Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

Austenitic steel with excellent durability, low reactivity and adequate elevated temperature properties. The alloy has a low carbon content which makes it particularly recommended when there is a risk of intergranular corrosion. Thus, parts manufactured with SS316L are an excellent choice in corrosion prone applications.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization ⁴
1.0 mm	15 kg	BS300	Uncoated	1398 °C	8.0 g/cm ³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Fe	с	Si	Mn	Cr	Ni	Мо
Bal.	0.02	0.9	1.7	18.5	12.0	2.7

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	146.6	196	24.81	99.7	-
450 nm	Rev 9 2024-12-05	1000	83.33	341	43.16	99.97	185 / 266

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser				Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Tr	eatment	nt As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	620	556 ± 8	547 ± 8	643 ± 6	655 ± 11	WIP	WIP	WIP	WIP
Yield strength [MPa]	420	215 ± 3	253 ± 17	429 ± 16	347 ± 28	WIP	WIP	WIP	WIP
Elongation [%]	35	65 ± 1	62 ± 2	38 ± 2	41 ± 4	WIP	WIP	WIP	WIP
Hardness [HV-30]	-	192	192	198	-	-	WIP	173	-

Reference Standards

	Cast (ASTM A743)	Cast (ASTM A403)	Wrought (ASTM A473-24)	Wrought (ASTM A351)
Ultimate Tensile strength [MPa]	485	515	450	550
Yield strength [MPa]	205	208	170	260
Elongation [%]	30	40	40	35
Hardness [HV-30]	-	215	-	225

Fatigue ²

	Infrared	d Laser	Blue Laser		
ASTM E466 (XZ)	As printed	Heat Treated	As Printed	Heat Treated	
Stress Range [Mpa]	220	190	WIP	WIP	
№ of Cycles (Nf)	5x10^6				
Stress Ratio (R)	-1				

Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

Internal Structure ³

Micrography

The as-built SS316L samples show a microstructure with both cellular and columnar dendritic solidification mode. In as printed condition we find around 5.6% ferritic structures which are reduced to 0.2 % after heat-treatment of re-austenization.

IR Laser



As-printed XY 100x Magnification

HT XY 100x Magnification



As-printed XY 100x Magnification

Tomography

CT Scan of 3D printed sample part in SS316L using IR Laser without detectable voids or defects. Resolution of 24 μ m per pixel.



3D / Top View



Front View

Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

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 2024-12-05** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL info@idonial.com*)

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 lab. (IR laser were carried out by *IDONIAL info@idonial.com* and Blue laser were carried out by *CETEMET* <u>i+d+i@cetemet.es</u>).

Heat Treatment

With SS316L it is not mandatory to perform a heat-treatment after 3D printing for general use case applications. As-built Meltio SS316L parts show a mainly austenitic structure with some small ferrite content. This Ferrite content may be adjusted via re-austenization to fit the requirements of a specific application. Applying the heat-treatment a 99.8% austenitic structure structure can be achieved. SS316L may also be stress relieved between 450°C and 500°C without affecting its microstructure.

Re-austenization

Protective atmosphere	1050°C	Maintain for 2h	Cooling 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.Fatigue Life

Specimens printed using Meltio's wire-laser metal 3D printing process can withstand high fatigue cycles, performing at the same level as samples produced using conventional manufacturing methods. The results also indicate that specimens exhibit good fatigue behaviour 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, from it 16 ASTM E466 samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL info@idonial.com*)

3.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and **Rev 9 2024-12-05** 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* <u>i+d+i@cetemet.es</u>, AIMEN <u>comunicacion@aimen.es</u>)

Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

4.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.



Meltio Stainless Steel 308L

ER308LSI / G 19 9 L Si / 1.4316

SS308L is an austenitic chromium-nickel steel with low carbon content, making it suitable for applications requiring reduced carbide precipitation. It supports service temperatures ranging from -196°C to 350°C. Due to its silicon addition, it offers improved fluidity, resulting in flatter and more uniform surfaces.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization ²
1.0 mm	15 kg	BS300	Uncoated	1390 °C	8.0 g/cm ³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Fe	С	Si	Mn	Cr	Ni
Bal.	0.02	0.9	1.7	20.0	10.0

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]
450 nm	Rev 8 2025-02-21	1000	109	261	32.91	99.98	27/ 65

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties

			Blue	Laser	
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Tre	eatment	As Printed	
		XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	580	WIP	WIP	WIP	WIP
Yield strength [MPa]	440	WIP	WIP	WIP	WIP
Elongation [%]	35	WIP	WIP	WIP	WIP
Hardness [HV-30]	-	-	-	-	WIP

	Casting (ASTM A743)	Wrought (ASTM A473)
Ultimate Tensile strength [MPa]	485	515
Yield strength [MPa]	195	205
Elongation [%]	35	40
Hardness [HV-30]	-	-

Meltio Stainless Steel 308L ER308LSI / G 19 9 L Si / 1.4316

Internal Structure ¹

Micrography

Micrographs of the type 308 stainless steel reveal dendritic and cellular morphologies. Cellular dendritic structures and columnar dendrites are observed, consisting of austenite (white phase) as the primary matrix and delta ferrite (dark phase) located in the interdendritic regions. Within the cellular zones, a predominantly austenitic region is present, containing dark precipitates or particles, likely corresponding to secondary phases formed during cooling.



As-printed XZ 100x Magnification

Meltio Stainless Steel 308L ER308LSI / G 19 9 L Si / 1.4316

1.Internal Structure

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*)

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and **Rev 21 2024-12-13** 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*)

2.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.



Meltio Stainless Steel 17-4PH

17-4PH / ER 630 / 1.4542 / UNS S17400

17-4PH is a precipitation-hardening martensitic stainless steel with excellent mechanical properties and corrosion resistance. It is a versatile material with high strength, good toughness, and good resistance to stress corrosion cracking, making it ideal for a wide range of applications in the aerospace and chemical industries.

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	1404-1440 °C	7.75 g/cm³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Fe	с	Ni	Si	Mn	Cr	Мо	Nb	Cu
Bal.	0.02	4.7	0.4	0.5	16.5	0.2	0.23	3.4

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	146.6	196	25.29	99.91	-
450 nm	Rev 21 2024-12-13	1000	111.11	251	32.38	99.96	70 / 282

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser				Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment		As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	990	-	1391 ± 7	-	1017 ± 15	WIP	WIP	WIP	WIP
Yield strength [MPa]	870	-	1243 ± 8	-	815 ± 17	WIP	WIP	WIP	WIP
Elongation [%]	9	-	10 ± 3	-	14 ± 0.1	WIP	WIP	WIP	WIP
Hardness [HV-30]	-	-	393	-	258	-	-	-	324

	Casting (ASTM A747)	Wrought (ASTM A7058/A7058 M)	Wrought (ASTM 1472)
Ultimate Tensile strength [MPa]	1205	1310	1310
Yield strength [MPa]	1035	1035	1170
Elongation [%]	5	5	10
Hardness [HV-30]	-	-	388

Meltio Stainless Steel 17-4PH

17-4PH / ER 630 / 1.4542 / UNS S17400

Internal Structure²

Micrography The as printed microstructure of 17-4 PH stainless steel is heterogeneous and mostly martensitic with some retained austenite.

Solution Annealing and Age Hardening results in a significantly refined grain structure with a predominantly martensitic microstructure and equiaxed morphology.

IR Laser



As-printed XY 100x Magnification

HT XY 100x Magnification



As-printed XY 100x Magnification

Tomography

CT Scan of 3D printed sample part in 17-4PH using IR Laser without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top View



Front View

MELTIO

Meltio Stainless Steel 17-4PH

17-4PH / ER 630 / 1.4542 / UNS S17400

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. Testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

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 21 2024-12-13** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL info@idonial.com*)

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. (*IDONIAL info@idonial.com*).

Heat Treatment

To achieve the best mechanical properties, 17-4PH should be heat-treated after 3D printing. The standard heat treatment process for 17-4PH involves two steps: Solution Annealing and Age Hardening. Solution annealing removes internal stresses of the metal that have been formed during 3D printing and Age Hardening will upgrade the mechanical properties. Machining may take place before or after the solution annealing depending on part tolerance requirements.

Solution Annealing

Age Hardening

Heat up toHold 1 hour1000°C-1050°CCooling to RT	Heat up to 480°C-500°C	Hold 3 hour Slow Cooling to RT
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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 21 2024-12-13** 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. (*SERMET3D info@sermet3d.com*)

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* <u>i+d+i@cetemet.es</u>, AIMEN <u>comunicacion@aimen.es</u>)

Meltio Stainless Steel 17-4PH

17-4PH / ER 630 / 1.4542 / UNS S17400

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.

Meltio Mild Steel ER70-S

ER70S-6 / S 42 4 M21 3Si1 / AWS A5.18

ER70-S, also known as low alloy carbon steel or mild steel, is a highly versatile material due to its strength, ductility, and low cost. It is used in many applications, including construction, automotive and manufacturing. Its excellent weldability and machinability make it easy to work with, while its high ductility and toughness make it suitable for structural 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	1425 -1485 °C	7.8 g/cm³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Fe	с	Mn	Si	S	Р
Bal.	0.07	1.45	0.85	0.02	0.01

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	146.6	196	18.72	99.19	-
450 nm	Rev 36 2025-02-21	1000	99.2	283	36.28	99.83	137 / 250

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties ¹

		Infrared Laser				Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment		As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	560	-	-	598 ± 5	525 ± 12	WIP	WIP	WIP	WIP
Yield strength [MPa]	480	-	-	484 ± 8	402 ± 37	WIP	WIP	WIP	WIP
Elongation [%]	25	-	-	71 ± 1	15 ± 9	WIP	WIP	WIP	WIP
Hardness [HV-30]	-	_	-	-	175	-	-	-	136

	Casting (ASTM A494)	Wrought (ASTM A.3)
Ultimate Tensile strength [MPa]	585	550
Yield strength [MPa]	205	250
Elongation [%]	24	23
Hardness [HV-30]	160	127

Meltio Mild Steel ER70-S ER70S-6 / S 42 4 M21 3Si1 / AWS A5.18

Internal Structure²

Micrography

The investigation reveals that the microstructure of the ER70-S specimens consists of a ferritic matrix intermixed with pearlite at the grain boundaries, wherein the interlayers exhibit larger grain sizes owing to the heat generated during material deposition.

IR Laser



As-printed XY 100x Magnification

HT XY 100x Magnification





As-printed XY 100x Magnification

Tomography

Computed Tomography Scan of 3D printed sample part in ER70-S without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top View



Front View

Meltio Mild Steel ER70-S

ER70S-6 / S 42 4 M21 3Si1 / AWS A5.18

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 36 2025-02-21** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*CETEMET* <u>i+d+i@cetemet.es</u>)

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. (*University of Jaen (UJA)* <u>info@strainanalysisuja.es</u>, IDONIAL <u>info@idonial.com</u>).

Heat Treatment

With ER70-S it is not mandatory to perform a heat-treatment after 3D printing for general use case applications. A Normalizing heat treatment can be applied to ER70-S to improve its microstructure and mechanical properties. By eliminating unstable constituents such as acicular ferrite and bainite, a more uniform and homogeneous microstructure is achieved, leading to a better distribution of pearlite and ferrite. This results in increased ductility and toughness, as well as a reduction in the anisotropy of the material.

Normalization

Protective atmosphere	Maintain for 2h
Heat up to 900°C	Cooling in air 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 36 2025-02-21** 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*, *ADIMME aidimme@aidimme.es*)

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* <u>i+d+i@cetemet.es</u>, AIMEN <u>comunicacion@aimen.es</u>)

Meltio Mild Steel ER70-S

ER70S-6 / S 42 4 M21 3Si1 / AWS A5.18

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.



Meltio Tool Steel H11

Tool Steel H11 / 1.2343

Tool Steel H11 is one of the most commonly used tool steels. It is a hot-work steel that is used to make hot-working tools such as forging, die-casting, extrusion, and plastic molds due to its resistance to thermal fatigue cracking and high-temperature abrasion. In addition to hot-working tools, it is also used to produce cutting tools and in the aerospace industry for mechanical components.

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	Copper	1480 °C	7.81 g/cm ³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Fe	с	Si	Mn	Cr	Мо	v
Bal.	0.38	1.0	0.4	5.0	1.1	0.45

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	220	141	18.05	99.8	-
450 nm	Rev 23 2025-03-13	1000	200	150	19.21	99.9	9.05 / 91.58

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser				Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment		As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	xz	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	-	-	2087 ± 2	-	1830 ± 105	WIP	WIP	WIP	WIP
Yield strength [MPa]	-	-	1735 ± 101	-	1170 ± 90	WIP	WIP	WIP	WIP
Elongation [%]	-	-	12.18±0.19	-	3.46 ± 0.36	WIP	WIP	WIP	WIP
Hardness [HRC]	57	_	51	_	52	_	_	50	-

	Wrought (ASTM 1472)
Ultimate Tensile strength [MPa]	1990
Yield strength [MPa]	1650
Elongation [%]	10
Hardness [HRC]	53

Meltio Tool Steel H11

Tool Steel H11 / 1.2343

Internal Structure²

Micrography

Tool Steel H11 displays tempered and fresh martensite, retained austenite, and columnar grain morphology aligned with the solidification front. Heat treatment reduces retained austenite and refines the grain to a primarily equiaxed shape, converting most of the martensite. Trace amounts of austenite may remain undetectable with light microscopy.

IR Laser



As-printed XY 100x Magnification

HT XY 100x Magnification

Blue Laser



As-printed XY 100x Magnification

Tomography

CT Scan of 3D printed sample part in H11 using IR Laser without detectable voids or defects. Resolution of 24 μm per pixel.



3D / Top View



Front View

Meltio Tool Steel H11

Tool Steel H11 / 1.2343

Cladding and Dual Material Applications With IR laser

Tool Steel H11 is highly resistant to wear, deformation and heat, which makes it an excellent material for cladding or dual material applications where not the entire component requires these properties. H11 steel has excellent weldability and can be used to form a dense and well-bonded coating layer that provides high wear resistance, high Hardness and temperature resistance as well as good corrosion resistance.

Elemental Distribution

interface of the two materials.

Hardness Profile

Composition mapping of H11 cladding on Hardness was measured across the material SS316L. Measurements were spaced 150 µm. transition and results indicate that a single Apart with measurement 5 coinciding with the cladding layer is sufficient to achieve good and stable properties.

MELTIO



Elemental Mapping

Elemental (EDX) Mapping is employed to characterize the dilution of the two materials. Meltio used as printed Stainless Steel 316L as the substrate without post processing. Results show low dilution between SS316L and H11.



Cladding interface layer XZ Electron Microscopy

Cladding interface layer XZ Chromium EDX Map

Cladding interface layer XZ Iron EDX Map

Cladding interface layer XZ Nickel EDX Map

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Meltio Tool Steel H11

Tool Steel H11 / 1.2343

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. Testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

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 23 2025-03-13** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL info@idonial.com*)

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. (*IDONIAL info@idonial.com*, *CETEMET* <u>i+d+i@cetemet.es</u>).

Heat Treatment

Tool Steel H11 is an Air-Hardening tool steel which during 3D printing reaches its hardened state. In this state machinability is affected and there is a high risk of cracking due to the reduced ductility. Consequently, a heat-treatment cycle is typically necessary, except for cladding applications or small feature addition. The ideal cycle should begin with an annealing step prior to removing the part from the build plate. The material will be softened and free of internal stresses, making easy to machine. After machining, the part should then undergo hardening and a suitable tempering cycle to achieve the desired hardness.

Annealing

Quenching

Tempering



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 23 2025-03-13** 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* <u>i+d+i@cetemet.es</u>, AIMEN <u>comunicacion@aimen.es</u>)

Meltio Tool Steel H11

Tool Steel H11 / 1.2343

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.



Meltio Nickel 625

Inconel 625 / ERNiCrMo-3 / S Ni 6625 / 2.4831

Nickel 625 is a superalloy that offers excellent strength, corrosion resistance, and heat resistance. It is a popular material choice in a wide range of applications, including aerospace, chemical processing, and naval industry, where it can withstand high temperatures and harsh environments. Among superalloys, Nickel 625 excels for its weldability, making it an ideal choice for cladding or repair of components working at high temperatures or requiring increased corrosion protection.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization ⁴
1.0 mm	15 kg	BS300	Uncoated	1290-1350 °C	8.20 g/cm ³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Ni	с	Si	Mn	Cr	Fe	Мо	Nb	S
Bal.	0.02	0.2	0.2	22.0	1.0	9.0	2.5	0.01

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	137.5	220	26.83	99.70	-
450 nm	Rev 15 2025-02-27	1000	66.13	446	54.39	99.88	92 / 162

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser				Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment		As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	800	-	739 ± 19	-	-	WIP	WIP	722.2	775.5
Yield strength [MPa]	520	-	323 ± 15	-	-	WIP	WIP	415.6	492.5
Elongation [%]	35	-	58.4 ± 3.9	-	-	WIP	WIP	52	50.2
Hardness [HV-10]	-	-	160 ± 3	-	-	-	-	222	-

Reference Standards

	Casting (ASTM A494)	Wrought (ASTM B564-22)	Wrought (ASTM B446)
Ultimate Tensile strength [MPa]	485	690	827
Yield strength [MPa]	275	276	414
Elongation [%]	25	30	30
Hardness [HV-10]	-	-	220

Charpy Test ²

	Infrared Laser			
ASTM E23 (XZ)	As printed	Heat Treated		
Temperature [°C]	-	- 60		
Energy Absorbed [J]	230	± 10		

Meltio Nickel 625 Inconel 625 / ERNiCrMo-3 / S Ni 6625 / 2.4831

Internal Structure ³

Micrography

The micrographs shows no significant micro-structural defects. Grains exhibit diverse sizes and no preferential orientation. Notable features include the presence of twins from thermal treatment, enhancing strength and toughness.

IR Laser



As-printed XY 100x Magnification

HT XY 100x Magnification



As-printed XY 100x Magnification

Tomography

CT Scan of 3D printed sample part in Nickel 625 using IR Laser without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top View



Front View

Meltio Nickel 625

Inconel 625 / ERNiCrMo-3 / S Ni 6625 / 2.4831 Cladding and Dual Material Applications With IR Laser

Nickel 625 is highly resistant to wear, deformation and heat, which makes it an excellent material for cladding or dual material applications where not the entire component requires these properties. Nickel 625 has excellent weldability and can be used to form a dense and well-bonded coating layer that provides high wear resistance as well as excellent corrosion and temperature resistance.

Elemental Distribution

the interface of the two materials.

Hardness Profile

Composition Mapping of Nickel 625 Cladding Hardness was measured across the material on SS316L. Measurements were spaced 150 transition and results indicate that a single µm.Apart with measurement 5 coinciding with cladding layer is sufficient to achieve good and stable properties.

MELTIO



Elemental Mapping

Elemental (EDX) Mapping is employed to characterize the dilution of the two materials. Meltio used as deposited Stainless Steel 316L as the substrate without post processing. Results show low dilution between the materials.



* Meltio's current work on material characterization is carried out using the Meltio M600 and it remains under constant development. Specifications provided herein may not reflect the latest state of our research. For further information and questions please contact us via info

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Meltio Nickel 625 Inconel 625 / ERNiCrMo-3 / S Ni 6625 / 2.4831

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 15 2025-02-27** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL info@idonial.com*)

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* <u>i+d+i@cetemet.es</u>).

Heat Treatment

To achieve the best mechanical properties Nickel 625 should be heat-treated after 3D printing. The standard heat treatment process for Nickel 625 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 could be compromised.

Solution Annealing

Age Hardening

Protective atmosphere Heat up to 1150°C	Hold for 2h Fast cooling to RT	Protective atmosphere Heat up to 700°C in 1h Hold at 700°C during 24h	Cooling in oven to RT
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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.Charpy Test

The Charpy V-notch test is a standardised high strain rate test that determines the amount of energy absorbed by a material during fracture. The energy absorbed is a measure of the notch toughness of the material. The results obtained with Meltio Ni 625 show the high performance of the alloy even at low temperatures.

3.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and **Rev 15 2025-02-27** 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*)

Meltio Nickel 625 Inconel 625 / ERNiCrMo-3 / S Ni 6625 / 2.4831

4.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.

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 °C	8.20 g/cm³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Ni	с	Si	Mn	Cr	Fe	Ti	Мо	Nb+Ta	AI
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	146.6	201	24.51	99.8	-
450 nm	Rev 8 2024-11-29	1000	83.33	350	42.68	99.9	9.05 / 91.58

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser						Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Tre S.A⁺	eatment ⊦A.H	Heat Treatment		As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	ХZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	1140	1256 ± 11	1208 ± 49	1016 ± 28	925 ± 86	-	833 ± 50	WIP	WIP	WIP	WIP
Yield strength [MPa]	-	1025 ± 7	980 ± 2	660 ± 10	631 ± 10	-	537 ± 32	WIP	WIP	WIP	WIP
Elongation [%]	-	11 ± 1	10 ± 5	18 ± 6	15 ± 2	-	25 ± 3	WIP	WIP	WIP	WIP
Hardness [HV-30]	-	_	332	_	285	-	245	-	WIP	247	-

	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 Nickel 718

ERNiFeCr-2 / S Ni 7718 / 2.4667

Internal Structure ²

Micrography

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.

IR Laser



As-printed XY 100x Magnification

HT XY 100x Magnification

Blue Laser



As-printed 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 μ m per pixel.



3D / Top View



Front View

Meltio Nickel 718

ERNiFeCr-2 / S Ni 7718 / 2.4667

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 8 2024-11-29** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*CETEMET* <u>i+d+i@cetemet.es</u>)

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* <u>i+d+i@cetemet.es</u>, University of Jaen (UJA) <u>info@strainanalysisuja.es</u>).

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 atmosphereHold for 1hHeat up to 1100°CCooling in water to RT	Protective atmosphere Heat up to 760°C in 2h Hold at 760°C during 8h	Cool down to 650°C in 1h50' Hold at 650°C during 8h Cooling in oven to RT
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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* <u>i+d+i@cetemet.es</u>, AIMEN <u>comunicacion@aimen.es</u>)

Meltio Nickel 718

ERNiFeCr-2 / S Ni 7718 / 2.4667

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.



Meltio Invar 36

Invar 36 / Alloy 36 / 1.3990

Invar is a type of nickel-iron alloy that is known for its unique properties, including low coefficient of thermal expansion and high dimensional stability over a wide range of temperatures. These characteristics make it a valuable material in various applications that require precision and stability, such as precision instruments, scientific measuring devices, cryogenics, composite molds and aerospace components.

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	1340 °C	8.10 g/cm ³	304 Steel	1.0 U-Groove	Local

Chemical Composition

Fe	с	Ni	Mn	Nb	Ті
Bal.	0.35	36.0	1.0	2.5	1.0

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	183	183.33	22.59	99.99	-

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser				
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment As Printed			rinted	
		XY	XZ	XY	xz	
Ultimate Tensile strength [MPa]	990	-	-	-	522 ± 14	
Yield strength [MPa]	870	-	-	-	337 ± 22	
Elongation [%]	9	-	-	-	24 ± 2	
Hardness [HV-30]	-	_	_	-	147	

	Wrought (ASTM A658)
Ultimate Tensile strength [MPa]	500
Yield strength [MPa]	241
Elongation [%]	31
Hardness [HV-30]	127

Meltio Invar 36

Invar 36 / Alloy 36 / 1.3990

Internal Structure ²

Micrography

The as printed microstructure of Invar is heterogeneous and mostly austenite with nickel dissolving in γ -Fe.



As-printed XZ 1000x Magnification

As-printed XY 1000x Magnification

Tomography

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



3D / Top View



Front View

Meltio Invar 36

Invar 36 / Alloy 36 / 1.3990

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. Testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization for IR Laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL info@idonial.com*)

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. (*IDONIAL info@idonial.com*).

Heat Treatment

Owing to the use of Invar in precision components, it is often recommended to subject it to an annealing heat-treatment after 3D printing. This is necessary as the 3D printing process introduces residual stresses, which affects the material's performance. After annealing, the sample should pass through an aging process to improve and achieve suitable mechanical properties.

Annealing

Aging

Protective atmosphere	Hold for 1h	Protective atmosphere	Hold at 425°C during 2h
Heat up to 800°C	Cooling to RT	Heat up to 425°C	Cooling in oven to RT

2.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR 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 <u>info@catec.aero</u>*)

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 <u>comunicacion@aimen.es</u>)

Meltio Invar 36

Invar 36 / Alloy 36 / 1.3990

4.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.

Meltio Titanium 64

Ti-6AI-4V / ER Ti-5 / S Ti 6402c / 3.7165

Ti64 is a popular and widely used alloy due to its excellent combination of strength, low density, and corrosion resistance. It is used in a variety of industries, including aerospace, and chemical processing, due to its properties. Its high strength-to-weight ratio makes it a preferred choice for lightweight applications.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization ⁴
1.0 mm	7.5 kg	BS300	Uncoated	1674 °C	4.4g/cm³	Titanium	1.0 V-Groove	Full chamber

Chemical Composition

Ti	AI	v	Fe	с	N	н	0
Bal.	5.5	3.5	0.4	0.08	0.05	0.015	0.2

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]	Oxygen Content
976 nm	Verified Density	1100	122.22	143	32.5	99.90	-	0.250 - 0.450
450 nm	Rev 30 2024-12-17	1000	47.62	333	75.68	99.87	376 / 550	0.095 - 0.213

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties 1

		Infrared Laser				Blue Laser			
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment		As Pi	rinted	Heat Treatment		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile strength [MPa]	895	802 ± 7	788 ± 12	-	-	852 ± 11	850 ± 11	958 ± 12	962 ± 12
Yield strength [MPa]	828	727 ± 17	693 ± 16	-	-	740 ± 9	699 ± 9	852± 11	854 ± 11
Elongation [%]	10	7 ± 1	9 ± 1	-	-	12.50 ± 0.5	14.13 ± 0.5	11.75± 0.5	9.50 ± 0.5
Hardness [HV-30]	-	-	311	303	-	-	-	332	-

Reference Standards

	Cast (ASTM B367)	Cast (ASTM F1108)	Wrought (ASTM A381)	Wrought (ASTM F1472)
Ultimate Tensile strength [MPa]	895	860	895	930
Yield strength [MPa]	825	758	828	860
Elongation [%]	6	8	10	10
Hardness [HV-30]	-	342	-	349

Fatigue ²

	Infrared	d Laser	Blue Laser			
ASTM E466 (XZ)	Heat Treated <i>(A.H)</i>	Heat Treated (HIP)	As Printed	Heat Treated		
Stress Range [Mpa]	450	530	WIP	WIP		
Nº of Cycles (Nf)		1x1	0^7			
Stress Ratio (R)	-1					

Meltio Titanium 64

Ti-6AI-4V / ER Ti-5 / S Ti 6402c / 3.7165

Internal Structure ³

Micrography The observed microstructure is composed of acicular martensite embedded in the beta phase. The columnar shape of the grains extends along the manufacturing direction due to epitaxial growth of the original beta phase. In the XY section, the microstructure appears as polyhedral grains of $\alpha' + \beta$, with alpha phases at grain boundaries.

IR Laser





Blue Laser



As-printed XY 100x Magnification

HT XY 100x Magnification

As-printed XY 100x Magnification

Tomography

CT Scan of 3D printed sample part in Ti64 using IR Laser without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top View



Front View

Meltio Titanium 64 Ti-6Al-4V / ER Ti-5 / S Ti 6402c / 3.7165

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 30 2024-12-17** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. IR laser were carried out by *CATEC* <u>info@catec.aero</u> and *AIDIMME* <u>aidimme@aidimme.es</u>)

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 lab. (IR laser were carried out by *CATEC info@catec.aero* and Blue laser were carried out by *CETEMET* <u>i+d+i@cetemet.es</u>).

Heat Treatment

Heat treatment is recommended for Ti64 to enhance its mechanical properties. Through heat treatment, the alloy becomes stronger, more ductile, and more resistant to fatigue, making it suitable for high-stress applications. Heat treatment also eliminates residual stresses and helps to refine the microstructure of the alloy, leading to improved toughness and increased resistance to crack growth. Heat treatment of Ti64 after 3D printing is a crucial step in maximizing its performance in applications.

Solution Annealing		Age Hardening				
Vacuum atmosphere	Hold for 2h	Vacuum atmosphere	Hold for 8h			
Heat up to 920°C	Cooling to RT	Heat up to 460°C	Cooling inside the oven to RT			

2.Fatigue Life

Specimens printed using Meltio's wire-laser metal 3D printing process can withstand high fatigue cycles, performing at the same level as samples produced using conventional manufacturing methods. The results also indicate that specimens exhibit good fatigue behaviour 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, from it 16 ASTM E466 samples were extracted using EDM and were analyzed by an external laboratory. (*AIDIMME <u>aidimme@aidimme.es</u>*)

3.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and **Rev 30 2024-12-17** 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*)

Oxygen Content

Oxidation is a crucial factor that particularly affects the properties and performance of 3D printed titanium samples. Titanium has a high affinity for oxygen when exposed to air at high temperatures, which leads to embrittlement and reduced mechanical properties, such as decreased resistance to wear, fatigue, and corrosion and were analyzed by an external laboratory. (*AIDIMME <u>aidimme@aidimme.es</u>*)

Relative Density

Characterizing materials for its Blue Laser technology using 300x400x60 mm Titanium 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*)

Meltio Titanium 64 Ti-6Al-4V / ER Ti-5 / S Ti 6402c / 3.7165

4.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 20 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.



Meltio ERCuNiAI (Marine Bronze)

ERCuNiAl / G CU 6328 (CuAl9Ni5Fe3Mn2) / 2.0923

Copper-Nickel-Aluminum wire is designed for high strength and durability. It offers excellent mechanical properties and corrosion resistance, ideal for demanding environments. This alloy ensures optimal performance in applications requiring wear and corrosion resistance.

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	1100 °C	8.00 g/cm ³	304 Steel	1.0 V-Groove	Local

Chemical Composition

Cu	AL	Mn	Fe	Ni
Bal.	9	1.5	3.2	4.5

Tested Print Hollow 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	146.6	196	24.81	-	-
450 nm	Rev 35 2024-12-20	1000	83.33	341	432.5	99.98	70/-

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties ¹

		Blue Laser				
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Tre	eatment	As Printed		
		XY	XZ	XY	XZ	
Ultimate Tensile strength [MPa]	690	WIP	WIP	WIP	WIP	
Yield strength [MPa]	280	WIP	WIP	WIP	WIP	
Elongation [%]	16	WIP	WIP	WIP	WIP	
Hardness [HV-10]	-	-	-	-	191	

	Wrought (ASTM B283/B283M- 24)
Ultimate Tensile strength [MPa]	565
Yield strength [MPa]	255
Elongation [%]	32
Hardness [HV-10]	152

Meltio ERCuNiAI (Marine Bronze)

ERCuNiAl / G CU 6328 (CuAl9Ni5Fe3Mn2) / 2.0923

Internal Structure ²

Micrography

The images show an acicular α -phase with Widmanstätten morphology in bright tones, alongside darker regions of retained martensite β '. Needle size variations suggest thermal effects from layer overlap. At higher magnifications, dispersed precipitates, possibly k-phases, are observed

Blue Laser

As-printed XZ 100x Magnification

As-printed XY 100x Magnification

MELTIO

Tomography

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



3D / Top View



Front View

Meltio ERCuNiAI (Marine Bronze)

ERCuNiAl / G CU 6328 (CuAl9Ni5Fe3Mn2) / 2.0923

1.Structural Properties

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. (*IDONIAL info@idonial.com*).

MELTIO

2.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the **Rev 21 2024-12-13** 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 <u>info@idonial.com</u>*)

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. (*SERMET3D info@sermet3d.com*)

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*)

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.



Meltio Material Datasheet

Meltio Aluminum 4046

AlSi10Mg / G AL 4046(AlSi10Mg) / 3.2381

Aluminum 4046 is an aluminum-silicon alloy wire designed for welding applications. With a high silicon content, it provides excellent fluidity, reducing the risk of hot cracking and ensuring smooth, uniform weld beads. This alloy is commonly used for welding aluminum castings and automotive applications. It offers good corrosion resistance and moderate mechanical properties, making it suitable for applications requiring high-quality, strong welds.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization ³
1.2 mm	7 kg	B300	Uncoated	577 - 630 °C	2.7 g/cm ³	Ti64	1.2 U-Groove	Full Chamber

Chemical Composition

AI	Fe	Cu	Mn	Mg	Zn	Ве	Ti
Bal.	< 0.50	< 0.03	< 0.4	0.2-0.5	< 0.1	<0.0003	< 0.15

Tested Print Hollow Profiles

Laser	Profile name	Meltio TRL ²	Laser Power [W]	Energy Density [J/mm3]	Deposition Rate [g/h]	Volume rate [cc/h]	Relative Density [%]	Max Pore/Defect [µm]
450 nm	Rev 10 2025-02-25	Develop	1000	23.15	420	155.52	-	-

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties

		Blue Laser					
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Treatment		As Printed			
		XY	XZ	XY	XZ		
Ultimate Tensile strength [MPa]	380	WIP	WIP	WIP	WIP		
Yield strength [MPa]	280	WIP	WIP	WIP	WIP		
Elongation [%]	15	WIP	WIP	WIP	WIP		
Hardness [HV-30]	-	-	-	-	WIP		

	Wrought (ASTM B740)
Ultimate Tensile strength [MPa]	450
Yield strength [MPa]	350
Elongation [%]	20
Hardness [HV-30]	-

Meltio Material Datasheet

Meltio Aluminum 4046

AlSi10Mg / G AL 4046(AlSi10Mg) / 3.2381

Internal Structure 1

Tomography

CT Scan of 3D printed sample part in Aluminum 4046 using Blue Laser without detectable voids or defects. Resolution of 24 μ m per pixel.



Μειτιο

Meltio Aluminum 4046

AlSi10Mg / G AL 4046(AlSi10Mg) / 3.2381

1.Internal Structure

Tomography

The tomography images were obtained from a 80x80x200 mm printed hollow cylinder using the **Rev 10 2025-02-25** Profile for Blue laser and were analyzed by an external laboratory. (*CATEC info@catec.aero*)

2.Meltio TRL Classification System

The manufacturing process of Copper and Aluminum using Meltio's Blue Laser technology has certain limitations. Currently, thin-walled geometries (produced in a single pass) can be reliably manufactured. However, solid or bulky components present challenges due to variations in material behavior and thermal properties as the volume and mass increase. While small solid volumes of these materials can be printed, scalability remains an area of ongoing development.

Additionally, the technological readiness of Copper and Aluminum printing is currently between **Technology Readiness Level (TRL) 3 and 5,** indicating that it is still in the experimental validation and optimization stages. In contrast, other Meltio materials, such as steels, nickel and titanium alloys, have reached higher maturity levels, ranging from TRL 7 to 9, with validated applications in industrial environments.

To clearly communicate the development and readiness level of materials within the Meltio ecosystem, an internal classification system has been established, aligned with the standard Technology Readiness Levels (TRL). This framework offers a structured reference for customers, partners, and integrators regarding the current validation stage and industrial applicability of each material.

Meltio Tier	TRL	Description
Meltio Explore	1–3	Exploratory phase focused on researching new alloys and process configurations. Designed for R&D environments aiming to push the boundaries of the technology.
Meltio Develop	4–6	Active development stage. Functional results have been achieved, with evolving process parameters. Suitable for concept validation and pre-industrial applications.
Meltio Qualified	7-8	Material and process qualified for demanding applications. High repeatability and reliability, ready for integration into real-world production environments.
Meltio Proven	9	Fully validated in industrial settings. Material used in end-use parts with proven performance in actual production. Represents the highest level of technological maturity.

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 20 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.

Meltio Material Datasheet



Meltio CuCrZr

CuCrZr

CuCrZr is a high-strength, high-conductivity copper alloy for demanding electrical and mechanical applications. It is non-magnetic, corrosion-resistant, and withstands temperatures up to 400°C. Ideal for aerospace, automotive, and railway cables, it offers excellent flex life and redrawability. Eco-friendly and free of lead, cadmium, and beryllium.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization ²
1.0 mm	15 kg	BS300	Uncoated	1083 °C	8.94 g/cm³	304 Steel	1.0 U-Groove	Full Chamber

Chemical Composition

Cu	Cr	Zr
99.88 -99.34	0.1-0.6	0.02 -0.06

Tested Print Hollow Profiles

Laser	Profile name	Meltio TRL ¹	Laser Power [W]	Energy Density [J/mm3]	Deposition Rate [g/h]	Volume rate [cc/h]
450 nm	Rev 8 2 mm 2025-02-13	Develop	1000	83.33	386	43.18
450 nm	Rev 9 3 mm 2025-02-25	Develop	1000	83.86	384	42.95

* Printing profiles available in our official Slicers: Meltio Horizon for standalone Printers and Meltio Space for Laser Integration Kits.

Structural Properties

		Blue Laser					
ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Heat Tre	eatment	As Printed			
		XY	XZ	XY	XZ		
Ultimate Tensile strength [MPa]	380	WIP	WIP	WIP	WIP		
Yield strength [MPa]	280	WIP	WIP	WIP	WIP		
Elongation [%]	15	WIP	WIP	WIP	WIP		
Hardness [HV-30]	-	-	-	-	WIP		

	Wrought (ASTM B740)
Ultimate Tensile strength [MPa]	450
Yield strength [MPa]	350
Elongation [%]	20
Hardness [HV-30]	-

Meltio CuCrZr

CuCrZr

1.Meltio TRL Classification System

The manufacturing process of Copper and Aluminum using Meltio's Blue Laser technology has certain limitations. Currently, thin-walled geometries (produced in a single pass) can be reliably manufactured. However, solid or bulky components present challenges due to variations in material behavior and thermal properties as the volume and mass increase. While small solid volumes of these materials can be printed, scalability remains an area of ongoing development.

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