M2 Series 5 Nickel X

Parameters for GE Additive’s Concept Laser M2 Series 5

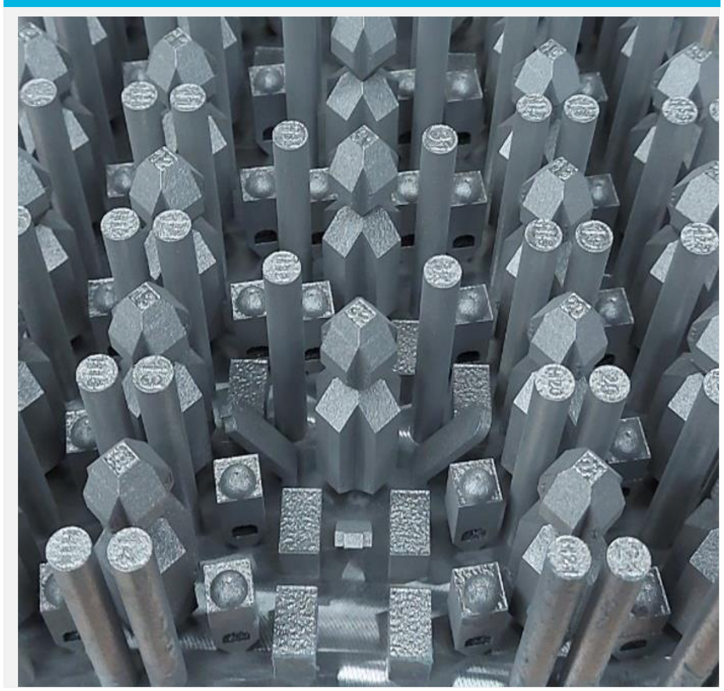
Data in this material datasheet represents material built with 50 µm layer thicknesses and in a nitrogen atmosphere on a Concept Laser M2 Series 5 single-laser or dual-laser machine. Values listed are typical.

Nickel X

Nickel-Chromium-Iron-Molybdenum based superalloys like Nickel X (UNS N06002) have an exceptional combination of oxidation resistance, fabricability and high-temperature strength. The outstanding resistance to oxidizing, reducing, and neutral atmospheres up to 1200 °C makes Nickel X an ideal candidate for high temperature applications across different industries. Typical applications include gas turbine combustion zone components, aircraft parts, industrial furnace systems, chemical process industry and petrochemical process equipment.

M2 Series 5 Nickel X

The Nickel X parameters for the Concept Laser M2 Series 5 are developed leveraging the performance of the previous M2 generations. The based parameter is a 50 µm parameter that produces surface roughness less than 10 µm without bead blast or shot peening for most surfaces, while delivering good productivity with dual lasers. Parameter 226 has been optimized for use of steel blade recoater. Moreover, the mechanical properties for both parameters succeed the limits specified in ASTM B572 in the heat treated state.



M2 Series 5 Nickel X

With corresponding approval* Nickel X can be used for manufacturing components for high-temperature applications.

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

POWDER CHEMISTRY†

Nickel X powder chemical composition et al. according to AMS7008.

† In general Nickel X is known to be susceptible to the formation of microcracks. The occurrence of microcracks is highly dependent on the microstructural evolution during solidification and thus on the local cooling rate. So microcracks may occur in dependence of part & print layout.

MACHINE CONFIGURATION

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

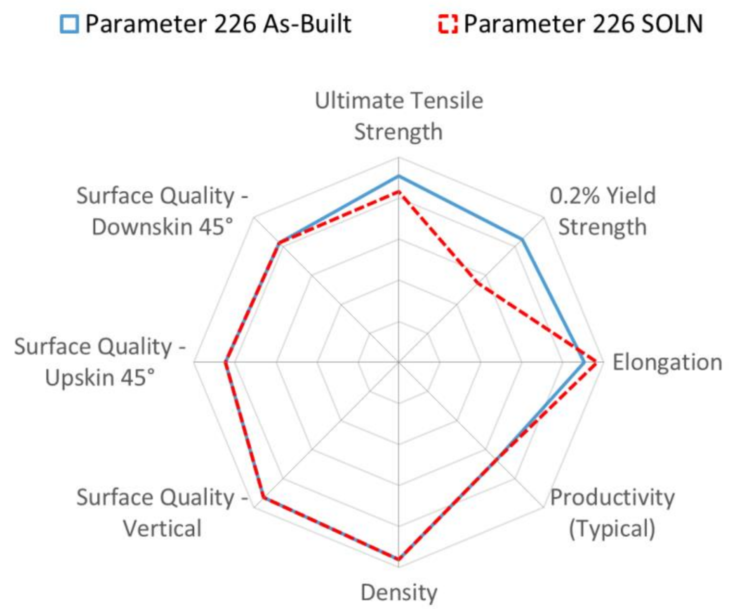
AVAILABLE PARAMETERS

- **Base Parameter 224** 50 µm layer thickness, rubber recoater
- **Base Parameter 226** 50 µm layer thickness, steel recoater

THERMAL STATES

1. As-Built
2. Solution Anneal (SOLN)
   SOLN: 1177°C, 1 hour, air cooling

PARAMETER 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 Nickel X, the ranges are as follows: UTS: 0-900 MPa, 0.2%YS: 0-700 MPa, Elongation: 0-45 %, Density: 0-100 %, Productivity: 5-30 cm³/h, Surface Quality (all): 40-5 µm

TYPICAL BUILD RATE

	(cm³/h)
Typical build rate[1] w/coating	19.8
Theoretical melting rate[2] bulk per Laser	18.0

[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)		
	45°	60°	75°
Upskin	12	9	7
Downskin	13	9	6

	Surface Roughness Ra** (µm)
H	7
V	9

	Relative Density (%)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.9	99.9	242	--	--	--
SOLN	-	-	-	--	--	--

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	183	166	615	555	840	755	33.5	40.0	--	--
SOLN	191	184	385	385	765	715	46.5	50.0	--	--

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

	(cm³/h)
Typical build rate[1] w/coating	20.2
Theoretical melting rate[2] bulk per Laser	18.4

[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	11	8	6
Downskin	12	8	6

	Surface Roughness Ra** (µm)
H	17
V	8

	Relative Density (%)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.9	99.9	241	--	--	--
SOLN	-	-	-	--	--	--

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	188	170	625	560	855	780	34.5	40.0	--	--
SOLN	189	191	380	380	765	730	47.5	49.0	--	--

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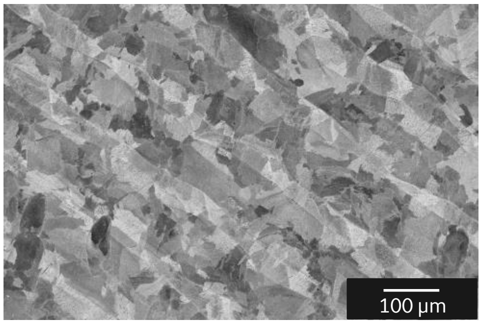
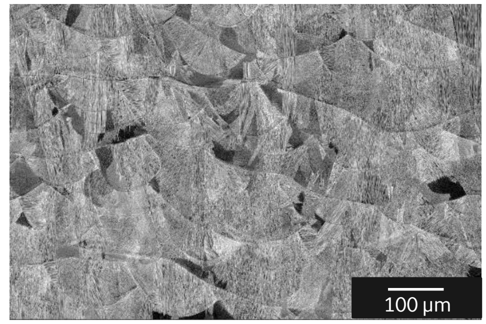
As-Built

Horizontal

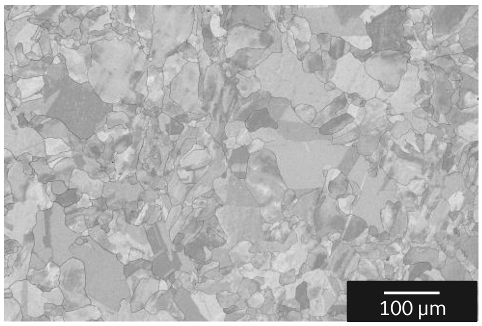


Vertical

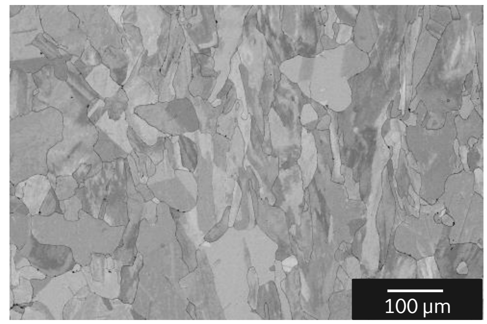


SOLN

Horizontal



Vertical



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