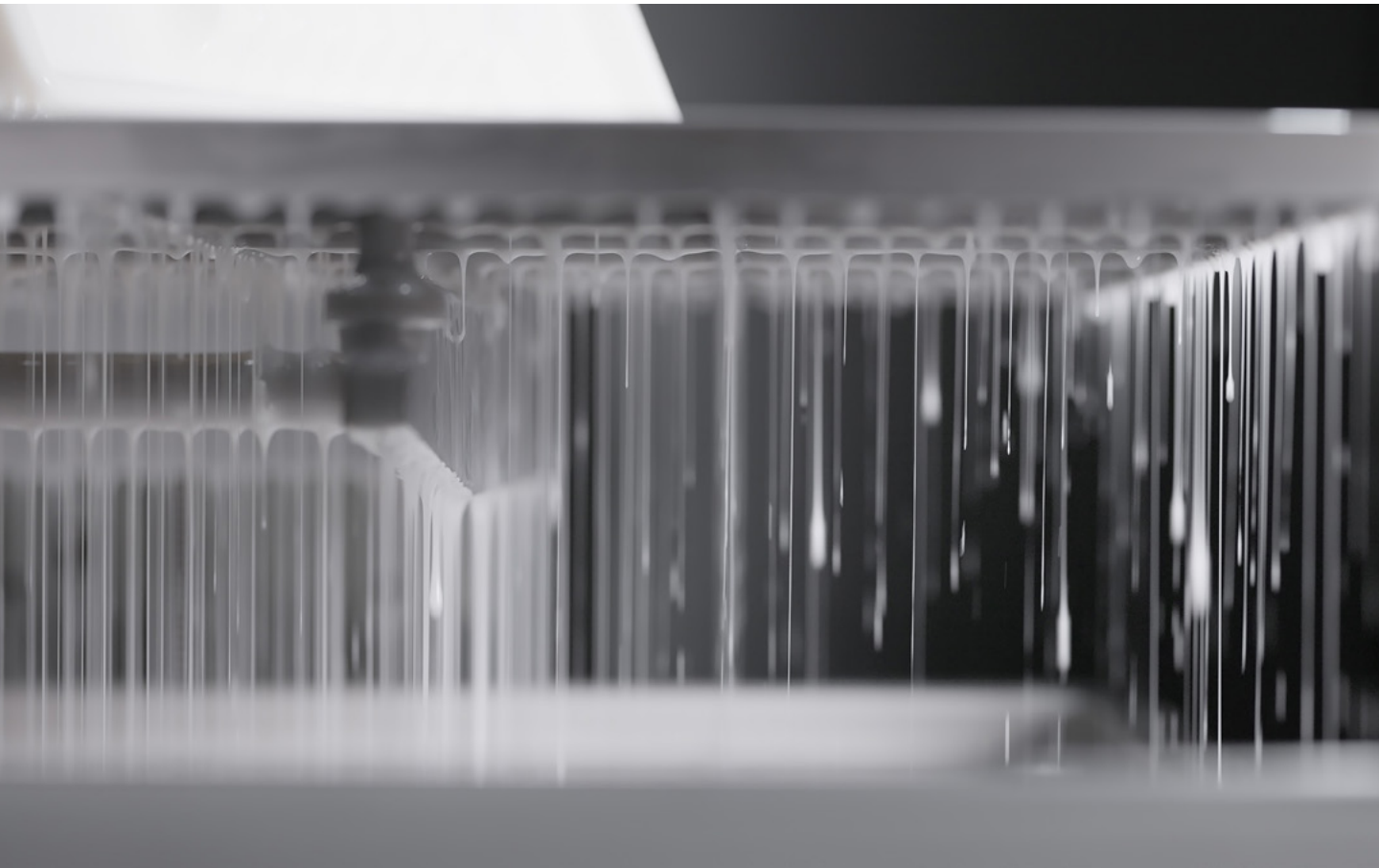




E-BOOK
SLA

Beyond the Specs: What Really Matters in SLA Printing





The Evolution of Stereolithography 3D Printing

From slow beginnings to high-speed precision

Stereolithography (SLA) has been shaping 3D printing technology for over 30 years. The earliest machines, like the SLA 250, were slow and could only print small parts. Back then, the materials were primarily **acrylate-based**, which brought its own set of limitations in terms of accuracy and performance.

Throughout the 1990s and 2000s, advancements in lasers, optics, and material formulations gradually improved the process. However, scanning systems and laser limitations remained a constraint, keeping print speeds frustratingly low.

After years of innovation, present-day SLA systems now feature **powerful lasers**, **advanced optics**, and a wide range of advanced materials designed for different applications.

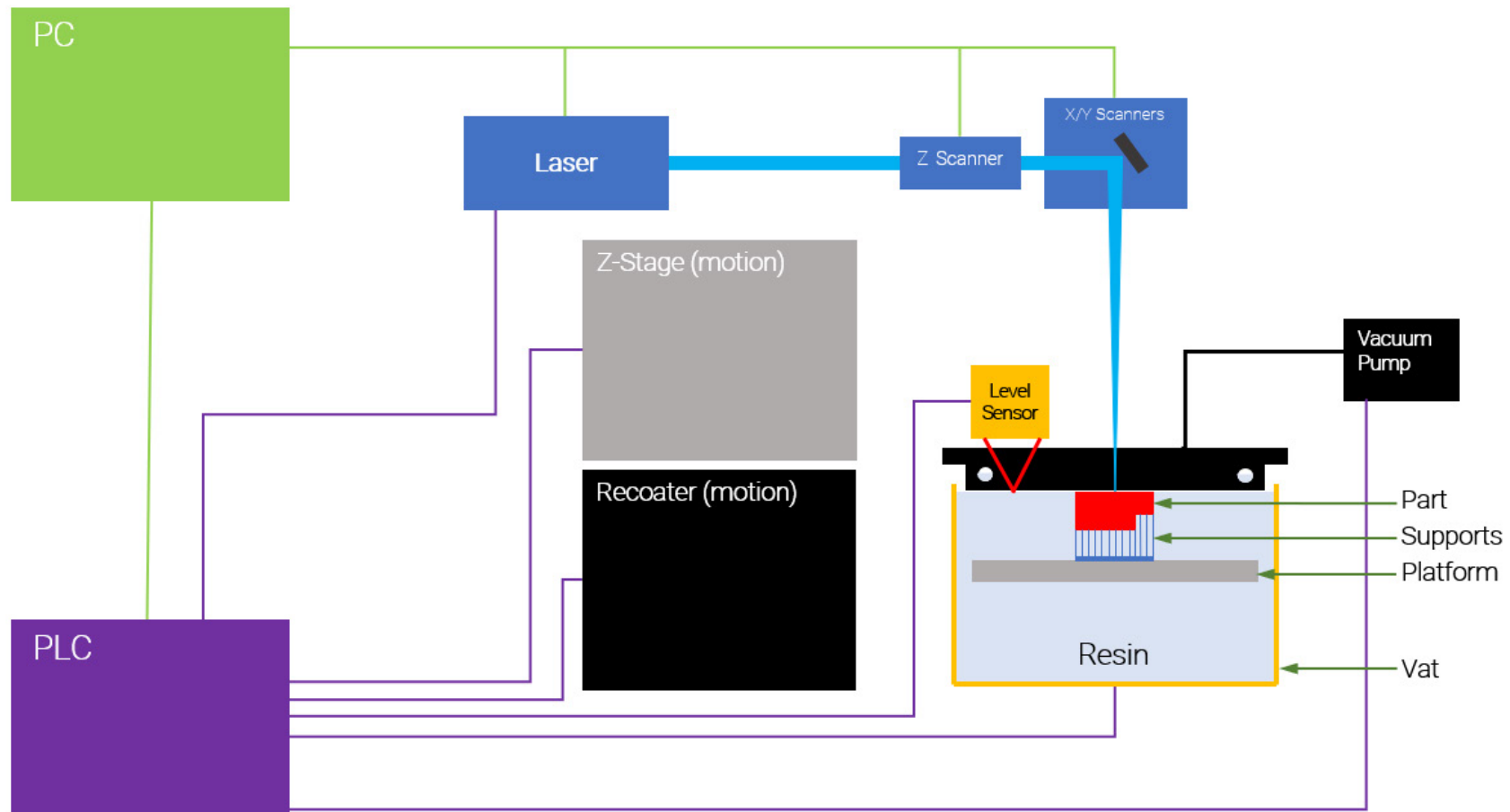
But here are the key questions:

Does higher laser power and faster optics automatically mean faster print speeds?

Does a machine's productivity come down to those specifications alone?

The short answer? Yes and no. Why?

It's not just about the hardware specifications. **Let's explore.**



What is SLA technology, and how does it work?

Stereolithography (SLA) 3D printing is renowned for delivering industry-leading part accuracy, detail, and sidewall quality.

This additive manufacturing process uses a vat of liquid, UV-curable photopolymer resin and a precision UV laser to build parts one layer at a time. The laser initiates the curing of the photosensitive resin, gradually forming the part within the vat.

With each new layer, the build platform lowers to the specified thickness, repeating the process until

the part is fully formed. After printing, parts are cleaned, supports are removed, and the post curing is completed.

This precise and meticulous layer-by-layer process ensures highly accurate, reliable results for even the most complex designs.

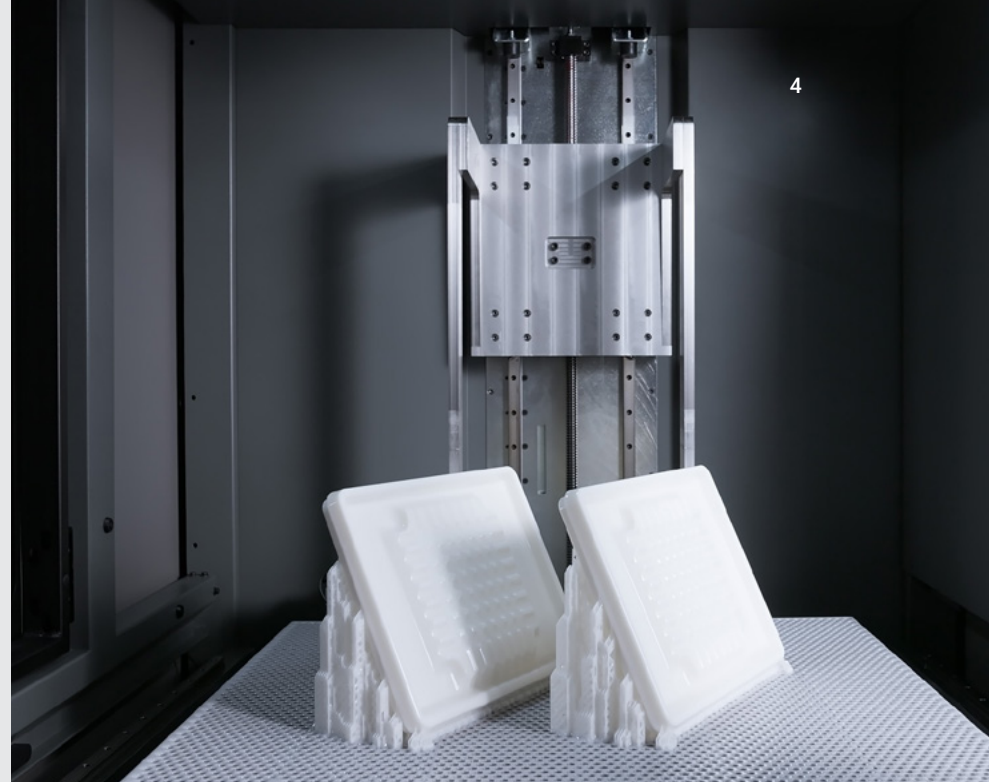
Breaking down the SLA process

There are two core tasks the SLA printer performs during a build, and each takes up a significant amount of time. But how much time each task requires isn't a simple formula. It depends on factors like material properties, geometry, and layer thickness.

Scanning is the process of moving the laser beam on a precise, predetermined path.

SLA print time is split into two key elements:

Preparing the layer and **Scanning**.



1. Preparing the layer

Preparing covers all machine movements and adjustments needed to get ready for the next layer. The goal is to ensure an even, stable material layer of pre-determined thickness that is ready for curing. The time required here depends on the material's viscosity and the surface area of each layer.

Preparing can consume **50-60%** of the total build time, and for larger or more complex builds, it can be as much as **70-80%**. It's a crucial part of the process that directly affects the build quality and reliability.

Here's what happens during preparing:

- **Pre-Dip wait time:** This is to allow continuation of the reaction and "green strength" build, before the force of the recoater is exerted on the last layer. Material development has led to this wait time reducing, through "faster" chemistry and property development.
- **Z-stage movement:** The build platform lowers to the specified layer thickness, from 50 to 200µm.

- **Recoater movement:** The recoater spreads an even layer of material across the vat over the last printed layer.
- **Z wait time:** A wait time to allow the material to settle after the recoater movement. The more viscous the material or the larger the layer's surface area, the longer this wait time needs to be to avoid mounding and layer inconsistencies.

Since preparation can take up a significant portion of the build time, optimizing these steps is essential to maintaining both speed and quality. Improper preparation can lead to issues like material starvation, mounding and uneven layers, resulting in sidewall and print defects, excessive surface roughness, low part repeatability, and inconsistent part quality, or worst case, build crashes.

2. Scanning

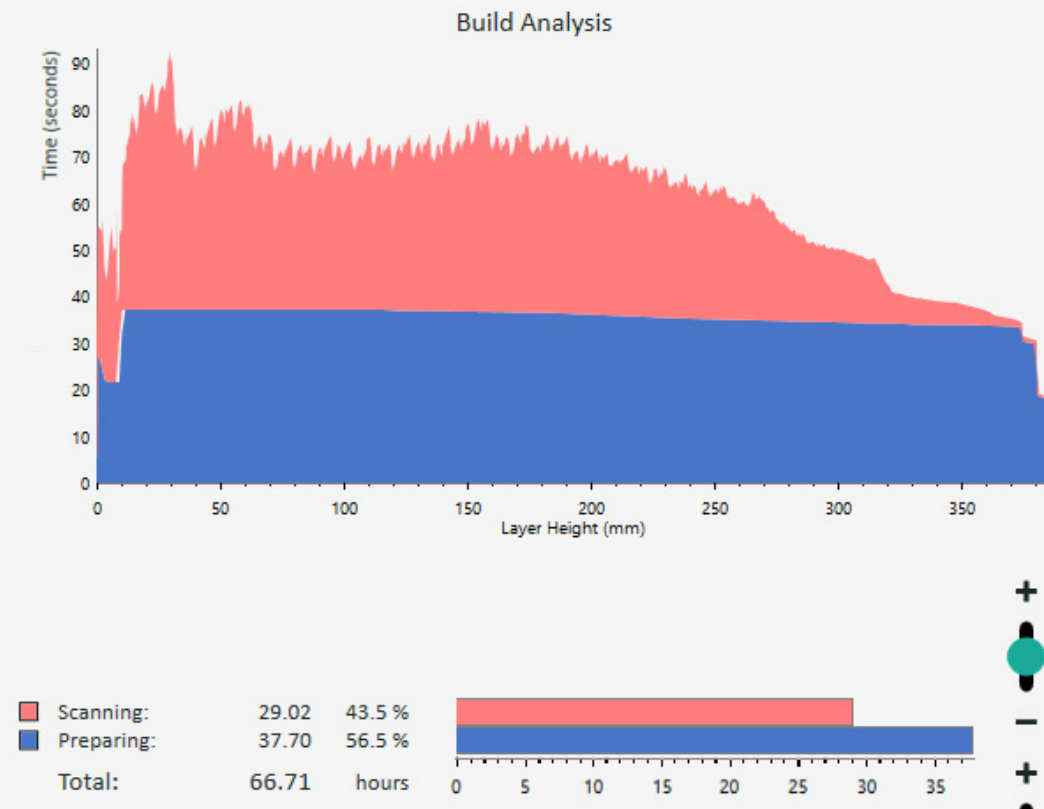
Scanning begins once preparation is complete. During this step, the laser initiates the curing of the material to form a solid layer. This step is typically faster than the preparation phase, making up **around 40-50%** of the overall print time (depending on geometries and number of parts).

Key steps include:

- **Laser adjustment:** The laser's power, spot size, and scan speed are determined based on the material's properties and build requirements.
- **Optics control:** The optics system precisely guides the laser along the X and Y coordinates to cure the material in the exact pattern needed. This accuracy is crucial for maintaining dimensional precision in the final part.

Build Analysis: Time spent on Scanning vs Preparing

The primary bottleneck in most SLA builds isn't the scanning process itself, but rather the build preparation stages. These initial steps, which involve precise mechanical movements and chemical reactions, are inherently time-consuming and can't always be significantly accelerated.



The image shows a "Build Time Breakdown for a Typical Build."



So, what makes a faster build?

Two lasers are better than one, right? One may think that dual lasers, coupled with dual imaging systems, would deliver significantly increased scanning speed and result in much improved print productivity. Not really.

While having two lasers might speed up the scanning process, it doesn't change how long preparation takes. And, as we've covered, in some cases preparation makes up approximately 70% of the total build time. That means doubling up on lasers doesn't give you the time savings you might expect.

Then there's maintenance to consider. More lasers mean more complexity - each laser requires regular maintenance, alignment check and servicing. Machines with two lasers are out of commission for longer during maintenance. With a single, powerful laser, your machine is back up and running sooner, giving you higher uptime and lower operating costs.

That's exactly why we designed the **Neo®800+ 3D printer** with a single, high-powered laser, coupled with a highly efficient, fast imaging system.

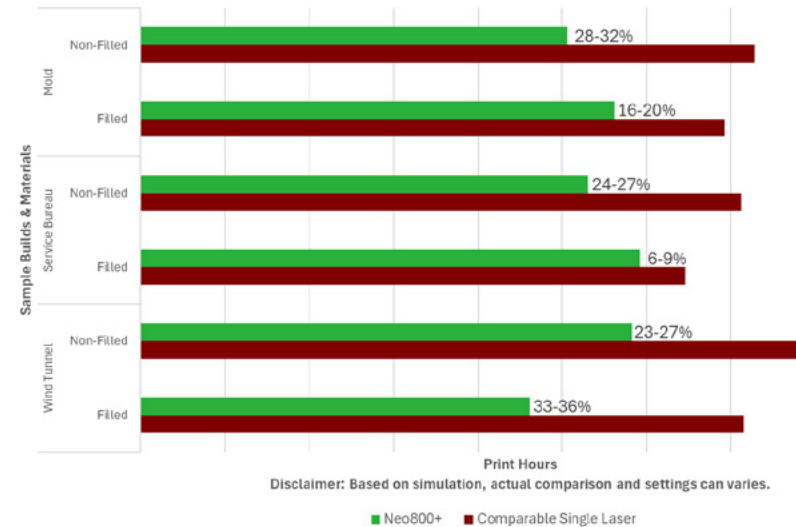
A second laser would give marginally faster scanning, but the gains are quickly offset by the increased maintenance and challenges with calibration. Dual-laser systems require precise coordination to avoid overlap or gaps in coverage, which adds to machine downtime and servicing needs.

Doubling the number of lasers doesn't double your performance or throughput. Once you factor in preparing time, increased calibration needs, the complex coordination between lasers, and higher maintenance requirements, that gain might only be 10-20% on a very limited number of applications/geometries. Meanwhile, costs for upkeep and potential downtime increase.

If a dual laser system is deployed without improvements in materials, scanning efficiency, etc., then the full benefit cannot be achieved.

Our approach with the Neo®800+ 3D printer was to focus on one powerful, reliable laser that delivers fast, efficient scanning, minimal downtime, and ultimately, better throughput and a lower total cost of ownership (TCO).

Neo®800+ 3D Printer vs Comparable 4W SLA Specs



The Neo®800+ 3D printer is not only 50% faster than its predecessor but also significantly faster than comparable SLA printers.

But now we need to talk about materials, how they behave at these elevated build rates, and how they impact your build quality.

How materials impact productivity

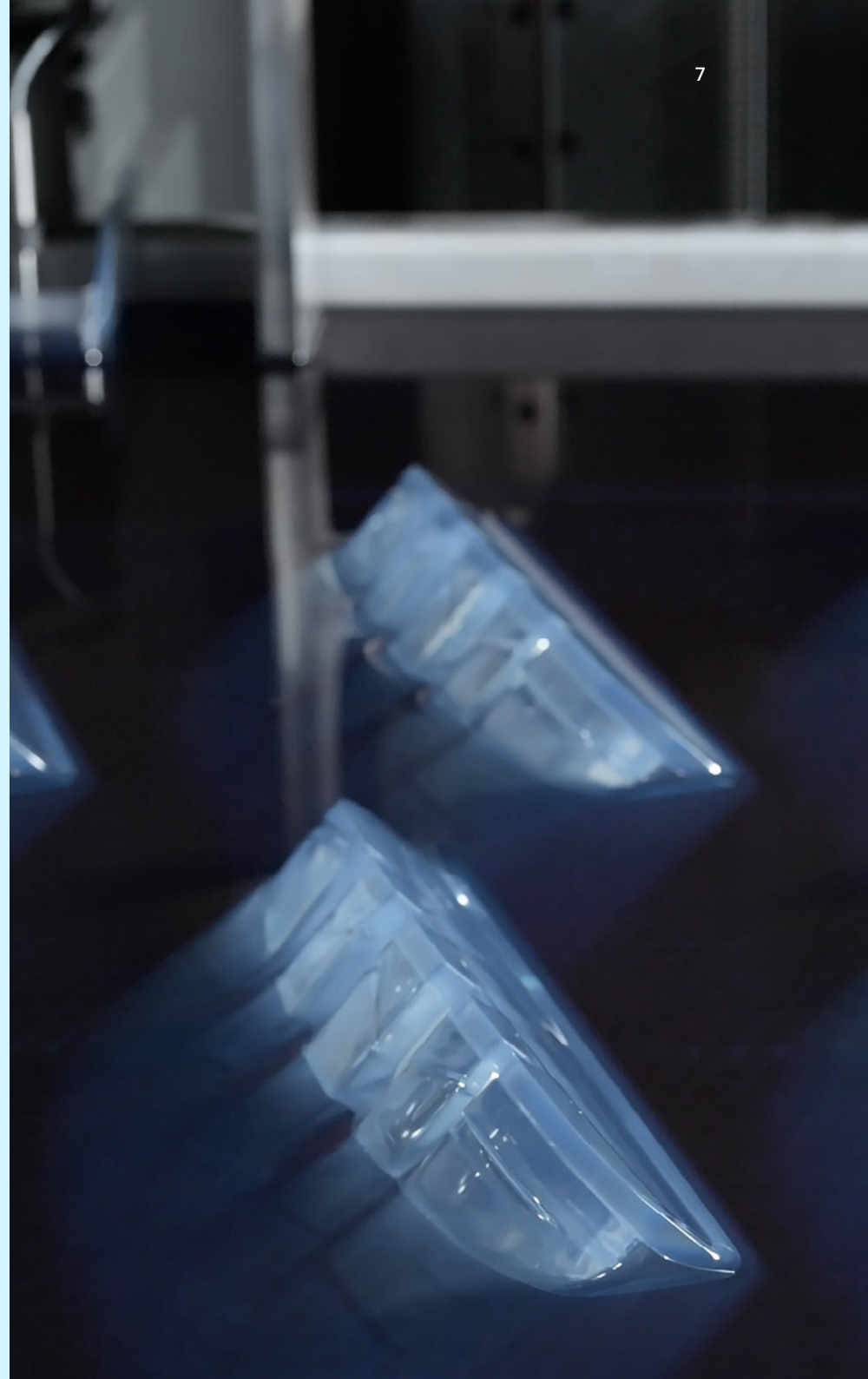
1. Viscosity and Surface Tension

Materials vary in viscosity and surface tension, which affects how smoothly each layer is prepared. High-viscosity materials behave a bit like thick maple syrup on a pancake – one needs to spread them carefully to get a smooth, even surface. The recoater handles this by applying a fresh layer of resin while also removing any excess. It breaks the material's surface tension in the process, ensuring a consistent, even layer. Without proper spreading, mounding forms, resulting in uneven layers, poor part quality, and in extreme cases, build crashes.

It's all about optimizing the recoater speed, to maintain that smooth build surface.

How to avoid it:

- Adjust the recoater movement to allow even material distribution
- Optimize the Z dip wait time per layer to ensure the material settles evenly for consistent results





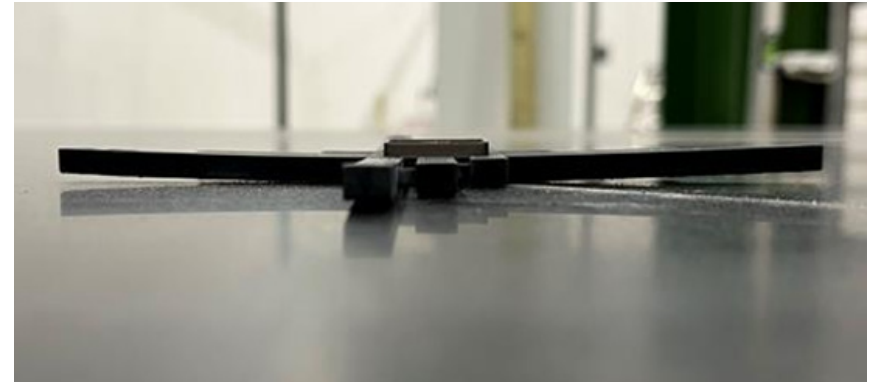
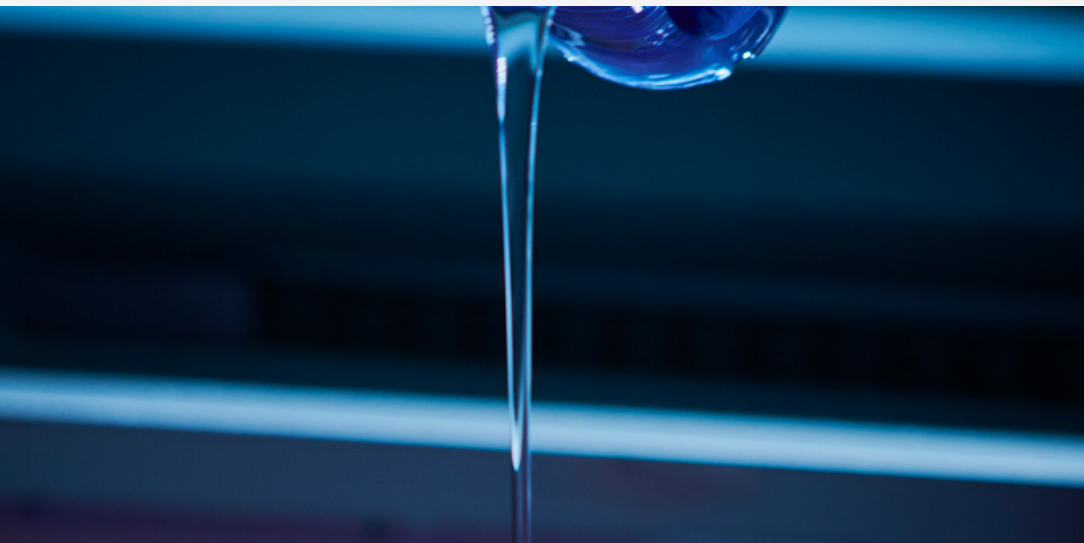
2. Material Types: Epoxy vs. Acrylate/Methacrylate

Most large format 355nm SLA materials are hybrid compositions of epoxies and acrylates. Epoxy-based materials cure more slowly and continuously even in the solid state but offer better dimensional stability. In contrast, acrylate/methacrylate - only (or acrylate/methacrylate-heavy) materials will demonstrate unacceptable and unpredictable shrinkage, distortion and warpage of printed parts. This is exaggerated as part size increases.

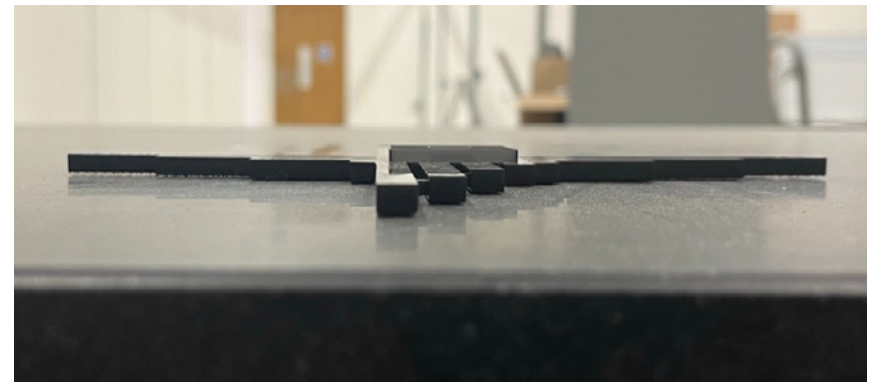
How to avoid it:

- Use balanced laser settings to minimize shrinkage and warping.
- Use a material with a balanced hybrid chemistry formulation of reactive components, fillers and additives.

For large accurate parts, well-tuned epoxy/acrylate hybrid materials are the best option.



Heavy percentage of acrylate-based material.



Epoxy-acrylate balanced material



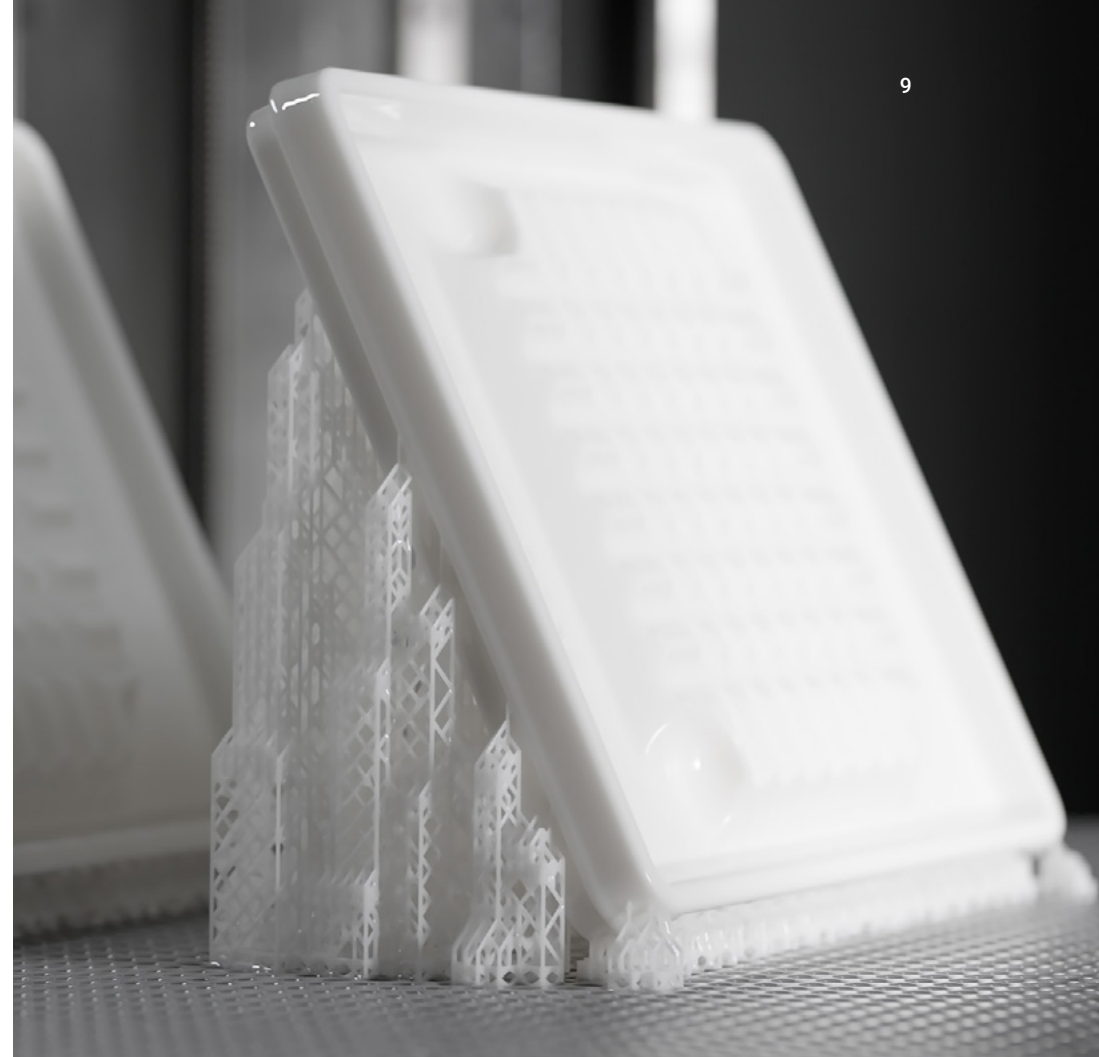
This sounds complicated!

How do I adjust everything to get a perfect part?

Setting the right laser power and scanning speed for each material is crucial to a successful build. But thankfully, the user doesn't need to adjust every setting by hand. That's where software and the predetermined material profile makes all the difference.

The Neo®800+ 3D printer uses **ScanControl+™**, a proprietary software that handles the complex coordination between laser and optics. It controls when the laser turns on and off for both scanning and non-scanning areas, adjusts power output, and fine-tunes the beam size and laser positioning across the material vat.

By optimizing these parameters, **ScanControl+™** reduces the distance the laser needs to travel, cutting down on build time without sacrificing part quality. This scanning strategy helps ensure each layer cures precisely as needed, resulting in faster print speeds, reliable accuracy, and repeatable results - all with minimal input from you. All these steps are done to extract the maximum benefit in properties and performance from well-tuned materials offered with the Neo®800+ printer.

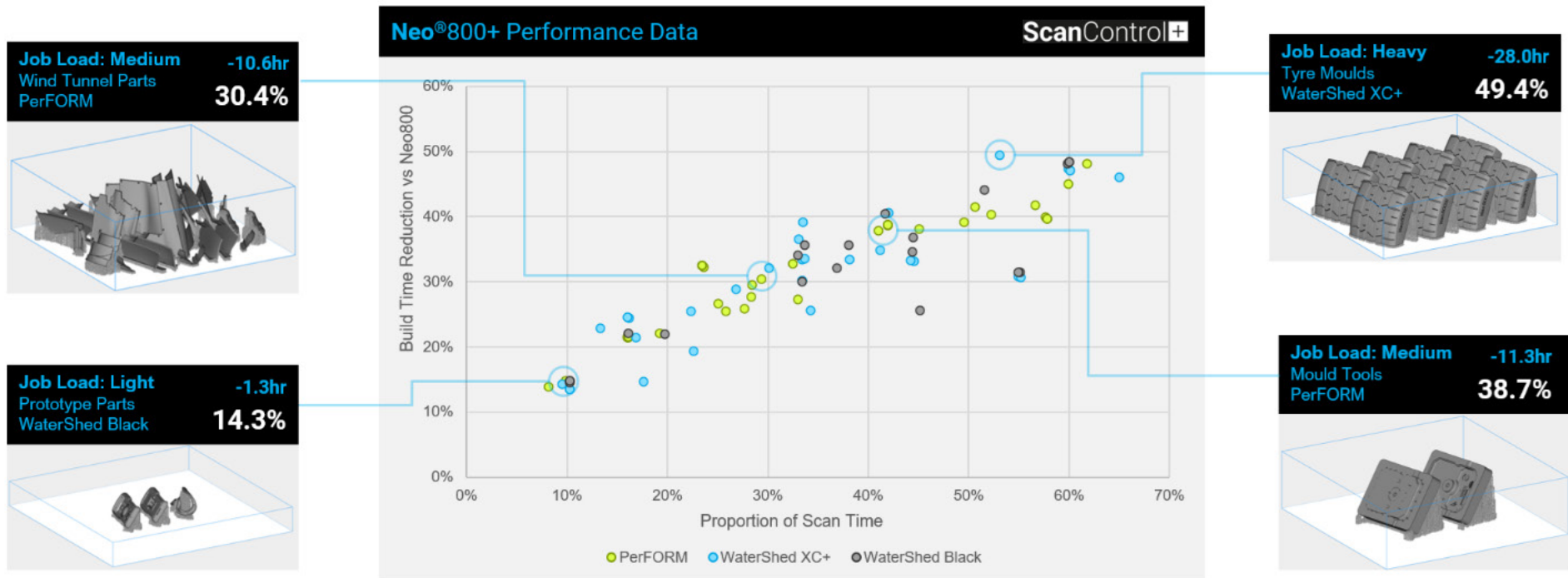




Faster printing with the Neo[®]800+ 3D printer and ScanControl+[™] Ready materials

ScanControl+[™] Ready materials are specifically designed for the Neo[®]800+ 3D printer to maintain accuracy and performance under high-speed scanning and elevated laser power.

These materials handle faster curing processes without compromising layer adhesion, dimensional stability, or property development. By optimizing both hardware and material properties, the Neo[®]800+ 3D printer reduces print times, minimizes defects, and ensures reliable, repeatable results even with complex builds.



Build Time Reduction with ScanControl+ vs. Neo[®]800 by Material and Job Load

The Neo[®]800+ 3D printer achieves up to 50% faster print times across various builds using ScanControl+[™] Ready materials. These materials are optimized for high-speed scanning, ensuring enhanced performance and reliability with reduced print times.



Conclusion

Ensuring a faster, more reliable machine is not as easy as adding more laser power. Our speed improvements can be attributed to carefully balanced machine performance, material formulation design, and scanning strategy.

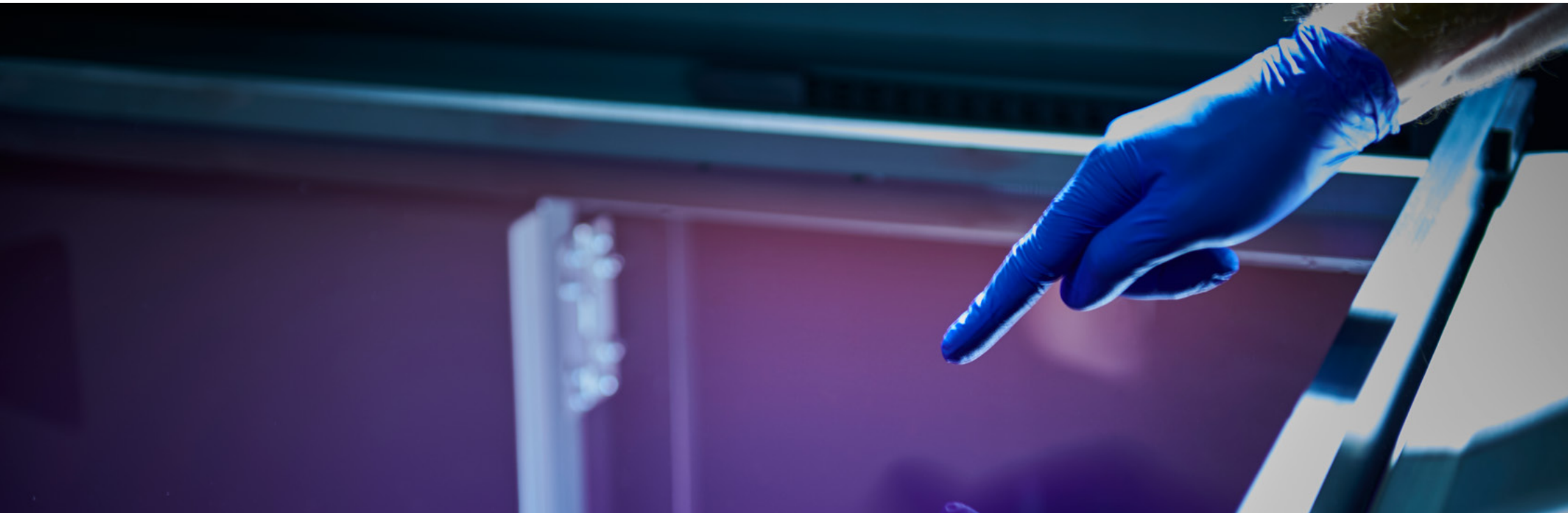
With the Neo[®]800+ 3D printer, we've designed a system that optimizes every step of the process, from preparation to scanning, ensuring smooth material handling and precise curing.

The combination of advanced software,

high-performance materials, and a powerful yet efficient single-laser system maximizes throughput and reduces the risk of downtime. ScanControl+[™] fine-tunes every aspect of the build, helping you avoid common build issues, keeping your machine running at its best, for longer.

This machine is an evolution of precision and performance, bringing greater productivity and lower total cost of ownership, with the same reliability our users have come to expect.

That's the Neo[®]800+ 3D printer.
Designed by engineers, for engineers.





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