Material Data Sheet

General:

It is known that the addition of Zirconium and Niobium to Titanium alloys provides an excellent combination of corrosion resistance and biocompatibility. ZTM14N powder belongs to the ZTi-Med® family and it is a ternary titanium alloy specifically made for additive manufacturing. ZTM14N powder offers a very good strength-ductility ratio, low density, high biocompatibility which means no Aluminum and Vanadium are found in contrast to Ti64 alloy. The mechanical properties of ZTM14N are very close to those of the human bone and its Young modulus is very close to the bone's when compared to Titanium. This adapted mechanical properties reduces drastically the friction between the bone and the medical implant, removing therefore the "stress shielding effect" which causes the loosing of implants. Because of its unique properties, ZTM14N offers a large range of applications such as medical and luxury.

Materials structure:

ZTM14N processing parameters were first developed on a powder bed fusion machine (PBF). Bulk parts were firstly made and later counterparts with different complex geometries were produced. The microstructure of the as- built state of ZTM14N parts under electron microscopy mainly shows fine β grains depending on chemical composition and post heat treatment. ZTM14N alloy was also processed through post heat treatments such as hot isostatic pressure (HIP) to obtain a full density and high fatigue resistance.

Material Data Sheet

ZTM14N [1]

Physical and Chemical Properties			
Mass density [2]	~ 5.56 g/cm³		
Component density [3]	> 99.3 %		
Melting point	~1614 °C		
Particle size [4]		15 - 45 µm	45 - 100 µm
Particle shape		Spherical	Spherical
Chemical composition [Mass fraction in %] [5]		Element	
		Ti	51.2
		Zr	20.35
		Nb	28.1
		C	0.039
		H	0.0008
		N	0.012
		O	0.09

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ZTM14N [1]

Mechanical Data at 25°C **Layer thickness 30 µm** M: Mean SD: Standard deviation			Stress relieved		Forged [7]	Ti64 [8]
			M	SD		
Tensile test [6]						
Tensile strength	R_m [MPa]		736	9	753	860
Offset yield strength	$R_{p0.2}$ [MPa]		469.5	11	729	795
Elongation at break	A [%]		11	1	14.5	10
Young's modulus	E [GPa]		47.5	2	-	113
Hardness test [9]						
Vickers micro-hardness	$HV_{0.2}$		182	14	170	340
Roughness measurements						
Roughness average	R_a [µm]		6	2	-	-

ZTi-Med® meting parameters are developed and enhanced at Z3DLAB facility. The physical and mechanical properties of ZTi-Med® made via additive manufacturing in addition to its powder were analyzed and tested according to ASTM and ISO standards by The French National Centre for Scientific Research (CNRS). More details about measurements procedures used by Z3DLAB are available upon request. We inform our clients that they are responsible for the qualified verification of the properties and their suitability for specific applications of parts made by their own technology.

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[1] Property and ownership of Z3DLAB. Further details are provided upon request.

[2] Subject to minor change within the range of possible chemical composition.
Measurements according to ASTM-B962 and ASTM B923.

[3] Rough value, subject to minor change within the range of possible heat treatments.
Theoretical density measurements via XRD.
Density measurements via Helium Pycnometry.
99.999% density obtained after HIP post-treatment.

[4] With respect to powder material.

[5] Chemical composition numbers are average values; each element was measured according to ASTM E2371-13, GB/T-4698. 14-2011, GB/T-4698.15-2011, GB/T4-698.7-2011, GB/T -4701.1-2009.

[6] Tensile tests were performed according to ASTM E8; stress relief heat treatment; testing machine Zwick 10KN; testing speed 0.001 s-1 at room temperature. The numbers are average values and are determined from samples with horizontal and vertical orientation

[7] Tensile tests were performed according to ASTM E8; testing speed 0.001 s^{-1} at room temperature. The numbers are average values.

[8] Minimum values according to ASTM F3001-14: Standard Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium ELI (Extra Low Interstitial) with Powder Bed Fusion.

[9] Micro-hardness testing according to ASTM E384.