13 Al

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

M2 Series 5 1 kW Ti-64 Grade 23

Parameter for GE Additive's Concept Laser M2 Series 5 1 kW

Data in this material datasheet represents material built with 60 and 120 µm layer thicknesses in an argon atmosphere on a Concept Laser M2 Series 5 1 kW single-laser or dual-laser machine and requires build-plate heating. Values listed are typical.

Titanium

In general, titanium (Ti) and its alloys have been used extensively in many industries due to their low density, high corrosion resistance and oxidation resistance. Titanium alloys are used in additive manufacturing to produce a wide range of industrial components, including blades, fasteners, rings, discs, hubs and vessels. Titanium alloys are also used to produce high-performance race engine parts like gearboxes and connecting rods. Due to its proven biocompatibility and its long history in the medical industry, it is an established material used for medical applications such as medical implants.

M2 Series 5 1 kW Ti-64 Grade 23

The parameters for the Concept Laser M2 Series 5 1 kW are developed leveraging the performance of the previous M2 generations of Ti-64. The productivity 1 kW parameter has a layer thickness of 60 µm and provides nearly 30% higher productivity than the 60 µm 400 W counterpart, but still offers similar surface quality. The maximum productivity of 93 cm^3/h for a dual-laser system – can be reached by the premium 1 kW productivity parameter having a layer thickness of 120 µm. All parameters have outstanding tensile properties in stress relieved state and meet the ASTM F136-02a (ELI Grade 23)/ ASTM F3001 standard.

M2 Series 5 Titanium Ti-64 Grade 23

With an appropriate approval* Ti-64 Grade 23 can be used for aerospace, orthopedic, and dental applications.

Data in this material datasheet represent material built with 60 and 120 µm layer thicknesses in an argon atmosphere on a Concept Laser M2 Series 5 1 kW single-laser or dual-laser machine and requires build-plate heating. Values listed are typical.

POWDER CHEMISTRY

Ti-64 Grade 23 powder chemical composition according to ASTM F136-02a (ELI Grade 23)/ ASTM F3001. For additional information on Ti-64 Grade 23 powder, visit https://www.advancedpowders.com/powders/titanium/ti-6al-4v-23.

MACHINE CONFIGURATION

- Concept Laser M2 Series 5 1 kW (single-laser or dual-laser)
- Argon gas
- Rubber recoater blade

AVAILABLE PARAMETERS

- **Productivity 1 kW Parameter 364**	60 µm layer thickness, rubber recoater
- **Premium Productivity 1 kW Parameter 318**	120 µm layer thickness, rubber recoater

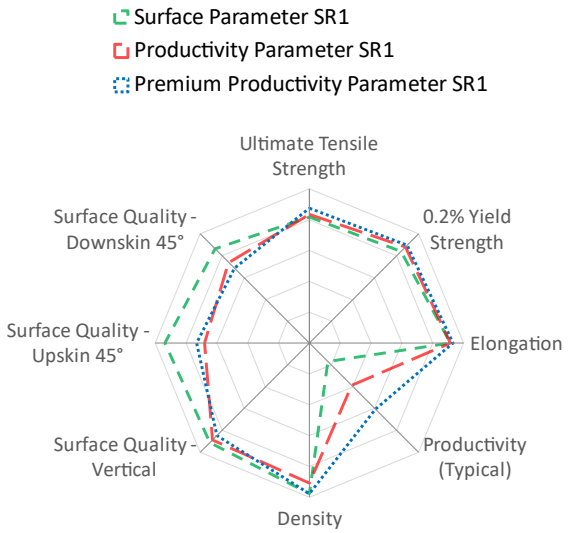
THERMAL STATES

1. As-Built
2. Stress Relief (SR1)

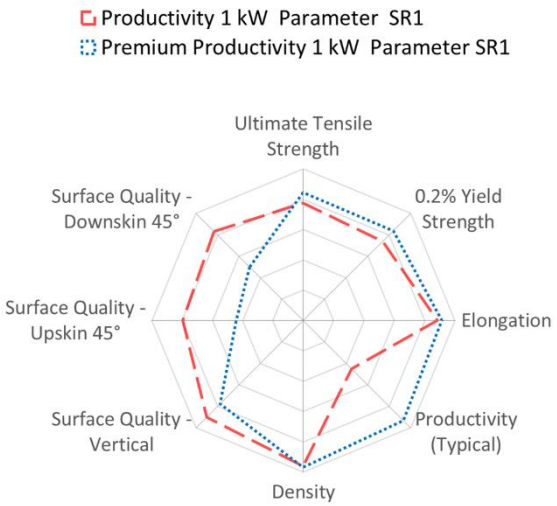
SR1: 900°C, 1 hour in argon, furnace cooling

PARAMETER COMPARISON

M2 Series 5 (2 x 400 W)



M2 Series 5 (2 x 1 kW)



Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For **Ti-64**, the ranges are as follows: UTS: 600-1100 MPa, 0.2%YS: 500-1000 MPa, Elongation: 0-20 %, Density: 99-100 %, Productivity: 0-100 cm^3/h, Surface Quality (all): 50-5 µm

TYPICAL BUILD RATE

Productivity 1 kW Parameter

	Productivity (cm^3/h)
Typical build rate[1] w/coating	44.7
Theoretical melting rate[2] bulk per Laser	69.1

[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)		
	45°	60°	75°
Upskin	15	13	10
Downskin	13	8	7

	Surface Roughness Ra** (µm)
H	18
V	10

	Relative Density (%)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.9	99.9	347	--	--	--
SR1	99.9	99.9	328	--	--	--

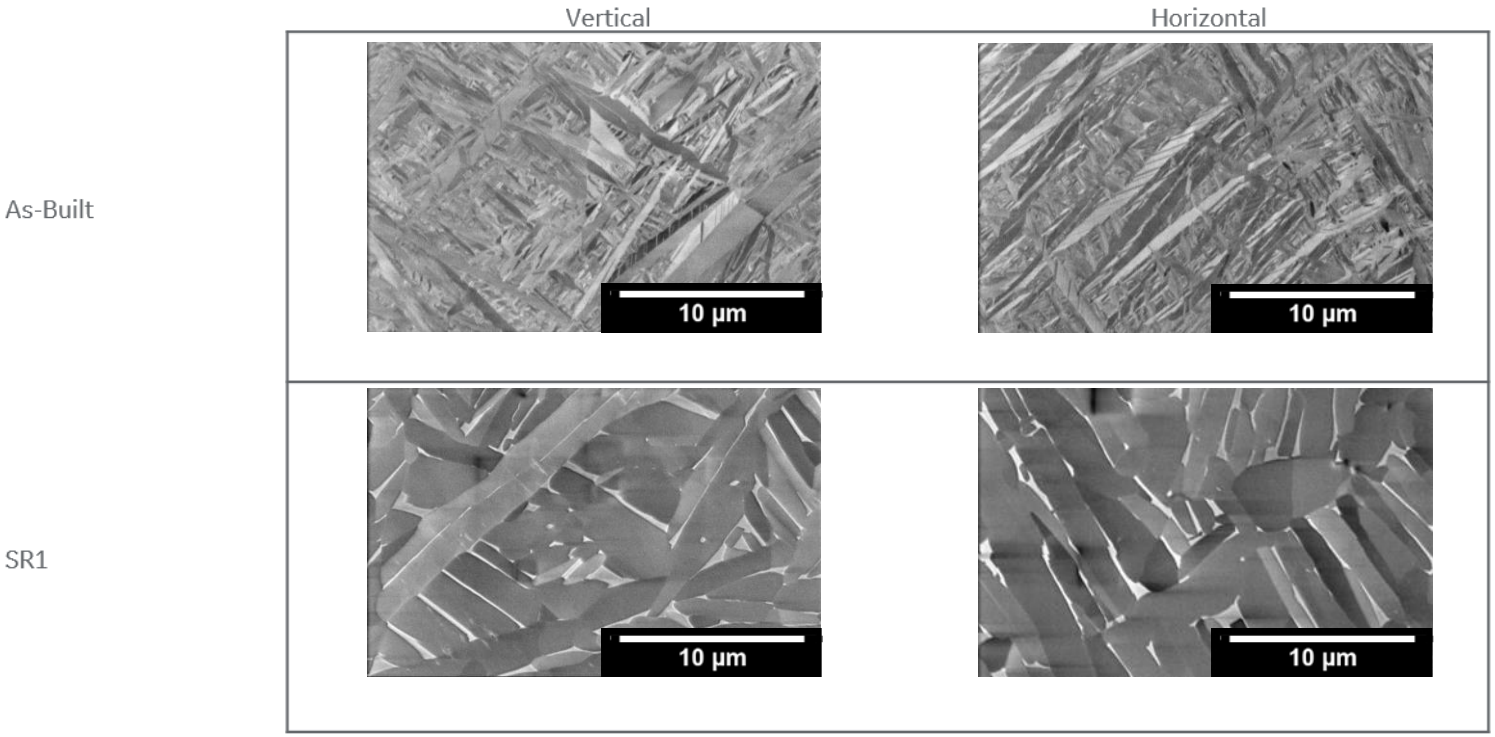
TENSILE DATA

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	110	112	975	1070	1125	1190	8	8	23	21
SR1	117	111	905	830	1005	965	15	13	39	34

SEM IMAGES



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.

TYPICAL BUILD RATE

Premium Productivity 1 kW Parameter

	Productivity (cm³/h)
Typical build rate[1] w/coating	93.2
Theoretical melting rate[2] bulk per Laser	100.4

[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)		
	45°	60°	75°
Upskin	31	23	17
Downskin	28	15	12

	Surface Roughness Ra** (µm)
H	45
V	16

	Relative Density (%)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.9	99.9	353	--	--	--
SR1	99.9	99.9	331	--	--	--

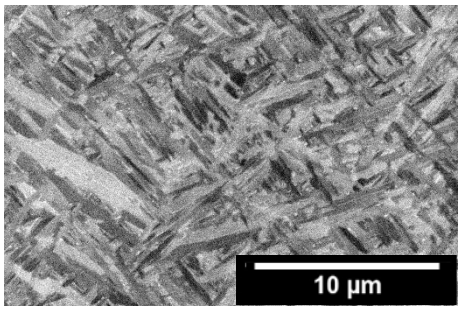
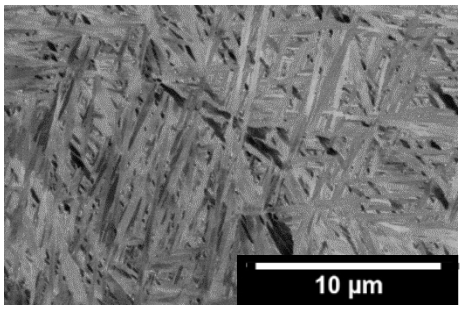
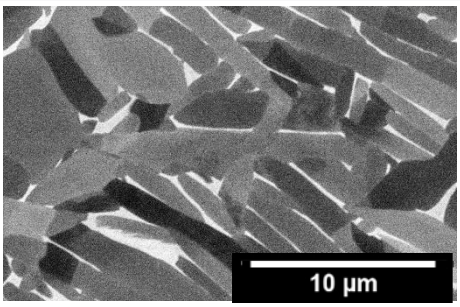
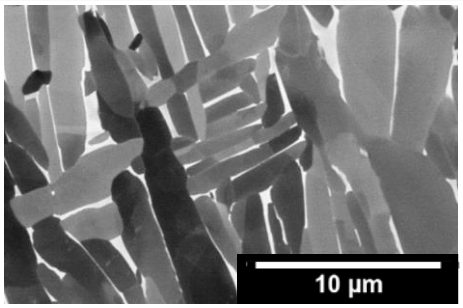
TENSILE DATA

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	114	113	1065	1115	1175	1230	10.5	5.5	35	19
SR1	118	117	920	910	1025	1015	16.5	14.0	40	27

SEM IMAGES

	Vertical	Horizontal
As-Built		
SR1		

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