ODEM

Short series production

DESIGN GUIDE : URETHANE MOLDING

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INTRODUCTION

Urethane molding is often used to produce high value-added products in short series. For example, the parts can be intended for electronic, scientific or medical devices.

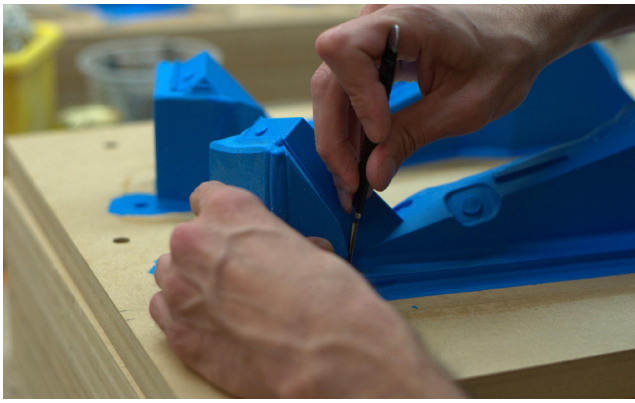
In each case, the production of urethane or silicone parts offers marked advantages if:

- Parts feature intricate details as well as thin and thick walls
- The quantity to be produced per order is low (from 5 to 1000 units)
- The available investment in tooling is limited
- The appearance of the product is important and must reflect its inherent qualities as well as its superiority in the market
- The profit generated by the sale of the product fully justifies the investment in the manufacturing of the parts.

THE PROCESS

1. Master

A master of the part is produced by stereolithography (SLA/SLS), by CNC machining or with an existing part. Careful finishing is carried out on all surfaces as these will be reproduced on every casting. It is also at this stage that moving parts are prepared if necessary. Additional preparation is required for holes that pass through the part and where inserts are required.



2. Mold

The silicone mold is poured around the die in two steps. The bottom half is poured first. When this is frozen, the upper part is cast including the supply channels and air vents so that the resin of the part fills the entire cavity of the mold. Some molds require silicone drawers that allow the part to unmold. These are integrated at this stage.

A silicone mold usually have a lifespan of 2 years. This mainly depends on the geometry of the part.

3. Molding

Once the silicone has completed its curing process, the mold is ready for parts production. Molding of parts can be done with various resins and precautions vary depending on the material used. The first part of a cure is done in the mold, then the part is removed and stored to complete its curing which can last between 2 hours and 24 hours depending on the resin.

4. Finishing and painting

The final step is to inspect the parts, deburr them and bring them to the desired surface finish by means of sanding and polishing. The parts can then be painted and receive the graphic application of logos or other visual elements of the customer’s choice.

ADVANTAGES

Fast

Upon receipt of the 3D files, production of the master, mold and first parts can usually be completed in 2 to 4 weeks.

Economic

Silicone molds are much less expensive than metal ones, but their lifespan is much shorter. However, this creates a great alternative for short series production.

Wide range of shapes and materials

Any part intended for injection molding can be produced in a silicone mold. The elasticity of the mold greatly facilitates demolding, which makes it possible to produce more complex parts. The resins used in these molds tolerate variations in wall thickness, which greatly reduces the risk of shrinkage deformation (sink marks). Finally, it is possible to carry out over molding to combine different materials in the same part.

GUIDELINES FOR PART DESIGN

Dimensions of parts

There is no minimum size for a part. However, minimum wall thickness must be respected to allow adequate filling. As for maximum dimension, it is possible to mold bulky parts. For example, we have once molded waste bins that had a capacity of 360 liters. Note that it must be considered that the weight of the part and the mold combined can be limiting in terms of handling.

Wall thicknesses

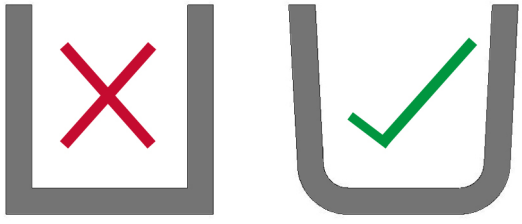
Minimum wall thickness is 0.040'' (1mm). For small parts it might be possible to reduce this down to 0.020'' (0.5mm). It is recommended to use thicker walls for larger parts. A constant wall thickness is a good practice to reduce the risk of deformation during curing. This applies less in the case of silicone molds which allow walls of varied thicknesses with zero or minimal shrinkage, it is however necessary to consider the final production process envisaged for the part if it is not casting itself.

Rounding and fillets

Adding radii and fillets is essential to prevent areas of stress concentration. All transitions between two surfaces should have a radius equal to or greater than 0.125'' (3mm). It is recommended to maximize the size of the radii. In some special cases, such as at the bottom of a small hole or on very small parts, radii up to 0.060'' (1.5mm) can be tolerated.

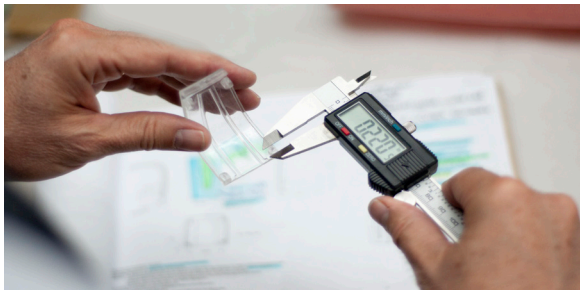
Draft angles

Silicone molds do not require a draft angle unlike metal molds. It is therefore possible to extract a part whose walls are parallel to the direction of opening of the mold. However, demolding a part in this way creates a significant shear force on all affected surfaces and reduces the life of the mold. If the design of the part allows it, it is preferable to provide 3 to 5 degrees of draft angle on the walls, which will greatly facilitate the removal of the part from the mold.



Accuracy and shrinkage

Basic tolerances vary between 0.002'' and 0.005'' per inch depending on the material. For example, for a 10'' part, a tolerance between 0.020'' and 0.050'' must be expected. It is important to know that part geometry and wall thickness can have an effect on tolerances. Depending on your needs, it is possible to obtain greater precision by using aluminum molds.



Moving parts

Some holes and small undercut details may require the use of moving parts such as metal rods or custom parts printed by stereolithography (SLA). These parts are called mobile, since they must be removed during each unmolding, and replaced before each molding. To find out if an undercut is possible in your part, contact our team at **sales@odem-inc.com** who will analyze your part and its feasibility.

Lettering

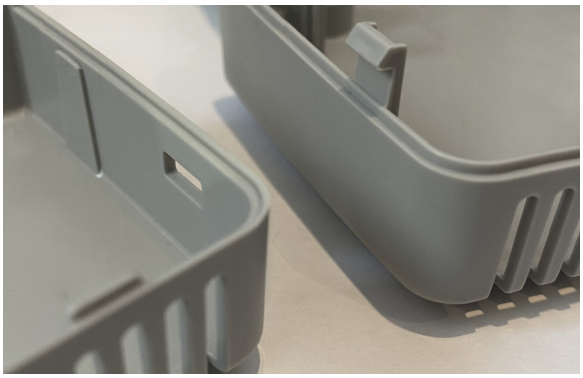
It is possible to mold logos and lettering directly into the surface of the parts. These details can be convex or concave. For optimal reading, it is preferable to keep a distance of 0.05" between letters. The width should be at least twice the height. Also, adding radii makes it easier to mold and read letters.

Joints between two parts

A good design practice is to provide alignment of parts with overlapping grooves that facilitate assembly. These grooves can be localized or follow the entire perimeter of the part. It is important to keep a distance between the walls of the two parts to be aligned to counter the tolerance as well as the increase in wall thickness generated by the application of primer and paint (between 0.002'' and 0.004'' for primer and between 0.001'' and 0.002'' for paint).

Hooks or snap fits assemblies

Urethane molding allows the production of hooks and/or snap fit assembly details. In both cases, it is recommended to follow the design constraints used for moulding thermoplastic resins.



Over molding

Over molding is a technique which consists of making a molding over an already finished part or section of a part. It offers the possibility of combining different materials, textures and colors.

Ribs

Ribs make it possible to increase the bending rigidity of a part without changing its thickness of the wall. This is a common addition to plastic parts that produces quality parts provided they are well designed.

Poorly designed ribs can cause distortion to exterior surfaces, shorten mold life and increase part cost.

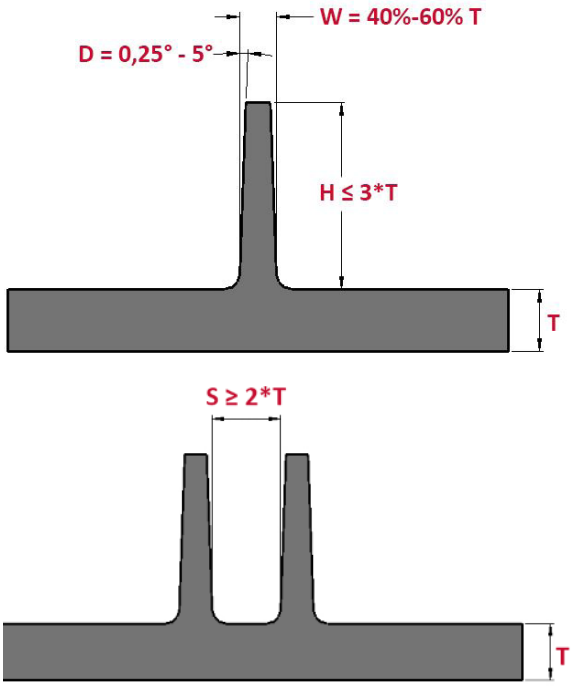
The dimensions of the ribs depend on the thickness of the wall (T):

Height (H) – Less than or equal to 3 times the wall thickness (T).

Width (W) – Between 40 and 60% of the wall thickness (T).

Spacing (S) – Greater than or equal to 2 times the wall thickness (T).

Draft Angle (D) – Between 0.25 and 5°, usually around 1°.



Bosses

Bosses are used to align parts and/or secure screws or threaded inserts. It is important to consider the forces applied to the screws or inserts during assembly and use in order to design bosses well suited to their use.

When a boss is located near a vertical wall, it is recommended to distance it from it and connect it to the wall by a rib in order to avoid excess thickness.

Generally speaking, the dimensions of the bosses also depend on the wall thickness (T):

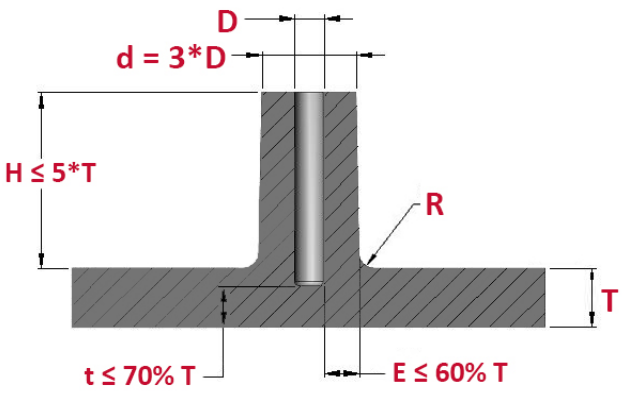
Height (H) – Less than or equal to 5 times the wall thickness (T).

Bottom thickness (t) – Less than or equal to 70% of the wall thickness (T).

Outside Diameter (D) – The greater of 3 times the inside diameter (d) or the inside diameter plus 1.2 times the wall thickness (T).

Boss wall thickness (E) - Approximately 60% of wall thickness (T)

Exterior Fillet Radius (R) – Approximately 25% of wall thickness (T).



Threaded inserts

To secure components together, we often suggest installing threaded inserts into the product. This hardware allows the integration of strong and durable captive threads into parts. It is important to plan the installation of inserts before manufacturing the mold since you must have the right diameter and depth of hole depending on the length and thread of the insert.

	Hole Depth	Hole Diameter
4-40	0.192'' ou 0.254’’	#25 (0.150)
6-32	0.238'' ou 0.301’’	#8 (0.199)
8-32	0.270'' ou 0.348’’	#2 (0.221)
10-32	0.316'' ou 0.395’’	G (0.261)
1/4"-20	0.395'' ou 0.504’’	Q (0.332)
5/16"-18	0.395'' ou 0.582’’	7/16''-29/64'' (0.443)
M-2.5 x .4	0,177" ou 0.227’’	#21 (0,157'')
M-3 x .5	0.192'' ou 0.254’’	#21 (0,157'')
M-3,5 x .6	0.238" ou 0.301’’	0.204''
M-4 x .7	0.270'' ou 0.348’’	7/32'' (0.219'')
M-5 x .8	0.316’’ ou 0.395’’	#G (0.261’’)
M-6 x 1	0.395’’ ou 0.504’’	#Q (0.332’’)

PAINTING AND FINISHING

Surface finish

Molded urethanes are receptive to advanced finishing. Applying paint to your parts is recommended in order to get a uniform finish on all surfaces.

Standard or metallic paint, colored or light tints, as well as EMI protection are some of the options available. Textured finishes or engravings can also be molded to achieve the desired level of product quality. Note that clear urethane parts require an advanced level of finishing.

Color match

We can paint the parts the color you have selected. Please provide us with a PMS (Pantone Matching System) code.

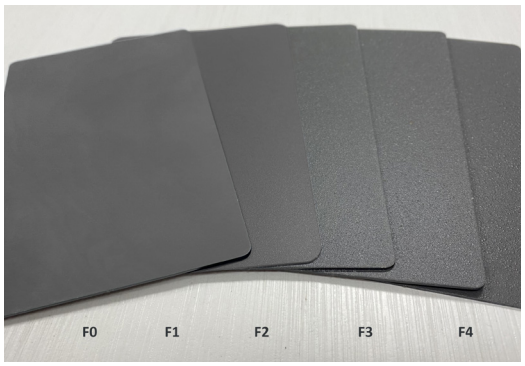
EMI Painting

The use of EMI (Electromagnetic Interference) protective paint on the interior surfaces of an enclosure will protect the electronic components it contains from interference caused by the proximity of an electromagnetic field.

Texture chart

A variety of textures can be applied on the surfaces of your parts.

F0 : Smooth
F1 : MT 11020 ou VDI 27-30
F2 : MT 11030 ou VDI 33
F3 : MT 11040
F4 : MT 11050
Sandblast : SPI B2



OUR SERVICES

Specialist in the short-run manufacturing of high value-added plastic components and products, we help innovative companies focus on the commercialization of their products by offering complete design development and production services.

Urethane and silicone molding

Surface painting and finishing

Graphics Applications

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- Water transfer decals
- Screen printing

Industrial design for short production runs

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Other services :

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Injection molding project management

For more information visit our website!
www.odem-inc.com

Contact us at **ventes@odem-inc.com**
to submit your project.