

Rapid Tooling Applications

Overview

Producing tooling directly from CAD models is regarded as an important method for reducing the cost and time to market of new products. Although this is a relatively new trend in manufacturing, it has already had a dramatic impact on the engineering environment.

Rapid tooling (RT) typically describes the process in which a rapid prototyping (RP) model is used as a pattern to quickly create a mold or in which the rapid prototyping process itself is used to fabricate a limited volume of tool prototypes. In general, RT is distinguished from conventional tooling in that:

- a) Tooling time is significantly shorter.
- b) Tooling cost is less expensive.

This applications note describes the advantages of PolyJet Technology to further increase the speed of tooling development. By way of example, it describes in detail how a colorful silicone keypad can be made in a short time after the design of the mold is completed.

Technology Advantages

The process for making injection molds by subtractive CNC or spark erosion methods is costly and time-consuming. To further complicate matters, while product complexity is increasing and product cycles are shortening, there is a shortage of skilled craftspeople to perform the work. This means the growing demand for more precise tools must be answered by fewer and fewer toolmakers. Consequently, a process that overcomes these limitations by providing both time and labor savings can offer significant advantages.

The following advantages make Objet's PolyJet™ Technology highly suitable for producing RTV molds:

High quality: Market-leading resolution of 16μ ensures smooth, highly detailed parts and models.

Highly accurate: Precise jetting and build material properties enable fine details and thin walls (600μ or less depending on geometry and materials).

Fast: High-speed raster build at full width, simultaneous building of multiple items and no post-curing together make the PolyJet process one of the fastest available.

Skill Level  Time  Cost 

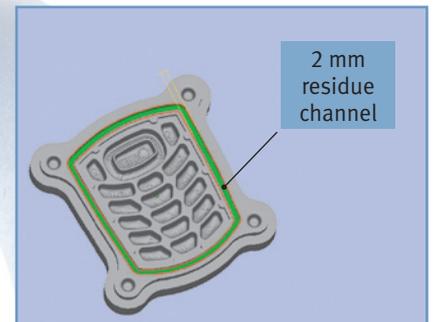


Figure 1. The mold designed by CAD prior to printing by PolyJet Technology.

Tip 1: Applying lacquer to the RTV mold will make the silicone part shiny. If a separation material is applied the part will be matte.



Figure 2. Preparing the silicone to be injected into mold.

Tip 2: To estimate the amount of silicone needed for the mold, measure the amount of water needed to fill the mold and add 15%.

The Rapid Tooling Process

In order to demonstrate how PolyJet Technology can be easily applied to the RT tooling process, below is a detailed explanation of how to quickly create a colorful silicone keypad. The example begins after the design of the mold has been completed.

The RTV Mold

Designed with 3-D CAD software, this RTV mold features fine details.

Preparing the mold for RTV

1. After printing, apply lacquer to the RTV mold and wait for it to dry before proceeding. If a separation material is to be used, apply it to the mold's inner space in place of the lacquer.
2. Clean any dust or excess particles off the mold. The easiest and best way to clean the holes inside the RTV mold is by applying air pressure.
3. Place the RTV mold on a flat plane with the inside facing upwards.

Preparing the injected material:

In this example, the mold is for a key pad for a cellular phone. The keypad has a red function key in the center; the rest of the keys are translucent. The injected material is RTV Silicone (GT Products, GT-7040 Translucent 40 shore A (HS) mixed with rubber curing agent CA7040). To create the red keypad button, mix the silicone with pigments. Creating colorful silicone is easy. Place a mixing pot (a paper cup will do) on a scale. Put X grams of GT-7040 Translucent 40 shore A (HS) with X/10g of rubber curing agent CA7040 and 1-2%*X grams of pigment. Stir the ingredients together with a wooden stick until you have a homogeneous paste.

Injecting the silicone into the mold

Fill a common plastic syringe with silicone (you will need to repeat this process for each color). Here we apply the red color first. You can use the wooden stick used for stirring to put the silicone into the syringe.

Fill the mold's cavities by injecting the appropriately colored silicone. In this example, the back of the keypad will be translucent. Therefore, we first inject the red silicone, leaving room to later inject translucent silicone.

Fill both sides of the mold until they slightly overflow. After closing the mold, the excess material will flow into the access channels.

Removing air bubbles from the silicone

To remove air bubbles from the silicone, place the mold on a tray inside a vacuum chamber of -2atm for ten minutes. All the air bubbles should be gone after ten minutes. However, if some air bubbles remain, place the mold inside a controllable vacuum chamber. In the controllable vacuum chamber, increase the vacuum gently until all the air bubbles have been sucked out of the silicone.

Tip 3: Do not add more than 2% pigment because otherwise the silicone will not harden.

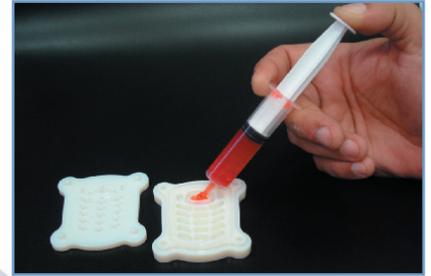


Figure 3. Injecting the silicone into the mold.

Tip 4: If you accidentally inject the wrong colored silicone into the RTV mold, use standard isopropyl alcohol (Isopropanol) to clean the mold.

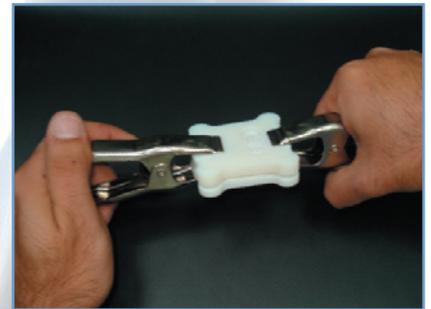


Figure 4. Clamping the mold before curing the silicone in oven.



Figure 5. Mold is placed in oven for fast silicone curing.

Final procedures

Close the RTV mold tightly by placing the mold in a vice to keep it straight. This removes the excess silicone and remaining air bubbles.

To dry the silicone, either place the mold in a pressure oven of 2 bar and 70°C for three hours or leave the mold closed at room temperature for 24 hours (see Figure 5).

When taking the mold out of the oven, check to make sure the silicone residue around the mold's edges is dry and hard. Gently open the mold and separate the silicone part. You can do this easily by lifting a small area of the silicone part and applying air pressure between the part and the mold – the part will separate smoothly.

Now the colorful cell phone keypad is ready for use.



Figure 6. Colorful cell phone keypad ready for use.



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