

Material data sheet

EOS Titanium Ti64

EOS Titanium Ti64 is a titanium alloy powder which has been optimized especially for processing on EOSINT M systems.

This document provides information and data for parts built using EOS Titanium Ti64 powder (EOS art.-no. 9011-0014) on the following system specifications:

- EOSINT M 280 with PSW 3.6 and Original EOS Parameter Set Ti64_Speed 1.0
- EOS M 290 400W with EOSPRINT 1.0 and Original EOS Parameter Set Ti64_Performance 1.0 und Ti64_Speed 1.0

Description

Parts built in EOS Titanium Ti64 have a chemical composition corresponding to ISO 5832-3, ASTM F1472 and ASTM B348.

This well-known light alloy is characterized by having excellent mechanical properties and corrosion resistance combined with low specific weight and biocompatibility.

This material is ideal for many high-performance engineering applications, for example in aerospace and motor racing, and also for the production of biomedical implants (note: subject to fulfilment of statutory validation requirements where appropriate).

Due to the layerwise building method, the parts have a certain anisotropy, which can be reduced or removed by appropriate heat treatment - see Technical Data for examples.

Material data sheet

Technical data

General process and geometric data

| | |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Typical achievable part accuracy [1], [8] | ± 50 µm |
| Min. wall thickness [2], [8] | approx. 0.3 – 0.4 mm approx. 0.012 – 0.016 inch |
| Surface roughness, as built [3], [8] | |
| Ti64 Performance (30 µm) | R _a 9 – 12 µm, R _z 40 – 80 µm R _a 0.36 – 0.47 x 10 ⁻³ inch, R _z 1.6 – 3.2 x 10 ⁻³ inch |
| Ti64 Speed (60 µm) | R _a 6 – 10 µm, R _z 35 – 40 µm R _a 0.23 – 0.39 x 10 ⁻³ inch, R _z 1.37 – 1.57 x 10 ⁻³ inch |
| Volume rate [4] | |
| Ti64 Performance (30 µm) | 5 mm ³ /s (18 cm ³ /h) 0.82 in ³ /h |
| Ti64 Speed (60 µm) | 9 mm ³ /s (32.4 cm ³ /h) 1.98 in ³ /h |

- [1] Based on users' experience of dimensional accuracy for typical geometries. Part accuracy is subject to appropriate data preparation and post-processing, in accordance with EOS training.
- [2] Mechanical stability is dependent on geometry (wall height etc.) and application
- [3] Due to the layerwise building, the surface structure depends strongly on the orientation of the surface, for example sloping and curved surfaces exhibit a stair-step effect. The values also depend on the measurement method used. The values quoted here given an indication of what can be expected for horizontal (up-facing) or vertical surfaces.
- [4] Volume rate is a measure of build speed during laser exposure. The total build speed depends on the average volume rate, the recoating time (related to the number of layers) and other factors such as DMLS-Start settings.

Material data sheet

Physical and chemical properties of parts

| | |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Material composition | Ti (balance) Al (5.5 – 6.75 wt.-%) V (3.5 – 4.5 wt.-%) O (< 2000 ppm) N (< 500 ppm) C (< 800 ppm) H (< 150 ppm) Fe (< 3000 ppm) |
| Relative density | approx. 100 % |
| Density | 4.41 g/cm ³ 0.159 lb/in ³ |

Material data sheet

Mechanical properties of parts [8]

| | As built | Heat treated [6] |
|----------------------------------------------|-----------------------------------------|--------------------------------------------------------------|
| Tensile strength [5] | | |
| - in horizontal direction (XY) | typ. 1290 ± 50 MPa typ. 187 ± 7 ksi | min. 930 MPa (134.8 ksi) typ. 1100 ± 40 MPa (160 ± 6 ksi) |
| - in vertical direction (Z) | typ. 1240 ± 50 MPa typ. 187 ± 7 ksi | min. 930 MPa (134.8 ksi) typ. 1100 ± 40 MPa (160 ± 6 ksi) |
| Yield strength (R_{p0.2}) [5] | | |
| - in horizontal direction (XY) | typ. 1140 ± 50 MPa typ. 165 ± 7 ksi | min. 860 MPa (124.7 ksi) typ. 1000 ± 50 MPa (145 ± 7 ksi) |
| - in vertical direction (Z) | typ. 1120 ± 80 MPa typ. 162 ± 12 ksi | min. 860 MPa (124.7 ksi) typ. 1000 ± 60 MPa (145 ± 9 ksi) |
| Elongation at break [5] | | |
| - in horizontal direction (XY) | typ. (7 ± 3) % | min. 10 % typ. (13.5 ± 2 %) |
| - in vertical direction (Z) | typ. (10 ± 3) % | min. 10 % typ. (14.5 ± 2 %) |
| Modulus of elasticity [5] | | |
| - in horizontal direction (XY) | typ. 110 ± 15 GPa typ. 16 ± 2 Msi | typ. 110 ± 15 GPa typ. 16 ± 2 Msi |
| - in vertical direction (Z) | typ. 110 ± 15 GPa typ. 16 ± 2 Msi | typ. 110 ± 15 GPa typ. 16 ± 2 Msi |
| Hardness [7] | typ. 320 ± 12 HV5 | |

[5] Tensile testing according to ISO 6892-1:2009 (B) Annex D, proportional test pieces, diameter of the neck area 5 mm (0.2 inch), original gauge length 25 mm (1 inch).

[6] Specimens were treated at 800 °C (1470 °F) for 4 hours in argon inert atmosphere. Mechanical properties are expressed as minimum values to indicate that mechanical properties exceed the minimum requirements of material specification standards. ASTM F1472-08. By fulfilling these minimum values, also the specifications of standards ASTM B348-09 and ISO 5832-3:2000 are met.

[7] Vickers hardness measurement (HV) according to EN ISO 6507-1 on polished surface. Note that measured hardness can vary significantly depending on how the specimen has been prepared.

[8] Hint: these properties were determined for Ti64_Performance 1.0 on an EOSINT M 280-400W and EOSINT M 290-400W. Test parts from Ti64_Speed 1.0 were determined on machine types EOSINT M 280-400W and correspond with data from an EOS M 290-400W.

Material data sheet

Thermal properties of parts

| | |
|-----------------------------------------|----------------------------------|
| Maximum long-term operating temperature | approx. 350 °C approx. 660 °F |
|-----------------------------------------|----------------------------------|

Abbreviations

| | |
|---------|---------------|
| typ. | typical |
| min. | minimum |
| wt. | weight |
| approx. | approximately |

Notes

The data are valid for the combinations of powder material, machine and parameter sets referred to on page 1, when used in accordance with the relevant Operating Instructions (including Installation Requirements and Maintenance) and Parameter Sheet. Part properties are measured using defined test procedures. Further details of the test procedures used by EOS are available on request.

The data correspond to our knowledge and experience at the time of publication. They do not on their own provide a sufficient basis for designing parts. Neither do they provide any agreement or guarantee about the specific properties of a part or the suitability of a part for a specific application. The producer or the purchaser of a part is responsible for checking the properties and the suitability of a part for a particular application. This also applies regarding any rights of protection as well as laws and regulations. The data are subject to change without notice as part of EOS' continuous development and improvement processes.

EOS[®], EOSINT[®] and DMLS[®] are registered trademarks of EOS GmbH.

© 2014 EOS GmbH – Electro Optical Systems. All rights reserved.