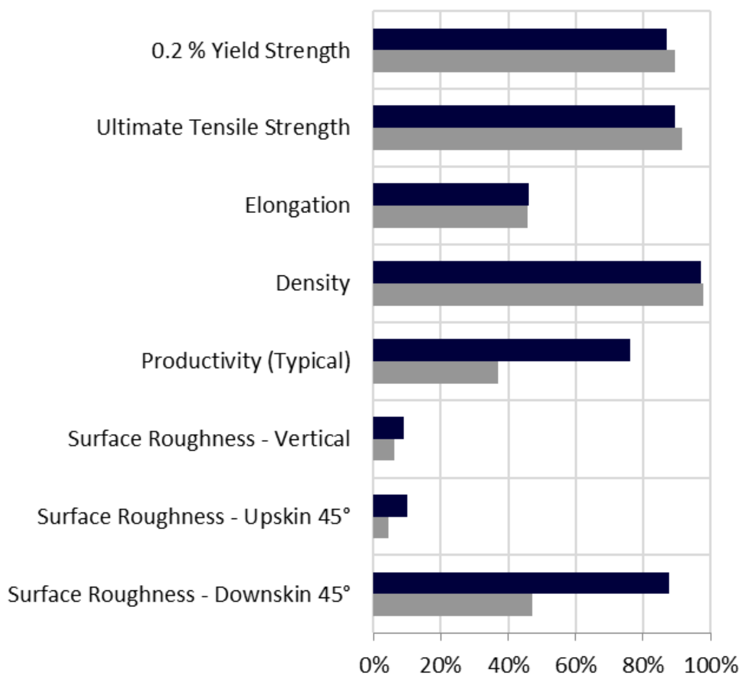
Parameter Availability and Thermal State Comparison

- Productivity Parameter 423 SOLN+AGE

  750 W, 60 µm layer thickness, rubber recoater

- Balanced Parameter 330/381 SOLN

  400 W, 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 this Nickel alloy, the ranges are as follows: 0.2% YS: 0-1400 MPa, UTS: 0-1600 MPa, Elongation: 0-40 %, Density: 99-100 % (As-Built), Productivity: 5-60 cm³/h, Surface Quality (all): 5-55 µm. 0% in the Bar Plot indicates the lower range value, 100% indicates the upper range value

Productivity Parameter 423 - 750 W / 60 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	46.9
Theoretical melting rate bulk per laser[2]	41.5

[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	16	180	735	1040	30.5	46.5
As-Built H - ST	16	179	725	1035	29.5	47.0
As-Built V	48	129	580	955	34.5	56.0
SOLN+AGE H	8	189	1260	1470	17.5	28.5
SOLN+AGE H - ST	8	188	1255	1455	15	29.0
SOLN+AGE V	28	155	1175	1390	20.5	37.5

Physical Properties at Room Temperature

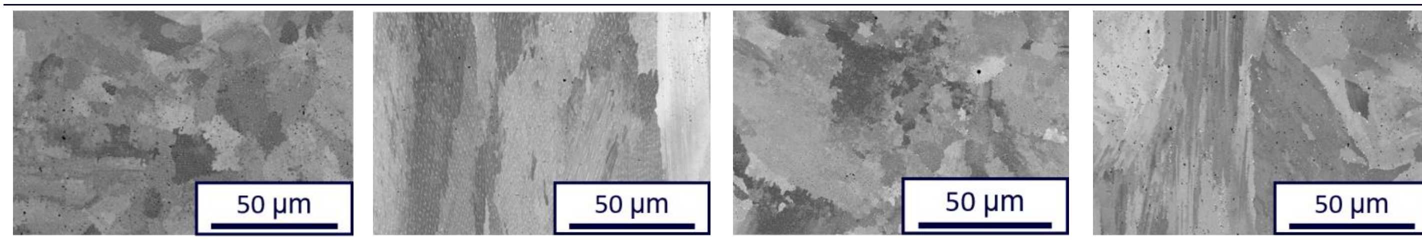
	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	11	7	6
Downskin	49	16	8

Surface Roughness, Ra (µm)	
H	---
V	10

Thermal State	Relative Density (%)		Hardness (HV10)
	H	H	H
As-Built	99.9	99.9	274
SOLN+AGE	99.9	99.9	467

Microstructure

As-Built		SOLN+AGE	
H	V	H	V



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

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.