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

X Line 2000R Nickel 718

Parameters for GE Additive's Concept Laser X Line 2000R

Data in this material datasheet represents material built with 60 µm layer thickness and in a nitrogen or argon atmosphere on a Concept Laser X Line 2000R and requires build plate heating. Values listed are typical.

Nickel 718

Nickel chromium superalloys like 718 are often used in high-stress, high-temperature aeronautical, petrochemical and auto racing environments. The excellent high temperature strength and creep resistance derive from precipitation hardening of finely dispersed precipitates. Next to that Alloy 718 is a metal that is also highly resistant to the corrosive effects of hydrochloric acid and sulfuric acid. The favorable weldability of Alloy 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.

X Line 2000R Nickel 718

The Alloy 718 parameters for the Concept Laser X Line 2000R are developed leveraging the performance of the previous X Line generations. The balanced parameters deliver a good balance between surface quality needs and productivity. Furthermore, the parameters offer a very good density leading to high strength and elongation - succeeding the minimum tensile properties specified in ASTM F3055 for additive manufactured parts in the heat treated state. The parameter performance was validated both in nitrogen and argon atmosphere. A large variety of heat treatments have been evaluated, in order to offer the best solution depending on the mechanical properties' requirements.

X Line 2000R Nickel 718

With corresponding approval* Nickel 718 can be used for manufacturing components for high-temperature applications.

Data in this material datasheet represents material built with 60 µm layer thickness and in a nitrogen or argon atmosphere on a Concept Laser X Line 2000R and requires build plate heating. Values listed are typical.

POWDER CHEMISTRY

Nickel 718 powder chemical composition according to ASTM B 637 UNS N07718
For additional information on Nickel 718 powder, visit www.advancedpowders.com/powders/nickel/718.

MACHINE CONFIGURATION

- Concept Laser X Line 2000R
- Nitrogen gas / Argon gas
- Carbon brush

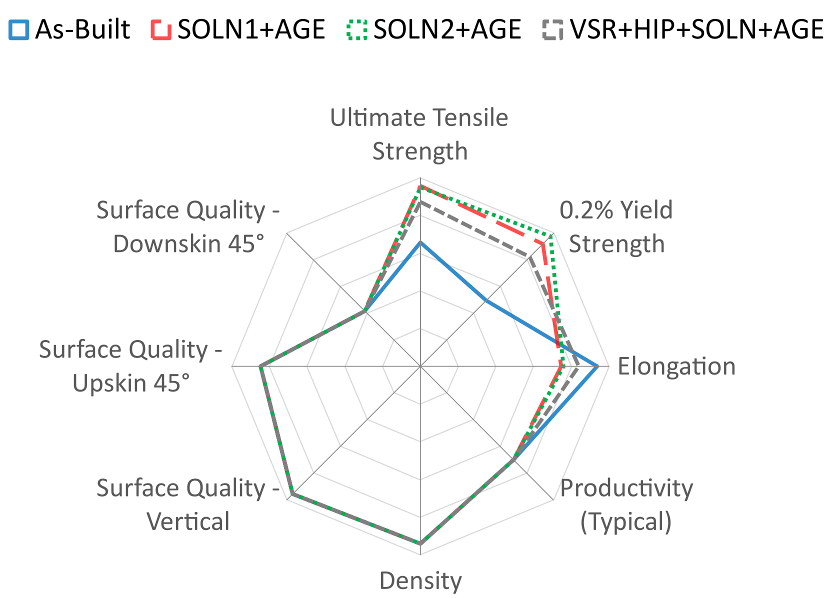
AVAILABLE PARAMETERS

- **Productivity Parameter 103/253** 60 µm layer thickness, argon gas, carbon brush
- **Productivity Parameter 147/254** 60 µm layer thickness, nitrogen gas, carbon brush

THERMAL STATES

1. As-Built
2. Solution Anneal + Age (SOLN1+AGE)
   SOLN1: 980°C, 1 hour in argon; AGE: 720°C, 8 hours, furnace cooling down to 620°C; 620°C, 8 hours, cooling in air
3. Solution Anneal + Age (SOLN2+AGE)
   SOLN2: 1065°C, 1 hour in argon; AGE: 720°C, 8 hours, furnace cooling down to 620°C; 620°C, 8 hours, cooling in air
4. Vacuum Stress Relieve + HIP + Solution + Age (VSR+HIP+SOLN+AGE)
   VSR: 950 °C, 2 hours in argon; HIP: 1160°C, 4 hours, 100 MPa; SOLN: 980°C, 1 hour in argon; AGE: 720°C, 8 hours, furnace cooling down to 620°C; 620°C, 8 hours, cooling in air

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-based superalloys, the ranges are as follows: UTS: 0-1600 MPa, 0.2%YS: 0-1400 MPa, Elongation: 0-40 %, Density: 0-100 %, Productivity: 5-30 cm³/h, Surface Quality (all): 70-5 µm

TYPICAL BUILD RATE

	(cm³/h)
Typical build rate[1] w/coating	19.0
Theoretical melting rate[2] bulk per Laser	25.0

[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	15	12	10
Downskin	43	13	9

	Surface Roughness Ra** (μm)
H	34
V	8

	Relative Density (%)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.9	99.9	276	--	--	--
SOLN1+AGE	99.9	99.9	468	--	--	--
SOLN2+AGE	99.9	99.9	475	--	--	--
VSR+HIP+SOLN+AGE	99.9	99.9	443	--	--	--

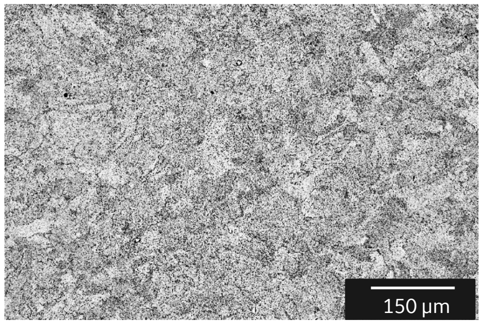
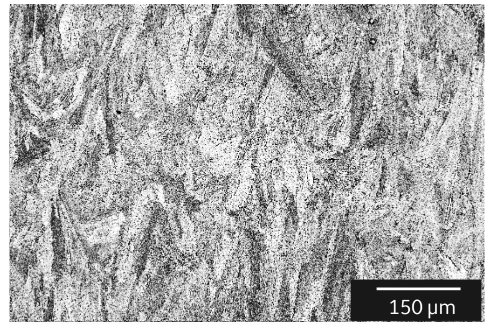
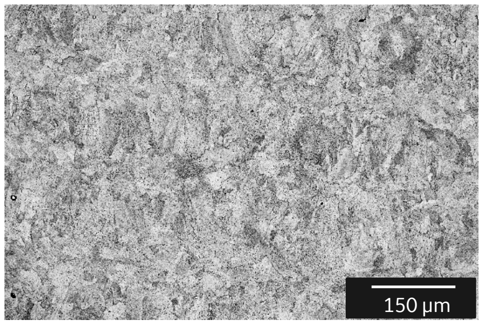
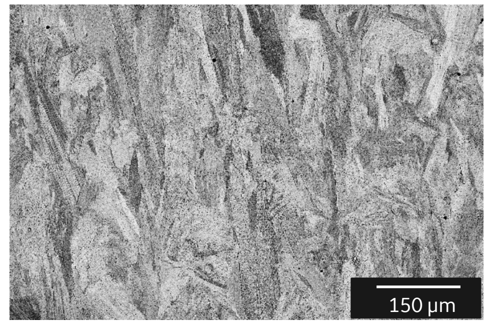
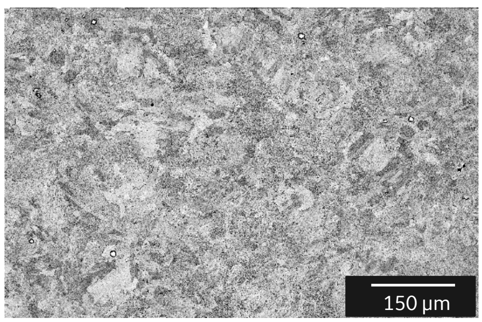
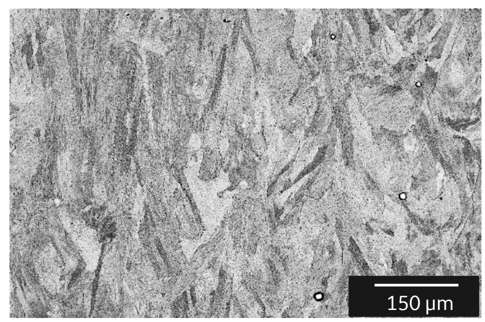
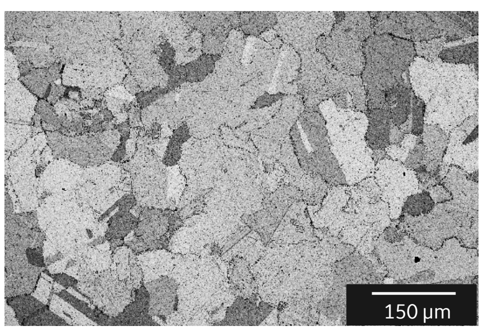
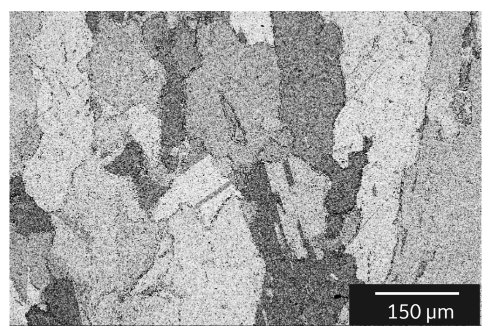
TENSILE DATA

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	176	153	705	580	1020	950	30.5	32.5	--	--
SOLN1+AGE	186	173	1220	1170	1460	1405	16.5	15.0	--	--
SOLN2+AGE	189	172	1305	1235	1460	1390	17.0	16.0	--	--
VSR+HIP+SOLN+AGE	195	184	1080	1050	1330	1290	22.0	22.0	--	--

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.

	Horizontal	Vertical
As-Built		
SOLN1+AGE		
SOLN2+AGE		
VSR+HIP+SOLN+AGE		

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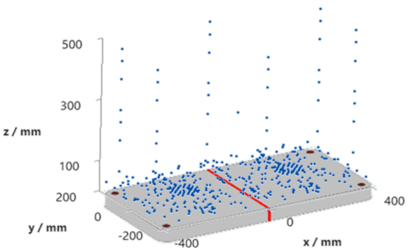
Within 3 platform stability builds porosity, roughness and tensile properties across different positions and orientations are evaluated. To illustrate the position dependency of the X Line 2000R, the samples were homogenously distributed across platform and height. Regarding surface quality all sides of the specimen, so all orientations with respect to gas flow and optical system, are included in the analysis. Data shown below are dependent on part & print layout as well as batch chemistry variations and thus might deviate from “typical values” given on previous pages.

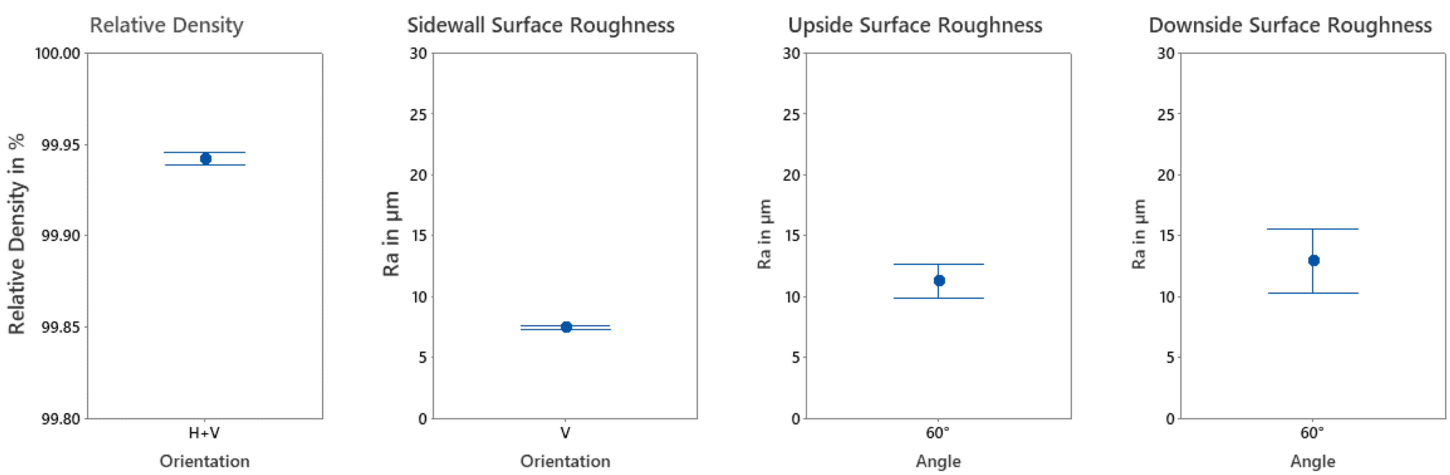
BUILD JOB DESIGN AND SUMMARIZED DATA (AS-BUILT)



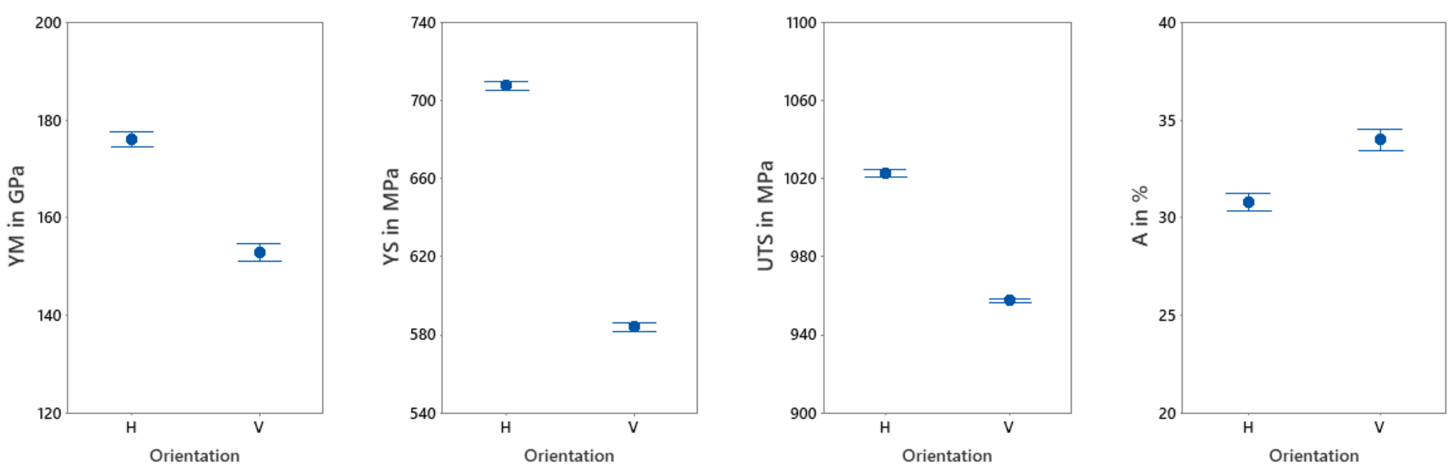
	Sample Size	Mean	St.Dev.
Rel. Density in %	267	99.94	0.03
Sidewall Roughness Ra in µm	549	8	2
Upside Roughness Ra in µm (60°)	16	11	3
Downside Roughness Ra in µm (60°)	16	13	5

	Sample Size	Mean	St.Dev.
YM in GPa (H/V)	82/88	176/156	7/9
YS in MPa (H/V)	82/88	707/583	11/12
UTS in MPa (H/V)	82/88	1022/957	9/5
Elongation in % (H/V)	82/88	30.7/33.9	2.0/2.4

RESULTS – RELATIVE DENSITY AND SURFACE QUALITY



RESULTS - MECHANICAL PROPERTIES IN AS-BUILT CONDITION



Data points represent the mean value, intervals the 95% confidence level.

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