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.

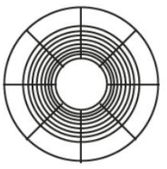
Properties	High Strength, Low Weight and Corrosion Resistance
Applications	Aerospace, Marine, Chemical industries and Automotive

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 IR Laser	> 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

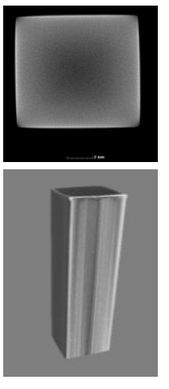
Gen I HT XY
100x Magnification

Gen II As-printed XY
100x Magnification

IR Laser	***Blue Laser***
Tests Carried Out In IDONIAL info@idonial.com	

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

IR Laser
Test Carried Out In CATEC info@catec.aero

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Deposition Parameters

The following printing parameters were obtained through rigorous testing. The **Infrared Profile** was derived from a 30 × 60 × 20 mm printed block, from which a 10 × 10 × 60 mm sample was extracted using EDM and analyzed via CT scan in an external laboratory. The **Blue Profile** was obtained from three scenarios (30 × 60 × 20 mm, 55 × 70 × 70 mm, and 250 × 250 × 30 mm) to ensure reliable unattended printing with maximum quality and energy density. Internally, samples were tested using Liquid Penetrant Testing (LPT) to evaluate surface-breaking defects on newly exposed internal surfaces after sectioning. Additional analyses, including Micrography, CT scan, and Structural testing, are conducted by an external lab.

These profiles are valid for 90% of solid parts, with a minimum part size of 30 × 30 mm. Their performance depends on geometry, overhangs, material, thickness, and base material. Profiles serve as a reference for specific applications, but operator expertise remains essential for achieving optimal print quality for the specific application. Adjustments may be necessary to overcome challenges or deviations from standard shapes.

The **Blue Profiles are under continuous development**, with updates released at least quarterly to enhance performance and reliability. The data presented reflects the current state, and improvements are ongoing. In case of doubts about performance or specific requirements, please contact the **Meltio Process Team** for guidance.

These printing parameters are available in **Meltio Horizon** and **Meltio Space** slicers latest release.

Technology	Revisión name	Laser Power [W]	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]	Volume rate [cc/h
IR Laser 976 nm	**V.D.**	1100	7.5	20.0	1.2	1.0	11.46	122.22	143	32.5
Blue laser 450 nm	**Solid 1.2x1.4 Rev 30 2024-12-17**	1000	12.5	25	1.2	1.4	29.03	47.62	333	75.68

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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.

Heat Treatment - 1

Solution 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					
	Wire Properties	**Cast Properties** ***(ASTM F1108)***	**Wrought Properties** ***(ASTM F1472)***	**Meltio XY properties IR Laser** ***(HT-1: S.A+A.H)***	**Meltio XZ properties IR Laser** ***(HT-1: S.A+A.H)***	**Meltio XY properties Blue Laser As printed**	**Meltio XZ properties Blue Laser As printed**	**Meltio XY properties Blue Laser (*HT-1: S.A+A.H)*)**	**Meltio XZ properties Blue Laser** ***(HT-1: S.A+A.H)*)**
Ultimate Tensile strength (UTS) [MPa]	895	860	930	802 ± 7	788 ± 12	958 ± 12	962 ± 12	852 ± 11	850 ± 11
Yield strength [MPa]	828	758	860	727 ± 17	693 ± 16	852± 11	854 ± 11	740 ± 9	699 ± 9
Elongation [%]	10	8	10	7 ± 1	9 ± 1	11.75± 0.5	9.50 ± 0.5	12.50 ± 0.5	14.13 ± 0.5
				Test Carried Out In IDONIAL info@idonial.com		*Test Carried Out In AIDIMME* aidimme@aidimme.es			

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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.

			UNE EN ISO 6507-1	
	Cast Properties *(ASTM F1108)*	**Wrought Properties** *(ASTM F1472)*	**Meltio IR Laser** *(Age Hardened)*	**Meltio Properties IR Laser** *(As printed)*
Hardness [HV-30]	342	349	311	303
			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 IR Laser *(Age Hardened)*	**XZ properties IR Laser** *(HIP)*
Stress Range [Mpa]	450	530
Nº of Cycles (Nf)	10^7	
Stress Ratio (R)	-1	

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 Laser	**Blue Laser**
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.*

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