APPLICATION BRIEF

# Silicone Molding with FDM Patterns

## Overview

Silicone molding, also known as room temperature vulcanizing (RTV) molding, is an affordable solution for prototyping, functional testing and short-run production. Silicone molding with FDM® patterns is ideal for production of small quantities (5 to 100) and offers lead times of three to seven days at costs well under those of machining or injection molding.

A firm yet flexible silicone mold can reproduce extremely complex geometries and intricate detail with tight tolerances. Silicone molds are commonly used to make urethane parts with a wide range of mechanical, thermal and electrical properties.

## Application Outline

Silicone molding with FDM patterns is a three-step process:

1. Make the FDM pattern (also known as a master pattern or mold master).
2. Make the mold by covering the FDM pattern with silicone and allow it to cure.
3. Cast the urethane in the mold.

Traditionally, patterns are fabricated from wood, plastic or metal, which can be expensive, have long lead times and require skilled labor to oversee the pattern-making process. As a result, designers may have to limit or simplify the geometry of the pattern to accommodate these factors.

FDM technology provides an alternative method for producing patterns for silicone molds. FDM is an additive manufacturing (3D printing) process that builds plastic parts layer by layer using data from computer-aided design (CAD) files. With fast FDM pattern creation, mold making can start shortly after pattern design, even when the pattern is complex. Low cost FDM materials also have greater longevity, strength, and heat resistance than those used with other additive manufacturing technologies. These characteristics allow manufacturers to create silicone molded products faster and less expensively than ever before.

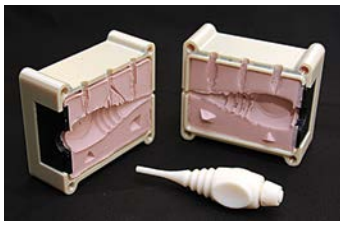

Figure 1: Silicone mold with FDM pattern.

Figure 2: FDM pattern for silicone molding.

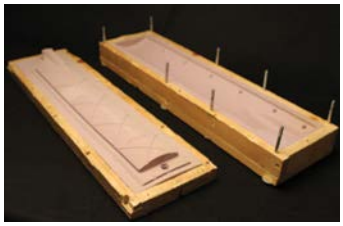

Figure 3: Silicone mold made with FDM pattern.

Figure 4: Painted urethane casting.

### BENEFITS OF FDM

**Average lead time savings:**
- Up to 90%

**Average cost savings:**
- Up to 70%

**Greater performance:**
- Inert: Will not inhibit curing
- Strong: No pattern distortion
- Stable: Store indefinitely
- Durable: Extractable without breakage
- Lightweight: Sparse fill interior option

*Typical time and cost savings derived from numerous end-user analysis, testimonials and feedback. Actual savings may vary based upon numerous factors, including traditional time/cost, part geometry and utilized technology.*

# SILICONE MOLDING WITH FDM PATTERNS

The weight of silicone rubber and heat from an accelerated curing process can cause patterns to bow, buckle or break. However, FDM thermoplastics are inert, so the finished patterns do not inhibit the curing reaction, nor are they affected by the heat and weight. The result is accurate molds.

Additionally, FDM materials are strong and durable. This makes it easy to extract the pattern from the mold without damage so the pattern can be reused to make future molds. Being dimensionally and physically stable, a single pattern can make molds for months or even years to come. And if a prototype or a cast urethane part reveals the need for design changes, a new pattern can be designed and ready for use within hours.

## Customer Story

ScanMed® of Resonance Innovations LLC, is a leader in engineering and manufacturing magnetic resonance imaging (MRI) coils. The coils' covers are visible to patients and come into contact with the body, so quality is important.

Prior to creating their mold masters in-house, ScanMed used an outside machine shop to CNC machine the mold masters at a cost of nearly $1,000 each. Production lead time was also substantial. Each master took approximately seven days to make, with an additional three to four days to actually pour and finish the mold. Adding in the time needed to actually make the mold once the pattern was received from the machine shop, the production lead time totaled nearly two weeks.

What's more, ScanMed's engineers had to weigh the limitations of CNC machining against the company's needs because special features could add significant time and cost, and designs with thin walls had a tendency to warp and deflect during machining.

ScanMed's management then considered the use of additive manufacturing to build its patterns. They subsequently purchased an FDM 3D Printer from Stratasys® because of its ability to create patterns that were rugged enough to withstand the silicone molding process and durable enough to be reused.

The company now prints its smaller part mold patterns in-house in less than two days for about $400 each — a 71% time savings and 60% cost savings.

"We have substantially reduced the time and cost required to make mold masters while also providing our engineers with virtually unlimited freedom to produce designs that meet our customers' requirements," said Martin Troudt, mechanical design manager at ScanMed.

Figure 5: A custom MRI coil with silicone molded component (blue).

## FDM IS A BEST FIT

**Design:**
- Complex, intricate
- Large parts
- Internal cavities
- Thin walls
- Revisions likely

**Molds:**
- Duplicate molds required
- Heat accelerated cure silicones
- Dual-purpose patterns: prototyping and mold making

**Size: (XYZ)**
- 25 mm (1 in) to 915 mm (36 in)

**Quantity:**
- 5 to 100 castings

**Life expectancy:**
- Reuse pattern to create multiple molds
- Pattern stored for re-use

stratasys

# SILICONE MOLDING WITH FDM PATTERNS

How does FDM compare to traditional methods for ScanMed?

| METHOD | COST | PRODUCTION TIME |
|---|---|---|
| CNC Patterns* | $1,000 | Up to 7 days |
| FDM Patterns** | $400 | Up to 2 days |
| Savings | $600 (60%) | 5 days (71%) |

*CNC pattern outsourced locally.
**FDM parts produced on in-house equipment.

## CANDIDATE PROFILE

**Forward-thinking designers and manufacturers of plastic parts that use silicone molding for:**
- Prototyping
- Pattern making
- Mold making

**Companies:**
- Designers and manufacturers of plastic components
- Prototyping, pattern-making or mold-making shops

**Characteristics:**
- Cast components are desirable or acceptable
- Making or sourcing patterns
- Possess or have access to silicone molding process
  - Expertise
  - Tools and equipment

**Traditional technology obstacles:**
- Bottlenecks in pattern creation
- Design features are omitted due to cost or time
- Inhibition during mold creation
- Patterns not reusable (break during de-molding)

## REPRESENTATIVE COMPANIES

ScanMed The Image is Everything
COHO DESIGNS
UTEP
TENNANT

## Application compatibility: (0 – N/A, 1 – Low, 5 – High)

- FDM: Idea (2), Design (3), Production (3)
- PolyJet™: Design (5), Production (5)

## Companion and reference materials:

- Technical application guide
  - Document
- Case Studies
  - ScanMed Customer Story
- Application brief
  - Document
- Video
  - Commercial
  - Success story
  - How It's Used

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