VACUUM CASTING

What Is Vacuum Casting

Vacuum casting is a modern advanced manufacturing technology, a 3D printing sibling that can contribute to product development.
The main application is on small batches and prototypes where geometries are complex, and there is a high possibility of air entrapment. The name of this method is derived by the use of vacuum which pushes a specific mean of liquid into a silicone mould. It is a relatively new process, and it belongs in the wider additive manufacturing family to generate a part.

How Does Vacuum Casting Work?

The process requires
➢ a master 3D CAD model which can be produced using stereolithography (SLA) or laser sintering or
➢ a physical model in high quality with excellent surface finish that can be used as a master model instead

Model Immersing
The printed model or the master physical model is then immersed into a two-piece liquid silicone rubber. A high-pressure vacuum is then used to remove the remaining air and finally form the mould.

Mould Curing
The next step includes the curation of the mould in a high-temperature oven in order to improve its mechanical properties, strength and durability. That process is called mould curing.
Once the curing process is complete, the parts are removed from the oven, and a gap has been formed in the centre of the cured mould. This gap has the exact shape and dimensions of the master part that been used at the beginning of the process.

Adding resin and a vacuum chamber
The mould is then filled with the required material and placed in the vacuum casting chamber. This step is critical as the trapped air bubbles will be removed from the mould.

Post Curing of the part
This is the final step where the mould is cured in high temperatures for the last time. The silicone mould will be removed from the produced part, and it can be used again to make more parts of the same geometry and shape.
The part can then be painted or decorated as required.

Common SLA Applications

The high quality of the produced parts, the easiness to manufacture as well as the minor need for post-process, make vacuum casting a competitive method among the additive manufacturing technologies. Below is a list of applications where vacuum casting is most commonly used:

➢ Small batch of products with complex geometry
➢ Prototypes for visualisation purposes
➢ For design validation prototypes
➢ For packaging, cases, housings
➢ Fit for function tests
➢ Marketing purposes

Design Requirements

Minimum wall thickness	1.0 mm
Minimum hole diameter	1.0 mm
Minimum feature size	2.0 mm
Minimum font size	6pt
Minimum space and clearance	1.0 mm
Minimum slit between walls	1.0 mm

Available materials for Vacuum Casting

Vacuum Casting produces parts from a very wide range of engineering thermoplastics. Here is a list of the Vacuum Casting materials available on 3Dtechnologies4U.

Materials	Specifications	Applications
ABS-like	Similar to ABS, Heat resistance at 77 Celsius, high tensile modulus (2250MPa)	• Pre-launch product testing • Concept models and prototypes • Low volume production • Housing and covers • Automotive, industrial, decorative, consumer applications
Water clear PC-like	Transparent or any customised colour, Heat resistance at minimum of 80 Celsius, good mechanical properties	
PA-like	Similar to Nylon, can be reinforced by CF or GF, high impact strength	
Water clear – Acrylic	Clear/transparent, high accuracy/stable dimensions	

PP-like	Similar to PP, heat resistance up to 90 Celsius, good impact resistance, high toughness	
Rubber-like	Similar to rubber, available from Shore 30A to 90A, smooth surface with customised colour	

How this technology can benefit your project or production?

Investing in vacuum casting can benefit a company which deals with small production batches or prototypes. The advantages of using vacuum casting are:

a) High product quality

Due to the nature of the process, it is possible to choose from a variety of polyurethane resins, and the hardness and flexibility can be carefully be selected prior to the production of the part. The casted finished object can then be easily painted or can be kept crystal clear without any subsequent post-processing.

b) High precision and very good surface finish

The use of liquid silicone during the process ensures that the resulted part will have excellent appearance and surface finish. This is a significant advantage, especially for those who want to replicate a small number of geometrically complex parts achieving a uniform finish and appearance.

c) Production cost can be competitive

The silicon use also guarantees that the cost will be much lower compared to other manufacturing techniques such as CNC or injection moulding. It also takes less time to produce a part than other methods such as 3D printing.

In conclusion

This method is far more economical than injection moulding and can be used as a good and much quicker alternative to 3D printing. From a cost and time point of view, vacuum casting is the preferred method for producing prototypes or small batches (e.g. 50-100 parts). It also combines all those manufacturing benefits that makes this process really attractive to customers.