WHITE PAPER

Moldmaking With 3D Prints: Six Techniques for Prototyping and Production

Moldmaking with desktop 3D printing allows engineers and designers to increase the functionality from their 3D printer beyond rapid prototyping and directly 3D printing parts. Moldmaking opens up a world of production materials, and provides the ability to produce short run batches and test mold designs prior to committing to expensive tooling.

This white paper answers the question: what types of moldmaking processes are possible with an in-house SLA 3D printer?

To answer this question, we will look at six techniques with accompanying case studies. This white paper will also provide links for further research and reading on each of the molding processes. It should be noted that these processes are best suited to stereolithography (SLA) 3D printing, given that printed parts are both isotropic and watertight.

formlabs

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Introduction

3D printing offers business much more than prototypes and physical representation of CAD models. 3D printing has the ability to supplement and enhance traditional manufacturing techniques to create new and exciting possibilities for product designers, which ultimately creates better end products for consumers. Combining traditional techniques like injection molding, thermoforming, or silicone molding with SLA 3D printed parts allows you to bring products to market faster with a more time- and cost-efficient manufacturing process.

This combination of 3D printed tools with traditional manufacturing techniques—called rapid tooling —has grown in popularity as affordable SLA 3D printers have become versatile, industrial-quality workhorses.

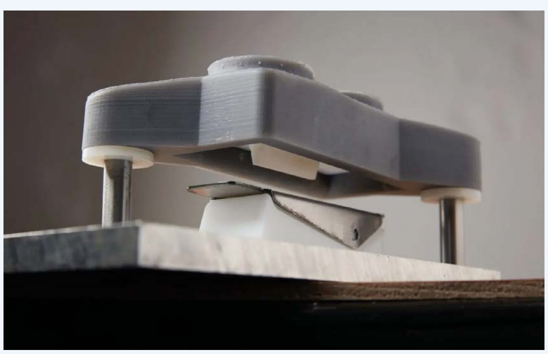
Part of the reason for this growth is the proliferation of high-performance SLA printing materials, which gives engineers access to a wide range of plastic materials. For example, Rigid 10K Resin, a highly glass-filled resin created for precise industrial parts that will be dimensionally stable under load and can withstand the clamping and injection pressures without breaking. Another material, Tough 1500 Resin, balances elongation and modulus. Parts printed in this material can bend significantly and quickly spring back to their original shape, which facilitates the demolding of the part. Materials such as Tough 1500 Resin and Rigid 10K Resin have enabled a range of demanding rapid tooling applications from injection molding to composite molding.

The combination of powerful SLA materials and high-resolution printers means rapid tooling leads to savings in both time and money compared to traditional manufacturing methods such as CNC machines. Below is an example of what is possible by bringing high-performance SLA 3D printing in-house.

PROCESS	EQUIPMENT	LEAD TIME	MATERIAL COST (E.G: 300 ML / CM^3 MOLD)
In-House Mold Creation and Part Production	Form 3 & molding machine	5–24 hours (mold print time)	Approx $50 in High Temp Resin
Outsourced SLA Mold	molding machine	3–5 days	Approx $700 from service bureau printing on industrial SLA
Outsourced Metal Mold	molding machine	1–2 weeks	Approx $6,400 from service bureau machined in alum
Outsourced Mold Creation and Production	none – fully outsouced	1–3 weeks	Ranging from $4,000 to $15,000, depending on volume and materials

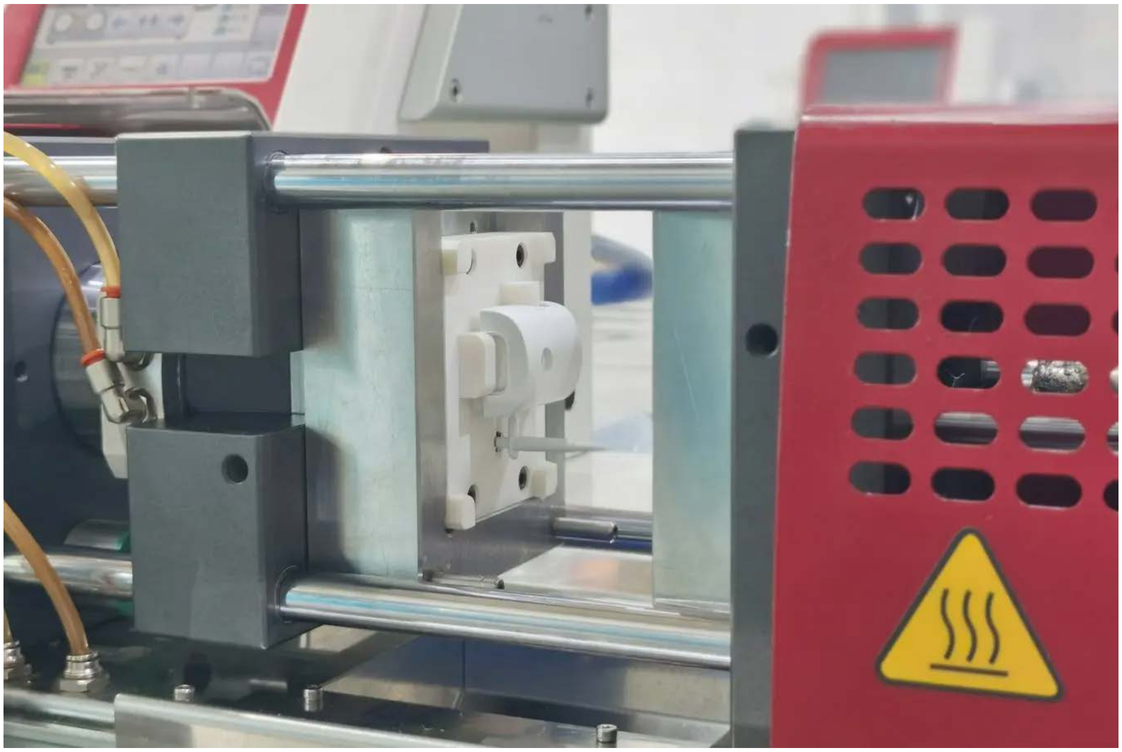
In this white paper, we will present an overview of the following rapid tooling workflows:

1. Injection molding
2. Overmolding
3. Vacuum forming
4. Silicone molding
5. Compression molding
6. Composite molding



This report is focused on molding processes for plastics, rubber, and composites, but it is also possible to use SLA 3D printing to enhance sheet metal forming workflows. For those looking for information on 3D printing tooling for sheet metal forming, our team has put together a free educational video on the topic. You can view it here.

Continue reading to learn the details of these rapid tooling workflows and see real-life case studies with companies saving hundreds of thousands of dollars and weeks to months of time along the way.



A mold 3D printed in Rigid 10K Resin during the injection molding process.

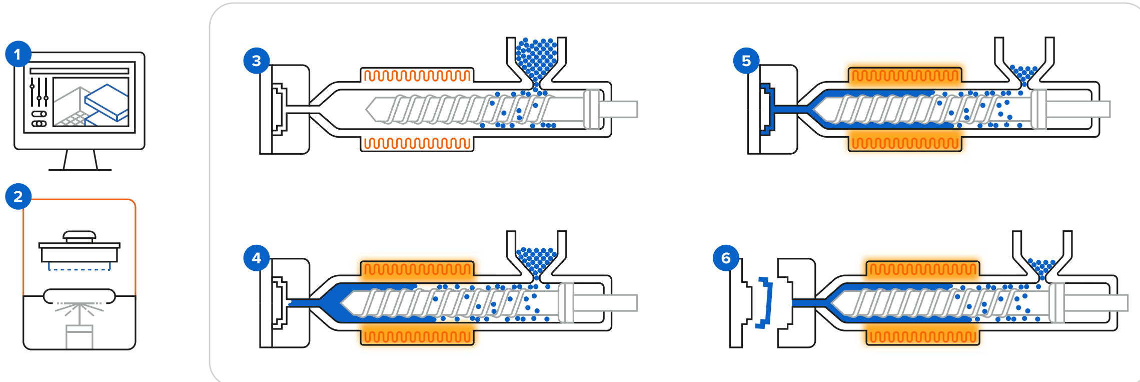
Injection Molding

Injection molding is one of the leading processes for manufacturing plastics. It is widely used for mass-producing identical parts with tight tolerances. It is a cost-effective and extremely repeatable technology that yields high-quality parts for large series. It can produce volumes from 1,000 to 100,000+ of parts at very low unit costs. Injection molding has a short cycle time, with each machine capable of building new parts every 15 to 60 seconds.

Desktop 3D printing is a powerful solution to fabricate injection molds rapidly and at low cost. It requires very limited equipment, saving CNC time and skilled operators for other high-value tasks in the meantime. Manufacturers can benefit from the speed and flexibility of in-house 3D printing to create the mold and couple it with the production force of injection molding to deliver a series of units from common thermoplastics in a matter of days. They can even achieve complicated mold shapes that would be difficult to manufacture traditionally and can be used on both desktop and industrial molding machines, enabling development teams to be more innovative. Furthemore, product development benefits from the ability to iterate on the design and test the end-use material before investing in hard tooling.

PROCESS WORKFLOW

INJECTION MOLDING PROCESS WITH 3D PRINTED MOLDS



1 Design the mold 2 3D print the mold 3 Mold clamping 4 Inject 5 Cooling 6 Demold

Injection molds need to withstand clamping pressures, injection pressures, injection temperatures, and any coolants or mold release agents that may be used. Doing so ensures the mold can be repeatedly used overtime and consistently produce parts true to the original design. Formlabs offers a range of materials that meet these requirements and are capable of replacing aluminum molds for low-volume manufacturing.

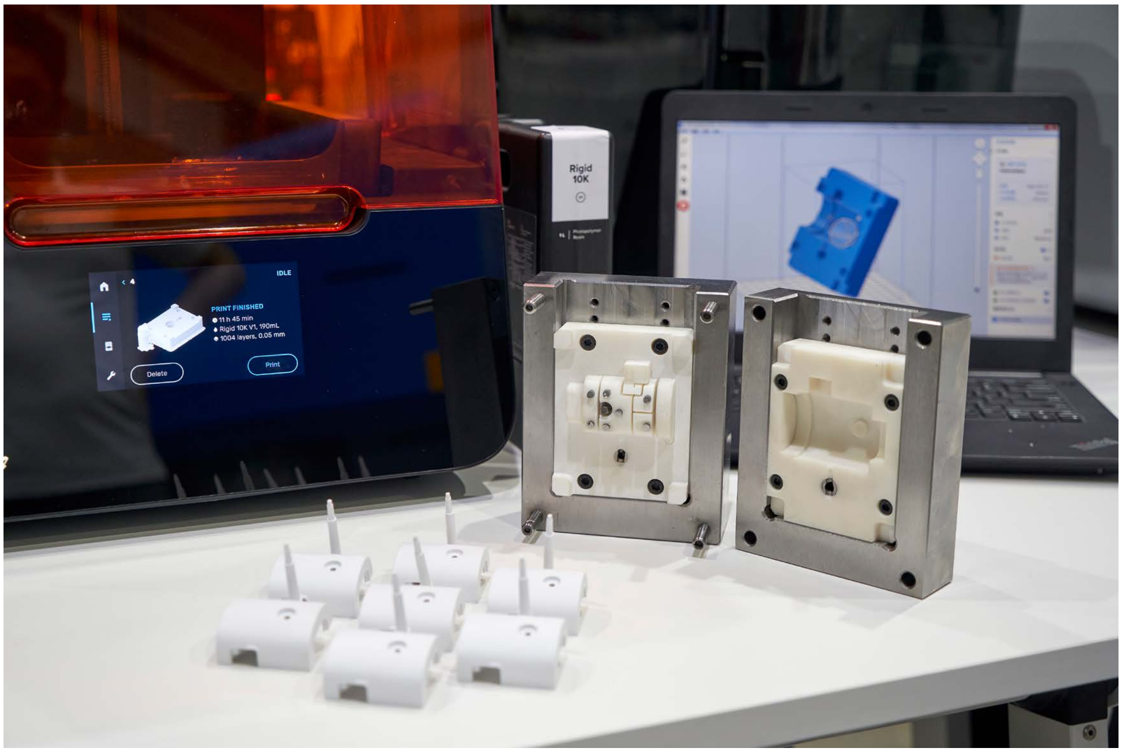
- To support short-run injection molding, Formlabs developed Rigid 10K Resin. The combination of strength, stiffness, and thermal resistance makes Rigid 10K Resin an ideal material for injection molds. Rigid 10K Resin has an HDT of 218°C @ 0.45 MPa and a tensile modulus of 10,000 MPa, making it a strong, extremely stiff, and thermally stable molding material that will maintain its shape under pressure and temperature to produce accurate parts.
- High Temp Resin is an alternative material that can be considered when clamping and injection pressures are not too high and Rigid 10K Resin cannot meet the required injection temperatures.
- Grey Pro Resin should be chosen when pressures and temperatures are low and the dimensional accuracy of your molded part is less critical. Molds made from Grey Pro Resin will bend before breaking, potentially increasing longevity, but potentially worsening accuracy over time as the mold is used.

Braskem, one of the world's leading petrochemical companies, ran 1,500 injection cycles with one mold insert 3D printed with High Temp Resin to produce mask straps. The company printed the insert and placed it inside a generic metallic mold integrated in the injection system. This is a powerful solution to produce medium series quickly. The printed insert can be replaced as the design evolves and in case of failure. It allows for creating molds on-demand with elaborate geometries that would be difficult to manufacture traditionally while still running multiple shots.

For Braskem, High Temp Resin was an excellent material for their injection molding application. But the resin can be quite brittle. That's why other users have turned to Grey Pro Resin or Rigid 10K Resin when creating injection molds.

The table below summarizes the ideal materials based on different molding conditions.

CRITERIA	RIGID 10K RESIN	HIGH TEMP RESIN	GREY PRO RESIN
High molding temperature	●●	●●●	●
Shorter cooling time	●●	●●●	●
High preassure	●●●	●	●●
Increase cycle number for complex geometries	●●●	●	●●



These Rigid 10K Resin injection molds printed on the Form 3 could produce 100+ parts.

While High Temp Resin worked for Braskem, Shenzhen-based contract manufacturer Multiplus went with Rigid 10K Resin. With multiple 3D printers and injection molding machines in their workshop, Multiplus was able to deliver hundreds of pieces in as fast as three days, which is substantially shorter than the three or four weeks needed if they were to injection mold parts with a CNC machined metal mold.

By seamlessly integrating 3D printing into their injection molding workflow, Multiplus was able to grow their business, take on more jobs, and be more competitive, all while reducing costs, improving turnaround time, and helping their clients bring better products to market quickly.

Deep Dive White Paper: Injection Molding

CASE STUDY: NOVUS APPLICATIONS IMPROVES INJECTION MOLDING PROCESS WITH RIGID 10K RESIN

Novus Applications, a product development company focused on consumer goods, takes injection molding to the next level by incorporating 3D printing into the workflow to speed up the process, enabling an agile manufacturing approach. By 3D printing injection molds using Formlabs' Rigid 10K Resin, Novus was able to achieve their desired outcomes while saving costs and time by a few days. As a result, the process is more automated. Formlabs' complete, easy-to-use ecosystem makes it simple to get started with 3D printing injection molds.

"The production of those parts is in an unattended fashion. I don't need a highly experienced individual, although I do need a person with experience and 3D printing. So the learning curve is faster. The production is far more unattended," said Mark Bartlett, president and founder of Novus.

Novus needed a material capable of bearing the high heat and pressure of this process while rendering small features. In particular, the threaded core was a delicate part. The advanced strength ensures the mold made from Rigid 10K Resin could withstand the clamping and injection pressures without breaking, while the high stiffness enabled the mold to maintain its shape under these pressures and produce accurate parts. Thanks to this set of properties, they were able to inject hundreds of parts of polypropylene and polyethylene with just one mold without breakage.

Not only did Rigid 10K Resin exhibit good dimensional stability, but it was also faster and easier to print compared to milling aluminum and steel. "How does it handle the pressures and temperatures in the materials we were running? It performed excellent...it was performing at a level that we hadn't seen historically capable in the traditional [Rigid 4000] material," Bartlett said.

To learn more details about how Novus Applications designed their molds, you can watch our free webinar. You will learn:

- Expert processes to design a 3D printed mold for injection molding.
- Which printing and molding conditions ensure success, including an overview of the Formlabs resins that Novus Applications and Braskem use for the molds.
- Strategies for the post-processing workflow, including ejection and demolding.

Watch the Webinar

Overmolding

Overmolding is a multi-step injection molding process where two or more components are molded over top of one another. Overmolding is sometimes referred to as two-shot molding because it is a two-step process. It uses a similar process as injection molding, and creates structurally similar parts.

Overmolding allows for the manufacture of products with multiple materials and/or colors relatively simply. Overmolding also uses fewer work-hours (and thus, costs less) compared to other manufacturing methods where a part would need to be transferred to a completely different mold or machine. Overmolding reduces the need for product assembly because parts are manufactured right on top of one another—resulting in a stronger, more durable overall design.

Overmolding is often the best manufacturing method for large production runs and/or products with colorful and multi-layered designs, but there are a few limitations that you need to be aware of. Similar to injection molding, overmolding has excessive upfront costs. It is time-consuming and expensive to manufacture and modify tooling out of metal, and two-shot injection molding machines are complex to dial in. This means that you need to produce a large number of parts to distribute these costs.

Prototyping is a crucial part of the product development process. Product designers and engineers need to test out concepts and troubleshoot design elements that have never been used before. But the downside is that prototyping overmolded parts can get very expensive, very fast. And if you're relying on outside sources to produce components, it can also be time-consuming.

Some of the world's top innovators are overcoming these prototyping challenges by combiningmanufacturing processes like overmolding and insert molding with 3D printing.

Dame Products used silicone overmolding to encapsulate internal hardware for customer beta prototypes.

Dame Products is a Brooklyn based startup that designs products for the health and wellness industry. Their product line incorporates complex ergonomic geometries, fully encapsulated in a layer of skin-safe silicone in vibrant colors. The team employs silicone overmolding in production and to encapsulate internal hardware for customer beta prototypes.

Dame Products engineers can prototype dozens of Clear Resin overmolded devices in one day by rotating through three or four SLA printed molds. While the silicone rubber of one prototype is curing, the next can be de-molded and prepared for the next fill; finishing and cleaning of de-molded prototypes happens in parallel.

3D printing can also be leveraged to dial in the overmolding process during product validation stages in manufacturing. Designers at the Google Advanced Technology and Projects (ATAP) lab were able to cut costs by more than $100,000 and shorten their testing cycle from three weeks to just three days using a combination of 3D printing and insert molding.

Read the Overmolding & Insert Molding White Paper

CASE STUDY: GOOGLE ATAP

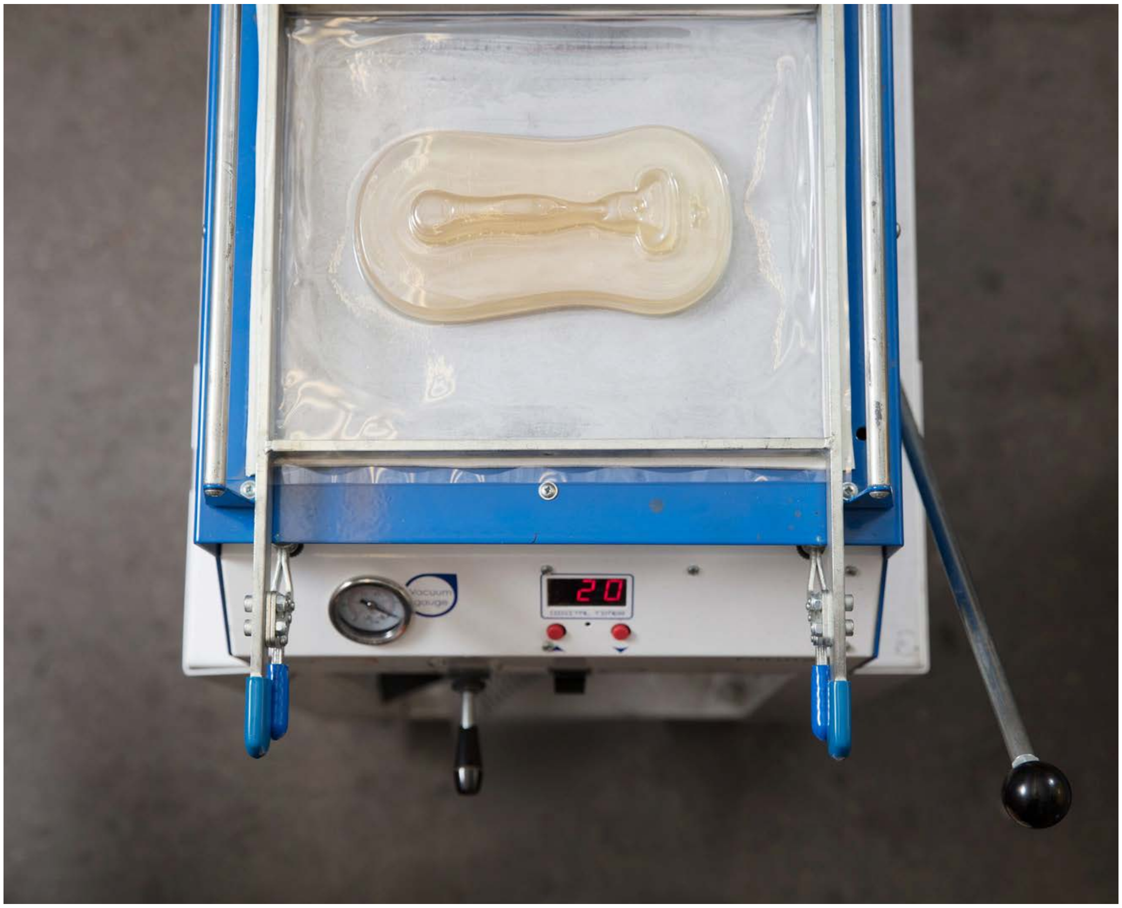
The Google Advanced Technology and Projects (ATAP) lab is uniquely set up to be a one-stop-shop for bringing hardware projects to life. The lab offers a vision into the future of both products and production, but uses problem-solving approaches that any company can learn from today, from an iterative mindset at every stage of development, to a technology toolset that enables agile, creative solutions.

In one case, the team's approach led to a process innovation that allowed them to circumvent a complex supply chain for the pre-production validation stage of an overmolded wearable device. Using High Temp Resin, they bridged the gap between prototyping and production, reducing turnaround time for a crucial component by 85% while saving over $100,000.

Read the blog to see how Google ATAP used High Temp Resin to:

- 3D print surrogate inserts using High Temp Resin that withstood overmolding with TPU injected at over 250 °C and 27,000 psi.
- Save an estimated $100,000 in wasted electronic sub-assemblies—even more when accounting for labor costs.
- Circumvent a complex supply chain to shorten the pre-production validation test cycle for the PCBA inserts from three weeks to three days.

Read the Blog



Vacuum Forming

Vacuum forming is a manufacturing method used to shape plastic materials and is among the most ubiquitous manufacturing methods for creating the packaging of various goods. During the vacuum forming process, a sheet of plastic is heated and then pulled around a single mold using suction. From grocery store salad mixes, the lid of your to-go cup of coffee, and high-end consumer electronics, vacuum forming is useful for producing lightweight, cost-effective packaging.

The process of vacuum forming is quite simple. It requires four basic elements: a mold or tool that will create the shape of the final part, a sheet of plastic, a heat source, and a source of vacuum. The sheet of plastic is heated as evenly as possible, until it becomes soft and pliable, and is brought down onto the mold or tool. Then the vacuum is applied, and the part is allowed to cool before being removed from the mold.

Creating vacuum forming molds with traditional manufacturing processes like machining or casting is time consuming and costly, especially for complex geometries, textured surfaces or fine features. Increasingly, designers and engineers are turning to 3D printed molds and tools for vacuum forming for significant cost and time savings. Additionally, 3D printed molds and tools can easily incorporate small features like text and intricate textures without impacting part cost.

Formlabs SLA 3D printers deliver high resolution, smooth prints which are perfect for vacuum forming molds. SLA printing offers almost total design freedom and the ability to print intricate and detailed molds. Plus, in-house SLA 3D printing offers a fast turnaround time and low price point, especially for shorter runs, custom parts, and prototype designs.

Read Our Vacuum Forming Guide

A 3D printed mold for vacuum forming product packaging.

CASE STUDY: HOW LUSH COSMETICS TAKES IDEAS FROM CONCEPT TO REALITY IN UNDER 24 HOURS WITH 3D PRINTING

With 928 stores spanning across 48 countries, Lush Cosmetics, the handmade cosmetics retailer known globally for making creative and crowd pleasing products such as Massage Bars, Body Butters, Bath Bombs and more, attributes its success to being able to respond quickly to trends and customer demand.

To enhance its product design capabilities, Lush Cosmetics opened a state of the art research and development facility in 2018, equipped with a range of additive manufacturing technologies. Here, they started using 3D printing to create molds for vacuum forming.

Two resins most commonly used for vacuum forming are Grey Resin and Draft Resin. Grey Resin offers smooth, highly detailed surfaces which excel during the vacuum forming process. For users that don't need the highest possible surface detail, Draft Resin is the fastest printing Formlabs SLA resin, printing up to four times faster than Grey Resin. This allows teams to quickly turn around prints for vacuum forming, speeding up the development process.

Lush Cosmetics utilizes vacuum forming techniques to create molds for new cosmetic designs. 3D printing the mold designs with their Formlabs printer is extremely effective for Lush as it enables the fast production of new prototypes. Additionally, 3D printed molds can easily incorporate small features like lettering and intricate textures without impacting part cost.

In this case study, you will learn:

- How the company takes ideas from design to manufacture in under 24 hours.
- How they used digital fabrication tools to fulfil 580 requests in just half a year.
- How they are rethinking traditional workflows by implementing 3D printing.

Read the Case Study

One-piece silicone molds are ideal for designs that have a flat side and no deep undercuts.

Silicone Molding

Silicone's flexibility makes it straightforward to work with, and creating silicone molds has seen increased adoption across multiple industries, most noticeable consumer goods and jewelry. Silicone is a strong choice for mold-making because it offers such a diverse array of benefits. You can easily create custom designs using silicone molding. The molds themselves are also quite durable, so you can use them repeatedly without fear of breakage. Silicone's inorganic makeup—compared to rubber, its organic counterpart—makes it highly resilient to heat and cold, chemical exposure, and even fungus.

3D printing allows users to directly print molds, opening up small-batch production to anyone with CAD skills and a 3D printer. But before you start making your molds, you'll need to determine which type of mold(s) are right for your application.

One-piece silicone molds are like ice cube trays. You fill the mold and then let the material set. However, just as an ice cube tray creates cubes with a flat top, one-piece molds will only work with designs that have a flat side. If your master has deep undercuts, that also makes it harder to remove it and the finished parts from the mold once the silicone sets without damage.

When these are not a concern for your design, a one-piece silicone mold is an ideal way to create a seamless 3D reproduction of your master on all of its other surfaces.

A two-piece silicone mold is better for reproducing your 3D master without a flat side or has deep undercuts. The mold splits into two pieces that join back together, forming a fillable 3D cavity (similar to how injection molding works). Two-piece molds leave no flat surfaces and are easier to work with than single block molds. On the downside, they are a bit more complex to create and seams may form if the two pieces aren't perfectly flush.

Two-piece silicone molds can reproduce any master design (image source)

A pattern—sometimes referred to as a master—is the part you use to create a precise negative in your silicone mold. If you are simply trying to replicate an existing object, it might make sense to use that object as your pattern. You'll just need to be sure that the object can withstand the mold-making process.

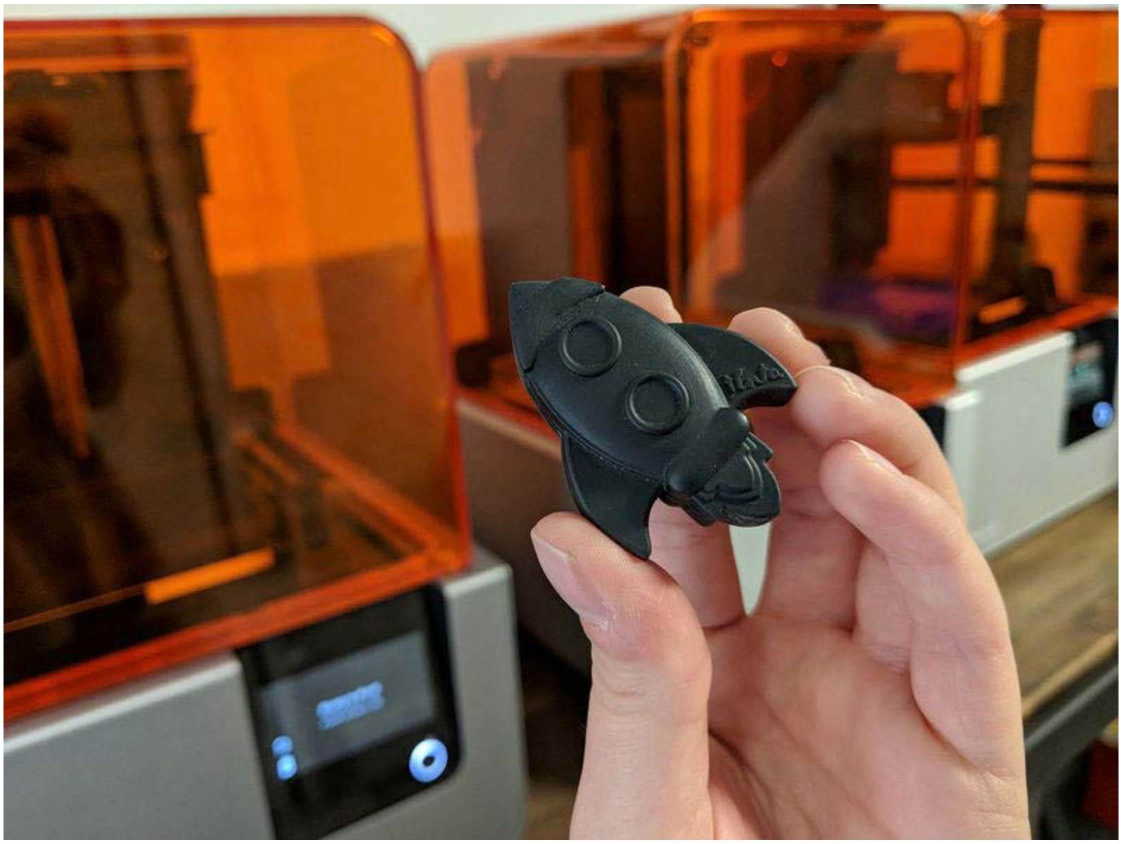
Many professionals and commercial designers choose to 3D print patterns. Desktop 3D printers offer many benefits, including design flexibility within CAD software, high accuracy, ease of prototype modification, and quick turnaround times.

Many users turn to Clear Resin when creating silicone molds. Clear Resin is most commonly used, because it provides a visual queue for mold filling. However, depending on your clamping pressure, other resins in our Tough and Durable Resin Family may be more appropriate.

At the end of the day, there's no one right way to make products, whether they're food, figurines, or commercial components. Various production methods are frequently used together to achieve the best results; understanding all of their unique advantages and disadvantages will help you make the best decisions for your project.

Download the White Paper

CASE STUDY: TINTA CRAYONS



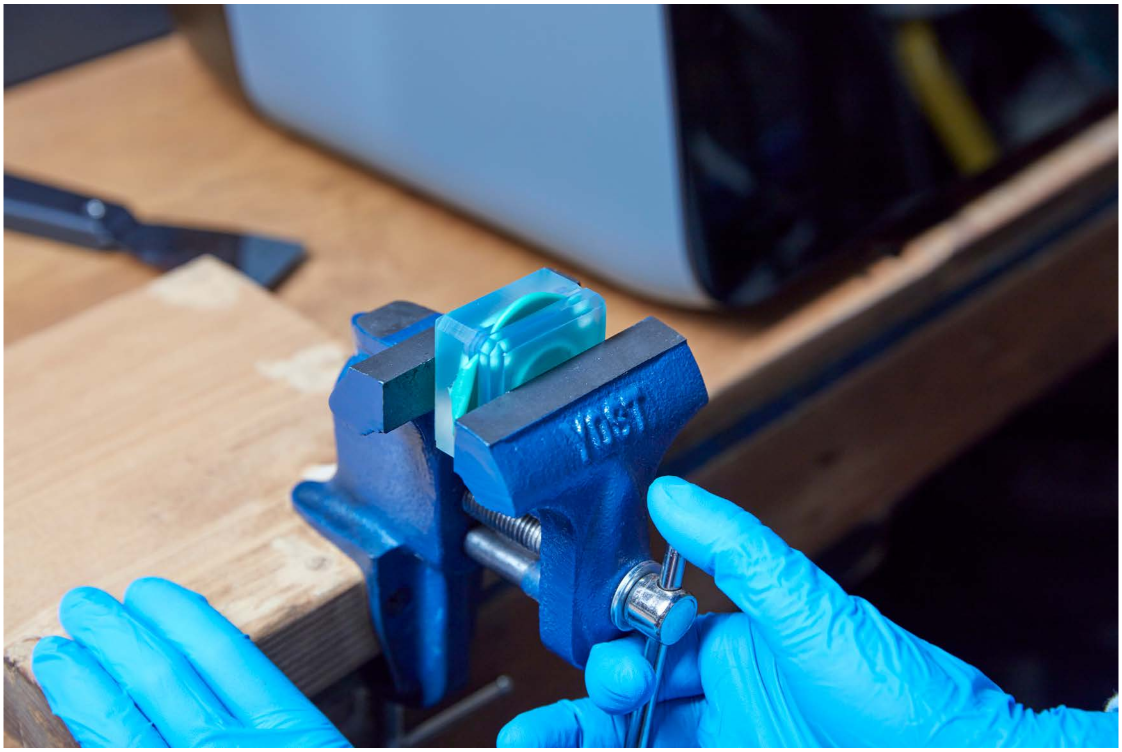
A rocket mould printed in Black Resin.

Tinta Crayons is a small Australia-based crayon company founded by two mothers of young children. They created their own formula for non-toxic and environmentally friendly wax, and employed silicone molding for small batch manufacturing of crayons with whimsical shapes and high surface detail.

Their process begins with printing a copy of the finished part (the master) with Formlabs standard resin. This part is then replicated in wax by first casting a silicone tray around the master, and then casting the wax into the silicone tray. This process uses 3D printing to effectively reverse engineering a part, then using the 3D print to create a mold. The mold is then used to produce new copies of the original object.

The open mold design is well suited for replicating parts that are flat on one side. This method can be extended beyond wax casting to include other end-use materials such as concrete, or two part epoxies. Unlike completely enclosed molds, this method can accommodate casting materials that heat up during curing, physically contract, or physically expand like castable foams.

Read the Full Case Study



A mold being compressed in a tabletop vise.

Compression Molding

Compression molding is a manufacturing process where a measured amount of molding material that's generally preheated (typically referred to as a charge) is compressed into the desired form using two heated molds.

As a general rule of thumb, high volume production is better suited for injection molding, while compression molding is used rather for low and medium series of part production.

Today's manufacturers frequently use both compression and injection molding but for different types of parts. Injection molding is typically a better choice for more complex parts, while compression molding is a great option for relatively simple designs, including ultra-large basic shapes that cannot be produced using extrusion techniques.

Depending on the material or charge you will be compression molding, you have several options for creating molds. The key is that your molds need to be able to withstand the compression molding process, so if you are using heat, you will need to create molds that can handle dramatic temperature changes. Molds will also need to be able to withstand the amount of pressure applied during compression.

Tooling for compression molding can also be made using 3D printing. If you are prototyping smaller parts, then 3D printing is a fast and cheap method for creating molds for compression molding. Multiple iterations can be made quickly with CAD software, reprinted, and then tested. 3D printing is most commonly used for compression molds intended for heatless applications.

Generally, Clear Resin can be used. Clear Resin provides a visual queue for mold filling, however other resins in our Tough and Durable Family of Resins may be used to optimize resistance to clamping pressure. Printing with a 50 µm layer height tends to be a good balance between smooth surface texture and fast printing time. Orient your parts on the build plate so that critical interior surfaces are free of support marks. The outer surface can be polished to a highly transparent finish.

The silicone mixture being placed into the 3D printed mold.

Read the White Paper

CASE STUDY: QUICK SILICONE CASTING FOR GASKET PROTOTYPES

OXO used 3D printing and silicone casting to improve their bottle seal

OXO is a US-based brand that creates ergonomic and practical items for the home, including some iconic kitchen gadget designs. Product developers at OXO use 3D printing for form and function prototyping, but rapid tooling methods are essential for prototyping rubbery components such as gaskets.

OXO engineers needed to produce a functional prototype that had watertight seals between parts. After testing many available silicones, they determined that compression molding two-part silicone putty Castaldo Quick-Sil was ideal for creating a watertight prototype that mimics the production gasket. In fact, the prototype compression mold is a good representation of method and mold design used in gasket manufacturing.

In this webinar, you will learn:

- The seven specific steps you can take to perform quick silicone casting with in-house 3D printed molds.
- How OXO created a gasket for a cocktail shaker using 3D printing.
- Best practices for mold design, alignment features, and material selection for RTV moldmaking.

Watch the Webinar

A 3D printed mold for hand laminating carbon fiber parts.

Composite Molding

Composites are highly versatile and efficient materials, driving innovation in various markets from aerospace to healthcare. They outperform traditional materials such as steel, aluminum, wood, or plastic, and enable the fabrication of high-performance lightweight products. Fiber-reinforced polymers (FRP) dominate the market and have fueled the growth of new applications in various industries. The most popular composite materials include carbon fiber, fiberglass, and kevlar.

FRP manufacturing is a skillful and labor-intensive process used in both one-off and batch production. Cycle time ranges from one hour to 150 hours depending on the size and complexity of the part. Typically in FRP fabrication, the continuous straight fibers are joined in the matrix to form individual plies, which are laminated layer-by-layer onto the final part.

The composite properties are induced by the materials as much as the laminating process: the way the fibers are incorporated strongly influences the performance of the part. The thermoset resins are shaped together with the reinforcement in a tool or mold, and cured to form a robust product.

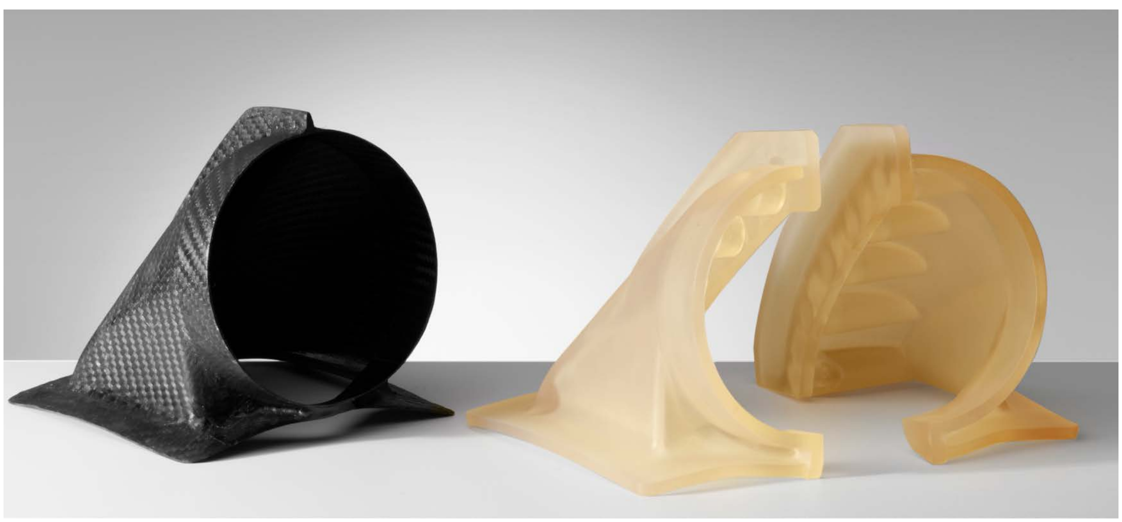
Fiber-reinforced polymer manufacturing is an exciting, yet intricate, and labor-intensive process. Additive manufacturing offers a solution for rapidly producing molds and patterns at low costs. Using 3D printed molds and patterns allows businesses to reduce workflow complexity, expand flexibility and design opportunities, and reduce costs and lead time.

For small-scale production, engineers can directly print the mold at low costs and within a few

hours without having to hand carve it or deal with CNC equipment; CAM software, machine setup, workholding, tooling, and chip evacuation. Labor and lead time for mold fabrication are drastically reduced, allowing for quick design iteration and parts customization. They can achieve complicated mold shapes with fine details that would be difficult to manufacture with traditional methods.

SLA 3D printing technology creates parts with a very smooth surface finish, which is essential for a layup mold. It allows for complex geometries with high precision. Additionally, the Formlabs Resin Library has engineering materials with mechanical and thermal properties that pair well with mold and pattern manufacture.

In-house desktop SLA 3D printing requires limited equipment and reduces workflow complexity. Professional desktop printers from Formlabs are affordable, easy to implement, and can be quickly scaled with the demand. With the recent release of the Form 3L, Formlabs's large format SLA 3D printer, this process can now be easily scaled to large molds to better enable innovations in markets such as automotive and aerospace.



A carbon fiber fender air duct next to the two-parts mold printed with High Temp Resin.

Read the White Paper

Carbon fiber is a common material on formula-style cars.

CASE STUDY: CARBON MOLDING AND END-USE 3D PRINTED PARTS FOR FORMULA STUDENT RACE CARS

The Formula Student is a yearly engineering design competition in which student teams from around the world build and race formula-style cars. The Formula Student Team TU Berlin (FaSTTUBe) is one of the largest groups; 80 to 90 students have been developing new racing cars every year since 2005.

Recently the team added a Form 3 SLA 3D printer to their toolset that they have used to save time, costs, and create parts that would not be possible any other way.

Tough 1500 Resin was chosen because it balances elongation and modulus: parts printed in this material can bend significantly and quickly spring back to their original shape. This is a desired mechanical property to avoid mold breakage while demolding.

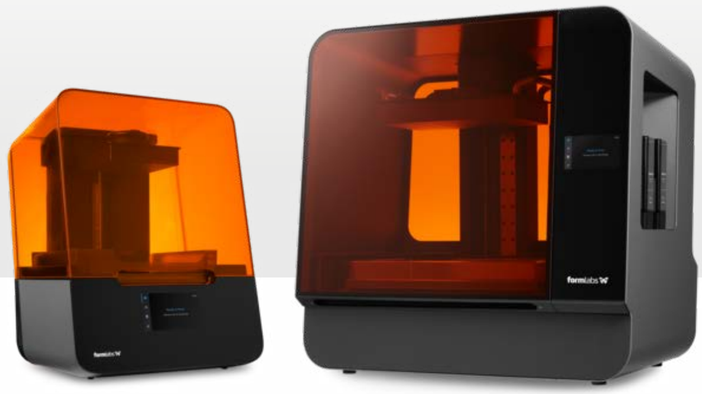
The team is using 3D printing for three purposes: prototyping, end-use parts, and molds to manufacture carbon fiber parts.

“The great thing about 3D printing is that a complex shape is as easy to do as a simple one, it requires the same amount of work and equipment. Some of the features here can literally not be done with any other process in an economical way,” said Hilken.

In our case study, you will learn:

- Why the FaSTTUBe uses 3D printed molds to create carbon fiber parts
- The workflow for using 3D printed molds for wet lay-up lamination
- Cost and lead time analysis for hand laminating carbon fiber parts.

Read the Blog



Get Started With 3D Printed Molds

Moldmaking with Formlabs SLA 3D printers is a powerful strategy for producing parts in small batch quantities, and in commonly used plastic and elastomeric materials. 3D printed rapid tooling also enables engineers and designers to easily prototype parts that look and function just like the final product, in geometries and material configurations that are challenging via 3D printing alone, such as encapsulated electronics and thin packaging.

For different types of moldmaking, the growing Formlabs material library offers a wide range of options, from High Temp Resin to Rigid 10K Resin, all of which enable engineers and designers to create the molds they need for any application.

Choose a Formlabs SLA 3D printer that is best suited for the applications you're planning to produce:

- **The Form 3:** Our go-to compact, workhorse SLA printer. Scale prototyping and production as your business grows with the Form 3, an affordable, industrial-quality 3D printer that consistently delivers.
- **The Form 3L:** A large format 3D printer compact enough for the office and robust enough for the factory floor. Bring your biggest ideas to life with the Form 3L, a cost-effective large format 3D printer that doesn't compromise on the details.

Explore Formlabs 3D Printers

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