FORTIFY

WHITE PAPER

QUICK-TURN INJECTION MOLDED PARTS WITHOUT BREAKING THE BANK

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I.

INTRODUCTION

Long lead times and extraordinarily high costs to cut tools during product development plagues injection molders. You order tools overseas to keep costs down, but now have to worry about supply chain issues on top of long lead times. Alternatively, cutting a metal tool domestically for low-volume and prototyping can eat up your whole product development budget. This story isn't new, but the innovation to break this cycle is. Fast-turn-on-demand tools for **functional** testing in end-use material in a matter of days and at a fraction of the cost is changing how product designers and engineers can iterate quickly before going to production tooling.

This white paper will discuss several use cases where quick-turn molded parts were able to accelerate product development and gain quicker regulatory approval, among other benefits. The key to success - 3D printed mold tools that actually work- and can mold high-performance plastics with complex geometries. If after reading this white paper you are interested in completing a molding project with Fortify, click here to get started.

II.

QUICK TURN PROTOTYPING FOR CPG

CAPS AND CLOSURES

Packaging industries across the globe are being required to meet new sustainability initiatives. Multi-material and single-use packaging will no longer be allowed, forcing companies to rapidly change the way caps have been designed for over 50 years. 3D printed tooling allows you to de-risk prototyping. This technology is a faster and cheaper solution for product designers that need to design for:

- Tethered closures
- New materials
- Recycled materials

These tools can also be used in the following instances:

- Mixing 3D printed inserts into production tooling for custom product lines
- Polishing and media blasting when a production look is required

Butterfly living hinges are one example of a tethered cap design that will soon be required in many countries, necessitating quick turn prototypes for new product design and development.

RECYCLED AND BIOMATERIAL DEVELOPMENT

With plastic waste on the rise, the need to reuse is driving the plastics industry's new product development. However, recycled materials have different mechanical properties than their previous lifecycle. This means that parts will need to be designed differently to perform the same function, and in turn, prototyped and functionally tested. Traditional aluminum tooling takes months and thousands of dollars with design constraints that make it challenging to implement early enough in the development cycle.

That is an issue when using regular (or non-recycled) materials, and recycled plastic exacerbates this problem because of its varied processing and mechanical properties. This leads to much more testing early on in the process to verify designs.

Recycled thermoplastics will perform differently than non-recycled materials , requiring new functional testing when using these materials.

II.

Recycled materials come in three major form factors today:

- **Post Consumer Regrind (PCR)** is largely made up of LDPE and HDPE and other variations of the polyethylene family. Polypropylene and polystyrene both can be recycled well, however, the infrastructure around obtaining PCR for these materials is lacking
- **Scrap Regrind** comes on the manufacturing floor when products have a certain amount of allowable regrind, which generally comes from scrap parts, runners, and sprues. Many different plastics can be remelted and therefore "recycled", dashing the myth that everything we use has to go directly to a landfill, however, the drawback is the loss in performance. When thermoplastics are remelted they lose molecular weight and exhibit a drop in mechanical performance as well as the threat of contamination in the melt.
- **Bottle to Bottle** recycling is one of the more interesting ways to increase the use of recycled materials in product development. There are several different technologies that are able to take PET bottles and grind, melt, pelletize and churn out clean pellets, which are FDA approved.

ASSEMBLY LINE TESTING

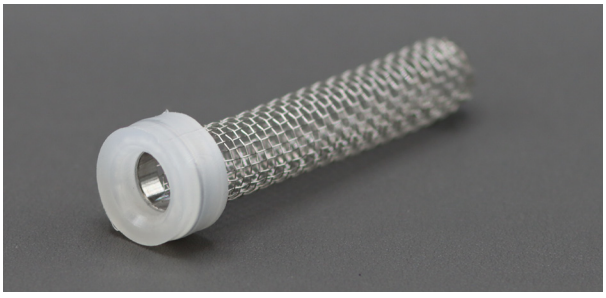
Mistakes in automated assembly lines can cost hundreds of thousands of dollars in downtime and scrapped parts. With quick-turn molded parts you can:

- Validate your assembly line with molded parts at a low cost while waiting for your production tooling
- Increase productivity by having a fully ready production line as soon as the production tool is delivered
- Media Blasting and Polishing available for a more finished look

Assembly line validation typically occurs once parts are being molded on the production tool, or possibly with metal bridge tooling. Utilizing quick turn molding the line can be validated and optimized in the time during the production tool build.

OVERMOLDING

From toothbrushes to razor handles to hand wipe packaging, overmolding is an extremely common practice, however, there is only one way to prototype it - injection molding. Getting overmolded parts requires tooling and the fastest and most cost-effective way to do this is with 3D printed tooling. Utilize Fortify's molding services to verify your material selection and part design in 10 days or less. These parts are completely functional and exhibit the same mechanical properties as parts molded on production tools so they are a great candidate for mechanical/ assembly testing.



An overmolded part for low volume production, saving thousands of dollars and nearly 4 weeks of lead time.

III.

LOW VOLUME PRODUCTION FOR AEROSPACE AND DEFENSE

LOW VOLUME PRODUCTION

Quantities of high-performance parts in the hundreds per year are often difficult to produce because of the need to justify tooling costs. These are being addressed by extremely expensive CNC parts or FDM 3D printing which cannot create isotropic parts. Whether for new low-volume product lines, or sustainment of small batch parts, manufacturers are forced to choose between sacrificing the ideal material by going with FDM or blowing budgets when choosing CNC. However, these are no longer the only two choices left to product designers. 3D printed injection mold tools can be printed in just a couple of days, and put into a molding press within a week. This solution is a fraction of the cost of CNC and with the right 3D printed tools, can run high performance plastics - which is needed for aerospace and defense - enabling a solution for low-volume injection molded production parts.

HIGH-PERFORMANCE PLASTICS

Quick-turn injection mold tools that can run high-performance plastics is the key to solving this problem. Fortify's 3D printed mold tools are ITAR certified, made in America, and can mold a variety of high-performance including (but not limited to):

- Carbon Fiber filled PEEK
- Ultem 1000
- Ultem 2300
- Liquid Crystalline Polymer
- Glass Filled Nylons
- Glass Filled Polycarbonates

PROTOTYPING

Tooling costs can often lead to less prototyping and less testing resulting in inferior products being sent to production. On the other hand, many projects will go to bridge tooling, costing $10K+ and then get scrapped.

Fortify's 3D printed tools offer quick turn molded parts in a range of materials including Ultem, Glass Filled Nylons, and other high performance plastics

IV.

ACCELERATING REGULATORY APPROVAL FOR MEDICAL DEVICES

ACCELERATING REGULATORY APPROVAL

Quick-turn injection molded parts can accelerate time to market while waiting for approval from regulatory bodies such as the FDA. By molding the prototype in end-use, high-performance plastics, medical device manufacturers can submit for approval while also waiting for metal tooling for mass production. Only low volumes (typically below 50) are needed for approval, making quick-turn molded parts from a 3D printed injection mold tool a cost effective solution. Utilizing a 3D printed mold tool upfront for design validation and approval saves weeks to months of production time while waiting for the metal tool for mass production.

LOWER COST, FASTER TO PRODUCTION

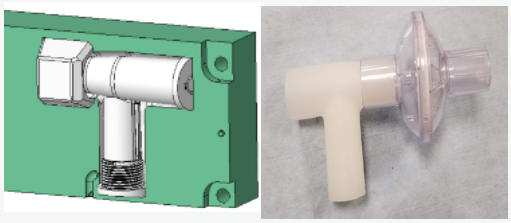
Many medical devices and projects will not make it to production, yet they still go through the tooling phase resulting in thousands of dollars lost. Using printed tooling can de-risk the entire development process and still provide usable prototypes to conduct testing. Not only does this lower tooling cost save money on current projects, the time savings allows for faster time to market and therefore a greater market share for a medical device.

CASE STUDY

Ventilator Project was on a mission to provide ventilators to clinicians and hospitals in need to meet high demand due to COVID-19. They sourced thousands of sleep apnea machines (such as CPAP and BiPAP) to serve as supplementary equipment to hospitals.

The Ventilator Project designed a T-splitter component to house the alarm, a critical feature to alert clinicians if airflow to the patient is interrupted. This new design would need to be tested in an oxygen rich environment in order to receive FDA approval. This became a materials problem, where the Ventilator Project needed to test the part and in the end-use manufacturing material (polypropylene) to conduct efficacy and safety validation testing to scale up for full scale manufacturing prototypes to conduct testing.

Not only does this lower tooling cost save money on current projects, the time savings allows for faster time to market and therefore a greater market share for a medical device and a better patient outcome.



The T-Splitter was tested in an oxygen rich environment, requiring testing to be done in end use material.

V.

VALIDATING AUTOMOTIVE COMPONENTS

UNDER THE HOOD

Plastics found under the hood and near the engine need to be tough, high temperature resistant and high performance. With the right 3D printed tool, you are able to mold these tough materials and tough geometries de-risking the work on new products and accelerating the time to market while maintaining favorable margins. In addition to under hood components in gas powered vehicles, quick-turn molded prototypes can be leveraged in the growing EV (electric vehicle market). Whether molding custom designs, or low volume of the same design, quick turn parts in high performance plastics can shorten the development time in EVs, especially with electrical connectors.

With Fortify's quick turn injection molded parts you can:

- Validate assemblies
- Mold low volume production parts for custom product lines or end-of-life parts
- Prototype new product lines in harsh materials like GF PBT, CF PEEK, PEEK, GF Ultem
- Speed up the development cycle with molded parts in 10 days

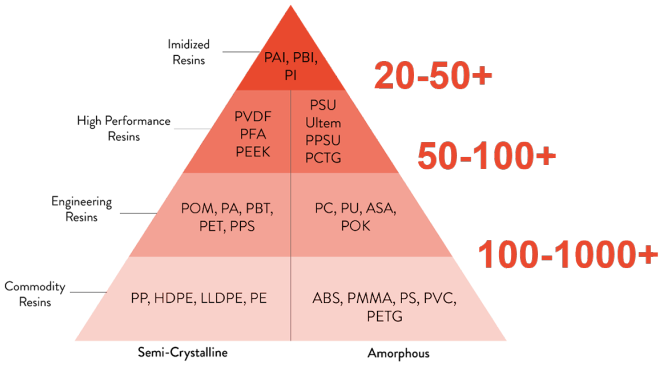
Fortify's injection mold press is in the same lab as Fortify's 3D printers. Once the tool comes off the printer and is post-processed it can go right onto the mold press.

VI.

SELECTING YOUR PART AND MATERIALS

MATERIAL SELECTION

The higher up a material is in the plastics pyramid, the more challenging it is to mold. Many quick-turn tools cannot withstand these tougher materials, but with Fortify's 3D printed mold tools offer the ability to mold these high-performance resins. The diagram below outlines the expected shot count from a Fortify 3D printed mold tool. The geometry and how the mold tool is designed will also play a role in the longevity of the tool.



PART SELECTION

There are 3 main factors when choosing a part for prototyping with 3D printed mold tooling:

Quantity

- Economic efficiencies for tooling are optimized when 25-200 parts are needed for functional prototyping.

Part Size

- Can it fit in your hand? The "sweet spot" is parts around 4.5in x 4.5in x 2.5 in
  - This makes sure that the prints can be completed in 8-12 hours
  - Ensures 10mm mold wall thickness can be kept on all sides
  - Keeps the mold blocks cost-effective
- Exceptions can be made
- Mold halves can be separated into two builds
  - This effectively makes the largest mold 13in x 8in x 4.5in on the Fortify system

Part Complexity

- Part complexity plays the largest part in selecting the right parts for printed tooling
- Use of inserts, slides, collapsible cores, and metal pins all allow for very complex parts to be created, but with little risk of tool failure
- Undercuts, high aspect ratio cores, and thin walls should follow the following guidelines:
  - Flexing off undercuts greater than .5 mm is not advised
  - Undercuts are reserved for materials like PP, TPE, LDPE, HDPE
- Threads are a great value add for printed tooling as they are expensive to incorporate in an aluminum tool and virtually no extra cost for a printed tool
- Slides and side actions can be easily made into hand actuated inserts

VII.

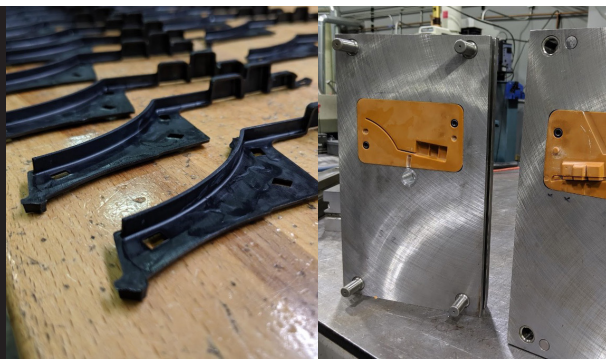
7. CASE STUDIES

CASE STUDY 1

CUSTOMER: Catalaysis
INDUSTRY: Industrial
MATERIAL: Polypropylene and Nylon 6
PROCUREMENT TIME: 3 Days
USE CASE: Prototyping solution for service bureau to offer quick-turn parts to customers

CASE STUDY 2

CUSTOMER: Henkel
INDUSTRY: Automotive
MATERIAL: Nylon 6 & GF Nylon 6 (35%)
PROCUREMENT TIME: 5 Days
USE CASE: Ability to iterate quickly and validate designs for new component



CASE STUDY 3

CUSTOMER: DeMarini Sports
INDUSTRY: Consumer
MATERIAL: Proprietary to customer
PROCUREMENT TIME: 10 Days
USE CASE: End cap of baseball bat that required functional testing in customer's end-use material

IX.

STARTING A PROJECT WITH FORTIFY

INJECTION MOLDING EXPERTS

Fortify is ready to deliver quick-turn molded parts in 10 days or less for your prototyping and low-volume needs. Whether for consumer packaged goods, aerospace and defense, medical devices, automotive components, or other industries, Fortify's molding services utilize on-demand 3D printed mold tools that mold commodity, engineering, and high performance plastics.

Do you have a part ready to be molded? You can quickly upload your design and get a quote here.

Are you interested, but not sure where to start? Fortify's team of injection molding experts are ready to chat about your needs. Get in touch here.

If you have an ongoing need for prototypes and short-run projects, Fortify can work with you on fulfilling those parts on a subscription basis.

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