Meltio Nickel 718

ERNiFeCr-2 / S Ni 7718 / 2.4667

Nickel 718 is a highly versatile and corrosion-resistant alloy with exceptional mechanical properties at both high and low temperatures. Its ability to withstand harsh environments and high-stress applications has made it a popular choice across a range of industries, including aerospace, energy, and marine. Being Nickel 718 a difficult alloy to work using conventional methods, 3D Printing facilitates its usage for a broader range of applications.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization[3]
1.0 mm	15 kg	BS300	Uncoated	1371-1427 ºC	8.20 g/cm³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Ni	C	Si	Mn	Cr	Fe	Ti	Mo	Nb+Ta	Al
Bal.	0.05	0.2	0.2	19.0	20.0	0.9	3.0	5.2	0.5

Tested Print Profiles

Laser	Profile name	Laser Power [W]	Energy Density [J/mm3]	Deposition Rate [g/h]	Volume rate [cc/h]	Relative Density [%]	Max Pore/Defect [µm]
976 nm	**Verified Density**	1100	122.22	266	32.44	99.8	-
450 nm	**Rev 9 2025-04-14**	1000	83.33	364	45.12	99.9	9.05 / 91.58
	Rev3 2025-06-13	1400	66.48	622	75.85	-	-

* Printing profiles available in our official Slicers: **Meltio Horizon** for standalone Printers and **Meltio Space** for Laser Integration Kits.
** Profiles developed for the 1.4Kw blue head will be available for Meltio Space for laser integration kits.

Structural Properties [1]

ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Infrared Laser						Blue Laser			
		Heat Treatment S.A+A.H		Heat Treatment S.A		As Printed		Heat Treatment HT 1		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	1140	1256 ± 11	1208 ± 49	1016 ± 28	925 ± 86	-	833 ± 50	1326 ± 25	1290± 26	895 ± 13	874± 9
Yield strength [MPa]	-	1025 ± 7	980 ± 2	660 ± 10	631 ± 10	-	537 ± 32	1072 ± 20	1062 ± 19	574 ± 11	520 ± 5
Elongation [%]	-	11 ± 1	10 ± 5	18 ± 6	15 ± 2	-	25 ± 3	10 ± 3	11 ± 2	24 ± 5	31 ± 2
Hardness [HV-30]	-	–	332	-	285	-	245	-	WIP	247	-

Reference Standards

	Cast *(AMS 5383)*	Casting (ASTM A494)	Wrought *(ASTM B5383)*	Wrought *(ASTM B637)*
Ultimate Tensile strength [MPa]	345	802	1275	1241
Yield strength [MPa]	125	758	1034	1034
Elongation [%]	10	5	12	10
Hardness [HV-30]	342	-	350	-

Meltio Material Datasheet

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Internal Structure [2]

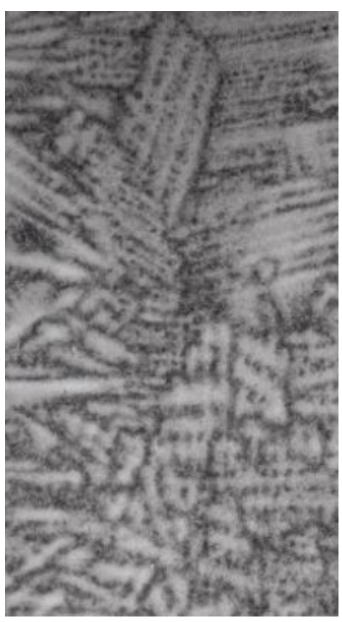
Micrography

IR: The images show delta-phase dendrites along the direction of manufacturing within the gamma nickel matrix. Under higher magnification, the presence of intermetallic phases and gamma prime has been noted.

Blue: The microstructural analysis of Nickel 718 reveals a predominantly dendritic gamma-phase (γ) morphology, with orientation varying according to the local solidification direction. In both the As-Built condition and after thermal treatments (HT and HT2), columnar dendrites are retained across the sample. Localized regions of equiaxed grains are observed at interlayer boundaries, likely resulting from internal stress accumulation, high dislocation density, and crystallographic discontinuities introduced during fabrication. The presence of secondary phases and precipitates is significant for the mechanical performance of the alloy.

IR Laser

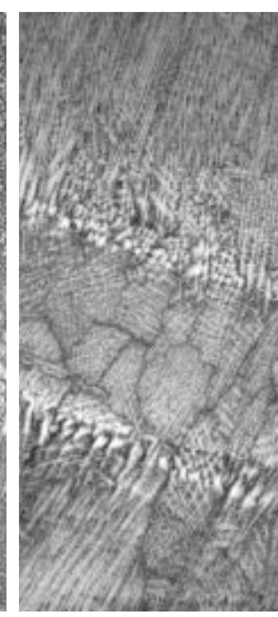
As-printed XY
100x Magnification



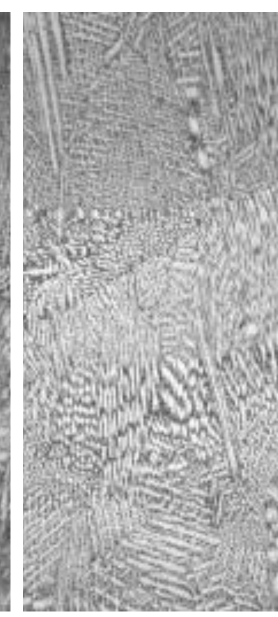
HT XY
100x Magnification

Blue Laser

As-printed XY
100x Magnification



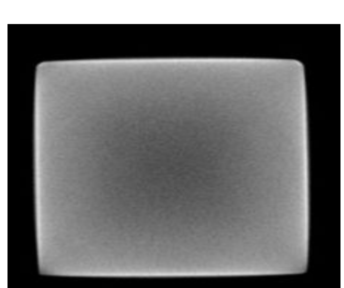
HT XY
100x Magnification

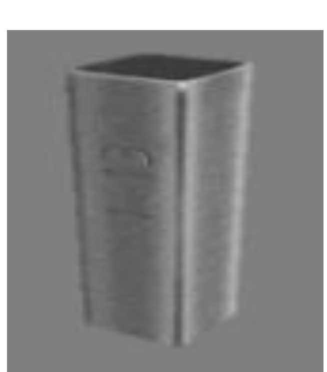


HT-2 XY
100x Magnification

Tomography

CT Scan of 3D printed sample part in Nickel 718 using IR Laser without detectable voids or defects. Resolution of 24 µm per pixel.





3D / Top View

Front View

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1.Structural Properties

Tensile Tests

Specimens printed using Meltio's wire-laser metal 3D printed process perform at the same level as samples made with conventional manufacturing methods. Results show low deviations and near isotropic properties even in the as-printed state without the application of heat-treatments.

Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization for IR Laser and a printed block of 95x155x55 mm using the **Rev 9 2025-04-14** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*CETEMET* i+d+i@cetemet.es)

Hardness

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM. from it UNE-EN ISO 6507-1 and was analyzed by an external laboratory. (*CETEMET* i+d+i@cetemet.es, *University of Jaen (UJA)* info@strainanalysisuja.es).

Heat Treatment

To achieve the best mechanical properties Nickel 718 should be heat-treated after 3D printing. The standard heat treatment process for Nickel 718 involves two steps: Solution Annealing and Age Hardening. Solution annealing removes internal stresses that have been formed during 3D printing. Machining may take place before or after the solution annealing. Once the component has been age hardened its machinability is compromised.

Solution Annealing		Age Hardening	
Protective atmosphere Heat up to 1100ºC	Hold for 1h Cooling in water to RT	Protective atmosphere Heat up to 760ºC in 2h Hold at 760ºC during 8h	Cool down to 650ºC in 1h50' Hold at 650ºC during 8h Cooling in oven to RT

Typical Parameters for a ASTM E8M cylinder sample of 4 mm diameter and 10 mm long extracted by EDM from a printed block for Tensile Tests

2.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and **Rev 8 2024-11-29** profile for the Blue laser. The metallographic analysis followed ASTM E3-11:2017 standards, ensuring proper preparation and examination of the microstructure and were analyzed by an external laboratory. (*IDONIAL* info@idonial.com)

Tomography

The tomography images were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and were analyzed by an external laboratory. (*CATEC* info@catec.aero)

Relative Density

Characterizing materials for its Blue Laser technology using 300x400x60 mm 304L steel build plates. Relative density and pore size are evaluated through micrography following NASA-STD-6030 "Additive Manufacturing Requirements for Spaceflight Systems," based on a 250x250x30 mm printed specimen. The results comply with NASA-STD-6030, showing an overall porosity fraction below 0.25% by volume and were analyzed by an external laboratory. (*IDONIAL* info@idonial.com , *CETEMET* i+d+i@cetemet.es , AIMEN comunicacion@aimen.es)

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3.Inertization

Inertization of Meltio M600 machinery can be performed in two ways: localised inertisation or full chamber inertization. Both options are designed to ensure a controlled environment during the 3D printing process and prevent oxygen contamination of reactive materials.

Localised Inertization:
In this mode, the shielding gas is supplied locally through the shield nozzle located in the deposition head, with a flow rate of approximately 15 L/min. This method is suitable for most applications where oxygen control in the work area is necessary without requiring a completely isolated environment.

Full Chamber Inertization:
For more demanding applications, it is possible to perform a full chamber inertization. In this case, the chamber must be preconditioned before the printing process is started, reaching an oxygen concentration of 50 ppm. It is essential to control the oxygen concentration in the chamber, as reactive materials can absorb oxygen even when the part is hot, not only when it is in the melt pool.

The choice of inertisation method depends on the properties of the material to be used and the specific requirements of the printing process, ensuring the highest quality and integrity of the manufactured parts.