SANDVIK

OSPREY® TI-6AL-4V
FOR ADDITIVE MANUFACTURING

DATASHEET

GENERAL DESCRIPTION

Osprey® TI-6AL-4V Grade 5 & Grade 23 powders are manufactured to the highest international standards by Electrode Inert Gas Atomization, using a state-of-the-art titanium powder plant that offers a high level of automation, ensuring even better reliability and consistency. Offering typically lower cost & higher capacity than plasma atomized powders. Designed for processing by Additive Manufacturing processes, including Powder Bed Fusion by Laser & Electron Beam for medical, aerospace, automotive and engineering applications that require significant weight saving while maintaining high performance. Suitable for repair and refurbishment of worn and damaged components by Direct Energy Deposition.

CHEMICAL COMPOSITION

Osprey® Ti-6Al-4V Class 5*, Chemical composition (nominal), wt%

Ti	Al	V	Fe	O	C	N	H	Y	Others, each	Other, each
Balance	5.50-6.75	3.5-4.5	<0.30	<0.20	<0.08	<0.05	<0.015	<0.005	<0.10	<0.40

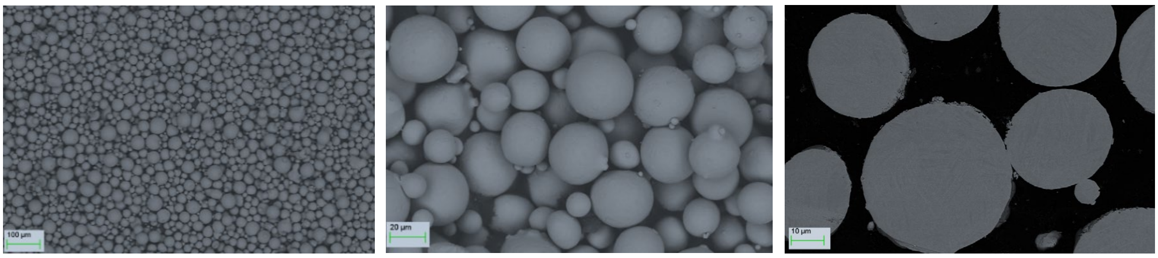
*According to ASTM F2924-14

Osprey® Ti-6Al-4V Class 23**

Ti	Al	V	Fe	O	C	N	H	Y	Others, each	Other, each
Balance	5.50-6.75	3.5-4.5	<0.25	<0.13	<0.08	<0.05	<0.012	<0.005	<0.10	<0.40

**According to ASTM F3001-14

POWDER MORPHOLOGY



SEM micrographs of -63 +20 µm powder with a spherical morphology (HS Circularity 0.95), smooth surface and

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low level of powder satellites (magnifications x100 & x250) and a section through the powder (magnification x1000), with no visible internal porosity.

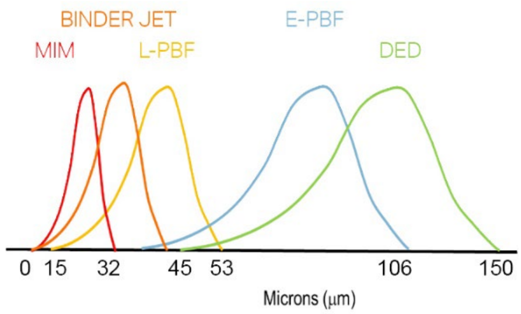
POWDER SIZE DISTRIBUTION

Available in a range of customized powder sizes suitable for different applications and AM platforms.

Laser Powder Bed Fusion (L-PBF)
e.g. 63 to 20 µm

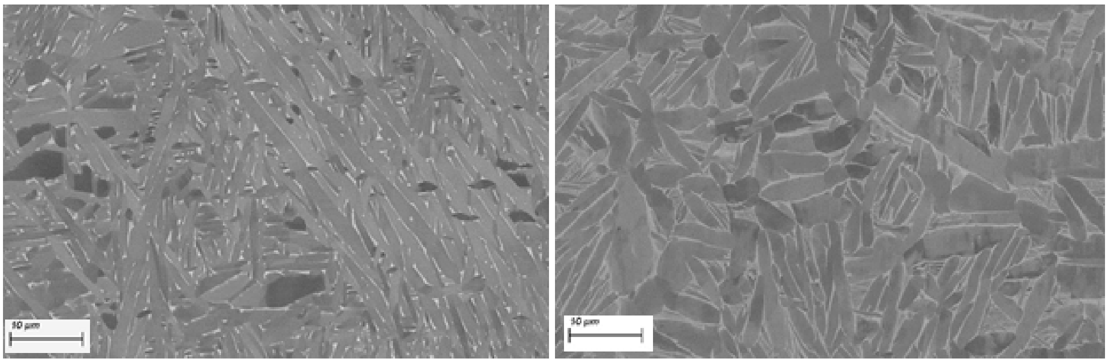
Electron Beam Powder Bed Fusion (E-PBF)
106 to 45 µm

Direct Energy Deposition (DED)
150 to 53 µm and 90 to 45 µm

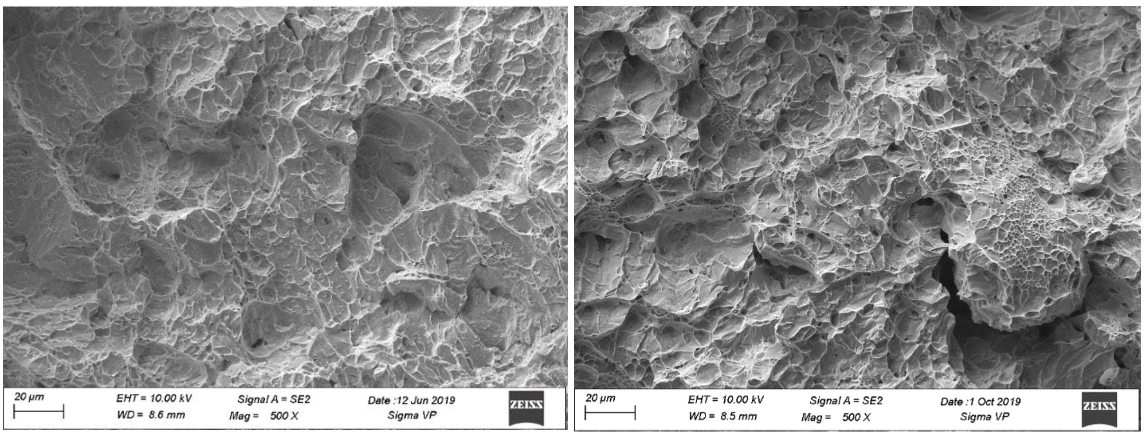


Other powder size range distributions are available by request.

MICROSTRUCTURE



SEM micrographs of Osprey® TI-6AL-4V L-PBF material in a heat-treated condition (solution annealed at 850 °C for 2 hours in argon) on the left, featuring a fine lamellar and dense microstructure is identified which originates from the decomposition of martensitic α’ as expected; showing a phase transformation that gave rise to a coarser structure consisting of a α phase matrix (grey) and an interlamellar β phase (bright). The difference in microstructure for vertical and horizontal builds is not significant. The mechanical properties of heat-treated L-PBF material are provided below. The microstructure, shown on the right, for L-PBF material after Hot Isostatic Pressing (HIP), which results in a coarsening of the grain size. The mechanical properties of HIP material are similar to that of the heat-treated material with an improvement in impact toughness, especially in the vertical direction.



SEM micrographs of Osprey® TI-6AL-4V L-PBF material in a heat-treated condition (left) and HIP material (right), both featuring ductile fracture surfaces.

MECHANICAL PROPERTIES

Typical mechanical properties Osprey® 2205 powder L-PBF in as-built & heat-treated condition (solution annealing 1000 °C for 5 minutes followed by air or water cooling) evaluated at room temperature, as measured in independent research[1].

Metric units

Condition	Direction	Proof strength	Tensile strength	E-modulus	Elongation	Impact Toughness
		$R_{p0.2}$	R_m		A	
		MPa	MPa	GPa	%	J
As built	Horizontal	957 ±7	1076 ±6	119 ±2	14.4 ±0.6	23 ±0.5
	Vertical	997 ±6	1094 ±4	122 ±2	15.5 ±0.5	22 ±0.9
HIP	Horizontal	906 ±2	1014 ±1	125 ±3	17.7 ±0.8	23 ±0.7
	Vertical	915 ±8	1015 ±4	126 ±3	17.2 ±0.04	25 ±0.8

Imperial units

Condition	Direction	Proof strength	Tensile strength	E-modulus	Elongation	Impact Toughness
		$R_{p0.2}$	R_m		A	
		ksi	ksi	ksi	%	J
As built	Horizontal	139 ±1	156 ±1	17,260 ±290	14.4 ±0.6	204 ±4
	Vertical	145 ±1	159 ±1	17,695 ±290	15.5 ±0.5	195 ±8
HIP	Horizontal	131 ±1	147 ±1	18,130 ±435	17.7 ±0.8	204 ±6
	Vertical	133 ±1	147 ±1	18,275 ±435	17.2 ±0.04	204 ±7

Typical Vicker’s Hardness levels (ASTM E92, ISO 6507-1, JIS Z2244, GB/T 4340.1), of Osprey® TI-6AL-4V Grade 23 in the L-PBF heat-treated condition.

Condition	Direction	Hardness HV
Heat treated	Horizontal	344 ±4
	Vertical	346 ±4
HIP	Horizontal	329 ±4
	Vertical	329 ±4

Typical surface roughness (Ra), of Osprey® TI-6AL-4V Grade 23 in the L-PBF heat-treated condition.

Condition	Direction	Rougness Ra (µm)
Heat treated	Horizontal	8.4 ±0.9
	Vertical	9.0 ±0.2

High cycle fatigue at 350MPa, of Osprey® TI-6AL-4V Grade 23 in the L-PBF heat-treated condition, at different build orientations and surface roughness conditions.

Reference: 1. Selective Laser Melting of Duplex Stainless Steel 2205: Effect of Post-Processing Heat Treatment on Microstructure, Mechanical Properties, and Corrosion Resistance. Materials 2019, 12, 2468; Suvi Papula et al.

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