

fictiv

URETHANE CASTING DESIGN GUIDE

INTRODUCTION

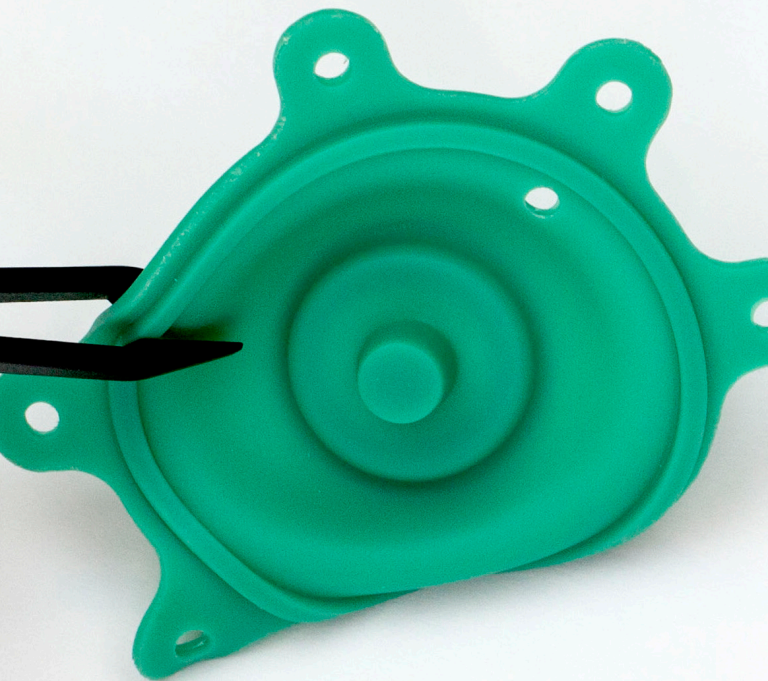
Urethane casting is a very flexible process. Most parts that can be 3D printed or CNC-machined can also be urethane cast. Unlike 3D printing and CNC machining, urethane casting produces production-quality parts regardless of their complexity. Urethane casting is often a less expensive option than traditional 3D printing, CNC, or IM in quantities between 20 and 200. It is an excellent choice for show quality cosmetic prototypes, which simulate the end production parts industrial design intent.

The urethane casting process starts with a master pattern made from 3D printing or a CNC machined part. The pattern is finished using the required cosmetics and finishes for the final part. Next, the pattern is used to create a silicon tool for casting the final parts. Then, the tool is either pressure or vacuum-filled with 2-part polyurethane plastic that hardens into the final part before it is removed, cleaned, and inspected before being supplied to you.

If you're familiar with designing parts for injection molding, you can apply the same design best practices for urethane casting. Here are some suggestions to get you started

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Material Selection

A Material Selection

Materials in urethane casting are designed to mimic production grade molded thermoplastics. They will have many of the same physical properties as their injected counterparts, but will differ in heat and chemical resistance.

A list of our materials can be found below:

MATERIALS

MATERIAL NAME	MATERIAL USE
ABS-like	General Purpose Rigid
ABS-like, HT	General Purpose, High Temperature
ABS-like FR V0	General Purpose, Flame Retardant
POM-like	POM-like, High Temperature
PP-like	Flexible Plastic
PC-like	High Strength (PC-like)
Nylon-like	High Strength, (Nylon-like)
Acrylic-like	Rigid Clear
Opaque Elastomer	Rubber - Opaque
Transparent Elastomer	Rubber - Transparent

FINISHES

FINISH	DESCRIPTION
Matte	Standard flat finish
Glossy	High gloss finish
Light Texture	MT11010 Equivalent
Medium Texture	MT11020 Equivalent
Heavy Texture	MT11030 Equivalent
Painting	Custom color with any texture or gloss requested
Pad/Screen Printing	Add logos or text to your finished part



Tolerances

B Tolerances

In urethane casting, tolerance is dependent on the quality of the 3D printed or CNC machined master. Fictiv uses CNC machining to create masters whenever possible, because we can hold tighter tolerances that way. However, not all geometries are suitable for machining — in these cases, we use a high resolution 3D printing process instead, such as Polyjet or SLA.

TOLERANCE TABLE

DIMENSION RANGE (Unit:mm)	TOLERANCE (Unit:mm)
0.00 to 25.00	± 0.25
25.01 to 50.00	± 0.32
50.01 to 75.00	± 0.40
75.01 to 100.00	± 0.48
100.01 to 125.00	± 0.55
125.01 to 150.00	± 0.63
150.01 to 175.00	± 0.70
175.01 to 200.00	± 0.78
200.01 to 225.00	± 0.86
225.01 to 250.00	± 0.93
250.01 to 275.00	± 1.01
275.01 to 300.00	± 1.08

TOLERANCE TABLE

DIMENSION RANGE (Unit:mm)	TOLERANCE (Unit:mm)
300.01 to 325.00	± 1.16
325.01 to 350.00	± 1.24
350.01 to 375.00	± 1.31
375.01 to 400.00	± 1.39
400.01 to 425.00	± 1.46
425.01 to 450.00	± 1.54
450.01 to 475.00	± 1.62
475.01 to 500.00	± 1.69
500.01 to 525.00	± 1.77
525.01 to 550.00	± 1.84
550.01 to 575.00	± 1.92
575.01 to 600.00	± 2.00
600+	± 2
ANGULAR	$\pm 1^\circ$

Tolerance table is "general tolerance table". We accept prints and many cases, such as hole to hole locations, offer tighter tolerances.

Compared to metals and thermoplastics, polyurethanes have a very high coefficient of thermal expansion (0.8 to $1.4 \times 10^{-4}/\text{in}/\text{in}/^\circ\text{F}$). Note that if a part is made to a ± 0.005 -inch tolerance, as measured at 75°F , it could be out of tolerance at 40°F or 110°F .



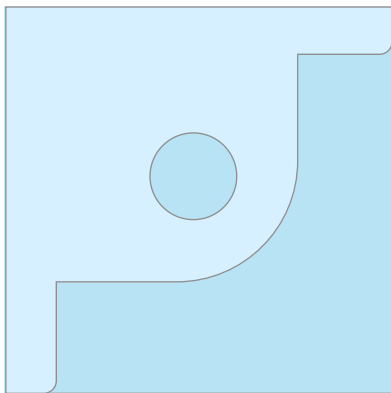
Wall Thickness

Wall Thickness

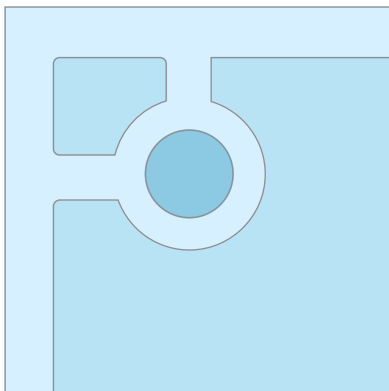
Walls between 1.5mm and 4mm perform best with urethane casting. A minimum wall thickness of 1mm is required in most cases.

Additionally, we recommend maintaining uniform wall thicknesses, although it's not a strict requirement as in injection molding.

To save on part costs, we also recommend coring out thick areas to save on materials.



Not Recommended



*Coring around boss to
reduce material*

Note: Thin sections less than 1mm thick are at risk of not filling completely. This is one of the few restrictions urethane casting has compared to injection molding because liquid polyurethane resin is not injected into the silicone molds at high pressure.



Ribs

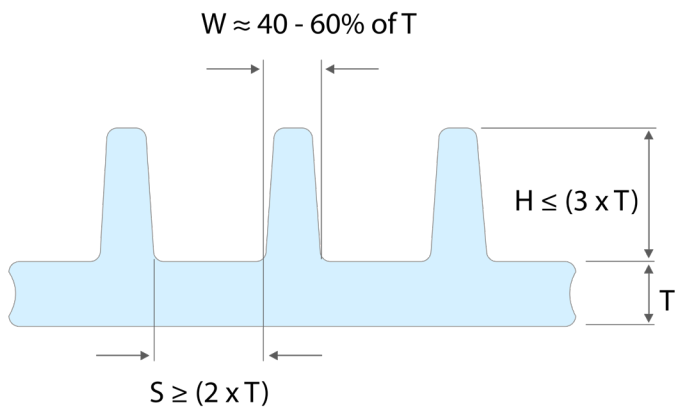
D Ribs

Ribs are used in part designs to increase the bending stiffness of a part without adding wall thickness

For urethane casting, rib thickness should not exceed 60% of the nominal wall thickness.

Additionally, the height of a rib should be limited to less than three times its thickness. It's also better to use multiple ribs to increase bending stiffness rather than to use one very tall rib.

The rib should be attached with corner radii as generous as possible to [minimize stress concentration](#).





Draft & Undercuts

E Drafts and Undercuts

DRAFTS

Draft is not a requirement for urethane casting. Whereas parts are injected out of a hard mold in injection molding, parts are “peeled” out of the soft mold in urethane casting.

If you are designing a part that will eventually be injection molded, you should create your design as intended for this process. In injection molding, walls perpendicular to the parting line should have a minimum draft of 0.5° . As pocket depth increases, the draft angle should also increase; a general rule of thumb is 1 degree of draft per 1 inch of cavity depth.

Pocket Depth	Minimus Draft Angle
0 - 0.5in / 12.7 mm	0.5°
0.5 - 1in / 25.4 mm	1°
1 - 2in / 50.8 mm	2°

UNDERCUTS

Undercuts are acceptable and relatively easy to achieve with urethane casting. However, if you're fabricating parts that will eventually be injection molded, you should consider what is feasible.



Threaded Holes

F Threaded Holes

We recommend installing press-in threaded inserts into cast urethane parts.

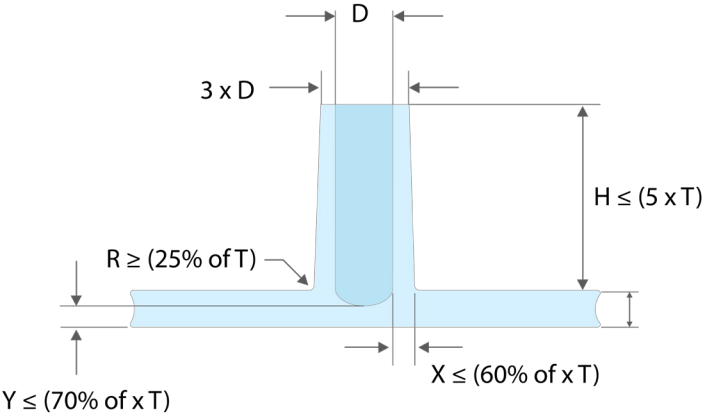
It is possible to use self-tapping screws as well, but they are less ideal if the fastener is installed and removed repeatedly.

Boss Design

Here are the recommended parameters for boss design:

Parameter	Inches	Millimeters
Minimum boss height	0.039	1.00
Minimum boss diameter	0.039	1.00

Recommended geometry for boss design:

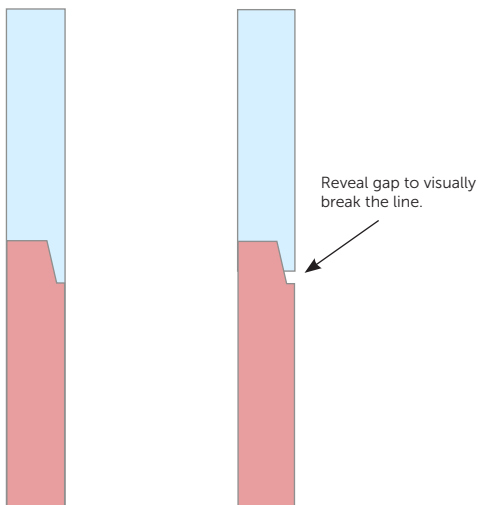




Overlap Joints Between Parts

G Overlap Joints Between Parts

When using overlap (lip and groove) joints between two parts, always leave a reveal gap. This will make slightly uneven edges less obvious and is also common practice for injection molding.



Perfectly flushed lip and groove makes it easier to spot uneven lip.

Slight gap helps to break the line visually.

Part Perimeter (inch)	Reveal Gap (inch)
< 10	0.025
10 to 20	0.040
20 to 60	0.060
> 60	0.080



Letters & Logos

H Letters and Logos

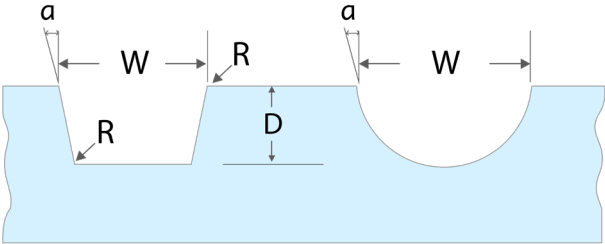
When incorporating letters and logos in your designs (raised or recessed), there are three factors to keep in mind:

1. Height or feature depth
2. Feature width
3. Radii on/between features

The space between letter strokes should be 1mm at the minimum, though this can vary between designs.

Parameter	Inches	Millimeters
Minimum embossed details (height & width)	H 0.020", W 0.039"	H 0.50, W 1.00
Minimum engraved/ debossed details (depth & width)	H 0.020", W 0.039"9	H 0.50, W 1.00

Below is the recommended geometry for engraved (debossed) letter stroke cross-section:



Where,

$$\alpha \geq 30^\circ$$

$$W \geq 2 + D$$

$$D = 0.010 \text{ in (max)}$$



Requirements Communication

I Requirements Communication

3D models are required for urethane casting. At Fictiv, STEP files are preferred because they allow us more flexibility in producing a CNC machined master.

In addition to submitting 3D files, we also recommend you provide a drawing that contains the following information, if applicable:

Cosmetic surfaces & their desired color & texture

Assembly features & surfaces

Size and locations of threaded inserts

Moldmakers want to know which surfaces are critical (whether for cosmetics or assembly) so they don't place gates and vents on those surfaces. Extra care is put into preparing those surfaces prior to making the mold.

Resources

About Fictiv

Fictiv is a global manufacturing company that simplifies sourcing for custom manufacturing, from prototype to production. Through its highly-vetted manufacturing network, AI-powered technology platform, and global operations centers across the USA, Mexico, India, and China, Fictiv delivers fast, high-quality custom manufacturing services from quote to delivery.

Fictiv's capabilities span the full mechanical bill of materials, including Injection Molding, Compression Molding, 3D Printing, CNC Machining, Die Casting, Sheet Metal and Urethane Casting.

To date, Fictiv has delivered more than 30 million commercial and prototype parts for early-stage companies and large enterprises alike, helping them innovate faster, free up precious resources, and drive profitable growth.

Resources

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