13 Al

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

M2 Series 5 Steel H13

Parameter for GE Additive's Concept Laser M2 Series 5

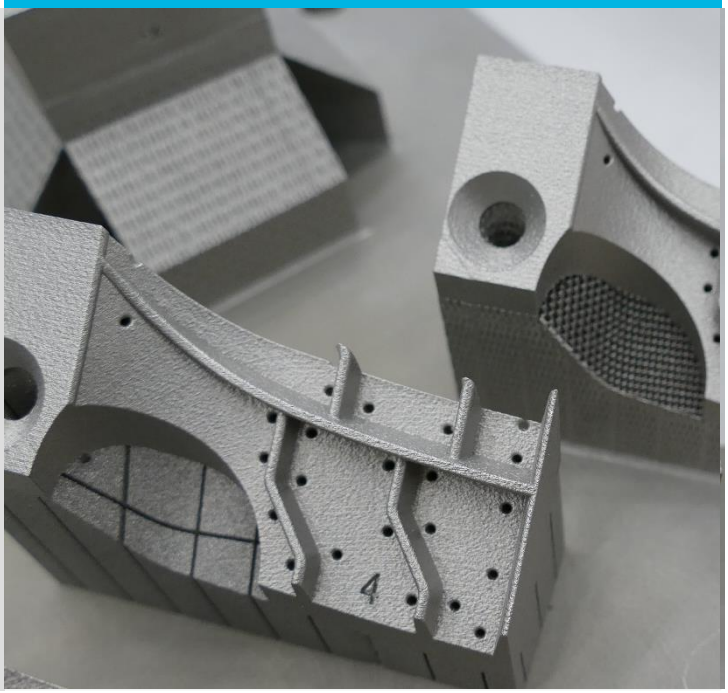
Data in this material datasheet represents material built with 50 µm layer thickness and in a nitrogen atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine and require build plate heating. Values listed are typical.

Hot-Working Tool Steel

Tool Steel H13 has a chemical composition according to ASTM A681. 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 Steel H13

The novel H13 parameter has recently been developed for the M2 Series 5 machine.
The base parameter is a 50 µm parameter that produces surface roughness less than 8 µm without bead blasting or shot peening for most surfaces, while delivering good productivity with dual lasers.



M2 Series 5 H13 Steel

With corresponding approval* H13 Steel can be used for manufacturing pressure die casting, extrusion, die forgings, and other applications requiring hot or cold-working.

Data in this material datasheet represents material built with 50 µm layer thickness and in a nitrogen atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine and require build plate heating. Values listed are typical.

POWDER CHEMISTRY

H13 Steel powder chemical composition et al. according to ASTM A681.

MACHINE CONFIGURATION

- Concept Laser M2 Series 5 (single-laser or dual-laser)
- Nitrogen gas
- Rubber recoater blade

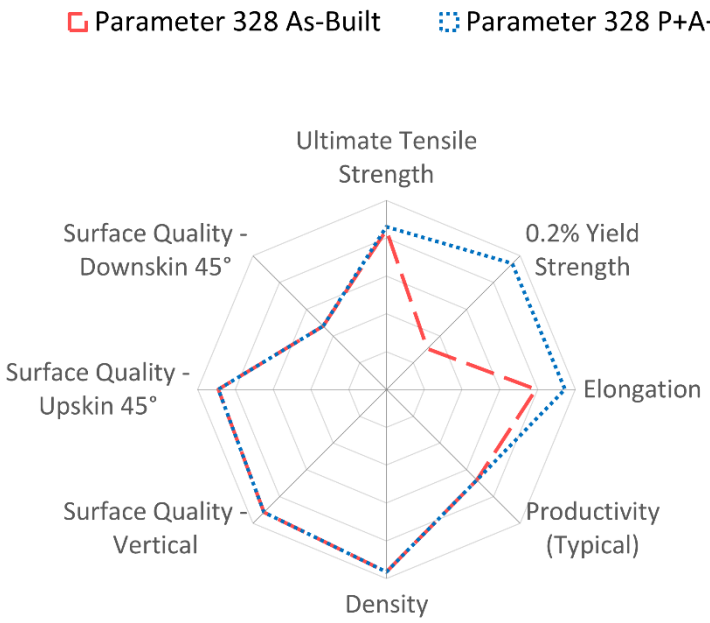
AVAILABLE PARAMETERS

- **Base Parameter 328** 50 µm layer thickness, rubber recoater

THERMAL STATES

1. As-Built
2. Pre-heating + Austenitizing + Tempering (P+A+T)
   P: 788°C, 2 hours, A: 1010°C, 0.25 hours, T: 552°C, 2x 2 hours

HEAT TREAT COMPARISON



Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For **Tool Steel** alloys, the ranges are as follows: UTS: 900-2000 MPa, 0.2%YS: 600-1600 MPa, Elongation: 0-10 %, Density: 99-100 %, Productivity: 5-30 cm^3/h, Surface Quality (all): 40-5 µm

TYPICAL BUILD RATE

Base Parameter 328

	(cm³/h)
Typical build rate[1] w/coating	20.3
Theoretical melting rate[2] bulk per Laser	14.0

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

PHYSICAL DATA AT ROOM TEMPERATURE

	Surface Roughness Ra** - Overhang (µm)				Surface Roughness Ra** (µm)
	45°	60°	75°		
Upskin	9	7	5	H	6
Downskin	24	12	7	V	8

	Relative Density (%)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.9	99.9	555	--	--	--
P+A+T	99.9	99.9	566	--	--	--

TENSILE DATA

Tensile testing done in accordance with ASTM E8 and ASTM E21

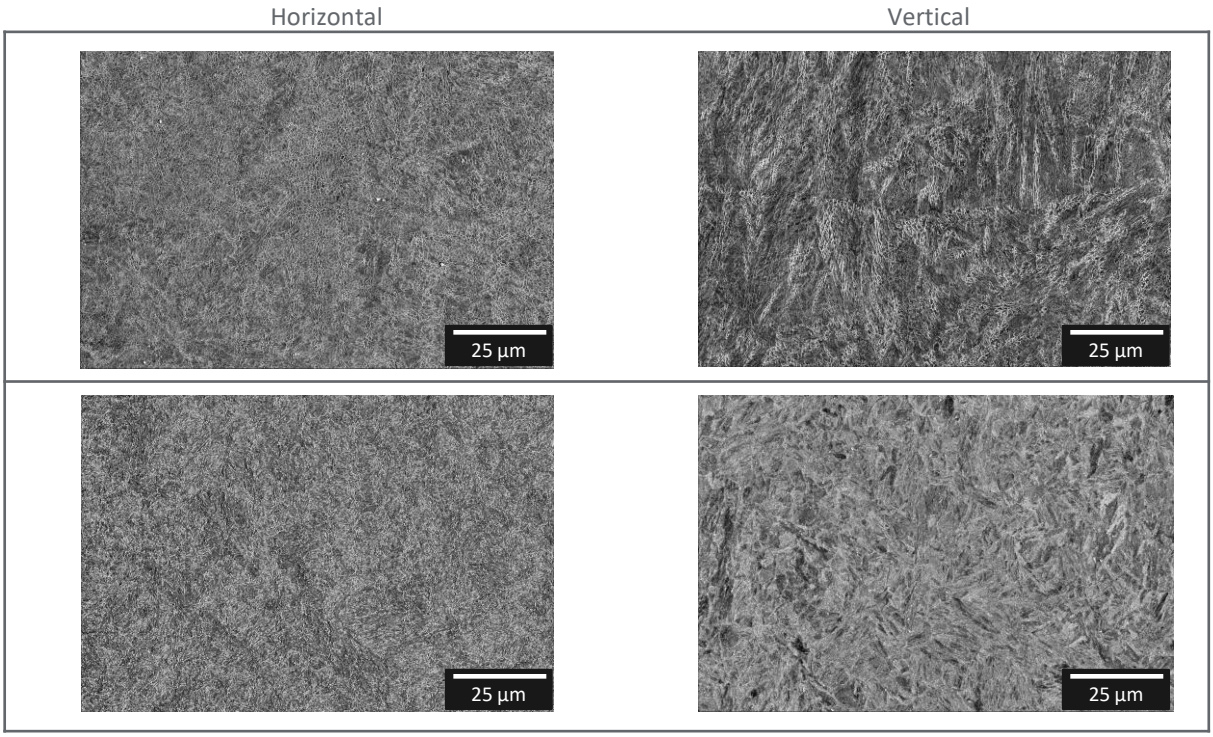
Test Temperature: RT

	Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	191	195	825	985	1625	2025	2.5	9.5	--	--
P+A+T	208	210	1510	1565	1820	1870	7.0	10.5	--	--

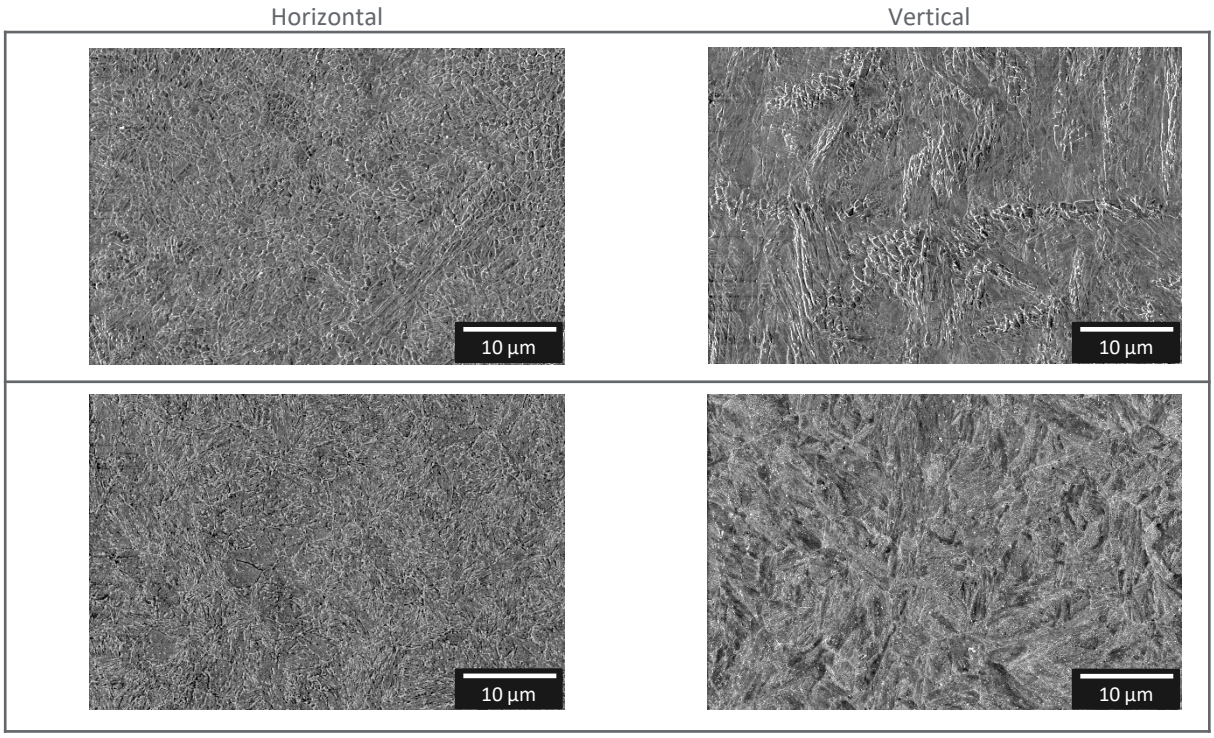
H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

* All of the figures contained herein are approximate only. The figures provided are dependent on a number of factors, including but not limited to, process and machine parameters, and the approval is brand specific and/or application specific. The information provided on this material data sheet is illustrative only and cannot be relied on as binding.
** 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.

SEM IMAGES (low magnification)



SEM IMAGES (high magnification)



Crack sensitivity

In general Tool Steel H13 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 different part & print layouts which should be considered during the development process.

H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

* All of the figures contained herein are approximate only. The figures provided are dependent on a number of factors, including but not limited to, process and machine parameters, and the approval is brand specific and/or application specific. The information provided on this material data sheet is illustrative only and cannot be relied on as binding.