MATERIAL DATASHEET

Inconel IN718

IN718_40µm_FL_M400_v1

ONE3D

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MATERIAL DATASHEET - IN718

Department: **QUALITY ASSURANCE**
If you are planning changes that affect this document/documented information, please inform the process owner - the processor **Lukáš Stolarik.**

Changes in the document are subject to the approval of David Paloušek, CTO ONE3D. Details are given in the **Revisions** table.

Revisions			
Rev.	Description	Date	Approved
1	IN718_40µm_FL_M400_v1	15. 4. 2025	Paloušek

Commenting:

This document is intended for the management of ONE3D s. r. o.

Values measured on devices:
Shimadzu AGV-X 300kN - Tensile testing
Innovatest Fenix 300U - Hardness testing
Keyence VHX-7100 - Digital microscope
ZEISS GOM ATOS 5 - Optical 3D scanning

INCONEL IN718

KEY CHARACTERISTICS OF MATERIAL

Inconel 718 is a high-strength nickel-based superalloy known for its excellent resistance to corrosion, oxidation, and high temperatures. This alloy is primarily used in the aerospace, energy, and chemical industries. It is commonly used in turbine blades, rocket engines, nuclear reactors, and highly stressed structural components.

Composition	Nickel (50-55%), chromium (17-21 %), iron, molybdenum, niobium, titanium, aluminum.
Mechanical properties	High strength and toughness even at temperatures up to 700 °C (1 292 °F).
Thermal resistance	Stable under extreme temperatures, making it suitable for jet engines, turbines and rocket engines.
Corrosion resistance	Excellent resistance to intergranular corrosion, pitting and stress corrosion cracking.
Machinability	Difficult to machine but better than other superalloys due to its ability to be precipitation-hardened.

EOS M400-4 | 40 µm

PROCESS INFORMATION

Manufacturing Inconel 718 (IN718) parts on EOS M400-4 machines is done using the Laser Powder Bed Fusion (LPBF) method. This additive technology enables the production of complex geometries with high precision and excellent mechanical properties.

ADDITIONAL INFORMATION

Layer thickness	40 µm
Volume rate	4,2 mm^3/s

HEAT TREATMENT

Heat Treatment of Inconel 718 (IN718) is crucial for achieving optimal mechanical properties, especially for enhancing strength and toughness, even at high temperatures. This process involves several steps that are specific to this alloy and its applications in demanding industries such as aerospace, space, and energy.

EOS M400-4 | 40 µm

PROCESS STEPS

Step 1	**CAD Model Preparation and Slicing** I. The 3D model is converted to STL format and prepared using EOSPRINT software. II. The model is sliced into 40 µm layers and optimized for printing. III. Support structures are added to ensure stability and minimize deformation.
Step 2	**Machine Setup** I. IN718 powder is loaded into the printing system and evenly distributed. II. Printing parameters (laser power, scan strategy, melting speed) are set according to the material specifications.
Step 3	**Printing Process (LPBF - Laser Powder Bed Fusion)** I. Using four 400W fiber lasers each 40 µm powder layer is melted by the laser according to the digital model. II. Then the build platform lowers by 40 µm and a new layer of powder is applied. III. This process is repeated until the full part is completed.
Step 4	**Heat Treatment (Annealing, Stress Relief)** To optimize mechanical properties and eliminate internal stresses: I. Solution Annealing: hold at 954 °C (1 750 °F) for 90 minutes, air(/argon) cool down. II. Ageing Treatment: hold at 718°C (1 312°F) for 8 hours, furnace cool down on 621°C (1 150°F) and hold for 8hours, air (/argon) cool down
Step 5	**Part Removal and Support Structure Removal** I. Once printing is completed, the part is removed from the build platform. II. Supports are mechanically removed (cutting, milling).
Step 6	**Final Machining and Surface Finishing** I. CNC machining, grinding and polishing are performed if necessary. II. Surface treatments include shot blasting, chemical polishing.

AS BUILT | 40 µm

MATERIAL PROPERTIES

Evaluation Tensile test - NOT MACHINED - ISO 6892-1 A224			
	Rm [MPa] *	$Rp_{0,2}$ [MPa] *	At [%] *
As built vertical	911	475	34
As built 45 degree samples	988	623	27

* These values were obtained based on testing 26 vertical samples and 32 angled samples.

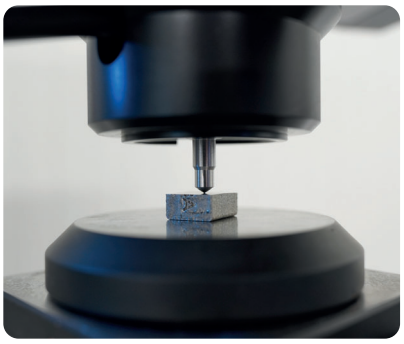
Evaluation Tensile test - MACHINED - ISO 6892-1 B10			
	Rm [MPa] *	$Rp_{0,2}$ [MPa] *	At [%] *
As built vertical	937	597	35
As built horizontal	1 036	746	29

* These values were obtained based on testing 12 vertical samples and 10 horizontal samples.

Typical hardness - ISO 6507	
	HRC**
As built	32

**HRC converted according to ASTM 140
Value obtained based on testing 32 samples.

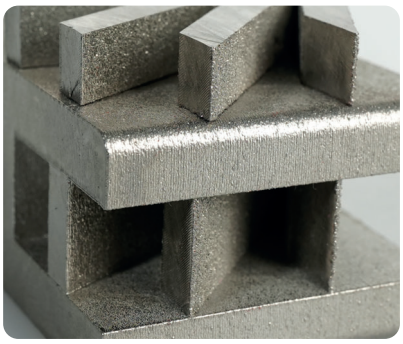
Typical roughness - ISO 21920	
	Ra [µm]
90° upskin	7.5
60° upskin	6.7
45° upskin	9.7
30° upskin	12.6



Hardness testing process

Hardness and porosity testing sample

Tensile testing process



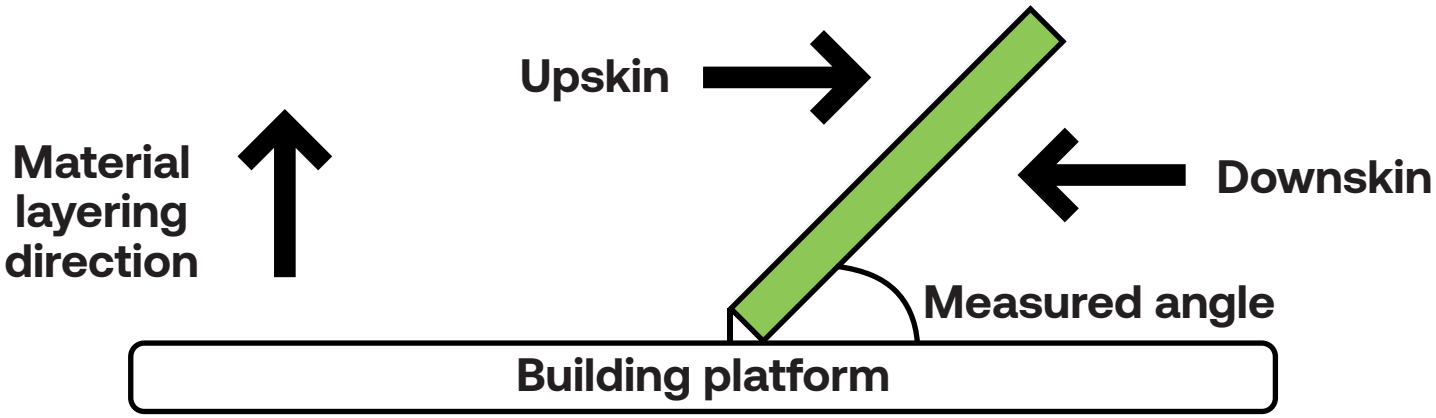
Typical roughness sample

Typical porosity		
	Average [%]	Max average permissible value [%]
***Area pore content	0.007	0.03

*** Porosity measured in area 13 x 13 mm
Value was obtained based on testing 61 samples.

AS BUILT | 40 µm

UPSKIN AND DOWNSKIN SIDES



AS BUILT | 40 µm

DEVIATIONS IN MATERIAL PROPERTIES

Deviations	± [%]	
Vertical tensile mechanical properties - as built		**Acceptance criterion (A-basis):** Defined in the document MIL-HDBK-5H (1998). **A-basis values** are the minimum mechanical property values that 99% of the material population are expected to exceed with 95% statistical confidence.
Angled tensile mechanical properties - as built		
Tensile mechanical properties - machined		
Angled tensile mechanical properties - machined		
Porosity	5	max - min < 0.005 %
Hardness	5	HRC [max - min] < 5
Roughness	5	

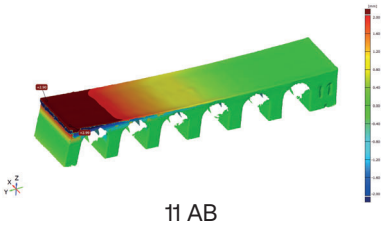
Creep behavior testing will be performed upon request by the customer.

AS BUILT | 40 µm

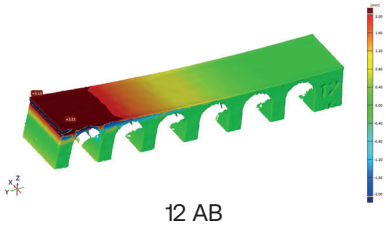
DEFORMATION

Deformation after cutting samples from the platform. Scanning and alignment to the largest leg.

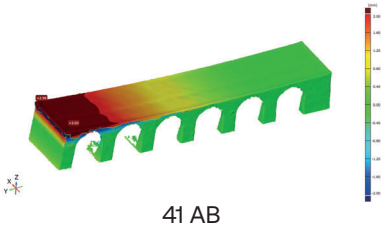
Deformation		
Sample	Measuring	Deviation [mm]
11 AB	1	2.99
	2	2.9
12 AB	1	3.2
	2	3.13
41 AB	1	3.03
	2	2.99
42 AB	1	2.85
	2	2.78
Average		2.98



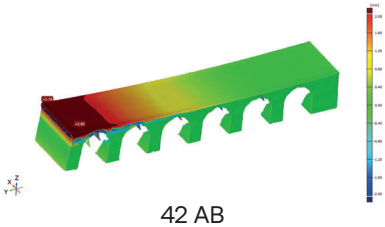
11 AB



12 AB



41 AB



42 AB

HEAT TREATED | 40 µm

MATERIAL PROPERTIES

Evaluation Tensile test - NOT MACHINED - ISO 6892-1 A224			
	Rm [MPa] *	$Rp_{0,2}$ [MPa] *	At [%] *
Heat treated vertical	1 281	1 003	17
Heat treated 45 degree samples	1 326	1 052	10

* These values were obtained based on testing 20 vertical samples and 32 angled samples.

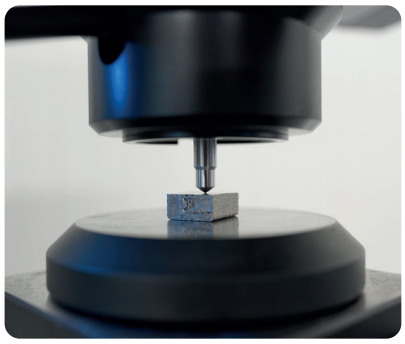
Evaluation Tensile test - MACHINED - ISO 6892-1 B10			
	Rm [MPa] *	$Rp_{0,2}$ [MPa] *	At [%] *
Heat treated vertical	1 326	1 072	20
Heat treated horizontal	1 425	1 126	16

* These values were obtained based on testing 12 vertical samples and 10 horizontal samples.

Typical hardness - ISO 6507	
	HRC**
Heat treated	32

**HRC converted according to ASTM 140
Value obtained based on testing 25 samples.

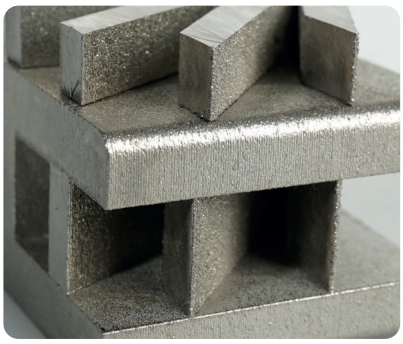
Typical roughness - ISO 21920	
	Ra [µm]
90° upskin	7.5
60° upskin	6.7
45° upskin	9.7
30° upskin	12.6



Hardness testing process

Hardness and porosity testing sample

Tensile testing process



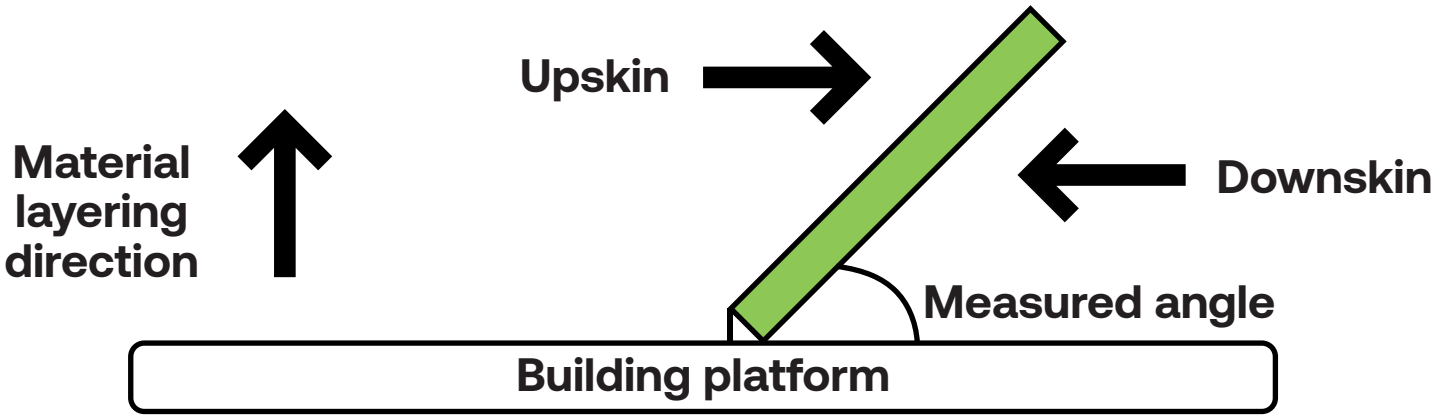
Typical roughness sample

Typical porosity		
	Average [%]	Max average permissible value [%]
***Area pore content	0.007	0.03

*** Porosity measured in area 13 x 13 mm
Value was obtained based on testing 61 samples.

HEAT TREATED | 40 µm

UPSKIN AND DOWNSKIN SIDES



HEAT TREATED | 40 µm

DEVIATIONS IN MATERIAL PROPERTIES

Deviations	± [%]	
Vertical tensile mechanical properties - as built		**Acceptance criterion (A-basis):** Defined in the document MIL-HDBK-5H (1998). **A-basis values** are the minimum mechanical property values that 99% of the material population are expected to exceed with 95% statistical confidence.
Angled tensile mechanical properties - as built		
Tensile mechanical properties - machined		
Angled tensile mechanical properties - machined		
Porosity	5	max - min < 0.005 %
Hardness	5	HRC [max - min] < 5
Roughness	5	

Creep behavior testing will be performed upon request by the customer.

HEAT TREATED | 40 µm

DEFORMATION

Deformation after cutting samples from the platform. Scanning and alignment to the largest leg.

Deformation		
Sample	Measuring	Deviation [mm]
11 HT	1	0.17
	2	0.17
22 HT	1	0.27
	2	0.28
32 HT	1	0.23
	2	0.25
41 HT	1	0.14
	2	0.18
Average		0.21