MELTIO
Rev 3.0

Meltio Material Datasheet

Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

SS316L is an 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.

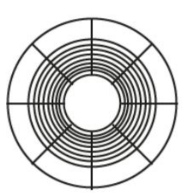
Properties	Corrosion Resistance, Machinable and Polishable
Applications	Machinery, Chemical and Food Industry and Naval

Wire Chemical Composition	Fe	C	Si	Mn	Cr	Ni	Mo
Weight Percent [%]	Bal.	0.02	0.9	1.7	18.5	12.0	2.7

Wire Density
8.0 g/cm³

Melting Point		
1671 K	1398 ºC	2548 °F

Spool Specs



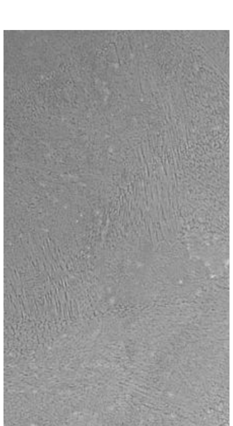
Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1875 cm³
Spool Type	BS300
Wire Coating	Uncoated

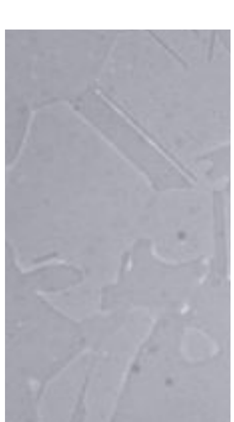
Relative density as 3D printed	> 99.7%

Micrography

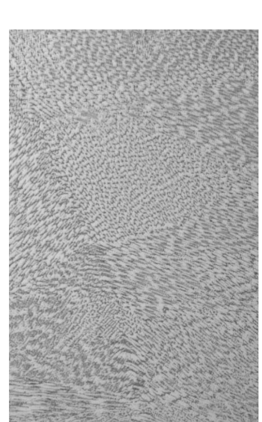
The as-built SS316L samples show a microstructure with both cellular and columnar dendritic solidification mode. In as printed condition we find around 5.6% ferritic structures which are reduced to 0.2 % after heat-treatment of re-austenization.



Gen I. As-printed XY
100x Magnification



Gen I. HT XY
100x Magnification



Gen II. As-printed XY
100x Magnification

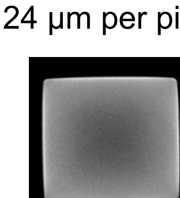
Published
in Q4

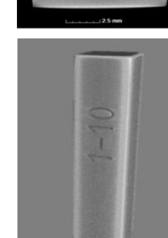
Gen II. HT XY
100x Magnification

Test Carried Out In IDONIAL
info@idonial.com

Tomography

CT Scan of 3D printed sample part in SS316L without detectable voids or defects. Resolution of 24 μm per pixel.





3D / Top View

Front View

Test Carried Out In CATEC
info@catec.aero

Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

Parametrization for Verified Density Profiles

The following fully dense printing parameters were obtained, based on a printed block of 30x60x20 mm. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed using CT Scan on an external lab. Please use the provided “Materials Handbook” to know better the printing parameters relation and their effect on part density. These printing parameters are available in our slicers Meltio Horizon and Meltio Space.

	Laser Power [W]	**Laser Wavelength (nm)**	**Velocity [mm/s]**	**Argon Flow [l/min]**	**Layer Height [mm]**	**Layer Width [mm]**	**Wire Speed [mm/s]**	**Input Energy Density [J/mm3]**	**Deposition Rate [g/h]**
IR	1100	976	7.5	10.0	1.0	1.0	9.6	146.6	196
Blue	1000	450	10.0	10.0	1.2	1.0	15.3	83.3	346

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 cylinder sample of 4 mm diameter and 10 mm long extracted by EDM from a printed block of 160x30x70mm.*

Mechanical Properties

Results show that 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.

			UNE EN ISO 6892-1				
	Cast Properties *(ASTM A403)*	**Wrought Properties *(ASTM A351)***	**Meltio XY properties *(H.T.)***	**Meltio XZ properties *(H.T.)***	**Meltio XY properties *(As printed)***	**Meltio XZ properties *(As printed)***	
Ultimate Tensile strength (UTS) [MPa]	515	550	556 ± 8	547 ± 8	643 ± 6	655 ± 11	**IR**
			Published in Q4				**Blue**
Yield strength [MPa]	208	260	215 ± 3	253 ± 17	429 ± 16	347 ± 28	**IR**
			Published in Q4				**Blue**
Elongation [%]	40	35	65 ± 1	62 ± 2	38 ± 2	41 ± 4	**IR**
			Published in Q4				**Blue**
			**Test Carried Out In IDONIAL* info@idonial.com				

The following Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory.

Meltio Material Datasheet

Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

			UNE EN ISO 6507-1		
	Cast Properties *(ASTM A403)*	**Wrought Properties *(ASTM A351)***	**Meltio Properties *(H.T)***	**Meltio Properties *(As printed)***	
Hardness [HV-30]	215	225	192	198	**IR**
			Published in Q4	173	**Blue**
			**Gen I Test Carried Out In IDONIAL* info@idonial.com **Gen II Test Carried Out in CETEMET* i+d+i@cetemet.es		

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed by an external lab.

Fatigue Life

The results demonstrate that 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.

	ASTM E466		
	XZ properties *(As printed)*	**XZ properties *(H.T.)***	
Stress Range [Mpa]	220	190	**IR**
	Published in Q1 of 2025		**Blue**
Nº of Cycles (Nf)	5x10^6		**IR & Blue**
Stress Ratio (R)	-1		**IR & Blue**
	**Test Carried Out In IDONIAL* info@idonial.com		

The following 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.

** Meltio's work on material characterization is carried out using the Meltio M450 and 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@meltio3d.com.*

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.

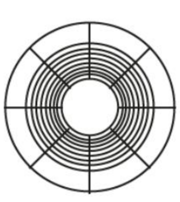
Properties	High Strength, Low Weight, Corrosion Resistance and Heat Treatable
Applications	Aerospace, Chemical Industries, Oil & Gas, Defense and Naval

Wire Chemical Composition	Fe	C	Ni	Si	Mn	Cr	Mo	Nb	Cu
Weight Percent [%]	Bal.	0.02	4.7	0.4	0.5	16.5	0.2	0.23	3.4

Wire Density
7.75 g/cm³

Melting Point		
1677 - 1713 K	1404 - 1440 ºC	2559 - 2624°F

Spool Specs



Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1935 cm³
Spool Type	BS300
Wire Coating	Uncoated

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

Heat up to 1000ºC-1050ºC	Hold 1 hour Cooling to RT

**Typical Parameters for a Sample of 160x60x30 mm*

Age Hardening

Heat up to 480ºC-500ºC	Hold 3 hour Slow Cooling to RT

Deposition Parameters

The following 3D printing parameters were found to provide dense samples. Please use the provided “Density Profiles” and refer to the document “Printing Parameters and their effect on part density” for additional information.

Laser Power [W]	Velocity [mm/s]	Argon Flow [l/min]	Layer Height [mm]	Wire Speed [mm/s]	Energy Density [J/mm3]
1100	7.5	10	1.0	9.6	147

Meltio Material Datasheet

Meltio Stainless Steel 17-4PH

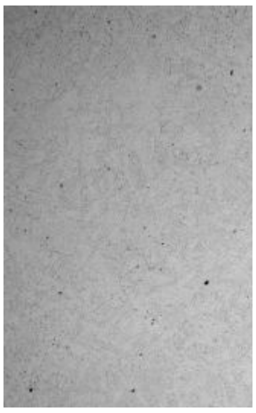
17-4PH / ER 630 / 1.4542 / UNS S17400

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.

As-printed XZ
100x Magnification

As-printed XZ
1000x Magnification

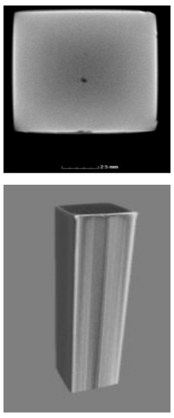


HT.1+ HT.2
1000x Magnification

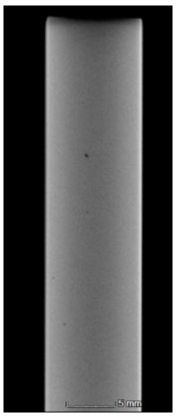
**Tests Carried Out In IDONIAL*
info@idonial.com

Tomography

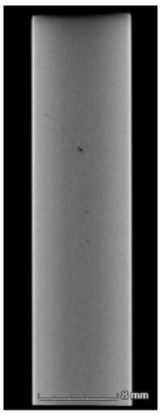
Computed Tomography Scan of 3D printed sample part in 17-4PH showing small detectable voids. Resolution of 24 µm per pixel.



3D / Top
View



Left View



Front View

**Test Carried Out In SERMET3D*
sermet3d@gmail.com

Relative density as 3D printed	99.90%

Mechanical Properties

Results show that specimens printed using Meltio's wire-laser metal 3D printed process perform at the same level as samples made with conventional manufacturing methods. Testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

		UNE EN ISO 6892-1	
	Wrought Properties (ASTM 1472)	**Meltio XZ Properties (HT.1 + HT.2)**	**Meltio XZ Properties (As Printed)**
Ultimate Tensile strength (UTS) [MPa]	1310	1391 ± 7	1017 ± 15
Yield strength [MPa]	1170	1243 ± 8	815 ± 17
Elongation [%]	10	10 ± 3	14 ± 0.1

**Tests Carried Out In IDONIAL*
info@idonial.com

		UNE EN ISO 6507-1	
	Wrought Properties (ASTM 1472)	**Meltio Properties (HT.1 + HT.2)**	**Meltio Properties (As Printed)**
Hardness [HV-30]	388	393	258

**Tests Carried Out In IDONIAL*
info@idonial.com

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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.

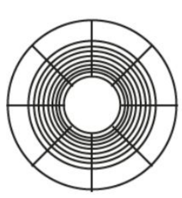
Properties	Low Cost, Easily Machined, Highly Ductile and Magnetic
Applications	Manufacturing, Tools and prototypes and Automotive industries

Wire Chemical Composition	Fe	C	Mn	Si	S	P
Weight Percent [%]	Bal.	0.07	1.45	0.85	0.02	0.01

Wire Density
7.8 g/cm³

Melting Point		
1700 - 1760 K	1425 - 1485ºC	2600 - 2700°F

Spool Specs



Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1923 cm³
Spool Type	BS300
Wire Coating	Uncoated

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 Heat up to 900°C	Maintain for 2h Cooling in air to RT

**Typical Parameters for a Sample of 160x60x30 mm*

Deposition Parameters

The following 3D printing parameters were found to provide fully dense samples. Please use the provided "Density Profiles" and refer to the document "Printing Parameters and their effect on part density" for additional information.

Laser Power [W]	**Velocity [mm/s]**	**Argon Flow [l/min]**	**Layer Height [mm]**	**Wire Speed [mm/s]**	**Energy Density [J/mm3]**
1100	7.5	10	1.0	9.6	147

Meltio Material Datasheet

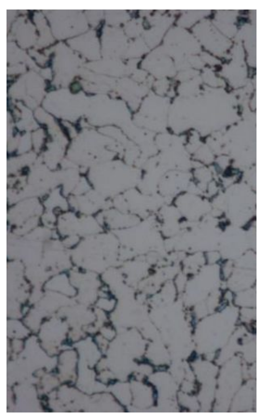
Meltio Mild Steel ER70-S

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

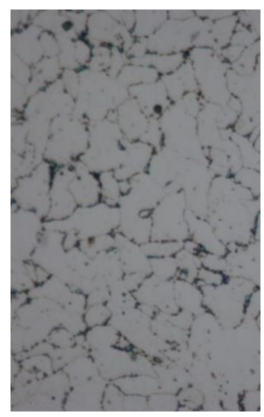
Micrography

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.

As-printed XY
100x Magnification



As-printed XY
1000x Magnification

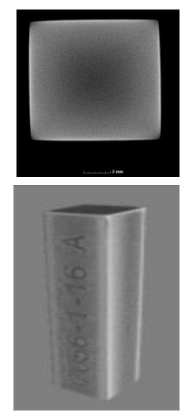


As-printed XZ
1000x Magnification

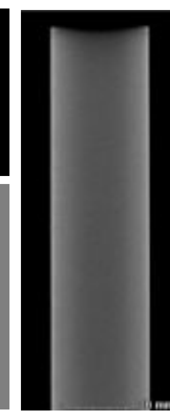
*Test Carried Out In ADIMME
aidimme@aidimme.es

Tomography

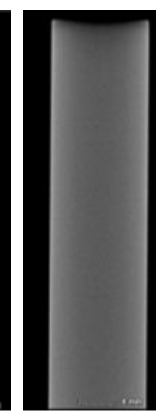
Computed Tomography Scan of 3D printed sample part in ER70-S without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top
View



Left View



Front View

*Test Carried Out In CATEC
info@catec.aero

Relative density as 3D printed	99.19%

Mechanical Properties

Results show that 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 in the as printed state without the application of heat-treatments.

			UNE EN ISO 6892-1	
	Cast Properties (ASTM A352)	**Wrought Properties (ASTM A36)**	**Meltio XY Properties (As printed)**	**Meltio XZ Properties (As printed)**
Ultimate Tensile strength (UTS) [MPa]	415 - 585	400 - 550	598 ± 5	525 ± 12
Yield strength [MPa]	205	250	484 ± 8	402 ± 37
Elongation [%]	24	23	71 ± 1	15 ± 9

*Tests Carried Out in CETEMET
i+d+i@cetemet.es

			UNE EN ISO 6507-1
	Cast Properties (ASTM A352)	**Wrought Properties (ASTM A36)**	**Meltio Properties (As printed)**
Hardness [HV-30]	160	127	175

*Test Carried Out In the University of Jaen (UJA)
info@strainanalysisuja.es

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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.

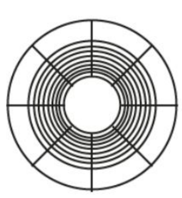
Properties	High Strength, High Temperature Resistance and High Hardness
Applications	Aerospace Components, Cutting Tools and prototypes and Molds and Dies

Wire Chemical Composition	Fe	C	Si	Mn	Cr	Mo	V
Weight Percent [%]	Bal.	0.38	1.0	0.4	5.0	1.1	0.45

Wire Density
7.81 g/cm³

Melting Point		
1753 K	1480 ºC	2700°F

Spool Specs



Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

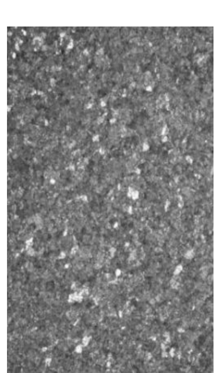
Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1920 cm³
Spool Type	BS300
Wire Coating	Copper

Relative density as 3D printed	> 99.9%

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.

Gen I As-printed XY
100x Magnification



Gen I HT XY
100x Magnification

Gen II As-printed XY
100x Magnification

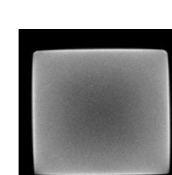
Published
in Q4

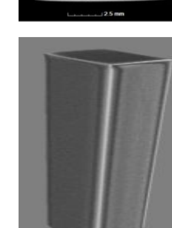
Gen II HT XY
100x Magnification

*Tests Carried Out In IDONIAL
info@idonial.com

Tomography

Computed Tomography Scan of 3D printed sample part in H11 without detectable voids or defects. Resolution of 24 µm per pixel.





3D / Top View

Front View

*Test Carried Out In CATEC
info@catec.aero

Meltio Material Datasheet

Meltio Tool Steel H11

Tool Steel H11 / 1.2343

Parametrization for Verified Density Profiles

The following fully dense printing parameters were obtained, based on a printed block of 30x60x20 mm. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed using CT Scan on an external lab. Please use the provided “Materials Handbook” to know better the printing parameters relation and their effect on part density. These printing parameters are available in our slicers Meltio Horizon and Meltio Space.

	Laser Power [W]	**Laser Wavelength (nm)**	**Velocity [mm/s]**	**Argon Flow [l/min]**	**Layer Height [mm]**	**Layer Width [mm]**	**Wire Speed [mm/s]**	**Input Energy Density [J/mm3]**	**Deposition Rate [g/h]**
IR	1100	976	5.0	10.0	1.0	1.0	6.4	220	144
Blue	1000	450	5.0	10.0	1.0	1.0	6.4	200	144

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

HT.1: Argon atmosphere Heat up to 820ºC	Slow Cooling in oven to RT

Quenching

HT.2: Argon atmosphere Heat up to 1025ºC	Hold for 2h Forced Air-cooling to RT

Tempering

HT.3 (Example): Argon atmosphere Heat up to 550ºC	Hold for 1h Slow Cooling to RT (Repeat 2x)

**Typical Parameters for a Sample of 160x60x30 mm*

Mechanical Properties

Results show that specimens printed using Meltio’s wire-laser metal 3D printed process perform at the same level as samples made with conventional manufacturing methods. Testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

		UNE EN ISO 6892-1		
	Wrought Properties (ASTM 1472)	**Meltio XZ Properties (HT.1 + HT.2 + HT.3)**	**Meltio XZ Properties (As Printed)**	
Ultimate Tensile strength (UTS) [MPa]	1990	2087 ± 2	1830 ± 105	**IR**
		Published in Q4		**Blue**
Yield strength [MPa]	1650	1735 ± 101	1170 ± 90	**IR**
		Published in Q4		**Blue**
Elongation [%]	10	12.18 ± 0.19	3.46 ± 0.36	**IR**
		Published in Q4		**Blue**
		*Tests Carried Out In IDONIAL info@idonial.com		

The following Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory.

Meltio Material Datasheet

Meltio Tool Steel H11

Tool Steel H11 / 1.2343

		UNE EN ISO 6507-1		
	Wrought Properties (ASTM 1472)	**Meltio Properties (HT.1 + HT.2 +HT.3)**	**Meltio Properties (As Printed)**	
Hardness [HRC]	53	51	52	**IR**
		Published in Q4	49	**Blue**
		*Tests Carried Out In IDONIAL info@idonial.com *Tests Carried Out in CETEMET i+d+i@cetemet.es		

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed by an external lab.

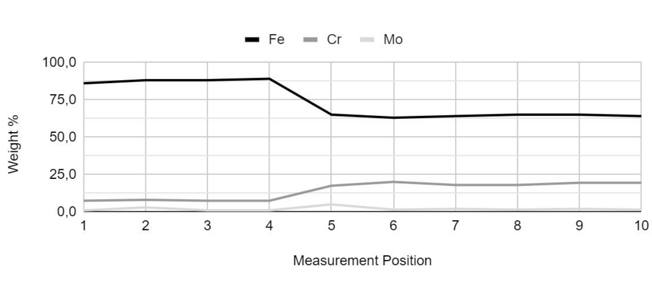
Cladding and Dual Material Applications

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

Composition mapping of H11 cladding on SS316L. Measurements were spaced 150 µm. Apart with measurement 5 coinciding with the interface of the two materials.

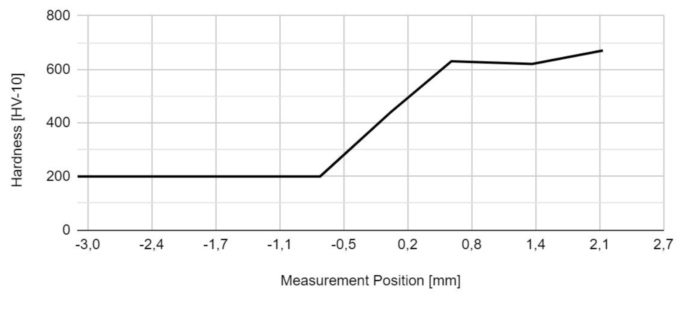
Measurement [Position]	Mo [wt%]	Cr [wt%]	Mn [wt%]	Fe [wt%]	Ni [wt%]
1	1.0	7.5	1.0	86.0	4.0
2	3.0	8.0	2.0	88.0	4.0
3	1.0	7.5	1.0	88.0	2.0
4	1.0	7.5	1.0	89.0	2.0
Interlayer					
5	5.0	17.5	1.0	65.0	10.0
6	1.5	20.0	1.0	63.0	14.0
7	2.0	18.0	2.0	64.0	11.0
8	1.5	18.0	1.0	65.0	13.0
9	2.0	19.5	1.0	65.0	11.0
10	1.5	19.5	1.0	64.0	12.0



Hardness Profile

Hardness was measured across the material transition and results indicate that a single cladding layer is sufficient to achieve good and stable properties.

Hardness [HV10]	Distance [mm]	Material [txt]
670	2.1	Tool Steel H11
620	1.4	
630	0.6	
440	0.0	**Interlayer**
200	-0.7	Stainless Steel 316L
200	-1.4	
200	-1.8	
200	-2.2	
200	-3.1	

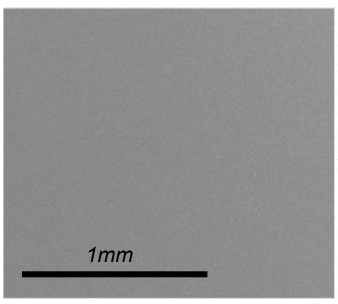


Meltio Tool Steel H11

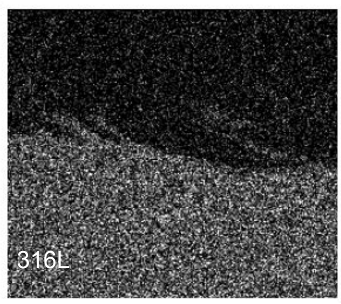
Tool Steel H11 / 1.2343

Elemental Mapping

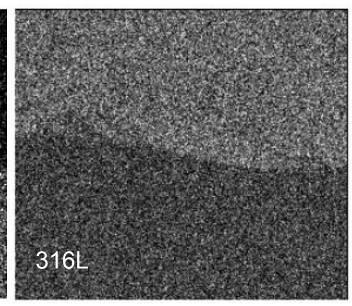
Elemental (EDX) Mapping is employed to characterize the dilution of the two materials. Meltio used as printed Stainless Steel 316L as the substrate without post processing. Results show low dilution between SS316L and H11.



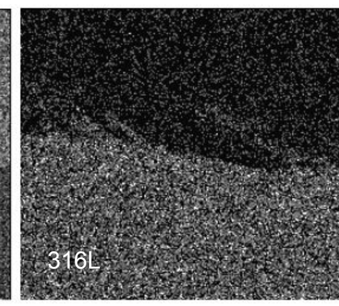
Cladding interface layer XZ
Electron Microscopy



Cladding interface layer XZ
Chromium EDX Map



Cladding interface layer XZ
Iron EDX Map



Cladding interface layer XZ
Nickel EDX Map

** Meltio's work on material characterization is carried out using the Meltio M450 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@meltio3d.com.*

*** Any technical information or assistance provided herein is given and accepted at your own risk and neither Meltio nor its affiliates make any guarantees relating to it or because of it. Neither Meltio nor its affiliates shall be responsible for the use of this information, or any product, method or apparatus mentioned and you must make your own determination for its suitability and completeness for you application. Specifications are subject to change without notice.*

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.

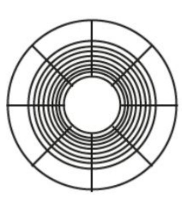
Properties	High Strength, Age-hardenable, High temperature and Corrosion Resistance
Applications	Aerospace, Energy / Oil and Gas and Chemical and Automotive

Wire Chemical Composition	Ni	C	Si	Mn	Cr	Fe	Ti	Mo	Nb+Ta	Al
Weight Percent [%]	Bal.	0.05	0.2	0.2	19.0	20.0	0.9	3.0	5.2	0.5

Wire Density
8.2 g/cm³

Melting Point		
1644 - 1700 K	1371 - 1427 ºC	2500 - 2600 °F

Spool Specs



Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

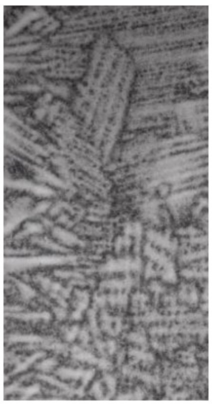
Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1829 cm³
Spool Type	BS300
Wire Coating	Uncoated

Relative density as 3D printed	> 99.8%

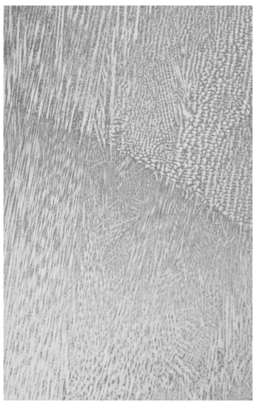
Micrography

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.

Gen I As-printed XY
100x Magnification



Gen I HT XY
100x Magnification



Gen II As-printed XY
100x Magnification

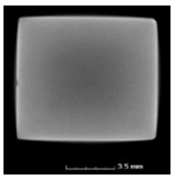
Published
in Q4

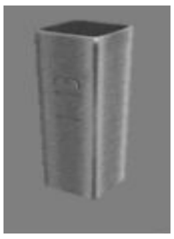
Gen II HT XY
100x Magnification

**Test Carried Out In IDONIAL*
info@idonial.com

Tomography

Computed Tomography Scan of 3D printed sample part in Inconel 718 without detectable voids or defects. Resolution of 24 µm per pixel.





3D / Top View

Front View

**Test Carried Out In CATEC*
info@catec.aero

Meltio Nickel 718

ERNiFeCr-2 / S Ni 7718 / 2.4667

Parametrization for Verified Density Profiles

The following fully dense printing parameters were obtained, based on a printed block of 30x60x20 mm. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed using CT Scan on an external lab. Please use the provided “Materials Handbook” to know better the printing parameters relation and their effect on part density. These printing parameters are available in our slicers Meltio Horizon and Meltio Space.

	Laser Power [W]	Laser Wavelength (nm)	Velocity [mm/s]	Argon Flow [l/min]	Layer Height [mm]	Layer Width [mm]	Wire Speed [mm/s]	Input Energy Density [J/mm3]	Deposition Rate [g/h]
IR	1100	976	7.5	10.0	1.0	1.0	9.6	146.6	201
Blue	1000	450	12.5	10.0	1.2	1.0	19.1	66.7	443

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

Protective atmosphere Heat up to 1100ºC	Hold for 1h Cooling in water to RT

Age Hardening

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 Sample of 160x60x30 mm

Mechanical Properties

Results show that specimens printed using Meltio’s wire-laser metal 3D printed perform at the same level as samples made with conventional manufacturing methods. Tensile testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

			UNE EN ISO 6892-1					
	Cast Properties *(AMS 5383)*	**Wrought Properties *(AMS 5662)***	**Meltio XY properties *(S.A. + A.H.)***	**Meltio XZ properties *(S.A. + A.H.)***	**Meltio XY properties *(S.A.)***	**Meltio XZ properties *(S.A.)***	**Meltio XZ Properties *(As printed)***	
Ultimate Tensile strength (UTS) [MPa]	802	1241	1256 ± 11	1208 ± 49	1016 ± 28	925 ± 86	833 ± 50	**IR**
			Published in Q4					**Blue**
Yield strength [MPa]	758	1034	1025 ± 7	980 ± 2	660 ± 10	631 ± 10	537 ± 32	**IR**
			Published in Q4					**Blue**
Elongation [%]	5	10	11 ± 1	10 ± 5	18 ± 6	15 ± 2	25 ± 3	**IR**
			Published in Q4					**Blue**

**Test Carried Out In CETEMET*
i+d+i@cetemet.es

The following Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory.

Meltio Nickel 718

ERNiFeCr-2 / S Ni 7718 / 2.4667

	Cast Properties *(AMS 5383)*	Wrought Properties *(AMS 5662)*	*UNE EN ISO 6507-1* Meltio Properties *(S.A. + A.H.)*	Meltio Properties *(S.A.)*	Meltio Properties *(As printed)*	
***Hardness* [HV30]**	342	350	332	285	245	**IR**
			Published in Q4		248	**Blue**

**Tests Carried Out in CETEMET*
i+d+i@cetemet.es
**Test Carried Out In the University of Jaen (UJA)*
info@strainanalysisuja.es

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed by an external lab.

** Meltio's work on material characterization is carried out using the Meltio M450 and 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@meltio3d.com.*

Meltio Material Datasheet

MELTIO
Rev 2.0

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.

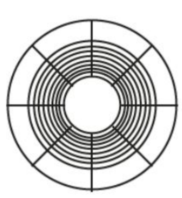
Properties	Weldability, High Temperature Resistance and High Corrosion Resistance
Applications	Aerospace, Chemical Processing,Naval and Oil & Gas

Wire Chemical Composition	Ni	C	Si	Mn	Cr	Fe	Mo	Nb	S
Weight Percent [%]	Bal.	0.02	0.2	0.2	22.0	1.0	9.0	2.5	0.01

Wire Density
8.20 g/cm³

Melting Point		
1565 - 1625 K	1290 - 1350 ºC	2350 - 2460°F

Spool Specs



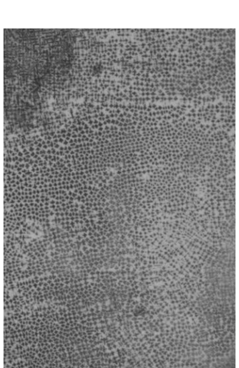
Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1829 cm³
Spool Type	BS300
Wire Coating	Uncoated

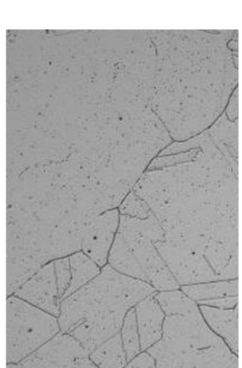
Relative density as 3D printed	> 99.7%

Micrography

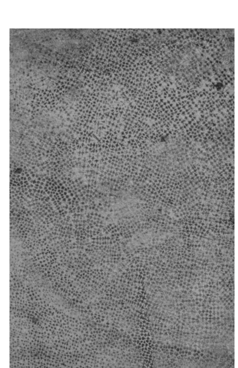
The micrographs shows no significant micro-structural defects. Grains exhibit diverse sizes and no preferential orientation. Notable features include the presence of twins from thermal treatment, enhancing strength and toughness.



Gen I As-printed XY
100x Magnification



Gen I HT XY
100x Magnification



Gen II As-printed XY
100x Magnification

Published in Q4

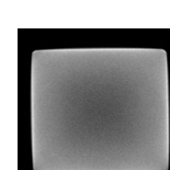
Gen II HT XY
100x Magnification

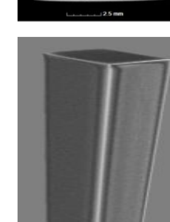
*Tests Carried Out In IDONIAL
info@idonial.com

*Tests Carried Out in CETEMET
i+d+i@cetemet.es

Tomography

Computed Tomography Scan of 3D printed sample part in Ni 625 without detectable voids or defects. Resolution of 24 µm per pixel.





3D / Top View

Front View

*Test Carried Out In CATEC
info@catec.aero

Meltio Material Datasheet

Meltio Nickel 625

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

Parametrization for Verified Density Profiles

The following fully dense printing parameters were obtained, based on a printed block of 30x60x20 mm. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed using CT Scan on an external lab. Please use the provided "Materials Handbook" to know better the printing parameters relation and their effect on part density. These printing parameters are available in our slicers Meltio Horizon and Meltio Space.

	Laser Power [W]	Laser Wavelength (nm)	Velocity [mm/s]	Argon Flow [l/min]	Layer Height [mm]	Layer Width [mm]	Wire Speed [mm/s]	Input Energy Density [J/mm3]	Deposition Rate [g/h]
IR	1100	976	6.6	10.0	1.2	1.0	10.08	137.5	220
Blue	1000	450	10.0	10.0	1.2	1.0	15.3	83.3	346

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

Protective atmosphere Heat up to 1150ºC	Hold for 2h Fast cooling to RT

**Typical Parameters for a Sample of 160x60x30 mm*

Age Hardening

Protective atmosphere Heat up to 700ºC in 1h Hold at 700ºC during 24h	Cooling in oven to RT

Mechanical Properties

Results show that specimens printed using Meltio's wire-laser metal 3D printed process perform at the same level as samples made with conventional manufacturing methods. Testing is carried out in the less favorable XZ direction to ensure the values are applicable across complete part.

		ASTM E8M	
	Wrought Properties ***(ASTM B446)***	**Meltio XZ Properties** ***(HT.1 + HT.2 + HT.3)***	
Ultimate Tensile strength (UTS) [MPa]	827	739 ± 19	**IR**
		Published in Q4	**Blue**
Yield strength [MPa]	414	323 ± 15	**IR**
		Published in Q4	**Blue**
Elongation [%]	30	58.4 ± 3.9	**IR**
		Published in Q4	**Blue**
		*Tests Carried Out In IDONIAL info@idonial.com	

The following Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory.

Meltio Material Datasheet

Meltio Nickel 625

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

		UNE EN ISO 6507-1	
	Wrought Properties ***(ASTM B446)***	**Meltio Properties** ***(HT.1 + HT.2 +HT.3)***	
Hardness [HV10]	220	160 ± 3	**IR**
		Published in Q4	**Blue**
		**Tests Carried Out in CETEMET* *i+d+i@cetemet.es*	

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed by an external lab.

Charpy V-Notch 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.

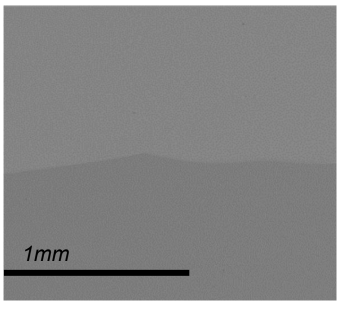
	ASTM E23	
	Meltio XZ Properties ***(HT.1 + HT.2 + HT.3)***	
Temperature [ºC]	- 60	**IR**
Energy Absorbed [J]	230 ± 10	**IR & Blue**
	Published in Q1 of 2025	**Blue**
	**Tests Carried Out In IDONIAL* *info@idonial.com*	

Cladding and Dual Material Applications

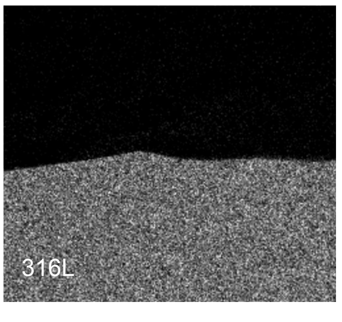
Nickel 625 is highly resistant to wear, deformation and heat, which makes it an excellent material for cladding or dual material applications where not the entire component requires these properties. Nickel 625 has excellent weldability and can be used to form a dense and well-bonded coating layer that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

Elemental Mapping

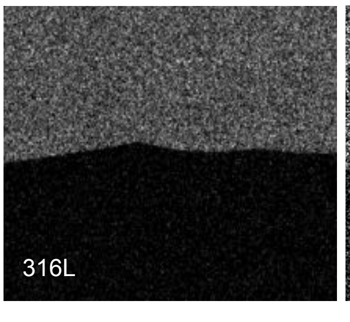
Elemental (EDX) Mapping is employed to characterize the dilution of the two materials. Meltio used as deposited Stainless Steel 316L as the substrate without post processing. Results show low dilution between the materials.



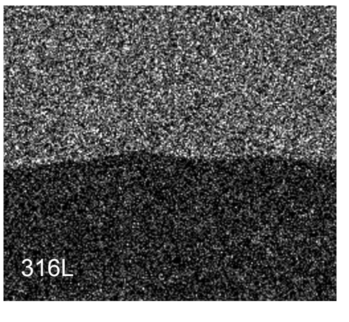
Cladding interface layer XZ
Electron Microscopy



Cladding interface layer XZ
Iron EDX Map



Cladding interface layer XZ
Nickel EDX Map



Cladding interface layer XZ
Molybdenum EDX Map

Meltio Material Datasheet

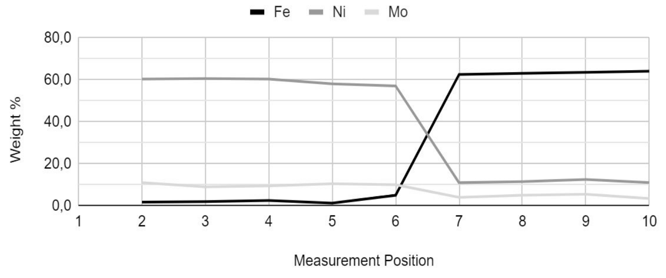
Meltio Nickel 625

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

Elemental Distribution

Composition Mapping of Nickel 625 Cladding on SS316L. Measurements were spaced 150 µm.Apart with measurement 5 coinciding with the interface of the two materials.

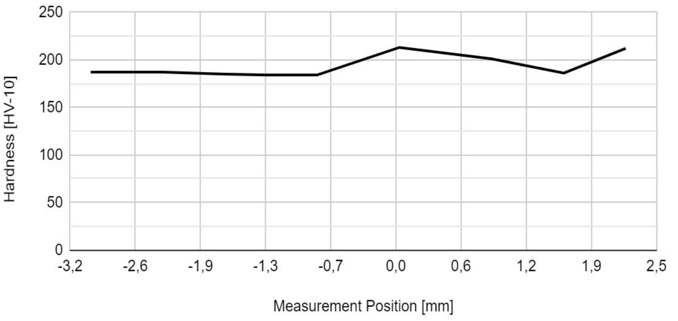
Measurement [Position]	Nb [wt%]	Mo [wt%]	Mn [wt%]	Fe [wt%]	Ni [wt%]
1	3.5	11.0	0.5	1.8	60.3
2	3.8	9.0	0.1	2.0	60.5
3	4.0	9.5	0.5	2.5	60.3
4	6.5	10.5	0.8	1.3	58.0
Interlayer					
5	4.0	10.0	0.5	5.0	57.0
6	0.5	4.0	1.5	62.5	11.0
7	1.5	5.0	1.0	63.0	11.5
8	0.5	5.5	1.5	63.5	12.5
9	0.5	3.5	1.5	64.0	11.0
10	1.0	4.0	1.5	64.5	11.5



Hardness Profile

Hardness was measured across the material transition and results indicate that a single cladding layer is sufficient to achieve good and stable properties.

Hardness [HV10]	Distance [mm]	Material [txt]
212	2.2	Nickel 625
186	1.6	
201	0.9	
213	0.0	**Interlayer**
184	-0.8	Stainless Steel 316L
184	-1.3	
185	-1.7	
187	-2.3	
187	-3.0	



** Meltio's work on material characterization is carried out using the Meltio M450 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@meltio3d.com.*

Meltio Titanium 64

Ti-6Al-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.

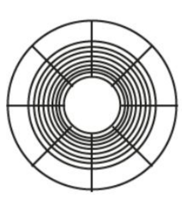
Properties	High Strength, Low Weight and Corrosion Resistance
Applications	Aerospace, Marine, Chemical industries and Automotive

Wire Chemical Composition	Ti	Al	V	Fe	C	N	H	O
Weight Percent [%]	Bal.	5.5	3.5	0.4	0.08	0.05	0.015	0.2

Wire Density
4.4 g/cm³

Melting Point		
1947 K	1674 ºC	3045 °F

Spool Specs



Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	7.5 kg
Volume on Spool	1704 cm³
Spool Type	BS300
Wire Coating	Uncoated

Relative density as 3D printed	> 99.9%

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 α´ + β, with alpha phases at grain boundaries.

Gen I As-printed XY
100x Magnification

Published
in Q3

Gen I HT XY
100x Magnification

Gen II As-printed XY
100x Magnification

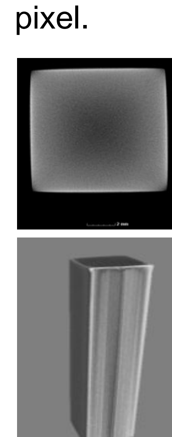
Published
in Q4

Gen II HT XY
100x Magnification

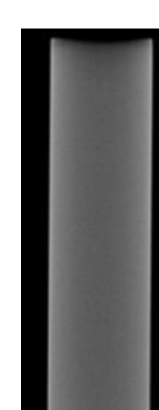
*Test Carried Out In ADIMME
aidimme@aidimme.es

Tomography

Computed Tomography Scan of 3D printed sample part in Ti64 without detectable voids or defects. Resolution of 24 μm per pixel.



3D / Top View



Front View

*Test Carried Out In CATEC
info@catec.aero

Meltio Titanium 64

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

Parametrization for Verified Density Profiles

The following fully dense printing parameters were obtained, based on a printed block of 30x60x20 mm. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed using CT Scan on an external lab. Please use the provided “Materials Handbook” to know better the printing parameters relation and their effect on part density. These printing parameters are available in our slicers Meltio Horizon and Meltio Space.

	Laser Power [W]	Laser Wavelength (nm)	Velocity [mm/s]	Argon Flow [l/min]	Layer Height [mm]	Layer Width [mm]	Wire Speed [mm/s]	Input Energy Density [J/mm3]	Deposition Rate [g/h]
IR	1100	976	7.5	20.0	1.2	1.0	9.6	122.22	143
Blue	1000	450	12.5	20.0	1.2	1.2	22.9	55.6	285

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.

Annealing

Vacuum atmosphere Heat up to 920ºC	Hold for 2h Cooling to RT

**Typical Parameters for a Sample of 160x60x30 mm*

Age Hardening

Vacuum atmosphere Heat up to 460ºC	Hold for 8h Cooling inside the oven to RT

Mechanical Properties

Results show that 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 after heat treatment. As printed data is not shown as it is not industrially relevant.

			UNE EN ISO 6892-1		
	Cast Properties *(ASTM F1108)*	**Wrought Properties** *(ASTM F1472)*	**Meltio XY properties** *(Age Hardened)*	**Meltio XZ properties** *(Age Hardened)*	
Ultimate Tensile strength (UTS) [MPa]	860	930	802 ± 7	788 ± 12	**IR**
			Published in Q4		**Blue**
Yield strength [MPa]	758	860	727 ± 17	693 ± 16	**IR**
			Published in Q4		**Blue**
Elongation [%]	8	10	7 ± 1	9 ± 1	**IR**
			Published in Q4		**Blue**
			**Test Carried Out In IDONIAL* *info@idonial.com*		

The following Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory.

Meltio Titanium 64

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

	Cast Properties (ASTM F1108)	Wrought Properties (ASTM F1472)	UNE EN ISO 6507-1 Meltio (Age Hardened)	UNE EN ISO 6507-1 Meltio Properties (As printed)	
Hardness [HV-30]	342	349	311	303	IR
			Published in Q4	345	Blue
			*Tests Carried Out in CETEMET i+d+i@cetemet.es *Test Carried Out In CATEC info@catec.aero		

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed by an external lab.

Fatigue Life

Meltio carried out a fatigue study on 3D printed specimens using two heat treatments, namely age hardening and hot isostatic pressing. The presence of residual porosity in the sample parts during the study, which has been resolved through process improvements, may explain the difference in fatigue behavior between the age-hardened and hot isostatic pressed specimens.

	ASTM E466 XZ properties (Age Hardened)	ASTM E466 XZ properties (HIP)	
Stress Range [Mpa]	450	530	IR
	Published in Q1 of 2025		Blue
Nº of Cycles (Nf)	10^7		IR & Blue
Stress Ratio (R)	-1		IR & Blue

The following 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.

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.

	IR	Blue
Oxygen Content [%]	0.25 - 0.45	0.095 - 0.213
	*Test Carried Out In AIDIMME aidimme@aidimme.es	

** Meltio's work on material characterization is carried out using the Meltio M450 and 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@meltio3d.com.*