![Carpenter Additive logo]

Ti64 ELI GRADE 23+

For Additive Manufacturing

NOVEL TITANIUM SOLUTION FOR AEROSPACE PRODUCTS WITH COMPLEX GEOMETRIES

TITANIUM

Ti64 ELI Grade 23+

Titanium alloys exhibit high strength and outstanding corrosion resistance along with outstanding toughness, making them suitable for a wide variety of aerospace/defense applications. Most 3D-printed aerospace/defense components use Ti64 Grade 5 to take advantage of its increased strength over Grade 23. The strength advantages that Grade 5 offers, however, come with two key challenges:

✖ Grade 5 has a tendency to build up large residual stresses during printing, making complex components difficult to manufacture

✖ Because Grade 5 has a higher oxygen strength (to attain the higher strength levels), the powder can rapidly fall out of chemistry specifications after only a few builds
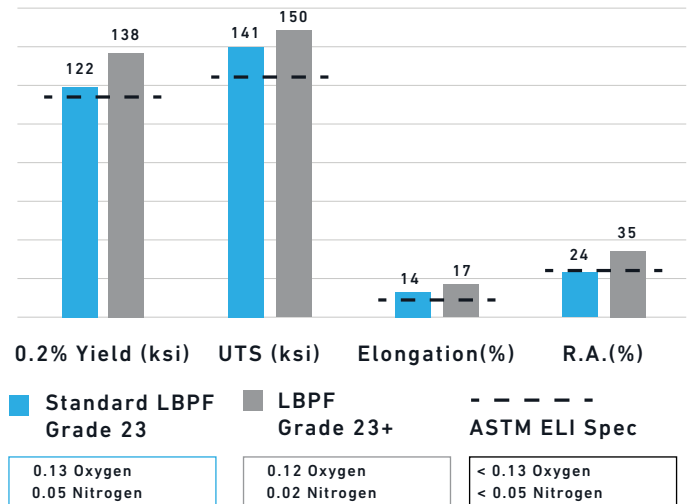
Composition and production

Carpenter Technology focused on developing an integrated Ti64 printing solution to control the entire additive lifecycle, from powder chemistry to process parameters during the additive build, and the powder recycling process to achieve consistent, high-quality results. We've developed a unique solution to enable the 3D printing of aerospace/defense components with higher mechanical strength and improved ductility.

Carpenter's Ti64 Grade 23+ additive manufacturing solution:

- Combines controlled powder chemistry with lower oxygen content and optimized print parameters
- Provides a 15-20% improvement in mechanical properties
- Coupled with topology optimization, lattice structures, and other advanced geometries, improved mechanical properties provide the freedom to innovate next-generation titanium-based components

Ti64 ELI Grade 23+ allows 3D printing of complex, high-quality aerospace parts with increased mechanical strength and improved ductility.

L-PBF + HIP: 13% STRENGTH IMPROVEMENT OVER GRADE 23

	0.2% Yield (ksi)	UTS (ksi)	Elongation(%)	R.A.(%)
Standard LBPF Grade 23	122	141	14	24
LBPF Grade 23+	138	150	17	35

■ Standard LBPF Grade 23	■ LBPF Grade 23+	– – – – ASTM ELI Spec
0.13 Oxygen 0.05 Nitrogen	0.12 Oxygen 0.02 Nitrogen	< 0.13 Oxygen < 0.05 Nitrogen

TI64 GRADE 23+ / ASTM F2924					
MATERIAL	FORM	0.2% YIELD STRENGTH	ULTIMATE TENSILE STRENGTH	ELONGATION	REDUCTION AREA
		ksi	ksi	%	%
Carpenter Grade 23+	As-Printed	175	196	10	21
	As-HIP	138	150	17	35
ASTM F2924		120	130	10	25