COLIBRIUM ADDITIVE
a GE Aerospace company

13 Al

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

L-PBF Hot Working Tool Steel H13

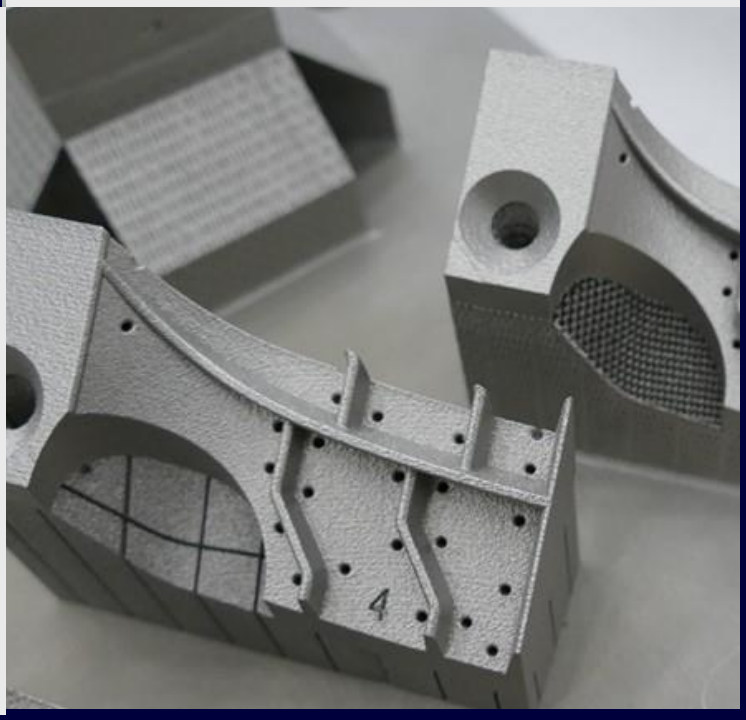
Parameters for Colibrium Additive's M2 Series 5

Hot-Working Tool Steel H13

Hot-working tool steels are a class of medium-carbon high strength alloys that maintain high strength and hardness at elevated temperatures. The combination of high strength and hardness with good wear resistance make hot-working tool steels excellent materials for applications such as pressure die casting, extrusion, die forgings, and other applications requiring hot or cold-working.

M2 Series 5 Hot Working Tool Steel H13

The H13 parameter has been developed for the Colibrium Additive M2 Series 5 machine. The balanced parameter has a layer thickness of 50 µm, enabling surface roughness of less than 8 µm without bead blast or shot peening, while delivering good productivity with dual lasers.



M2 Series 5 Hot Working Tool Steel H13

Machine Configuration

M2 Series 5

Single- or dual-laser architecture

Nitrogen gas

Platform heating: 200°C

Powder Chemistry

Steel H13 powder chemical composition according to ASTM A681

Particle size: 15-45 µm

Thermal States

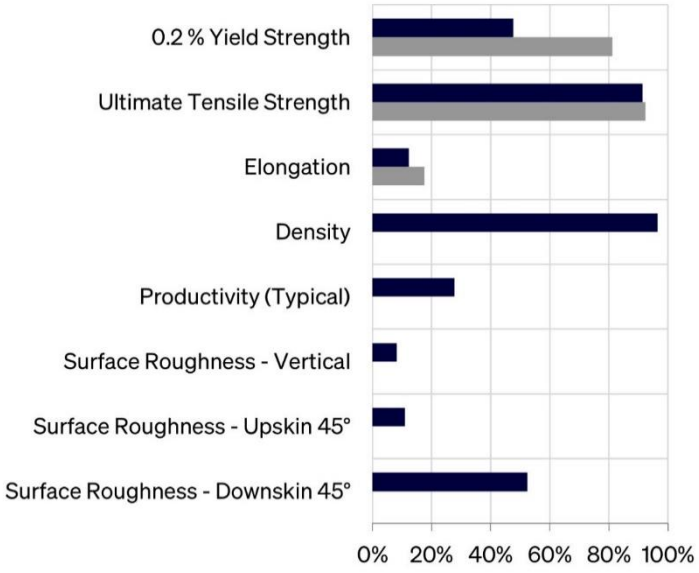
As-Built (AB)

Pre-heating + Austenitizing + Tempering (P+A+T)

P: 788°C for 2 hours, A: 1010°C for 0.25 hour, T: 552°C 2x for 2 hours

Parameter Availability and Thermal State Comparison

- Balanced Parameter 328 AB
  400 W, 50 µm layer thickness, rubber recoater
- Balanced Parameter 328 P+A+T
  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 tool steels, the ranges are as follows: 0.2%YS: 0-1900 MPa, UTS: 0-2000 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 328 - 400 W / 50 µm

Typical Build Rate

	(cm^3/h)
Typical build rate with coating[1]	20.3
Theoretical melting rate bulk per laser[2]	14.0

[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	191	195	825	985	1625	2025
P+A+T	208	210	1510	1565	1820	1870

Thermal State	Elongation (%)	
	H	V
As-Built	2.5	9.5
P+A+T	7.0	10.5

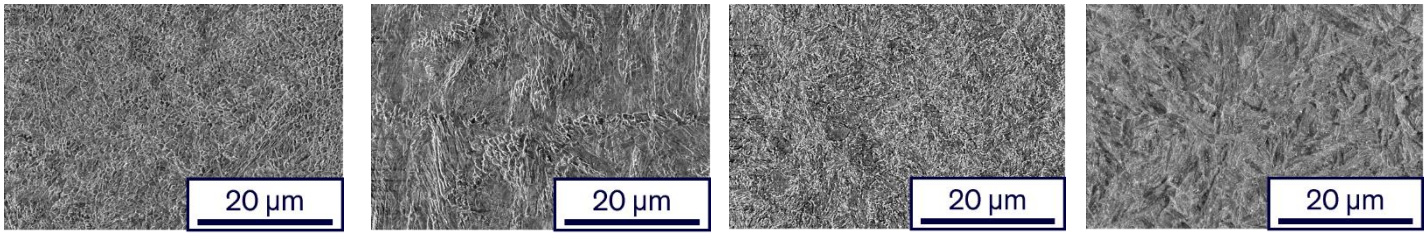
	Overhang Surface Roughness, Ra (µm)		
	45°	60°	75°
Upskin	9	7	5
Downskin	24	12	7

Surface Roughness, Ra (µm)	
H	6
V	8

Thermal State	Relative Density (%)		Hardness (HV10)
	H	V	H
As-Built	99.9	99.9	555
P+A+T	---	---	566

Microstructure

As-Built		P+A+T	
H	V	H	V



Scanning electron microscope images in As-Built and Pre-heating + Austenitizing + Tempering condition as defined previously.

In general, H13 hot-working tool steel is susceptible to microcrack formation. The occurrence of microcracks is highly dependent on the microstructural evolution during solidification and determined by local chemistry and cooling rate conditions. A crack-free microstructure is dependent on batch chemistry variations as well as part design and build job layout.

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.

All figures and data contained herein are approximate and/or typical only and are dependent on several factors including but not limited to process and machine parameters. The information provided on this material data sheet is illustrative only and cannot be considered binding.