Material Data Sheet

General:

ZTP-DeD is a near α titanium matrix nanocomposite (nTMC) designed specifically for additive manufacturing (AM). ZTP-DeD belongs to the ZTi-Powder® family and it offers several powders (ZTP05D, ZTP10D and ZTP25D) with different mechanical properties. The powders consist of Ti64 matrix doped by yttria and zirconia ceramic powders in addition to some minor additives. they possess very high mechanical properties at room and high temperature compared to forged and AMed Ti64. The unique chemical composition and processing of ZTP-DeD allows a very high corrosion resistance at high temperature and experiments showed a very stable microstructure at 850 °C. In addition, in-house heat resistance coatings could be applied over ZTP-DeD parts in order to sustain the harsh environments of aerospace applications. ZTP-DeD is already in use for the MRO market to repair landing gears and produce shackles. In addition, it is also used for coating in the medical field to produce very hard acetabular cups using DMT® machines from InssTek™.

Materials structure:

ZTP-DeD processing parameters were first developed on a powder bed fusion machine (PBF). Using this alloy, bulk parts were firstly made and later parts with different complex geometries were produced. The microstructure of the as- built state of ZTP-DeD parts consists of fine lamellae alpha grains in addition to minor traces of beta phase precipitates depending on chemical composition. ZTP-DeD was also processed through post heat treatments such as hot isostatic pressure (HIP) in order to obtain a full density and high fatigue resistance. Research papers were issued in high impact factor journals stating the work on ZTP-DeD.

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ZTP-DeD [1]

Physical and Chemical Properties					
Mass density [2]	~ 4.43 g/cm³				
Component density [3]	> 99.9 %				
Melting point	1690~1772 °C				
Chemical composition [Mass fraction in %][4]		Element	ZTP05D.	ZTP10D.	ZTP25D.
		Ti	Balance	Balance	Balance
		Al	7.2	6.79	7.1
		V	4.14	3.98	3.99
		Y	0.01	0.03	0.09
		Zr	0.15	0.27	1.66
		O	0.1	0.19	0.6
		Fe	0.22	0.22	0.25
		C	0.7	0.07	0.08
		H	0.01	0.01	0.0125
		N	0.03	0.03	0.03
		Others			
Particle size [5]		50 - 150 µm			
Particle shape		Spherical			

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ZTP-DeD [1]

Mechanical Data at 25°C **Layer thickness 30 µm** M: Mean SD: Standard deviation			As-built	
			M	SD
Tensile test [6]				
Tensile strength	R_m [MPa]	ZTP05D	1077	11.7
		ZTP10D	1147	9.2
		ZTP25D	1269	12.6
Offset yield strength	$R_{p0,2}$ [MPa]	ZTP05D	998	4
		ZTP10D	1069	5.3
		ZTP25D	1147	
Elongation at break	A [%]	ZTP05D	14.3	1.2
		ZTP10D	13.7	0.7
		ZTP25D	3.5	0.12
Young's modulus	E [GPa]	ZTP05D	101	2.3
		ZTP10D	108	3.7
		ZTP25D	120	1.5
Hardness test [7]				
Vickers micro-hardness	$HV_{0.2}$	ZTP05D	399	4.5
		ZTP10D	439	8.7
		ZTP25D	468	11.4
Roughness measurements [8]				
Roughness average	R_a [µm]		12.5	3.4
Mean roughness depth	R_z [µm]		87	11

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Compression test [9]				
Compressive strength	R_m [MPa]	ZTP05D	1699	35.2
		ZTP10D	1890	22.1
		ZTP25D	1941	11.3

ZTi-Powder® meting parameters are developed and enhanced at Z3DLAB facility. The physical and mechanical properties of ZTi-Powder® 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. However, some results are detailed in our research papers published in Materials & Design (JMAD) , MATEC Web of Conferences and Data in Brief (DIB) journals. 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. All results here represent data collected from ZTP05D, ZTP10D and ZTP25D manufactured via Directed Energy Deposition (DED) technology using DMT® machines from InssTek™. Results are the fruit of a Eureka program under the acronym ZTI POWDER-DMT. 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 chemical composition.
Theoretical density measurements via XRD.
Optical density via optical light microscopy.

[4] Chemical composition made via inductively coupled plasma (ICP) & Energy Dispersive X-Ray Spectroscopy (EDX).

[5] With respect to powder material; for PBF technology (15-45µm) and DED (50-150µm).

[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

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

[8] Roughness measurement according to DIN EN ISO 4288 λc = 2,4 mm.

[9] Compression tests were performed according to ASTM E9; stress relief heat treatment; testing machine Zwick 10KN; testing speed 0.001 s-1 at room temperature.