



protomold®

Rapid Injection Molding

# JOURNAL™

Fall 2004

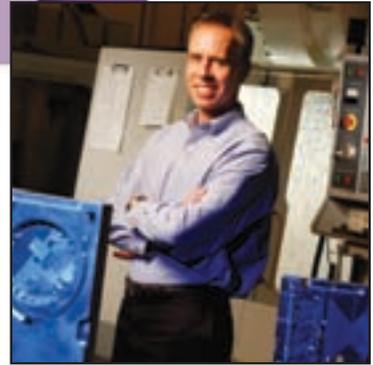
## In this issue:

Aluminum molds—  
What's the catch?

ProtoQuote®—  
Prototype pricing  
and a whole lot more.

Book review :  
"Plastic Part Design  
for Injection Molding."

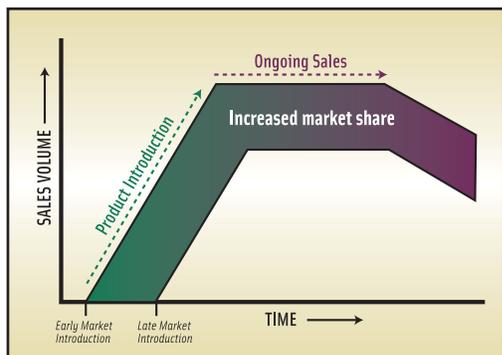
# Time really is Money



Every product has a lifecycle. It is born, it grows, it lives, and eventually it makes way for better products. With luck and careful management, the growing and living parts of the cycle are long ones. But as they say on Wall Street, “Trees don’t grow to the sky.”

In other words, your product won’t live forever. But as a businessperson, you want the curve representing your product’s life to be as long and profitable as possible. And the most cost-effective way to accomplish this is to be early to market, because whoever is

first gets a shot at the entire market. The second entrant is, at best, aiming for a piece of the market, and so on (see illustration). Early entry also lets you define the market; later entry means you play by someone else’s rules. It is easier to defend an established leadership position than overtake one.



*Earlier market introduction leads to greater market share*

Once upon a time, the emergence of new market niches could span months or even years. Taking a few extra months to “get it right” made perfect sense. Today, market emergence is far faster and product lifecycles are shorter. Delaying the introduction of your new product just a few weeks can cost you dearly in terms of both market position and revenue. But you still have to get it right.

At Protomold, we know the value of being first to market, and we can help.

**Brad Cleveland**  
President & CEO  
bradc@protomold.com



## Reducing Risk with Rapid Iteration

In software development, a process called agile programming is replacing the traditional phased approach of specification, development, testing, and release. In adopting the agile approach, software developers are recognizing that, in today’s fast-changing markets, it is increasingly difficult to precisely predict what markets will demand a year or two in advance. Rather, they are employing an “iterative” methodology in which software is developed in small increments, tested, reworked, and retested, with specifications changing at any point in the process.

The same approach is also being applied to new product development. Products are being tested, “tweaked,” and retested to meet the fast-changing, often fickle tastes of the market. Just as with software development, this new approach means old attitudes need to change with the times.

Unfortunately, when tooling for prototype parts takes months, there isn’t much time for iteration. Technologies like rapid injection molding can solve that problem by allowing speedier prototyping

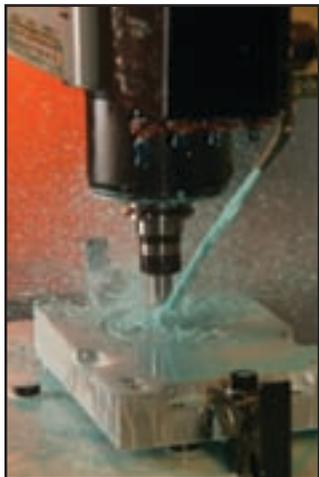
and production, but the first step is to recognize that the market may know things that we don’t. That can be a tough admission for designers. We must realize that, even if our knowledge of the market were perfect when we wrote the product spec, it could easily be wrong today. Market expectations can be less predictable than the weather, and can be shifted by anything from a competitor’s new offering to a new season’s color palette. Sometimes the only way to keep up with change is to prototype, test, and adapt accordingly.

# Aluminum Molds: WHAT'S THE CATCH?

*In many applications, aluminum is steel's equal or superior*

You get what you pay for, right? So, if aluminum molds turn out injection-molded parts in one-third the time and at a fraction of the cost, they must be inferior. Right?

Wrong! In many applications, aluminum is steel's equal or superior. It may feel flimsy in the beverage can you flatten for recycling, but it's strong enough for airliners and high-end automobiles. So what are the facts regarding aluminum molds?



*Aluminum molds can be CNC machined in their entirety*

**MYTH:** Steel is superior to aluminum because it is harder.

**FACT:** Steel is harder, but that doesn't make it superior. Steel's hardness actually makes mold creation slower and more expensive. For prototype or low-volume production and where time and cost matter – aluminum is probably a much better choice.

**MYTH:** Steel has a cost advantage because molds last longer.

**FACT:** The primary advantages of steel relate only to long production runs. Protomold's aluminum molds have produced tens of thousands of parts.

**MYTH:** New CNC machining techniques can now produce molds as quickly in steel as in aluminum.

**FACT:** This is just true enough to be misleading. CNC can, in fact, be used to quickly cut simple molds in certain steels. But for more complex designs in steel, e.g., deep, narrow grooves, steel molds require the use of slow, costly techniques like electronic discharge machining (EDM).

**MYTH:** Aluminum molds won't run "filled" resin.

**FACT:** Protomold runs a wide variety of filled resins in aluminum molds. Check out the Protomold Web site to review the extensive list of filled resins that can be used.

**MYTH:** Aluminum can't provide an acceptably polished surface.

**FACT:** Protomold offers polishes up to an SPI A-2 finish. Cosmetic parts, light pipes and many optical components can be accommodated.

Aluminum even offers some advantages over steel. For example, it weighs less, which makes molds far easier to handle. In addition, its



*Aluminum molds can produce tens of thousands of parts*

high thermal conductivity carries heat quickly away from the molded part, whereas steel requires expensive and time-consuming cooling mechanisms.

Bottom line? Aluminum will perform comparably to steel for the majority of prototype or low-volume injection molding applications, but at lower cost and without the delays. In today's competitive markets, it just makes sense to start with aluminum.

## ADVERTISEMENT

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# CASE IN POINT

## Medical Companies finding fast relief with Rapid Injection Molding

*Quality counts no matter what the industry, but nowhere is it more important than in medicine, where the stakes range from health and well-being to life and death. At the same time, as in other fields, the advantages of being first to market are enormous. Faced with the need for high-quality molded parts in this demanding, competitive environment, medical manufacturers Advance Bio-Surfaces Inc. (ABS) and American Medical Systems Inc. (AMS) turned to Protomold.*

ABS of Minnetonka, MN is currently conducting clinical trials of an innovative polyurethane cushion that can be surgically implanted to replace deteriorated cartilage in the knee. With 36 sizes to choose from, surgeons actually determine the correct size during surgery using a set of trial devices that can be inserted one after the other until the right one is found.



*Polyetherimide parts produced in multiple family molds for ABS*

during surgery. The solution was rapid injection molding from Protomold. Six multi-cavity molds cut the cost of the trial devices by over 90 percent and provided the necessary finish and color choice. "Cost, quality, and speed are crucial in the medical device manufacturing business," says Duchon. "Rapid injection molding allowed us to achieve all three."

At first, sets of trial devices were being machined. "We realized that CNC machining just wasn't practical," says Doug Duchon, vice president, research and development at ABS. "Parts were costly and frequently unable to provide the proper surface finish." Even color was a problem. CNC-machined parts came only in black and white, but ABS wanted to color-code the 36 pieces in each set to eliminate confusion

The BioArc™ SP Sling System developed by AMS, also located in Minnetonka, uses synthetic and biologic materials to restore urethral support with the aid of a specialized plastic suture clamp. Because prototypes have to closely duplicate the finish and function of actual production parts, AMS had traditionally relied on conventional injection molding for their prototypes.



*Glass-filled nylon prototypes manufactured for AMS*



The process was both expensive and time-consuming. This changed when they discovered rapid injection molding.

"The development cycle is the primary area where we try to reduce costs and speed time-to-market," says Principal Design Engineer Robert Lund. "Rapid injection molding gave us a process that could quickly and cost-effectively provide a finished, production-quality part. The parts provided by Protomold hit our blueprint exactly and easily saved us at least six weeks of development time. Rapid injection molding has definitely helped put us at a competitive advantage."

"Rapid injection molding gave us a process that could quickly and cost-effectively provide a finished, production-quality part. The parts provided by Protomold hit our blueprint exactly and easily saved us at least six weeks of development time."

# ProtoQuote®

## Prototype Pricing and a Whole Lot More

Design is all about evaluating options and making choices. With the advent of 3D modeling tools, we've become accustomed to an environment where multiple "what if" scenarios can be explored interactively. Design parameters can be varied and their predicted impacts evaluated almost immediately.

A similar approach lies at the heart of ProtoQuote, Protomold's proprietary online quoting system. When your 3D CAD model is uploaded as part of a request for quotation, the ProtoQuote software analyzes the geometry in order to identify undercuts, draft issues, radii produced by the milling process, and areas of inadequate wall thickness. It then applies a simulation of the overall rapid injection molding process to your part design in order to prepare an interactive model for your use.

Your ProtoQuote arrives in the form of an interactive Web-based interface to this model with a set of pull-down menus that allow you to adjust several parameters and receive instant cost feedback:

- desired speed of delivery
- surface finish requirements
- number of mold cavities
- choice of thermoplastic resins

**ProtoQuote**  
Rapid Injection Molding  
Real Parts. Real Fast. Real Savings!

**ProtoQuote Sample Part**  
ABC Design Co.  
Quote date: 4/22/2002 Quote number: 718

Tooling cost: **\$2635**  
25 sample parts cost: **\$0**  
**Total: \$2635**

Prices update based on your selections below.

Cavities: 1 cavity  
A-side finish: PMF1 (Low-cosmetic - most toolmarks removed)  
B-side finish: PMF0 (Non-cosmetic - finish to Protomold discretion)  
Sample Quantity: 25  
Delivery: Sample parts ship in 15 business days (standard delivery)  
Material: ABS, Black (Lustran 433-904000)

\* The highlighted materials are preferred for their availability and/or cost.

Finalize quote

Price quote quotation for future/additional orders in ABS, Black (Lustran 433-904000):

Lot size:	100	300	500	1,000	2,000
Price per part:	\$7.14	\$4.64	\$3.14	\$2.64	\$2.39

Custom lot size:  Go

Protomold tooling can produce over 100,000 parts. Please consult your customer service representative for a custom quotation on quantities over 2000 parts.

Protomold's interactive ProtoQuote Web page

## ProtoQuote® Sample Parts Issues:

Yellow color coding indicates areas where wall thickness is significantly less than nominal. Fill problems are possible with respect to these areas.



Minimum thickness of 0.035" is required to create the feature where the tool is shown.



Corners which will have a radius due to the milling process are color coded as follows:

 radius = 0.016 inches

Note that the model does not need to be changed. The radius will occur as a natural result of the mold milling process.



Need faster delivery? It's available for a premium. Considering a larger production run? See what happens with more mold cavities. Need a special surface finish on the part? Make the appropriate selection. Working on a tight budget? Maybe standard delivery is fast enough. As in any interactive modeling environment, how you choose to explore your options is up to you.

And, in addition to the interactive cost analysis, the ProtoQuote will also include the results of the design analysis described above, as well as suggested remedies or guidelines for correcting the problem. Most suggested changes can be made easily and can improve moldability without compromising your original design.

Because the ProtoQuote service is free, interactive and readily accessible online, it is a powerful tool for fine-tuning your part design, exploring options, and, of course, initiating prototype or low-volume production orders.

Try our ProtoQuote system the next time you need prototype injection molded parts. If you have any questions just call our Sales & Customer Service Group at (763) 479-3680.



Examples of ProtoQuote design consultation

## Details, Details

When it comes to rapid injection molding, whoever said “Don’t sweat the small stuff” was only half right. The “small stuff” in your part design can make a big difference in your results. But you don’t need to sweat it, because most potential problems are easy to fix.

Take text, for instance (see Diagram 1). Size matters, but size requirements vary with location. The deeper into the mold the text is, the bigger it should be. The reason is that deep, thin text needs to be cut with long, thin tools that are more difficult to control accurately. In general, text that is .020” deep with features at least .020” wide usually works well.

For similar reasons, typefaces without serifs are generally preferred unless the type is relatively large. If text appears on a surface that will be polished, it is better to have the text milled into the mold surface than standing above it. The reason is that we can’t polish smoothly up to the intricate details of the font, leaving an unsightly area around the text.

Clips are another common feature of molded plastic parts (see Diagram 2). If you would like to take advantage of the cost savings associated with straight pull molds, clips require special attention. The face and bottom of the clip hook are formed by a projection of the bottom mold half. This projection comes up through the rectangular hole in the “floor” of the part.

Diagram 1

Make text big enough, convex and without serifs



Diagram 2

Provide plenty of draft for sliding mold surfaces

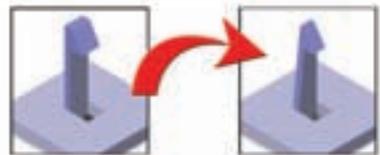
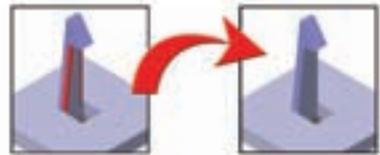


Diagram 3

Be careful when placing fillets on internal shutoff surfaces



To prevent damage to the part or mold as the mold is opened and closed, this projection must be kept from sliding across surfaces of the part or the other mold half. This is accomplished by making the hole larger than the underside of the clip hook and drafting (tapering) all mating surfaces by at least three degrees. This ensures that the mold halves draw away from one another as the mold is opened.

One final potential problem area is rounded edges, or “fillets,” where a projection of one mold half penetrates a surface of the part (see Diagram 3). In a previous article, we recommended rounding the sharp edges of parts. In this case, however, rounding the front edge of the clip (shown in red) would require the creation of a small, projecting lip along that edge on either the top or bottom mold half. If the lip were part of the top mold half, it would be trapped under the clip hook when the mold was opened. If it were part of the bottom mold half, it would get trapped at the back edge of the rectangular hole.

Theoretically, the problem could be solved by changing the shape of the hole to follow the rounded edge; this, however, would weaken the part. The real solution is to leave the front corners of the clip square. So, while fillets can be valuable, there are instances in which they do more harm than good. ProtoQuote® will typically identify these instances in designs submitted for quotes.

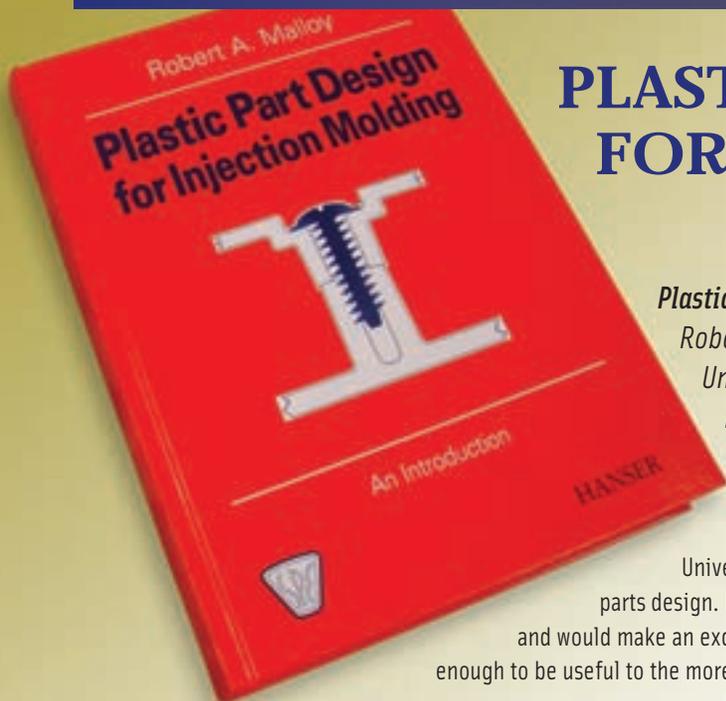
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## BOOK REVIEW:



# PLASTIC PART DESIGN FOR INJECTION MOLDING

By Kevin Crystal, Protomold Senior Quality Engineer

## *Plastic Part Design for Injection Molding*

Robert A. Malloy, Professor, Department of Plastics Engineering,  
University of Massachusetts, Lowell MA

Hanser/Gardner Publications Inc., Cincinnati OH

ISBN US: 1-56990-129-5

Professor Robert A. Malloy of the Department of Plastics Engineering at University of Massachusetts has written exhaustively yet clearly on the subject of parts design. His book covers most of what one would learn in a semester course on the subject and would make an excellent reference for the experienced designer. At the same time, it is accessible enough to be useful to the more casual reader and occasional parts designer.

While Malloy does treat theoretical background, for example, chemical structure of plastics, most of his material is of direct, practical use. In chapter three, he addresses mechanical issues – stress vs. strain, force vs. deflection, impact resistance, creep, and stress relaxation – relating them to the applications in which parts will be used. In chapter four, he proceeds to specific geometry and issues of strength, rigidity, and durability. Throughout, Malloy emphasizes “manufacturability,” suggesting that part designers work collaboratively with tooling and molding professionals. We couldn't agree more.

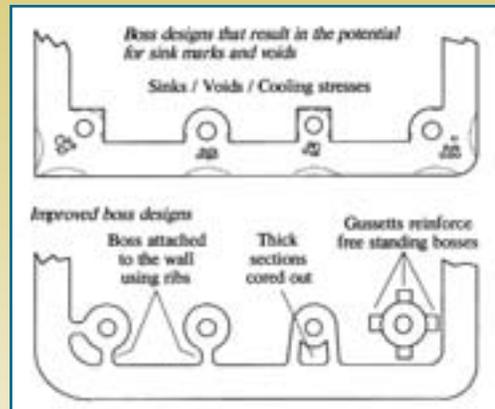
The author's points are well illustrated with clear, concise drawings. For example, in chapter six, he shows side-by-side examples of proper and improper boss design (see illustration taken from Figure 6.58 in the book).

Where poorly designed bosses show stresses, sinks, and voids, the improved versions eliminate unnecessary material thickness, providing the same functionality without the problems. This is typical of Malloy's approach. He provides illustrated examples of features to avoid and preferable alternatives. Convenient checklists cover issues regarding material, details, assembly, and molding.

Writing over a decade ago, Malloy noted the importance of creating processing proto-

types. These are real, injection-molded parts that could “provide true-to-life information on product performance, moldability and dimensional tolerances.” His concern at the time was for the cost and time requirements of such prototyping. Today, both of these concerns are eliminated with rapid injection molding technology.

While virtually all of Malloy's insights are still valid today, some are slightly less relevant than they were 10 years ago. Material data he provides is now available via the Internet. Also, some of the analysis he teaches can now be done automatically with Finite Element Modeling analysis software. The bulk of his work, however, is as useful today as it was when it was written.



*Whenever possible, bosses should be free standing, gussetted, or attached to sidewalls using ribs in order to minimize the potential for sink marks and shrinkage voids.*

## ADVERTISEMENT



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# WHAT'S NEW

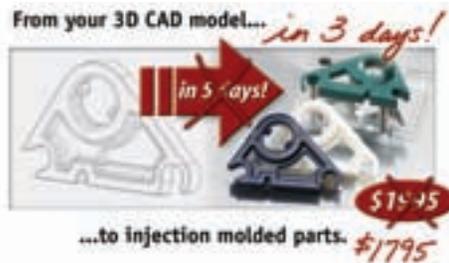
## Protomold News

**Bigger** – Since the Summer issue of the journal, we have installed several new machining cells and expanded our overall space by 40 percent.



**Better** – We can now support some simple undercuts in your part geometry. Visit the Design Guide on the Protomold Web site for details.

**Faster & More Savings** – For small, simple parts, we now offer three-day premium delivery at a minimum standard delivery price of \$1795.



**Free** – While supplies last, we will send you a very nice leather portfolio as our way of thanking you for using any of our premium quick turn services (one per customer).



At Protomold, we bring together Information Age technologies and advanced mold-making techniques to slash tooling and production times for prototype and low-volume plastic parts.

That's why we can mold your parts in the engineering resin of your choice faster and more cost-effectively than anyone else. Visit our Web site to see application examples or request an online ProtoQuote®.

## Everything by Design

Bringing new products to market can be a very frustrating experience, so it's a good idea to find humor wherever you can. Please email your suggestions for future "Everything by Design" cartoons to: [marketing@protomold.com](mailto:marketing@protomold.com).



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