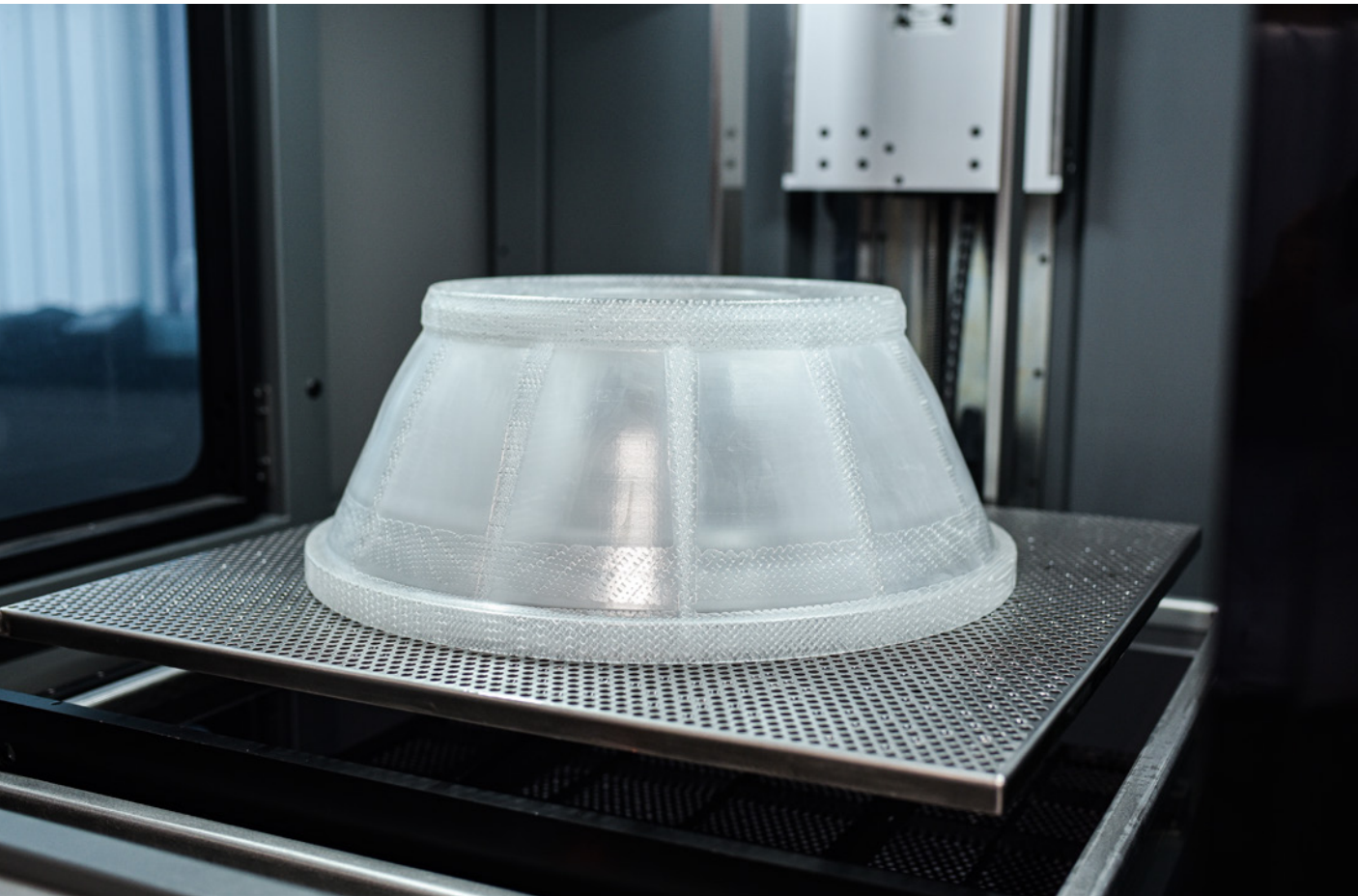


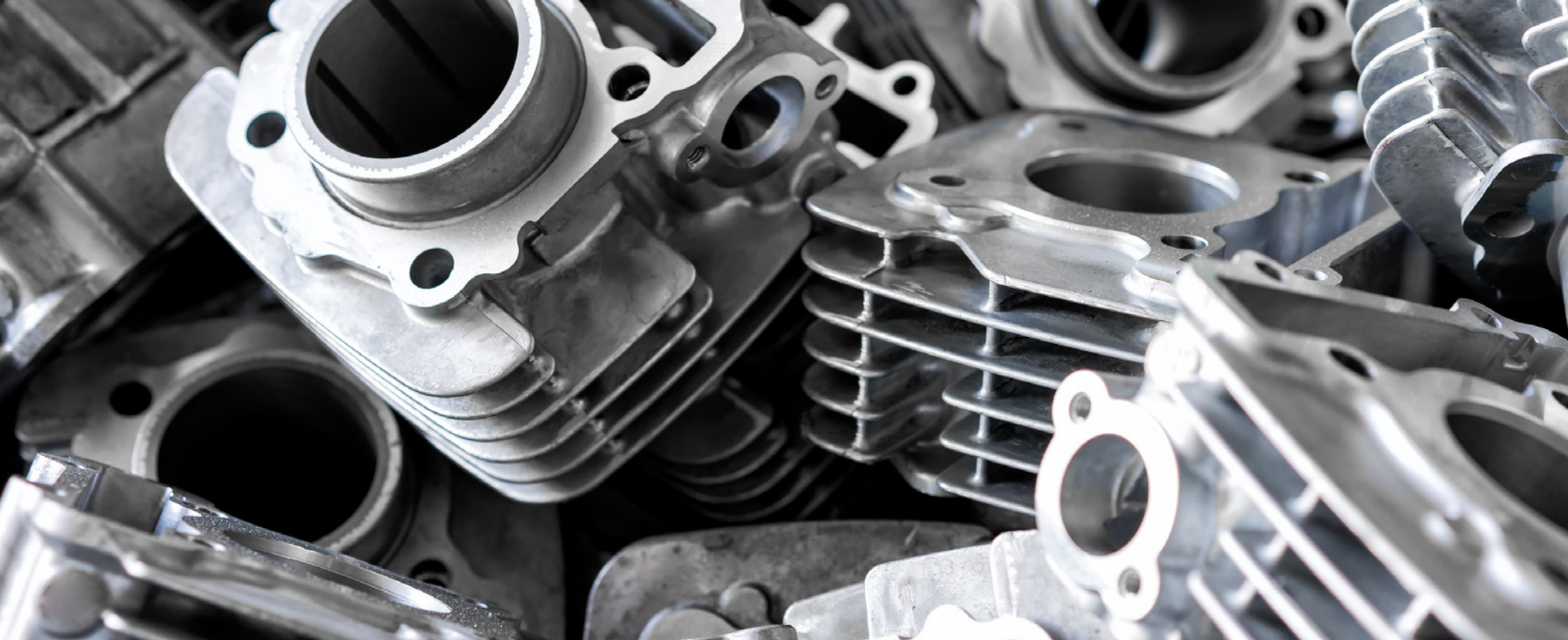


eBook
INVESTMENT CASTING

Investment Casting with 3D Printing

Achieve Faster, More Productive, and Consistent
Investment Casting with Stratasys Neo[®] Stereolithography





A Bronze Age Technique Meets 21st Century Innovation

Investment casting (or 'lost-wax casting') has long been a trusted method for producing metal parts with smooth surfaces and precise dimensional tolerances. In fact – it's a method that's been around since the Bronze Age!

But in recent years manufacturers are moving away from traditional CNC-machined molds and wax injection and searching for greater design freedom and cost savings. Investment casting is traditionally a lengthy process, with high tooling costs, a lot of waste and inconsistent quality of the final part.

Stereolithography (SLA) is an additive manufacturing technology now commonly used to directly 3D print master patterns for casting. It provides a modern, efficient, and cost-effective solution for investment casting, enabling manufacturers to produce high-quality parts with greater design freedom and shorter lead times.



Why Use Stereolithography for Investment Casting?

3D printing master patterns can reduce the investment casting production time from weeks to days, potentially resulting in up to 75% time savings compared to traditional methods of manufacturing, for example, CNC machined wax molds.

The ability to rapidly produce intricate designs that were previously unachievable with conventional techniques opens new possibilities for innovation in part design and functionality specifically with small-series production runs.

Save Time and Costs

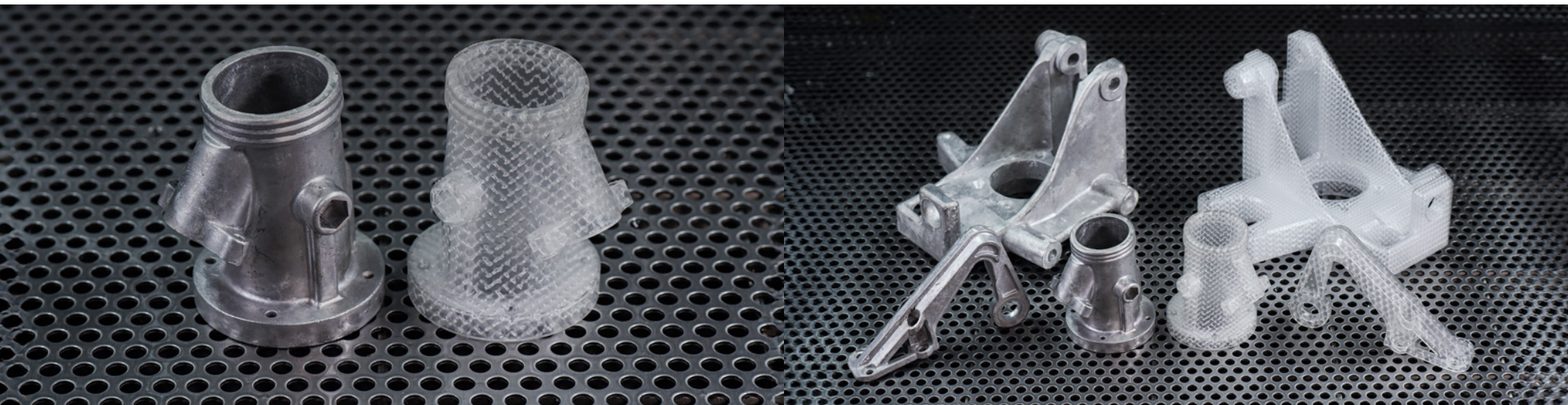
By using 3D printing for investment casting, you can eliminate the need for expensive molds and dies, significantly cutting down on high tooling costs. Plus, you'll be able to produce patterns overnight, drastically reducing lead times and getting your products to market faster.

Enhance Design Freedom

With 3D printing, you can achieve intricate geometries and complex designs that traditional methods simply can't produce. Need to make changes? No problem! You can quickly and affordably iterate designs, making rapid prototyping a breeze.

Improve Quality and Stability

Stratasys Stereolithography 3D printers and Somos materials designed for investment casting ensure your parts are of the highest quality, delivering superior surface finishes and dimensional accuracy. 3D printed patterns are also incredibly robust, standing up to handling and shipping without any damage.





The Stratasys Difference

Achieve faster and more reliable production of 3D printed master patterns with the Neo's Optimized Stereolithography workflow.

By incorporating the Stratasys difference, you benefit from:

- **Optimized software integration:** The Neo Build Processor developed with Materialise speeds up build file processing and build speeds, improving overall efficiency.
- **Advanced printing capabilities:** The reliable Neo450 and Neo800 SLA printers deliver superior surface part quality and dimensional accuracy.
- **High-performance materials:** Somos® WaterShed XC and Somos® WaterShed AF resin provide reliable and high-quality results and clean burn out reducing defects and enhancing stability.
- **Streamlined workflow:** Automated processes and advanced software features such as variable layer thickness build option reduce manual intervention, minimizing errors and increasing productivity.
- **Superior post-processing:** Enhanced curing processes ensure patterns are fully stabilized and ready for casting, meeting the highest industry standards.





Stereolithography 3D Printing Investment Casting Process:

1



3D Printed Pattern

Investment Casting Patterns are designed in CAD and saved to an STL file which is uploaded to the Neo and printed in hours.

2



Mold Assembly

Printed patterns are then assembled at the foundry, with the patterns secured on to a central wax bar with gates, called a sprue.

3



Shell Building

A shell mold is created by dipping (investing) the assembly multiple times in ceramic slurry. The first layer allows for the reproduction of fine detailed features. After this coating, the shell is layered with a fine ceramic refractory grain like sand. After drying, the process is repeated to obtain the desired shell thickness.

4



Burn Out

After the shell mold dries, it is typically flash-fired in a furnace to burn out the printed part and remove the shell, leaving a negative impression of the assembly.

5



Pouring

After burnout, the mold is preheated prior to pouring the molten metal. The molten metal is then poured into the mold becoming one solid casting as the metal cools.

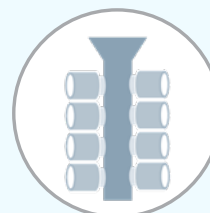
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Shell Removal

The ceramic shell is removed from the solid metal

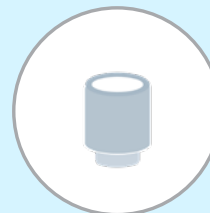
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Cut-Off

The original parts are now cut from the sprue and gates and ground smooth so that they are ready for additional processes.

8



Finished Metal Part

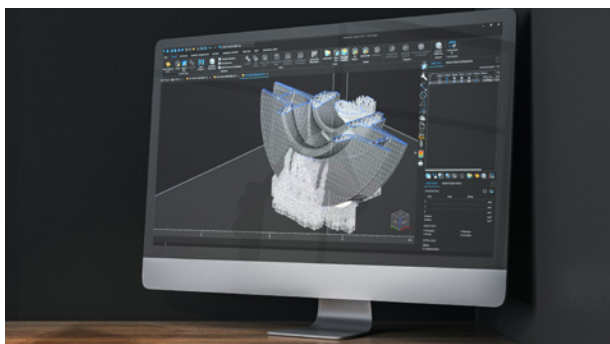
Final inspection is performed on each part and is finished using traditional techniques.



How to Print Detailed, Robust Molds with Neo Stereolithography

You've seen how Stratasys enhances each step of the investment casting process. But if you're unsure of the process of creating exceptional molds, let us walk you through the steps involved.

Prep



1. Pattern Creation

Start by creating a detailed STL part file of the pattern you wish to cast.

Tetrahedral lattices ensure part stability, isotropic security, structural integrity, and sufficient material drainage. Together with Materialise, we've developed a new build processor. It integrates seamlessly with Materialise's Lattice module to speed up file preparation and reduce processing times without sacrificing final part quality.

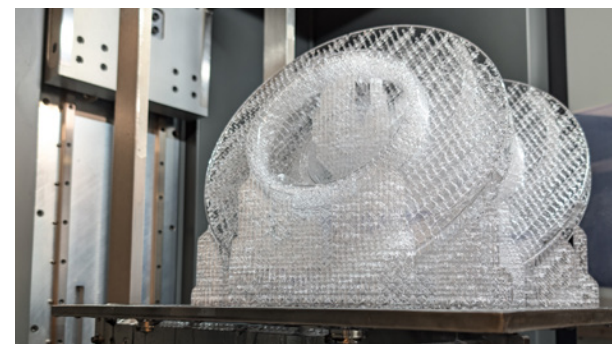
Printing



2. Material Selection

Next, choose a resin for your pattern, such as Somos WaterShed AF - an antimony-free resin that reduces scrap rates, contains no phosphorus, and produces very low ash.

Integrating Materialise's tetrahedron lattice structure with Somos WaterShed AF minimizes scraps by reducing shell cracking and casting defects, lowering operating costs. It's a perfect combination to ensure strong, stable patterns with fewer defects.



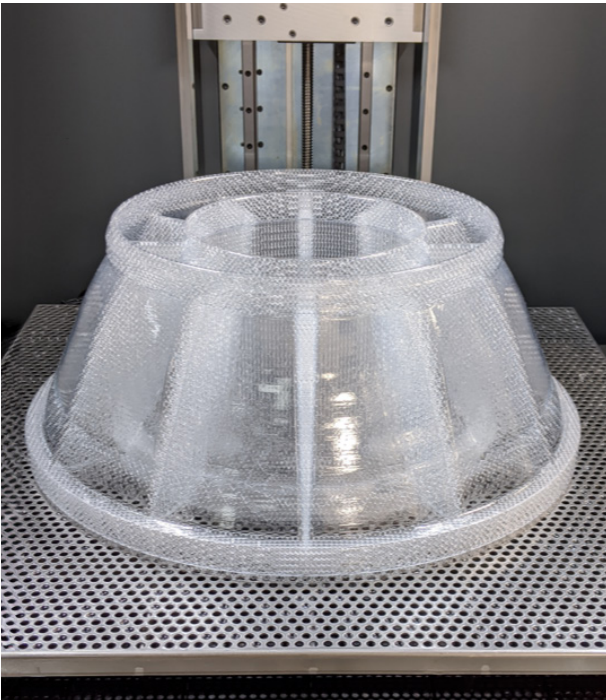
3. Choose your printer

Choose a Stratasys Neo stereolithography (SLA) printer, such as the Neo 450 or Neo 800 for larger parts.

These printers are designed for high-quality, precise 3D printing, ensuring the best possible outcomes for your investment casting patterns.



Post-Processing

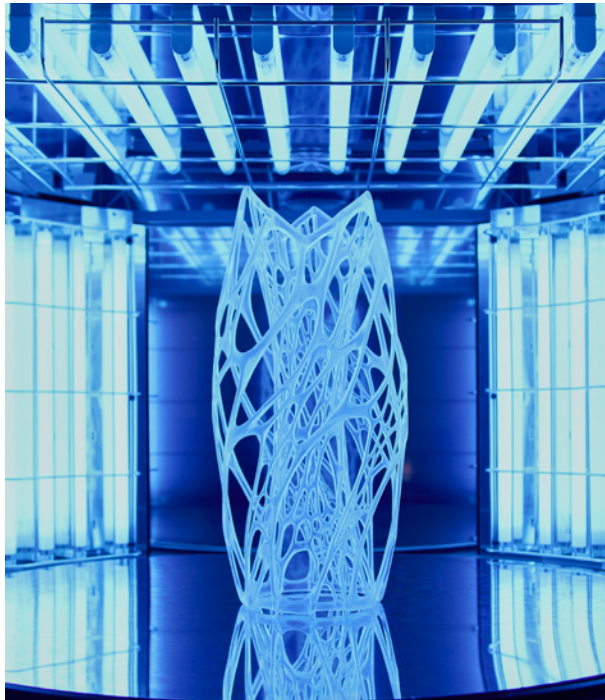


4. Draining & Cleaning

Once the pattern is printed, allow most of the uncured resin to drain back into the vat.

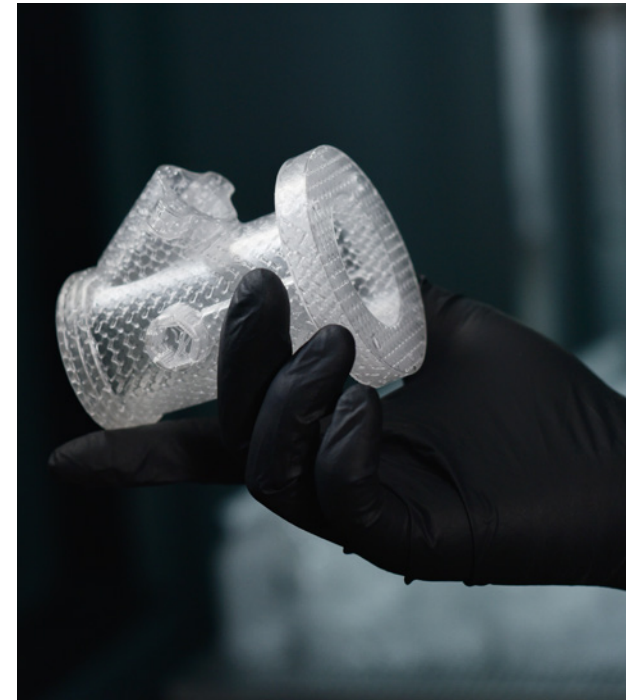
Use a honey spinner for centrifuge draining to remove any residual, non-recoverable resin.

Clean the parts manually with paper towels or lint-free cloth soaked in IPA, ensuring the solvent fully evaporates.



5. UV Post Cure

Following initial cleaning and draining, the parts should undergo UV post-curing in an oven such as the UV800 for an additional 30 minutes to 1 hour to ensure they are fully stabilized and polymerized.



6. Seal Holes

Seal any vent and drain holes, damaged holes, and joints using foundry wax or SL resin with a UV gun/wand (EFOS, OmniCure, Dymax).

Make sure to leave one hole unsealed for the connection spout, which will be cured in place.



Post-Processing



7. Leak Testing

To ensure the integrity of the pattern, conduct vacuum testing to make sure it holds a vacuum up to 10 inHg (250 mmHg) using a handheld device like Mityvac.

Apply slight pressure to detect any leaks, using an electronic stethoscope if necessary, and seal any detected holes.



8. Bonding & Handling

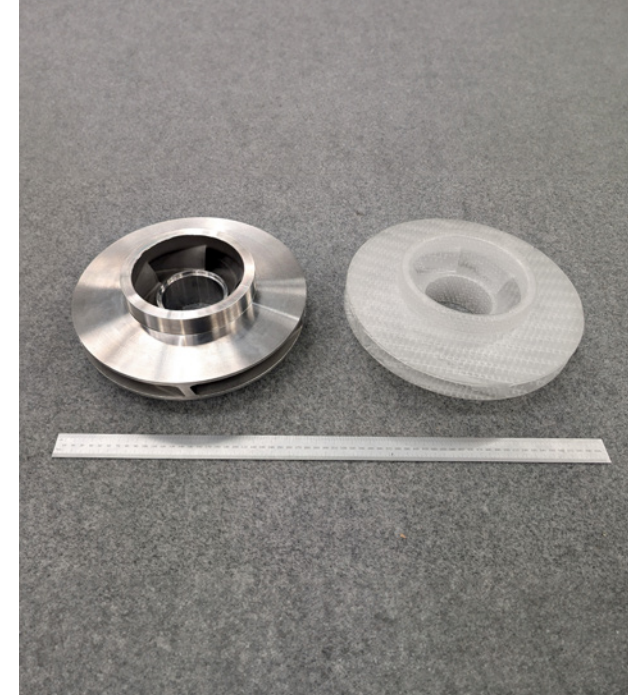
For patterns that are too large for the platform, split and join parts separately.

For example, gas turbines up to 2.5m in diameter and 1.5m in height have been built in sections with the Neo and cast in one piece.

Thoroughly vacuum test each individual part and the final pattern, fixing all leaks.

Store and ship the parts in sealed bags with desiccant to prevent moisture absorption.

Quality Assurance



9. Final Pattern

Finally, prepare your part to meet specific foundry requirements. This might include leaving holes open for some processes, clear-coating patterns for protection, or sanding patterns to achieve the desired surface finish (although this is unlikely to be needed with high-quality Neo parts).



Our Recommended Resin

Selecting the right material is vital for achieving high-quality investment casting patterns. Somos® WaterShed AF is designed to meet the stringent demands of modern investment casting applications.

Why we love Somos WaterShed AF:

- **Easy-to-remove “fluffy” ash** simplifies cleanup, reducing time and labor.
- **30-50% reduction in metal scrap rates** lowers waste and material costs.
- **Good green strength** for robust patterns that are easy to handle and process.
- **Low moisture absorption (0.31%)** prevents warping or distortion over time.

Somos® WaterShed AF (Antimony Free)

Antimony (Sb) is a metalloid element that is present in most stereolithography resins and is left behind when the resin is burned out of the shell. It is a potential contaminant for metals like Titanium. Recycled metal leftover after casting (such as the gating) could be contaminated with antimony and this would recirculate & accumulate in the re-used molten metal over time and thus increase scrap rates. Somos WaterShed AF contains no antimony, resulting in very small amounts of residual ash and therefore eliminating any antimony contaminant introduced into the melt pool.

Somos WaterShed AF produces patterns with very little ash when burned out, meeting the strict requirements for casting specialty alloys. This material results in accurate, geometrically complex patterns with excellent surface finishes and no detectable levels (<1pmm) of antimony.

Use the Stratasys-enhanced Materialise Magics TetraShell software with a tetrahedron lattice, Neo Build Process for Investment Casting, and Watershed AF material to enhance structural integrity, reduce material usage, minimize shell cracking and casting defects, and lower operating costs, resulting in strong, stable, and high-quality investment casting patterns.





Stratasys Neo

Redefining Precision and Efficiency in Stereolithography

Our Neo SLA printers are at the forefront of investment casting technology, offering unparalleled precision, superior surface quality, and reliable performance. These advanced stereolithography printers are designed to meet the demanding needs of modern manufacturers, ensuring high-quality production with enhanced efficiency and flexibility.

- **Large or compact build envelopes:** The Neo800 is ideal for large parts (800 x 800 x 600 mm) or multiple smaller parts in a single print run, maximizing productivity. For a more compact option, choose the Neo450 with a build envelope of 450 x 450 x 400 mm.
- **Square build platform:** Optimizes the use of build volume, especially for circular parts, reducing material waste.
- **Excellent surface quality:** Minimizes post-processing and finishing time, delivering parts with superior surface finishes.
- **Highly reliable system:** Ensures consistent performance and uptime, crucial for meeting production deadlines.
- **Open materials platform:** Flexibility to use a wide range of materials tailored to your specific application needs.

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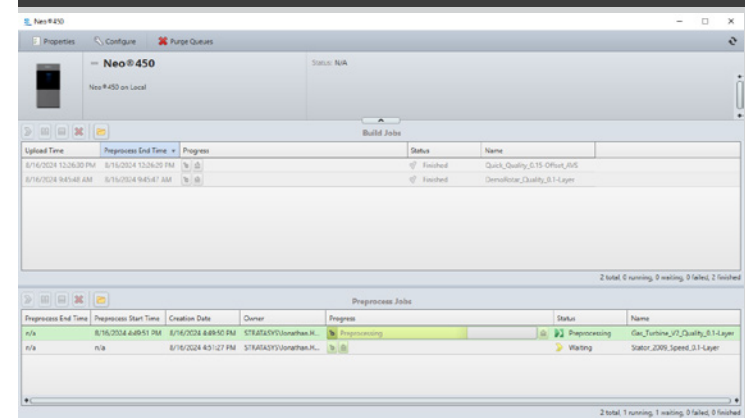
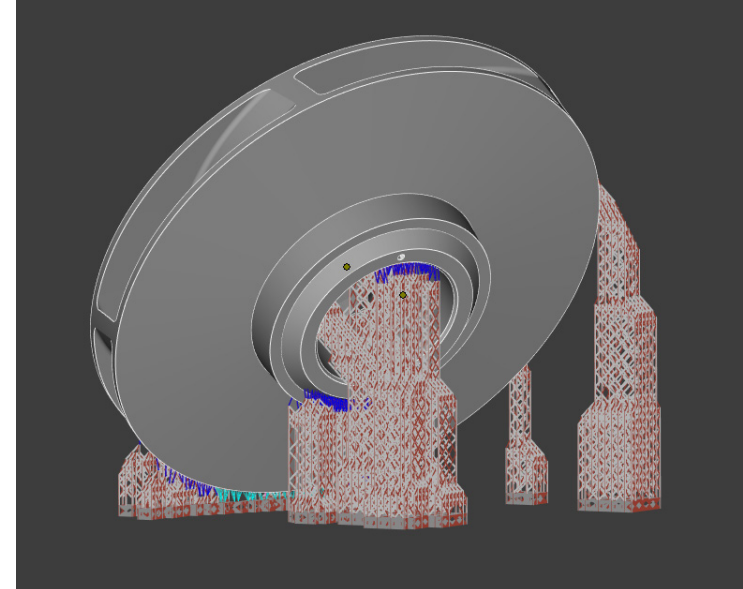




The Neo Build Processor for Faster, More Stable Investment Casting

Stratasys and Materialise have developed a new build processor specifically for the Neo SLA 3D printer, integrated with Materialise's Lattice module in Magics to speed up file processing without compromising on quality.

- **Up to 50% faster file processing speeds:** The build processor optimizes master pattern file preparation by offloading processing tasks.
- **30% faster build speeds:** Enhanced scanning techniques and variable layer thickness feature accelerate part production, maintaining superior part quality.
- **Seamless build prep workflow:** The software integrates smoothly with Neo's Titanium software for a superior user experience and workflow efficiency.
- **Improved part quality and stability:** When you combine Somos WaterShed AF resin, Neo SLA technology, and advanced Materialise software, you get highly accurate 3D master patterns requiring minimal finishing.



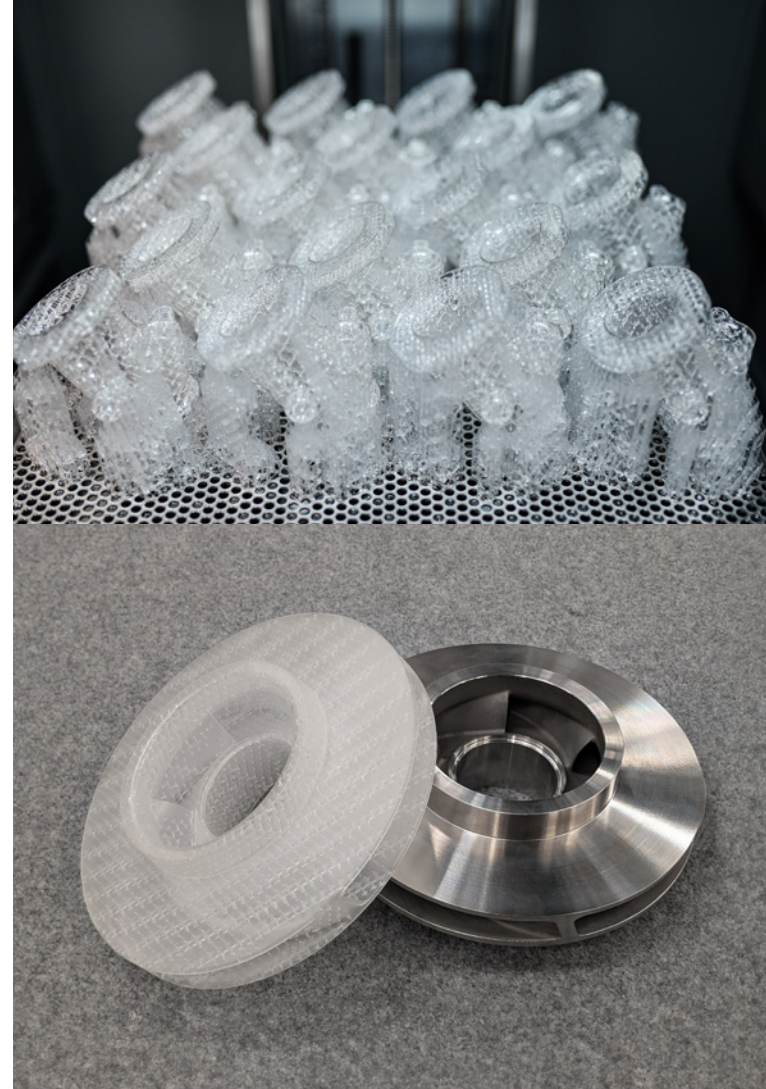


Transform your investment casting process with the latest in stereolithography

Stratasys Neo series printers, specialised software, and advanced materials like Somos WaterShed AF deliver unmatched design freedom, cost savings, and top-notch quality.

Discover how these innovations can boost your production efficiency and reliability.

Contact us today to learn more or to discuss your specific needs. We're here to help you elevate your investment casting to the next level.



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