APPLICATION BRIEF:

RTV MOLDING WITH INKJET OR FDM PATTERNS

Stratasys® 3D Printers and Production Systems

OVERVIEW

Room temperature vulcanization (RTV) molding, often referred to as resin casting or silicon molding, is an affordable solution for prototyping, functional testing, product demonstrations and short-run production. RTV molding offers lead times of three to seven days at well under the cost of machining or injection molding. The molds are made by pouring liquid silicone rubber over a pattern. The resulting firm but flexible mold can reproduce extremely complex geometry and intricate detail with tight tolerances. The molding process uses urethane thermoset materials that are available with a vast array of mechanical, thermal and electrical properties. Due to the cycle time, cost per piece and tool life, silicone molding is ideal for applications producing 1 to 100 parts. However, since the tools are inexpensive and quickly made, creating multiple silicone rubber molds to produce more parts is a viable option.

The traditional approach is to machine patterns for RTV molds. This method is expensive, requires lead times of one to two weeks and restricts the geometric complexity of the molded parts. Design changes to machined parts require substantial lead times.

With 3D printing (also called additive manufacturing), silicone rubber molding is once again a competitive and attractive solution. Inkjet-based technology and FDM Technology™ each reduce the time, labor and cost of silicone molding. Also, 3D printing makes it possible to produce a prototype pattern for customer review, with a typical lead time of less than 24 hours.

APPLICATION CHECKLIST

INKJET OR FDM PATTERNS ARE A BEST FIT FOR RTV MOLDING WHEN:

- ✓ The pattern is complex or intricate
- ✓ Challenging characteristics include thin walls or internal geometry
- ✓ Multiple duplicate RTV molds are required
- ✓ RTV rubber requires a high cure temperature
- ✓ Design changes are likely
- ✓ Patterns are large or bulky

BENEFITS OF INKJET AND FDM PATTERNS FOR RTV MOLDING INCLUDE:

- ✓ Lead times reduced by 50 to 80%
- ✓ Cost reduced by 40 to 75%
- ✓ Inert models that won't inhibit curing
- ✓ Stable models that won't distort with heat
- ✓ Durable models that can be used many times
- ✓ Optional dissolve-away internal cores

STEPS

1. Print the master: Directly from the CAD file, 3D print the master model that will be used to generate the pattern. Coat all surfaces with mold release. Since mold-release selection depends on the type of silicone rubber, refer to manufacturer recommendations.

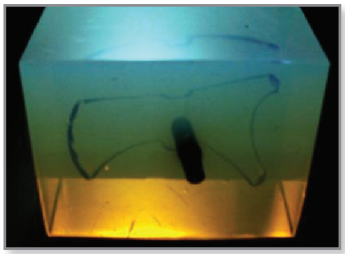
2. Add vents and gating: Vents allows air to exit the tool during mold creation.

3. Block: Build a frame around the master pattern to hold the silicone molding material. Then, use a black permanent marker to mark the parting line on the master pattern. This will make it easier to see where to cut the mold after the silicone has hardened.

4. Make the mold: Pour the mixed silicone rubber into the prepared frame, pouring into the corner of the frame to allow smooth flow around the master.

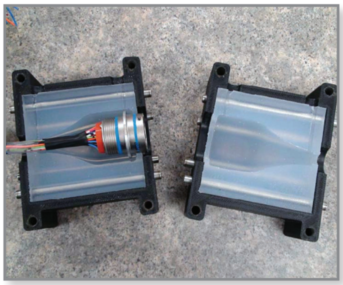
5. Remove the master: After curing the silicone rubber, remove the frame and cut the mold using a dissector knife along the parting line. Special tweezers are available to aid cutting.

6. Use the mold: The mold is now ready for casting as many as 100 parts.



The parting line is visible through the silicone.

Inkjet master model and silicone mold



RTV silicone mold, made with an FDM master, for overmolding operation

Finished overmolded harness

APPLICATION OUTLINE – INKJET

With inkjet 3D printing, masters can be printed and ready for mold-building immediately after they are cleaned. The high accuracy and ultra-low layer thickness achievable with inkjet results in models with fine details and smooth surfaces right off the printer. Models typically require no post processing such as sanding, filling and priming to smooth the surfaces. The recommended type of silicone material for use with inkjet 3D-printed masters is two-component addition silicone rubbers consisting of a vinyl base polymer and SiH base hardener and using a platinum-based catalyst.

These silicone materials are translucent with very little shrinkage (<0.1%). Typically, inkjet users dealing with silicon molding use the following silicon materials: ALPINA additive silicone rubber, EBALTA silicone for rapid prototyping and Axson.

APPLICATION OUTLINE – FDM

FDM materials have the strength and heat resistance to withstand the mold-making process without distorting or breaking, allowing for subsequent silicone molds to be produced from a single master pattern. Patterns are stable over time and can be stored for later use, increasing their value. In addition, FDM allows for internal geometries. This can be done by creating a soluble core that defines a cavity in the urethane casting. FDM's ability to easily produce large, complex shapes makes it a great solution for larger molds.

Using secondary processes and optimal build parameters, FDM parts can produce the desired surface finish with little or no extra time. A combination of filling and sanding the master-pattern surface can result in smooth finished castings that show no layer lines. To expedite this process, semi-automated methods such as mass finishing, solvent dipping, or (with ABS-M30) the Stratasys Finishing Touch Smoothing Station, are available. These work best in combination with optimizing the build orientation and parameters.

CUSTOMER STORY – FDM

Coho Design specializes in rapid prototyping services and provides solid modeling, product development and consulting services. Recently, a military subcontractor was asked by a customer to completely encapsulate an electrical connector for underwater use — in less than a week. The original equipment manufacturer (OEM) that supplied the connector said the best it could do was deliver 10 parts in 14 days.

After winning the contract to encapsulate the parts, Ed Huber, Coho Design president, modified the customer's CAD design to account for the shrinkage of the RTV mold. Then he 3D printed the pattern in the shape of the finished connector with its overmolding. He built a mold box, added the FDM pattern, added gate and vent rods, and poured the RTV rubber. After the mold had cured, he placed a connector in the mold cavity and poured urethane potting compound into the mold to seal the part. After a couple of hours, the electrical connector was removed from the mold, the flashing was trimmed, and the part was ready for testing. The customer gave Coho Designs the go-ahead to make the rest of the parts.

"Using an FDM pattern substantially reduced the time and cost required to overmold the electrical connectors," Huber said. "We met the customer's delivery time requirements by producing finished parts in only three days. We charged the customer less than half the price that was quoted by the OEM. If there had been design changes, the use of an FDM pattern would have allowed us to react by quickly changing the geometry of the overmolded part."

How did FDM compare with traditional methods for Coho Design?

Method	Cost	Time
Machined Pattern	$1,011	14 days
FDM Pattern	$500	3 days
SAVINGS	**$511 (51%)**	**11 days (79%)**

For more information about Stratasys systems, materials and applications, contact Stratasys Application Engineering at 1-855-693-0073 (toll free), +1 952-294-3888 (local/international) or ApplicationSupport@Stratasys.com.

Stratasys Incorporated
7665 Commerce Way
Eden Prairie, MN 55344
+1 888 480 3548 (US Toll Free)
+1 952 937 3000 (Intl)
+1 952 937 0070 (Fax)
www.stratasys.com
info@stratasys.com

Stratasys GmbH
Weismüllerstrasse 27
60314 Frankfurt am Main
Germany
+49 69 420 994 30 (Tel)
+49 69 420 994 333 (Fax)
www.stratasys.com
europe@stratasys.com

ISO 9001:2008 Certified