Selecting a RAPID-SERVICE BUREAU

A rear section of an electronic housing for a scale (blue part) was made using cast urethane. The part rests atop its mold.

Think of RP as the *right process + the right material = the right part.* Do your homework and find a firm you can depend on to help slash prototyping time and costs.

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Key points

- When selecting an RP service bureau, check out its processes, timing, expertise, and customer service.
- Designs don't always call for advanced additive technologies. Sometimes a simple approach works better.

Resources

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There's nothing like the rush of a new design idea. Maybe it hit you in the shower or just clicked when you opened that can of tomato soup. You have an idea — and it's your "baby." But of the hundreds of rapid-prototyping (RP) firms that will be vying to make the prototype of your baby, how do you know which to trust? The notion of form following function is only as good as the appropriateness of the RP process and material selected. In other words, only the correct RP process will produce a prototype that acts almost exactly as the product will in the operating environment.

First, accept the premise that you don't know what you don't know. This helps make it clear that you need to educate yourself and also look for firms that will help educate you. **Quickparts** founder Ronald Hollis says, "Designers are too often removed from production processes. But engineers might make adjustments on the factory floor and tooling managers could invent a way to enhance manufacturing efficiencies. Obviously, the more educated the designer, the better. And this goes for innovators as well."

Important considerations

Bottom line: Better informed users get better pricing and better solutions. Considerations in selecting an RP service bureau include: processes, timing, expertise, and customer service. Find out whether the service bureau offers the major RP technologies. They are stereolithography (SLA), selective laser sintering (SLS), and fused-deposition modeling (FDM). These firms provide the widest expertise

The industrial pipes and blue translucent spacer are examples of SLA parts.

and generally have the most up-to-date processes and materials. In addition, their experts have the know-how to steer you away from making costly mistakes.

How do you know they care enough to make sure you are getting what you really need? When you submit a CAD model for a quote, better companies go one step further by alerting you to alternative methods and explaining the advantages and disadvantages of each one.

For example, say you submitted a CAD model and select SLA — what you think is the correct process — to build a prototype of a product with a living hinge. Companies that care will contact you and advise that due to the living hinge feature, you would be better off with SLS. Use SLA, and the hinge will just break off.

Along with expertise comes objectivity. Because more successful RP providers are exposed to so many new designs, processes, and materials daily, they view designs with a broader perspective. In fact, a good company will often pick up on and address potential flaws that might not have otherwise surfaced until the part had been in use for some time.

And never underestimate the advantage of timing. It's no longer good enough to be good. What's needed is an RP bureau that it is both good *and* fast. Don't just take their word for it. Reasonable turnaround times for most prototypes should range from around one to four days.

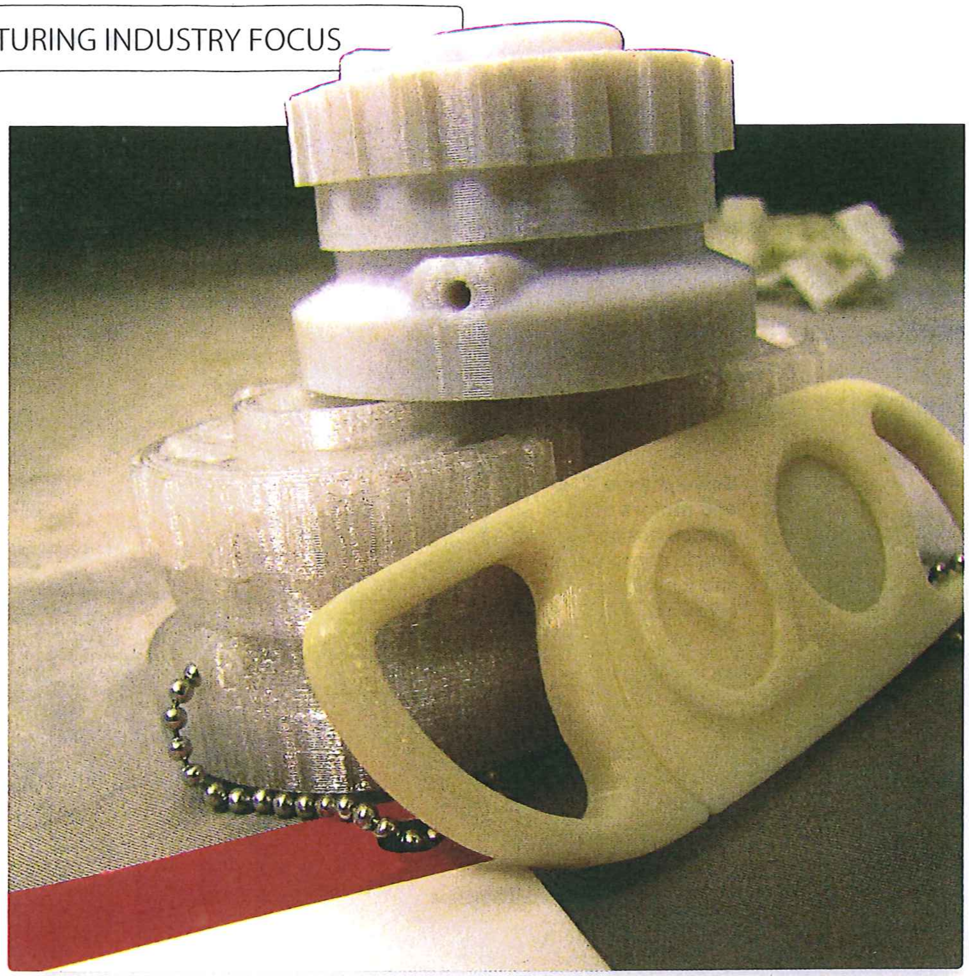
Examine the firm's track record, check references, and ask plenty of questions. Customer endorsements and case studies will also help you determine whether a firm has expertise and provides quality prototypes.

The ABCs of AF

To understand the basics of RP, it helps to start with an explanation of additive fabrication (AF). AF started in the 1980s. It involves the use of automated equipment to fabricate physical 3D parts from electronic 3D data by building parts layer-by-layer.

AF is used in every major industry for transitioning design concepts to physical prototypes to save time and money. It plays a part in testing form, fit, and function. AF lets users detect and correct design errors earlier in the cycle, helping to eliminate waste and costly design changes.

Today there are more than 40 AF systems in the worldwide market. All are competing for business from designers, innovators, tool



The cigar cutter and locking knobs were made using FDM.

manufacturers, manufacturing engineers, and ultimately, the end consumer.

Individual, specialized technologies fall beneath the umbrella of AF. SLA is where it all began. The laser-based technique turns virtual models into plastic parts, usually in a matter of hours. SLA equipment uses photo-curable liquid resin with a UV-laser system to apply successive layers and build parts. Computer software "slices" the CAD model and outputs the data to the SLA machine.

SLA works well for form-and-fit testing and for showroom models. The smooth surfaces can be painted or plated. Note, however, that SLA and all AF process are not exact manufacturing techniques, so it's necessary to apply tolerances to the design. Tolerance and accuracy depend on the geometry and build orientation of the part.

Most SLA resins are epoxy based and provide strong, durable, and accurate models. They make an excellent all-around choice for prototypes, but you need to identify the material that best supports the prototype's function. Does the prototype need to be clear, or water resistant? How durable must it be? Will the part be used for actual testing or only for trade-show presentations?

SLS makes functional parts from powdered thermoplastics. This method creates solid 3D objects by fusing or sintering particles of nylon-based powder material with a CO_2 laser. The technique produces durable, heat-resistant parts for testing or actual use in tough environments such as engine blocks, engine components, mounting brackets, and hot-liquid dispenser parts. Other examples include trade-show models, master patterns, low-volume production, snap fits and living hinges, and airflow models for testing.

SLS primes the creative pump for many engineers. By getting functional parts directly from CAD, they can cut out much of the guesswork that would be necessary when designing for traditional tooling.

Available in a range of materials, including a glass-filled variety, SLS is a good choice for high-heat and chemical-resistant applications. For display purposes, however, its dull, rough surface makes it less attractive than SLA.

Fused-deposition modeling (FDM) is the strongest, but slowest, way to produce plastic parts. A heated head with two extrusion nozzles builds parts from microlayers of rapidly solidifying melted filament. One nozzle dispenses melted support material

The clear gaming chair speaker cover was made using the "high-tech" SLA process. The blue industrial motor housing was made with LVIM, while the red rescue launcher and the gray electronic enclosure were made using cast urethane. Although LVIM and cast urethane are both so-called "low-tech" methods, depending on the application, they can provide the best solution.

that dissolves away in water. The other nozzle extrudes the permanent base material.

FDM produces parts suitable for testing form, fit, and function. Parts are near-production quality and resistant to heat, water, and chemicals. FDM parts lack a sexy, smooth look, so they usually don't work well for trade shows and presentations.

A simple approach

Designs don't always call for the advanced SLA, SLS, or FDM technologies. Sometimes a simple approach is the wisest solution. Basic formative and subtractive fabrication methods provide classic solutions that are anything but old-fashioned. Often referred to as "low tech," these processes can provide a low-cost transition between prototyping and tooling.

For example, cast urethane (CU) produces real plastic parts by copying a pattern. Technically speaking, CU parts are not engineered plastic parts, but they function well enough to be used in many kinds of testing. Also, the aesthetic properties of CU, such as color, texture, and finish, make prototypes look just like expensive production parts. CU parts work well for marketing samples, preproduction parts, and low-volume production.

Computer numerical-control (CNC) machining is a relatively low-cost method that begins with a block of material and cuts away unneeded material. It cuts and shapes parts that call for high accuracy, repeatability, reliability, and stability. Formerly run by operators, control modules have made this method almost error-free.

The method cuts automotive parts, compressors, and high-accuracy components used in aerospace, industrial, and machining industries. Designers usually like the many options afforded by CNC because they can shape almost any material including metal, plastic, wood, and foam.

Low-volume injection molding (LVIM) uses injection molds or tools of aluminum or soft steel to produce functional parts from thermoplastic. LVIM is lower in cost and faster to produce than traditional production tooling, but the LVIM molds have a much shorter life span. They can typically withstand up to 50,000 parts, while high-quality steel production molds have the strength and durability to make millions. LVIM molds typically take two to four weeks to make, while production tools take eight or more weeks. **MD**