

# GUIDE TO VACUUM CASTING (OR SILICONE MOLDS)

In the last few years 3D printing has had widespread diffusion both at the industrial level and in other sectors such as the medical, artistic and hobbyist one.

However, this technology has its limits when you want to produce a lot of pieces, when you are looking for special finishes, when you want to use a specific material. The Vacuum Casting technique represents a good solution to overcome these limits, without having to tackle the mass-production costs.

## HOW DOES IT WORK?

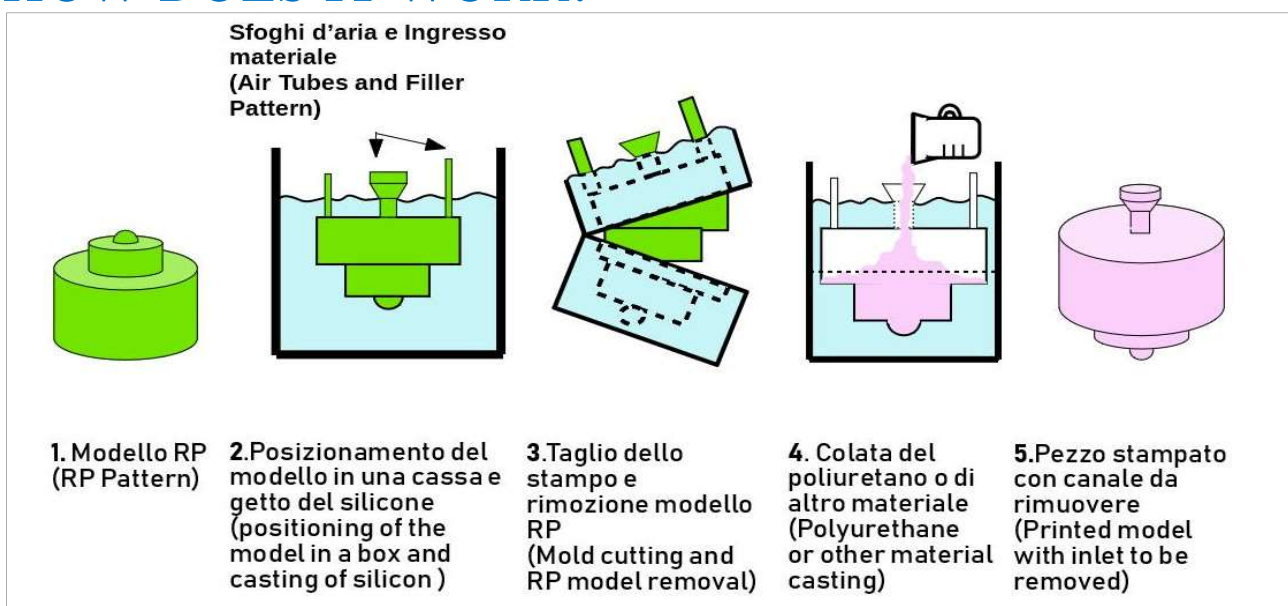


Figura 1. Steps of Vacuum Casting process .

The vacuum casting process consists of making a rapid silicone mold, obtained from the impression of a master model. With the equipment thus built, the pieces to be obtained are then printed, usually using a two-component polyurethane. Both the making of the mold and

the casting of the polyurethane must be carried out under vacuum, to guarantee the excellent characteristics of mechanical strength and surface finish typical of this technology.

Usually the master is obtained through 3D printing, possibly with a technique that provides a good surface finish, as stereolithography, and the casting polyurethane is chosen according to the characteristics to be obtained for the piece (mechanical strength, transparency, color, elasticity, weight, conductivity, flame resistance, etc.).

Alternatively, the master can also be realized with other technologies (numerical control, handmade modeling) and it can also be made up by a detail commercially available, an old piece out of production or a work of art. Even the casting material can be of different types: epoxy resins, waxes, ceramic and composite materials can be used instead of polyurethane.

## WHAT ARE THE BENEFITS?

The vacuum casting represents an intermediate solution between the production of a single model made in 3D printing and a series produced with injection molding or other mass production solutions.

In general, compared to 3d printing, the vacuum casting:

- it is more convenient economically if there are several pieces to be made;
- allows the use of a wider range of materials;
- provides anisotropic and mechanically more performing pieces;
- supplies pieces with more controllable finishes and similar to the pieces produced with standard technologies;
- is able to manage features that are difficult to be obtained with 3D printing, like transparency, elasticity, color gradation;



Picture 2: Transparent, elastomeric, translucent colored items, obtained from silicone molds.

- can be used to assemble different materials, for example to incorporate bushings, pins, different types of inserts, electronic boards, but also to overmold two different plastic materials or a plastic and an elastomer.



Picture 3: Co-molded pieces: white polyurethane on a threaded steel pin, colored elastomer on black rigid polyurethane, polyurethane on a bronze threaded bush.

Instead, compared to mass production solutions, such as injection molding:

- is convenient if there are few pieces to make;
- allows the management of some undercuts, without the use of inserts;
- accepts, within certain limits, the presence of variable thicknesses without giving rise to important distortion to the pieces.

## HOW MUCH DOES IT COST TO BUILD A PRE-SERIES?

It is obviously difficult to give cost indications valid for every model but, in general, it can be said that the cost of a mold can vary between 200 and 1000 €, while the cost of the single piece can vary between 10 and 100 €, moving from smaller and simpler pieces to larger and geometrically complex ones. Considering that each mold can print about 20 times, the unitary cost, including equipment, can vary between 20 and 150 €. These costs can be reduced if multi-impression molds can be produced or cheaper materials can be cast.

## WHEN DOES THIS SOLUTION MAKE SENSE?

These technical and economic features make silicone molds the ideal solution for different situations:

- for small series productions for niche articles (from tens to hundreds of pieces);
- to manufacture custom products, with different sizes, difficult to manage with an injection-mold;
- for the intermediary development of a project, when all the details are not defined yet but you want to start testing a small series of the final product in the field;
- for the advanced development of a project, when you have a product that is basically ready for the market but that you are not able to produce in large numbers (because of costs and time to set up the equipment, because the market is very variable both in terms of consumer demand and in terms of available components);
- to copy and replicate objects for which the CAD model is not available, that can be craft models, artistic works, natural objects;
- to make spare parts for items out of production, that is believed to have market numbers that are not compatible with mass production.

In the latter two cases, the silicone molds solution is usually a cheaper alternative, compared to the reverse engineering process that includes: scan, data-processing, CAD re-modeling, which can be very expensive and not always necessary.