General:

Increasing depth in exploration and its complex service environment require materials with higher performance than before. Therefore, Z3DLAB introduced successfully a new type of TiZr-based alloy with higher hardness, strength, and better anticorrosion properties than conventional Ti alloys in the AM industry. ZTP20Z belongs to the ZTi-Powder® family, it features low density, excellent mechanical properties and flexible microstructures over a wide range. ZTP20Z is an excellent candidate material for aerospace and high-strength applications, particularly in landing gear, truck beam, springs and struts in addition to others. These applications require high fatigue endurance properties. For instant, it was proven that ZTP20Z alloy has higher fatigue endurance than Ti64 and the fatigue endurance limit was as high as 775 MPa and fatigue ratio of 0.67 whereases Ti64's ratio is 0.3.

Materials structure:

ZTP20Z 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 ZTP20Z parts consists of a typical basketweave microstructure, which consists of fine acicular martensite α-phase and coarse β-phase lump in. ZTP20Z was also processed through post heat treatments such as hot isostatic pressure (HIP) to obtain a full density and high fatigue resistance.

ZTP20Z [1]

Physical and Chemical Properties		
Mass density [2]	~ 4.60 g/cm^3	
Component density [3]	> 99.3 %	
Melting point	~1614 °C	
Chemical composition [4] [Mass fraction in %]	Element	
	Ti	Balance.
	Zr	21.3
	Al	6.45
	V	4.02
	C	0.03
	H	0.0016
	N	0.012
	O	0.08
Particle size [5]	15 - 45 µm	45 - 100 µm
Particle shape	Spherical	Spherical

ZTP20Z [1]

Mechanical Data at 25°C M: Mean SD: Standard deviation		as-built
Tensile test [6]		
Tensile strength	R_m [MPa]	1149
Offset yield strength	$R_{p0.2}$ [MPa]	988
Elongation at break	A [%]	11.5
Area reduction	2D [%]	33
Young's modulus	E [GPa]	120
Hardness test [7]		
Vickers micro-hardness	$HV_{0.2}$	404

Fatigue endurance **Layer thickness 30 µm; 10^7 fatigue cycle** M: Mean SD: Standard deviation		Stress relieved		Ti64 [8]
		M	SD	M
Stress at 10^7 cycles	R_{effe} [MPa]	775	24	430

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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] Chemical analysis 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.

[5] With respect to powder material.

[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] 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.