LLIF & XLIF SPINAL IMPLANT

HIGH-VOLUME ADDITIVE MANUFACTURING FOR LARGE SPINE IMPLANTS

HISTORY

Large spinal fusion devices are typically produced on small-format machines using Powder Bed Fusion (PBF) or machined from polyetheretherketone (PEEK) bar stock.

When manufactured additively, these larger spine implants are usually printed on small-format machines with limited build plates and only one or two lasers. The standard approach is to orient the implants with their anterior face upwards in Z, and to rely on multi-step processes that often create worst-case production scenarios.

Production costs are driven largely by the process itself, not just by materials. While additive manufacturing (AM) can increase cost, the value for large spinal implants is found in the lattice design and improved surface roughness, which support better osseointegration and ultimately better patient outcomes.

Another reason AM is preferred for spinal fusion devices is material performance. AM enables the use of titanium, which offers greater fracture toughness and higher tensile strength than PEEK. In contrast, PEEK implants lack ideal osseointegrative features and the material itself poses stability and supply chain challenges. For this reason, producing these implants additively is increasingly the preferred route, despite the lingering inefficiencies in legacy production approaches.

INDUSTRY
Medical

MATERIAL
Ti 6-4 ELI Grade 23

CHALLENGE
Lower production costs and increase output of additively manufactured large spinal implants

KEY BENEFITS
- Cut production time
- Increase output by 2.61 parts per hour
- Fine feature resolution
- Optimal osseointegration

IMPROVED PERFORMANCE

INTEGRATED FEATURES

REDUCED LEAD TIME

Version: US-06122025

CHALLENGES

Although AM enables greater osseointegration, higher-strength materials, and improved patient outcomes, manufacturing LLIF devices on small platforms with only 1–2 lasers drives up finished part costs. These implants are often built in the Z orientation which increases build times; an issue compounded by limited laser counts.

When using scraper or brush recoating systems, the underside of the anterior face usually requires breakaway supports, and removal often involves electrical discharge machining (EDM), adding another step and another charge to the process. These inefficiencies are baked into small build platforms and slow recoating cycles, making traditional AM systems a costly solution for large spinal fusion implants.

STRATEGY

The FormUp 350 challenges the industry's reliance on small-format platforms by increasing both the build area and laser count, enabling up to 152 large spinal implants in a single build, about 1.5x more than typical systems.

The four-laser architecture drives higher throughput, cutting print times and lowering cost per part. More importantly, the machine's powder roller recoating system minimizes the need for dense supports and improves surface uniformity, which directly translates to less post-processing and more predictable part quality.

By tackling the constraints that slow down legacy systems like limited build space, slow recoating, and excessive supports, the FormUp 350 shifts the economics for manufacturers. The result: the ability to produce large, complex spinal implants at scale, without the historical trade-offs in cost, speed, or finishing.

RESULTS

When benchmarked against typical small-platform solutions, the FormUp 350 consistently delivers lower cost per part and nearly doubles annual throughput (29,079 parts/year vs. 13,710). This isn't just incremental improvement, it's a fundamental shift in production economics.

For manufacturers of large spinal implants, this means the ability to scale production without being bottlenecked by build size or laser limitations. The process becomes more reliable, predictable, and ultimately more commercially viable for devices that have historically been costly to manufacture additively.

	2 Lasers FormUp 350	4 Lasers FormUp 350	2 Laser Competition
Parts per Laser	81	40-41	46
Runtime 30µm (hrs)	52.8	32.5	3825
Annual Throughput 30µm*	18,009	29,079	13,710
Printed Part Cost	$37.54	$22.54	$43.15

BUILD REPORT • F350V2_306 • Build #299
Project ID: 78d3252b-8875-4dc6-b262-b48ddaa7a210

Time	
Whole Build (platform loading > platform unloading)	95:42:24 (100%)
Preparation (platform loading > first layer)	4:17:38 (4.5%)
Production (first layer > last layer)	35:11:39 (36.8%)
Recoating	5:38:33 (5.9%)
Melting (including delays)	29:32:49 (30.9%)
Prod. Finalization (last layer > production end)	55:53:49 (58.4%)
Post-Production (production end > platform unloading)	0:19:16 (0.3%)

Parameter	Setpoint	Fault Min	Alarm Min	Alarm Max	Fault Max
Minimum melting time (s)	0				
Platform heating	off				
Platform temperature (°C)	n/a				
Enclosure oxygen ratio (ppm)	500	1000		2000	
Gas flow speed (m/s)	2	1.5	1.6	2.4	2.6

KEY VALUES

Parts Produced / Expected: 152 / 152

Oxygen Level:
Min - 154 ppm @ layer 1407
Max - 203708 ppm @ layer 0

Gas Consumption: 20.97 m³

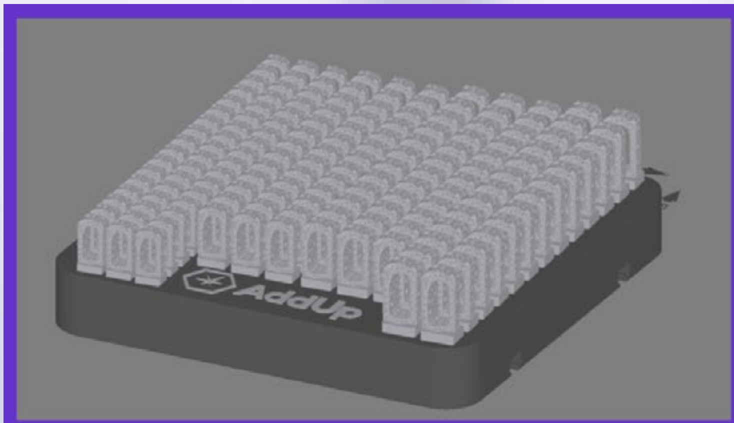
Build Height: 56.16 mm – 1872 layers

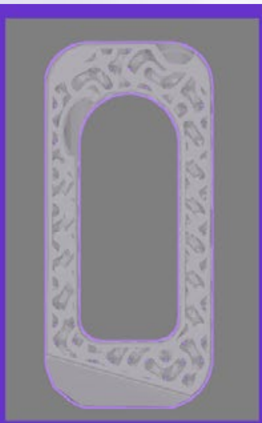
Temperature:
Min – 22.8 °C @ layer 0
Max – 122.7 °C @ layer 152

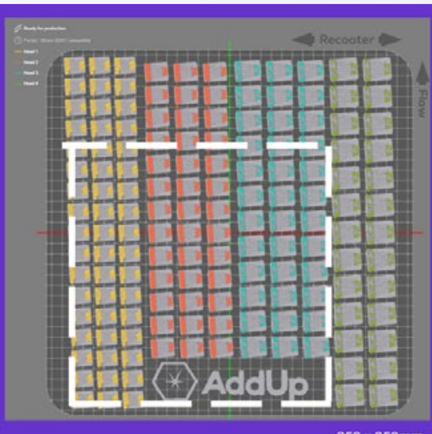
Layer Thickness: 30 µm

Layer Duration: Max – 2:27:23 @ layer 1199

Roller Torque > 80% On: 801 layers





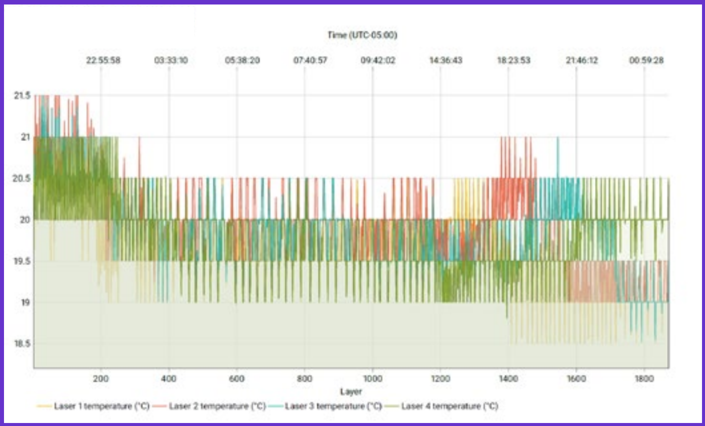


If you can't measure it, you can't improve it.

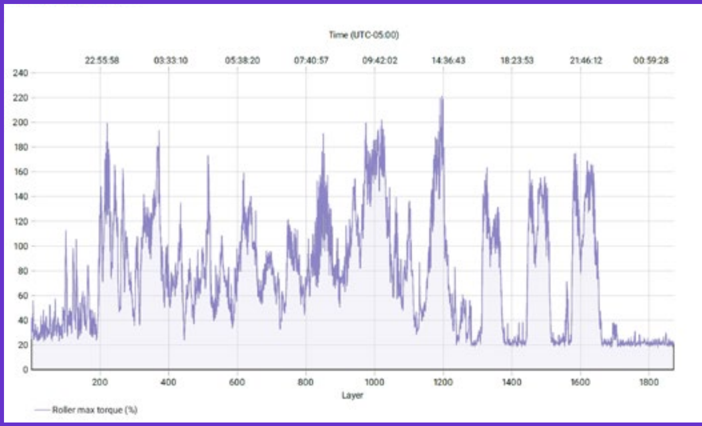
Consistent, high-quality medical device production depends on more than just machine capability, it requires full process visibility. Identify, troubleshoot, and eliminate production bottlenecks with traceability, quality assurance, and continuous improvement, from R&D through validated serial production.

CHARTS

OXYGEN LEVEL (ppm)



LASER TEMPERATURE(°C)



ROLLER TORQUE (%)

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