MARK RATHBONE

STRATEGIES AND TECHNOLOGIES FOR RAPID PRODUCT DEVELOPMENT
Time-Compression TECHNOLOGIES
MAY/JUNE 2008
WWW.TIMECOMPRESS.COM

Functional Injection-Molded Prototypes

In the product development process, molders must react quickly and accurately to engineering changes, and delays in the schedule can make a difference between success and failure. Functional prototypes give the product designer or the original equipment manufacturer a best-results approach to proving product integrity and providing answers to critical questions needed for a production path.

No matter what industry you serve, the market for injection molding often demands expedited launch schedules, lower overall development costs and products that do not compromise the intended design or material. In the product development process, molders must react quickly and accurately to engineering changes, and delays in the schedule can make a difference between success and failure. The need for functional prototyping has never been greater.

But what is functional prototyping? Simply put, it's a prototype process where the same tool that provides the prototype for testing and validation can be used for the initial production run. In some low-volume scenarios one tool is used for the entire production run.

The functional prototype process gives the product designer or the original equipment manufacturer a best-results approach to proving product integrity and providing answers to critical questions needed for a production path.

Benefits of Functional Prototyping

There are several benefits to functional prototyping, including:

• *Speed to launch:* A functional prototype allows product engineers to prove concepts and support initial production launch with a short, cost-effective path using real-time and real-life validation data.

Images courtesy of PTI Engineered Plastics.

In the tool room at PTI Engineered Plastics, functional prototypes are created to support customers' early production needs, also known as bridge tooling. Functional prototypes meet aggressive market entry targets with tools that provide high repeatability and molded-in quality without compromising long-range goals.

Case Study:

A Process for Speed In Automotive

A leading automotive switch manufacturer was introducing a global switch program for its OEM customer. The product would be used on a variety of automotive platforms, and the new switch required 11 molded plastic components in its complete assembly.

The timetable for product validation in the production launch was already set in stone. There was not enough time to go through a traditional prototype process, which would include validation, making changes, moving into production and validation of production tools. The process had to come from a different perspective in order to pull the process ahead and meet the accelerated timeframe set by the customer. Therefore, they approached PTI Engineered Plastics (Clinton Township, MI).

To meet the requirements, prototype tooling and production tooling launched in parallel. The solution was to use functional prototypes with the understanding that they would support initial validation and produce all the pilot builds. Concurrently, the feedback from validation and pilot builds supplied real-time engineering changes to the production tool, which was following a parallel path.

The multiple-cavity production tools for 11 molds were delivered in 14 weeks. During this process, information garnered and learned from the prototype process allowed PTI to make a total of 67 engineering changes to the production tool program.

Case Study:

Sustaining Product Integrity in Healthcare

A leading endoscopy company came to PTI Engineered Plastics (Clinton Township, MI) for a design enhancement on a surgical device. The functional prototype was used for critical medical validation and clinical studies, and then bridged to the initial production launch for clinical and surgical use. The complex, 10-part component included metallic and non-metallic pieces and required secondary assembly and decorating.

The timeline for medical device assembly was seven weeks, and products were delivered on schedule. Validation and clinical testing were performed and enhancements made to the product. The 10 molds supported the initial 75,000-piece market ramp-up for the first seven months while higher-volume tooling was finalized.

Without the use of functional, uncompromised prototypes for injection molding, neither one of these two examples would have come to fruition.

You will create a mold that not only supports initial fast-path-to-market requirements and low- or moderate-volume needs, but there will also be **NO COMPROMISE TO THE CUSTOMER'S ORIGINAL PRODUCT DESIGN OR GEOMETRY.**

Once entering the manufacturing phase, a functional prototype mold is capable of producing between 50 and 200,000 shots. Customers are able to stretch program budgets further and reduce the amount of manufacturing processes it takes to bring a product to market.

• *No compromises:* When building a functional prototype mold in the hybrid process—using all of the machining technologies available and the methodology of inserting a variety of soft, hard and heat-treated hybrid materials—you will create a mold that not only supports initial fast-path-to-market requirements and low- or moderate-volume needs, but there will also be no compromise to the customer's original product design or geometry. Tolerances in the range of +/- 0.0025 over one inch are achieved.

• *A bridge to manufacturing:* Depending on the material and geometry of the functional prototype tooling, any one prototype tool is fabricated using a hybrid concept of tool manufacturing. Functional prototypes of this nature can yield between 50 and 200,000 shots, which bridges prototyping to production and can cover either the initial or complete production volume.

• *Complexity at lower cost:* Functional prototyping is ideal for highly detailed, tight-tolerance molded products and assemblies, and affords customers the opportunity to lower overall project cost. Customers are able to stretch program budgets further and reduce the amount of manufacturing processes it takes to bring a product to market successfully and economically.

Traditional Choices are Limited

Functional prototyping offers distinct advantages when you need to move straight to production, while traditional options have their shortcomings for various reasons. SLA, for example, the process of stereolithography, cannot be used. It is strictly for producing three-dimensional "feel and touch" models, essentially a mock-up or visual aid for presenting a product concept or idea.

Another option is a prototype that is machined from a solid. However, this often does not represent final product intent. In many cases, the machine-from-solid-plastic-part concept requires numerous concessions to your product design.

Another traditional process would be the use of the SLA or machine-created model representing the actual prototype part required in the urethane-casted rubber mold process. Urethane cast molds will yield a short-life product yield for injection molded parts, but with a large sacrifice to the eventual tolerance repeatability and in many cases, resin limitations.

The term "rapid tooling" is not a process, patented software or a special machine. It is merely a loose term used to describe tooling created in the fastest path available. If you are to use rapid tooling for your mold process, you will be required to make numerous design concessions so your product or math data can be created in a CNC cutter path program.

A True Functional Prototype

When considering a functional prototype, be sure that the prototype meets all the aspects and requirements needed on the project. If absolute speed and the fastest turnaround are imperative, there is a prototype process out there that will give just that. But the word "functional" needs to be dropped from the inquiry.

A true functional prototype:

• Does not limit design or require compromises with the tool fabrication. It also should not require sacrifices in the final resin or allow for loose tolerances.

• Uses the exact product geometry and math data, 100 percent. The only design changes should come as part of design-for-manufacturability recommendations that will stabilize the product during post-mold shrinkage, thereby optimizing the dimensional tolerance and repeatability of the manufacturing process.

• Can be made out of any engineering-grade thermoplastic in any color. The mold-fabrication process must take into consideration the material and its tolerance requirements.

• Must be manufactured in a molding process that is controlled and monitored, with documented repeatability and part-to-part, lot-to-lot dimensional stability.

• Brings products to market quickly and does not leave a customer stranded on the dock when a product needs go beyond the initial prototype phase.

• Supports initial product validation requirements and initial product fulfillment.

When we think "prototype" we think of something that's produced fast. It's also nice to realize the prototype, in a functional sense, can connect with production and support initial or complete production needs. A prototype that will be there initially and quickly without any compromise to product math data or dimensional tolerancing and is based on the quantity or total volume required may be the only tool needed for a component or product. **TCT**

Mark Rathbone *founded PTI Engineered Plastics (Clinton Township, MI) in 1984 and serves as the company's CEO. Rathbone started the company as a specialist in product development, prototyping and low-volume manufacturing, areas which continue to make up a large portion of the company's business. Rathbone is currently leading the expansion of PTI's advanced product development team and helping customers leverage the power of imagination. He can be reached at (586) 263-5100 or via e-mail at mrathbone@teampti.com.*