

MATERIAL DATA SHEET

Ti6Al4V ELI (Grade 23)

The alloy chemical composition complies with ASTM F3001, ASTM F3302, ISO 5832-3, ASTM F136, and ASTM B348 Grade 23 standards.

General Material and Process Specification

Ti6Al4V or Ti 6-4 is a titanium alloy with aluminum and vanadium as major alloying elements. Ti 6-4 grade 23 is ELI (extra low interstitials) grade which offers an excellent balance between mechanical strength, toughness, and ductility. This titanium alloy is widely used in medical and aerospace applications because of its excellent biocompatibility, high strength, and low density.

This data sheet specifies the expected mechanical properties and characteristics of this alloy when manufactured on a FormUp® 350 system. All data is based on parts built with AddUp standard 60 µm layer thickness parameters, using standard spherical 20-53 µm Ti 6Al4V ELI (grade 23) powder.



Physical Properties

	Results
Density (%) ¹	Typical 99.9
Theoretical density (g/cm ³) ²	4.42

¹ Relative density measured using optical microscopy

² Values based on literature

Surface Roughness Ra^{3,4,5}

	As-printed	Bead blasted ⁵
Vertical surface	5 to 7	3 to 6

³ Depends on orientation and testing method

⁴ Tested using optical profilometer - average of back and side surface

⁵ Surface treatment performed with glass blasting medium at 4 bar

Mechanical Properties⁶

	Test Method	Thermal State		
		As-built	Stress relieved ⁷	Heat treated ⁸
Tensile strength (MPa)	ASTM E8			
Horizontal direction (XY)		1265±7	1080±12	911±5
Vertical direction (Z)		1252±6	1086±6	911±5
Yield strength (MPa)	ASTM E8			
Horizontal direction (XY)		1104±7	991±9	816±5
Vertical direction (Z)		1126±8	1003±7	812±5
Elongation at failure (%)	ASTM E8			
Horizontal direction (XY)		11±1	12±1	19±1
Vertical direction (Z)		10±1	14±2	19±1
Reduction of area (%)	ASTM E8			
Horizontal direction (XY)		36±2	40±3	48±3
Vertical direction (Z)		35±3	37±2	48±2

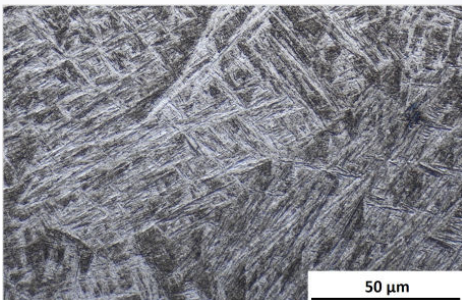
Mechanical Properties ⁶ (cont.)	Test Method	Thermal State		
		As-built	Stress relieved ⁷	Heat treated ⁸
Modulus of Elasticity (GPa)	ASTM E8			
Horizontal direction (XY)		111±1	116±3	118±2
Vertical direction (Z)		113±2	116±1	117±3
Rockwell hardness (HRC)	ASTM E18			
Horizontal direction (XY)		36±1	37±1	34±1
Vertical direction (Z)		34±2	34±1	32±1
Impact strength (J)	ASTM E23			
Horizontal direction (XY)		-	23±2	42±5

⁶ Tested at ambient temperature to ASTM E8. Machined before testing. Values based on a sample size of a minimum 27 across the build plate

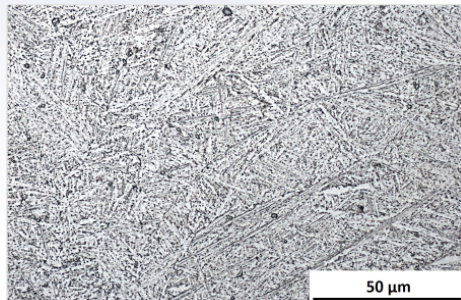
⁷ Specimens were stress relieved at 720°C for 2 h in vacuum

⁸ Specimens were heat treated at 940°C (±10°C) for 4 h (±30 min) followed by slow cooling

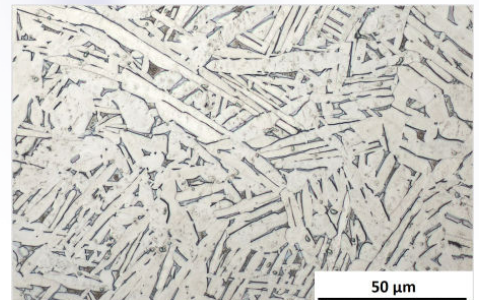
Microstructures



As-built



Stress relieved



Heat treated

Generic Data⁹

Thermal and Electrical Properties	Results
Thermal conductivity (W/mk)	7.1
Electrical conductivity (S/m) [x10 ⁵]	5.9
Melting range (°C)	1604-1660
Coefficient of thermal expansion (1/k)	9.2

⁹ Based on the literature data

Chemical Composition¹⁰

Element	Ti	Al	V	Fe	O	N	H	C	Y	Other, each	Other, total
Weight (%)	Balance	6.00-6.50	3.50-4.50	≤ 0.25	≤ 0.10	≤ 0.03	≤ 0.012	≤ 0.08	≤ 0.005	≤ 0.10	≤ 0.40

¹⁰ Based on the manufacturer material datasheet

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