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Ti6Al4V ELI-0406 powder for additive manufacturing

Process specification

Powder description	Titanium alloy powder
Layer thickness	30 µm and 60 µm
Laser power	200 W
Additive manufacturing system	AM250

Material description

Ti6Al4V ELI-0406 alloy comprises titanium mass fraction up to 90% alloyed with aluminium up to 6.75% and vanadium up to 4.5%, along with other minor elements. Ti6Al4V grade 23 is otherwise referred to as Extra Low Interstitial (ELI) with regards to the interstitial impurities oxygen, carbon, and nitrogen. It is a higher purity version of the most commonly used titanium alloy Ti6Al4V grade 5. The reduced interstitial elements in grade 23 lead to an increase in both ductility and fracture toughness.

Ti6Al4V ELI-0406 has excellent specific strength (strength to weight ratio) which makes it an ideal choice where weight saving load structures are required. It has good corrosion resistance, it is also biocompatible, so can be used for a range of surgical and dental applications. For medical and dental applications Renishaw supplies Ti DG1 powder, for more infomation refer to document H-5983-9026.

Material properties

- High specific strength
- High corrosion resistance
- Excellent biocompatibility
- Good osseointegration
- Low thermal expansion
- Low thermal conductivity

Applications

- Medical and dental (Refer to document H-5983-9026)
- Aerospace and defence
- Motor sport
- Jewellery and art
- Maritime applications
- High-end sports equipment

Generic data - wrought material

Density	4.42 g/cm^3
Thermal conductivity	6 W/mK to 8 W/mK
Melting range	1635 °C to 1665 °C
Coefficient of thermal expansion (see note 1)	8 × 10^{-6} K^{-1} to 9 × 10^{-6} K^{-1}

Note 1 In the range of 0 °C to 100 °C.

Note 2 Annealed at 850 °C ±10 °C for 2 hr.

Note 3 Tested at ambient temperature to ASTM E8. Machined before testing. Values based on a sample size of 6.

Note 4 Tested to ASTM E384-11, after polishing.

Note 5 Tested to JIS B 0601-2001 (ISO 97), after bead blasting.

Note 6 HIP (hot isostatic pressing).

Composition of powder

Element	Mass (%)
Titanium	Balance
Aluminium	5.50 to 6.50
Vanadium	3.50 to 4.50
Iron	≤ 0.25
Oxygen	≤ 0.13
Carbon	≤ 0.08
Nitrogen	≤ 0.05
Hydrogen	≤ 0.012
Yttrium	≤ 0.005
Residuals	≤ 0.10 each, ≤ 0.40 total

*ASTM standard composition powder. Renishaw powders are supplied to a tighter specification to minimise batch-to-batch variations. Results quoted in this data sheet are from samples produced using Renishaw's tighter specification powder. Please contact Renishaw for further information about specifications or if you require support in qualifying non-Renishaw powders.

Mechanical properties of additively manufactured components processed in 30 µm layers

	Heat treated (See note 2)		**HIP treated** (see note 6)	
	Mean	**Standard deviation (±1σ)**	**Mean**	**Standard deviation (±1σ)**
Ultimate tensile strength (UTS) (See note 3)				
Horizontal direction (XY)	1089 MPa	7 MPa	1033 MPa	4 MPa
Vertical direction (Z)	1085 MPa	12 MPa	1034 MPa	7 MPa
Yield strength (see note 3)				
Horizontal direction (XY)	1007 MPa	5 MPa	947 MPa	4 MPa
Vertical direction (Z)	985 MPa	23 MPa	923 MPa	21 MPa
Elongation at break (See note 3)				
Horizontal direction (XY)	16%	1%	16%	1%
Vertical direction (Z)	14%	1%	17%	1%
Modulus of elasticity (see note 3)				
Horizontal direction (XY)	129 GPa	7 GPa	127 GPa	3 GPa
Vertical direction (Z)	126 GPa	15 GPa	125 GPa	4 GPa
Hardness (Vickers) (see note 4)				
Horizontal direction (XY)	368 HV0.5	10 HV0.5	352 HV0.5	9 HV0.5
Vertical direction (Z)	372 HV0.5	7 HV0.5	360 HV0.5	7 HV0.5
Surface roughness (R_a) (See note 5)				
Horizontal direction (XY)	4 µm to 6 µm			
Vertical direction (Z)	4 µm to 7 µm			

Density of additively manufactured Ti6Al4V is typically 99.8%, measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.

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Mechanical properties of additively manufactured components processed in 60 µm layers

	Heat treated (see note 2)		**HIP treated** (see note 6)	
	Mean	**Standard deviation (±1σ)**	**Mean**	**Standard deviation (±1σ)**
Ultimate tensile strength (UTS) (see note 3)				
Horizontal direction (XY)	1091 MPa	6 MPa	1052 MPa	3 MPa
Vertical direction (Z)	1084 MPa	8 MPa	1058 MPa	9 MPa
Yield strength (see note 3)				
Horizontal direction (XY)	1020 MPa	25 MPa	957 MPa	2 MPa
Vertical direction (Z)	987 MPa	22 MPa	973 MPa	24 MPa
Elongation at break (see note 3)				
Horizontal direction (XY)	16%	1%	16%	1%
Vertical direction (Z)	17%	1%	18%	1%
Modulus of elasticity (see note 3)				
Horizontal direction (XY)	132 GPa	9 GPa	127 GPa	3 GPa
Vertical direction (Z)	128 GPa	7 GPa	131 GPa	6 GPa
Hardness (Vickers) (see note 4)				
Horizontal direction (XY)	363 HV0.5	11 HV0.5	361 HV0.5	7 HV0.5
Vertical direction (Z)	363 HV0.5	13 HV0.5	360 HV0.5	10 HV0.5
Surface roughness (R_a) (see note 5)				
Horizontal direction (XY)	3 µm to 4 µm			
Vertical direction (Z)	5 µm to 7 µm			

Density of additively manufactured Ti6Al4V is typically 99.8%, measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.

For worldwide contact details, please visit www.renishaw.com/contact

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