Independent Study:

Mold Making for the Theatre

Senior Honors Project

THR 483-01

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Molding and Casting Material Section

Silicone

Silicone rubber is a preferred mold making material in both the theatre and the film industry. In props, the type of silicone used is typically a two-component system known as RTV silicone, or Room Temperature Vulcanizing silicone. This means that when properly mixed, these types of silicone will cure at room temperature.

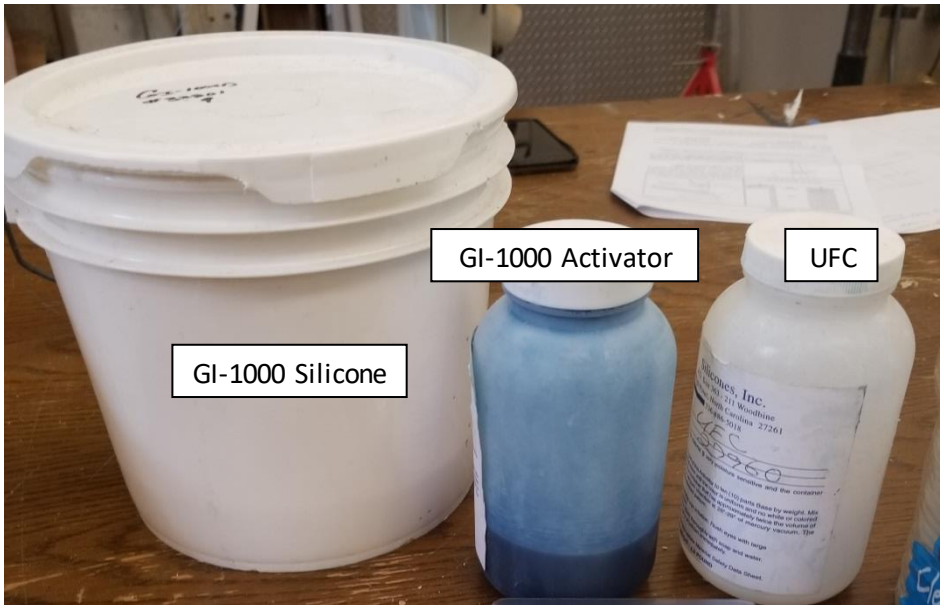
RTV silicones use either a tin or platinum based catalyst. More commonly used in theatre is the tin-cured silicone rubber. This is the cheaper option, but still maintains a high level of performance. These high-tear resistant silicones can be used for casting wax, plaster, hot glue, and some low temperature melt metal alloys. However, these silicones are most commonly used to cast urethane, epoxy, and polyester resins.

GI-1000 Silicone

GI-1000 silicone is a product specific to Silicone, Inc. A two-component system that contains uses GI-1000 silicone and GI-1000 Activator. The typical ratio of silicone to activator is 100 grams to 10 grams. The product information sheet can be found on page 11.

UFC (Ultra-Fast Catalyst)

UFC is a product specific to Silicone, Inc. This Ultra-Fast Catalyst can be used in GI-1000 silicone to significantly speed up the cure time of the silicone. The typical ratio of silicone to UFC is 100 grams to 5-7 grams depending on the desired cure time. The product information sheet can be found on page 10.



Hot Glue

Hot glue, also known as a hot melt adhesive is a common form of thermoplastic adhesive. Though not typically thought of as a casting material, some innovative theatre artists have started hot glue as a cost saving material for casting smaller props. Hot glue can commonly be bought at any hobby store, and can either be melted by using a hot glue gun, or simply by applying continuous heat to the glue sticks, such as in a pot or kettle.

FlexFoam-iT! Series

The FlexFoam-iT! Series are premium quality water blown flexible foams that can be used for a variety of industrial, special effects and art & crafts and projects. There are many different types of FlexFoam-iT! which expand at different rates and have different properties. The product information sheet can be found on pages 6-7.

Plaster of Paris

Plaster of Paris, or gypsum plaster, is produced by heating gypsum to about 300°F. The following equation is the chemical process when dry plaster powder is mixed with water and re-forms into gypsum:

$CaSO_4 \cdot 2H_2O + heat \rightarrow CaSO_4 \cdot 0.5H_2O + 1.5H_2O$ (released as steam).

Although the ratio of water to dry plaster mix is somewhat bendable, the usual ratio is about one part water two parts dry mix. Plaster typically starts setting up 10 minutes after mixing, finished after about 45 minutes, and fully set after about 72 hours.

Smooth-Cast 300

The Smooth-Cast 300 Series is a liquid plastic resin commonly used in theatre props. This is a product specific to Smooth-On, and their product information sheet can be found on pages 8-9.

407 Latex Casting Rubber

407 Latex Casting Rubber is made from pure organic refined latex. Latex compounds are not the same, some have poor tear strength while other latex emulsions take longer to cure. 407 Latex Casting Rubber has the maximum tear resistance in the minimum cure time. It is a high quality latex and will provide you with the high elasticity and tear resistant casting; an important factor in making masks.

FlexFoam-iT!™ Series

Flexible Polyurethane Foams

3lb., 4 lb., 5lb., 6 lb., 7 lb., 8 lb., 10 lb., 14 lb., 17 lb., 23 lb. or 25 lb.

www.smooth-on.com

PRODUCT OVERVIEW

FlexFoam-iT!™ Series foams are premium quality water blown flexible foams that can be used for a variety of industrial, special effects and art & crafts and projects. With several to choose from, uses include making theatrical props (swords, knives, hammers, etc.), industrial gaskets, custom padding and cushioning, and more. SO-Strong™ colorants can be added for color effects.

Part A and B liquids are combined, mixed and poured into a mold or other form (apply release agent if necessary). Mixture will rise and cure quickly to a solid, flexible foam. Foams vary by density and offer good physical properties. The lower the number, the more the foam expands. **FlexFoam-iT™ III** is the lowest density foam and expands the most. **FlexFoam-iT!™25** is the highest density foam and expands the least.

FlexFoam-iT!™ 7 FR is flame rated to FMVSS-302 specification
FlexFoam-iT!™ 23 FR is flame rated to UL-94 HB specification

8oz./237mL of FlexFoam-iT! A+B poured into a 32oz./946mL cup.

TECHNICAL OVERVIEW

	A:B Mix Ratio by Volume	A:B Mix Ratio by Weight	Specific Gravity (g/cc) (ASTM D-1475)	Specific Volume (cu. in./lb.)	Pot Life (Creamtime) (ASTM D-2471)	Handling Time	Approximate Volumetric Expansion	Approximate Lbs. / Cu. Foot = Kgs. / Cu. Meter
FlexFoam-iT!™ III	1:2 pbv	57.5:100 pbw	0.05	504	35 sec.	25 min.	15 times	3 lb/ft³ = 48 kg/m³
FlexFoam-iT!™ IV	N/A	80:100 pbw	0.06	420	30 sec.	45 min.	13 times	4 lb/ft³ = 64 kg/m³
FlexFoam-iT!™ V	1:1 pbv	105:100 pbw	0.08	315	50 sec.	45 min.	11 times	5 lb/ft³ = 80 kg/m³
FlexFoam-iT!™ 6	1:1 pbv	105:100 pbw	0.09	280	35 sec.	60 min.	10 times	6 lb/ft³ = 96 kg/m³
FlexFoam-iT!™ 7 FR	1:1 pbv	100:88 pbw	0.11	229	35 sec.	60 min.	8 times	7 lb/ft³ = 110 kg/m³
FlexFoam-iT!™ VIII	1:2 pbv	52.6:100 pbw	0.13	194	35 sec.	25 min.	7 times	8 lb/ft³ = 128 kg/m³
FlexFoam-iT!™ X	1:1 pbv	105:100 pbw	0.16	157	50 sec.	45 min.	6 times	10 lb/ft³ = 160 kg/m³
FlexFoam-iT!™ 14	1:2 pbv	100:190 pbw	0.22	114	60 sec.	45 min.	4 times	14 lb/ft³ = 220 kg/m³
FlexFoam-iT!™ 17	1:2 pbv	100:185 pbw	0.27	93	60 sec.	30 min.	3.5 times	17 lb/ft³ = 270 kg/m³
FlexFoam-iT!™ 23 FR	N/A	85:100 pbw	0.37	68	90 sec.	60 min.	2 times	23 lb/ft³ = 370 kg/m³
FlexFoam-iT!™ 25	N/A	1:2 pbw	0.40	63	90 sec.	25 min.	2 times	25 lb/ft³ = 400 kg/m³

Mixed Viscosity *(ASTM D-2393):* 1000 cps | ***Color:*** White | ***Tack Free / Cure Time:*** 2 Hours

* Values measured at room temperature (73°F/23°C)

PROCESSING RECOMMENDATIONS

PREPARATION...

Store and use at room temperature (73°F/23°C). Use in a low humidity environment (below 50% RH). Mixing containers should have straight sides and a flat bottom. Mixing sticks should be flat and stiff with defined edges for scraping the sides and bottom of your mixing container. Good ventilation (room size) is essential. This product has a limited shelf life and should be used as soon as possible. Wear safety glasses, long sleeves and rubber gloves to minimize contamination risk.

IMPORTANT: Shelf life of product is reduced after opening. Remaining product should be used as soon as possible. Immediately replacing the lids on both containers after dispensing product will help prolong the shelf life of the unused product. **XTEND-IT™ Dry Gas Blanket** (available from Smooth-On) will significantly prolong the shelf life of unused liquid urethane products.

Safety First!

The Material Safety Data Sheet (MSDS) for this or any Smooth-On product should be read prior to use and is available upon request from Smooth-On. All Smooth-On products are safe to use if directions are read and followed carefully.

Keep Out Of Reach Of Children.

Be careful. Part A (Yellow Label) contains methylene diphenyldiisocyanate. Vapors, which can be significant if heated or sprayed, may cause lung damage and sensitization. Use only with adequate ventilation. Contact with skin and eyes may cause severe irritation. Flush eyes with water for 15 minutes and get immediate medical attention. Remove from skin with soap and water.

Part B (Blue Label) is irritating to the eyes and skin. Avoid prolonged or repeated skin contact. If contaminated, flush eyes with water for 15 minutes and get immediate medical attention. Remove from skin with soap and water. When mixing with Part A, follow precautions for handling Isocyanates. If machining cured FlexFoam-It!™, wear dust mask or other apparatus to prevent inhalation of residual particles.

Important: The information contained in this bulletin is considered accurate. However, no warranty is expressed or implied regarding the accuracy of the data, the results to be obtained from the use thereof, or that any such use will not infringe a copyright or patent. User shall determine suitability of the product for the intended application and assume all associated risks and liability whatsoever in connection therewith.

Because no two applications are quite the same, a small test application to determine suitability for your project is recommended if performance of this material is in question.

APPLYING A RELEASE AGENT...

Urethane foams are adhesive and will stick / bond to many surfaces. **We recommend Ease Release™ 2831 to release urethane foam from most surfaces.**

If the release application is particularly difficult (example; releasing urethane foam from urethane rubber), we recommend an application of Universal Mold Release™ followed by an application of Ease Release™ 2831. **WARNING;** Do not use Universal Mold Release by itself, or any other silicone based release agents. This will collapse the foam.

PRE-MIXING & MIXING...

Pre-mix Parts A & B – Stir or shake both Part A & Part B thoroughly before dispensing.

Measuring – Stop! Know the mix ratio of the foam product you are using. Some are by weight and some are by volume. Dispense the correct amounts of Part A and Part B into a large mixing container.

For Best Results - Pre-Mix Part B after measuring out material – although not necessary, pre-mixing Part B using a drill and mechanical mixer (such as a turbine mixer available from Smooth-On) after measuring out and before combining with Part A will yield best results.

For Best Results - Use a Mechanical Mixer – Mix for a minimum of 15 seconds and pour into mold or form.

Mixing by Hand – Stir quickly and deliberately for a minimum of 15 seconds. Make sure that you aggressively scrape the sides and bottom of your mixing container several times. Pour into mold or form.

Be careful not to splash low-viscosity liquid out of container. Remember, these materials cure quickly. Do not delay between mixing and pouring.

POURING, CURING & PERFORMANCE...

Pouring & Curing - For best results, pour your mixture in a single spot at the lowest point of the containment field and let the mixture seek its level. Allow space in the containment field for the foam to grow as it expands to its ultimate volume. Allow foam to cure for at least 30 minutes before handling. Cure time will be affected by mass and mold configuration.

Mass Concentration / Mold Configuration – Pouring large amounts at a time in certain mold configurations (i.e. cylinder) could cause excess heat to be generated and result in splitting (fissures). Step pouring in layers may resolve this problem.

Improving Surface Finish & Minimizing Voids With Back Pressure - Capping the mold cavity opening with a board that has predrilled holes will improve surface finish for some foams. For more information, watch the video at **smooth-on.com/backpressure**

Is Your Foam Collapsing? - This is a common phenomenon associated with cold temperatures, inadequate mixing or both. **Environment or material too cold?** Warm it up. **Inadequate mixing?** You must thoroughly pre-mix both parts A and B. After combining A and B, mix thoroughly. If using a mechanical mixer, mix for 30 seconds. When hand mixing, mix quickly and aggressively, almost whipping the material.

Smooth-Cast™ 300 Series

Bright White, Ultra Low Viscosity Liquid Plastics

www.smooth-on.com

PRODUCT OVERVIEW

The **Smooth-Cast™ 300 Series** of liquid plastics are ultra-low viscosity casting resins that yield castings that are **bright white and virtually bubble free.** Vacuum degassing is not necessary. They offer the convenience of a 1A:1B by volume or 100A:90B by weight mix ratio. The differences between them are pot life and demold time.

These resins readily accept fillers (such as URE-FIL™ 3 from Smooth-On) and can be colored with SO-Strong™, UVO™ or Ignite™ color tints (Smooth-Cast™ 325 series accepts pigments better than the Smooth Cast™ 300 series). Fully cured castings are tough, durable, machinable and paintable. They resist moisture and mild solvents. Applications for **Smooth-Cast™ 300 Series Liquid Plastics** include reproducing small to medium size sculptures, making prototype models, special effect props and decorative jewelry.

Those interested in making roto cast pieces should refer to the Smooth-Cast™ 65D technical bulletin.

TECHNICAL OVERVIEW

	Pot Life @ 73°F/23°C (ASTM D-2471)	Cure Time** @ 73°F/23°C	Tensile Strength (ASTM D-638)	Tensile Modulus (ASTM D-638)	Elongation at Break % (ASTM D-638)	Flexural Strength (ASTM D-790)	Flexural Modulus (ASTM D-790)	Compressive Strength (ASTM D-695)	Compressive Modulus (ASTM D-695)	Shrinkage in./in. (ASTM D-2566)
Smooth-Cast™ 300Q	30 Sec.	4 - 5 Min.	3,000 psi	139,500 psi	5%	4,510 psi	128,000 psi	4,000 psi	45,800 psi	0.01
Smooth-Cast™ 300	3 Min.	10 Min.	3,000 psi	139,500 psi	5%	4,510 psi	128,000 psi	4,000 psi	45,800 psi	0.01
Smooth-Cast™ 305	7 Min.	30 Min.	3,000 psi	134,000 psi	7.50%	4,000 psi	118,000 psi	3,800 psi	44,900 psi	0.0065
Smooth-Cast™ 310	15-20 Min.	3 - 4 Hours	3,000 psi	134,000 psi	7.50%	4,000 psi	118,000 psi	3,800 psi	44,900 psi	0.0065

Mix Ratio; 1A:1B by volume or 100A:90B by weight

Mixed Viscosity, cps; 80 (ASTM D-2393)

Specific Gravity, g/cc; 1.05 (ASTM D-1475)

Specific Volume, cu. in./lb.; 26.4 (ASTM D-1475)

Color; White

Shore D Hardness; 70 (ASTM D-2240)

Heat Deflection Temp; 120°F/50°C (ASTM D-648)

*All values measured after 7 days at 73°F/23°C

* *Depending on Mass

PROCESSING RECOMMENDATIONS

Safety - Wear safety glasses, long sleeves and rubber gloves to minimize contamination risk. Use only in a well-ventilated area

Preparation - These products have a limited shelf life and should be used as soon as possible. Materials should be stored and used in a warm environment (73°F/23°C). All liquid urethanes will react with moisture in the air, causing bubbles. Use in a low humidity environment (below 50% RH). Mixing containers should have straight sides and a flat bottom. Mixing sticks should be flat and stiff with defined edges for scraping the sides and bottom of your mixing container. **Because no two applications are quite the same, a small test application to determine suitability for your project is recommended if performance of this material is in question.**

Applying a Release Agent - A release agent is necessary to facilitate demolding when casting into or over most surfaces. Use a release agent made specifically for mold making (Universal™ Mold Release or Mann's Ease Release™ 200 available from Smooth-On or your Smooth-On distributor). A liberal coat of release agent should be applied onto all surfaces that will contact the plastic.

~IMPORTANT: To ensure thorough coverage, apply release and brush with a soft brush over all surfaces. Follow with a light mist coating and let the release agent dry for 30 minutes. Smooth-On silicone rubber molds usually do not require a release agent unless casting silicone into the mold. Applying a release agent will prolong the life of the mold.

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Safety First!

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Smooth-Cast™ 300 PART A

WARNING: IRRITANT TO EYES, SKIN & MUCOUS MEMBRANES. Contains Methylene Diphenyl Isocyanate. Do not get in eyes, mucous membranes or on skin. Do not take internally. Do not breathe fumes. Use only with adequate ventilation. Wear chemical-resistant gloves and eye protection when using this product.

First Aid: In case of eye contact, flush thoroughly with water for 15 minutes and get immediate medical attention. In case of skin contact, wash thoroughly with soap and water. If irritation persists, get medical attention. If swallowed, do not induce vomiting. Drink 1-2 glasses of water and get immediate medical attention. If vapors are inhaled or if breathing becomes difficult, remove person to fresh air. If symptoms persist, get medical attention. **Keep Out Of Reach Of Children.**

Smooth-Cast™ 300 PART B:

CAUTION: In case of eye contact, flush with water for 15 minutes. If irritation persists, get medical attention. For skin contact, wash with soap and water. **Keep Out Of Reach Of Children.**

CAUTION: HOT! When combined, parts A & B generate heat in excess of 212°F (100°C) which could cause burns to the skin. Let cured plastic cool before handling. **Keep Out Of Reach Of Children.**

IMPORTANT - The information contained in this bulletin is considered accurate. However, no warranty is expressed or implied regarding the accuracy of the data, the results to be obtained from the use thereof, or that any such use will not infringe upon a patent. User shall determine the suitability of the product for the intended application and assume all risk and liability whatsoever in connection therewith.

MEASURING & MIXING...

Liquid urethanes are **moisture sensitive** and will absorb atmospheric moisture. Mixing tools and containers should be clean and made of metal, glass or plastic. Materials should be stored and used in a warm environment (73°F/23°C).

Stir or shake both Part A & Part B thoroughly before dispensing. After dispensing equal amounts of Parts A and B into mixing container (100A:90B by weight), mix **thoroughly.** Scrape the sides and bottom of your container several times. Be careful not to splash low viscosity material out of the container.

POURING, CURING & PERFORMANCE...

Pouring - Pour your mixture in a single spot at the lowest point of the containment field and let the mixture seek its level. This will help minimize air entrapment.

For Best Results . . . Best results are obtained using a pressure casting technique. After pouring the mixed compound, the entire casting assembly (mold, dam structure, etc.) is placed in a pressure chamber and subjected to 60 PSI (4.2 kg/cm²) air pressure for the full cure time of the material.

Curing - ***Important:*** Use this product with at least room size ventilation or in proximity to a forced outlet air vent and do not inhale/breathe fumes. Fumes, which may be visible with a significant mass concentration, will quickly dissipate with adequate ventilation. Castings with significant mass may be hot to the touch and irritate skin immediately following cure. Let casting cool to room temperature before handling.

Demold time of the finished casting depends on mass and mold configuration. Low mass or thin-walled castings will take longer to cure than castings with higher mass concentration. Smooth-Cast™ 300 will cure in 7 - 10 minutes (Smooth-Cast™ 305 in 30 – 40 minutes and Smooth-Cast™ 310 in 2 - 4 hours) depending on mass and mold configuration.

Post Cure - Castings will reach "full cure" faster and achieve maximum physical properties if post cured. Allow material to cure for recommended Cure Time at room temperature followed by 4 - 6 hours at 150°F/65°C. Allow casting to come to room temperature before handling.

Performance - Cured castings are rigid and durable. They resist moisture, moderate heat, solvents, dilute acids and can be machined, primed/painted or bonded to other surfaces (any release agent must be removed). If machining cured material, wear dust mask or other apparatus to prevent inhalation of residual particles. Castings can be displayed outdoors after priming and painting. Unpainted castings will yellow over time - more quickly when exposed to ultra-violet light.

Because no two applications are quite the same, a small test application to determine suitability is recommended if performance of this material is in question.

SMOOTH-ON

Call Us Anytime With Questions About Your Application.

Toll-free: **(800) 381-1733** Fax: **(610) 252-6200**

The new **www.smooth-on.com** is loaded with information about mold making, casting and more.

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High Point, NC 27261
Tel: 336-886-5018
Fax: 336-886-7122
www.silicones-inc.com

RTV-2 Silicones Since 1974

GI-1000

Product Information

General Information

GI-1000 is an extrememly high tear strength, tin-catalyzed RTV-2 silicone rubber, which was designed for casting polyester parts. **GI-1000** is not sensitive to inhibition, meaning it will cure at room temperature over virtually any surface. It is easy to mix and de-air, and will cure with only a slight degree of shrinkage. The speed at which the rubber hardens can be accelerated with special activators. Condensation cure two-component silicone rubbers are excellent for most general mold making and prototype applications. They are excellent for casting waxes, gypsum, epoxies and other plastics. **GI-1000** is extremely useful for those applications where superior mechanical properties are required.

Typical Properties

Uncatalyzed Compound

Color	Base: White	Activator: Blue
Viscosity (cps)	Base: 50,000-70,000	Activator: 300-400
Mixing Ratio (B/A)	By weight: 100 / 10	By volume: 100 / 11.1
Viscosity (cps)	Mixed: 30,000-45,000	
Working Time	1.5 to 2.5 hours	
Cure Time	16-18 hours	
Shelf Life	6 months	

Vulcanized (cured) Properties (7 days @ 70° F / 50% relative humidity)

Shore A Hardness (±4)	One day: 28	7 Days: 32
Tear Resistance (ASTM D624)	120 ± 10 ppi	
Tensile Strength (ASTM D412)	525 ± 25 psi	
Elongation (ASTM D412)	300 ± 25 %	
Service Temperature (° F)	-60 to 350	
Shrinkage	0.10 %	
Specific Gravity	1.09	
Coverage (in^3 / lb)	25.4	
Dielectric Strength (volts/mil)	500	
Dielectric Constant (@ 100 HZ)	3.3	
Dissipation Factor (@ 100 HZ)	0.019	
Volume Resistivity (ohms/cm)	1×10^{15}	

Silicones, Inc.
RTV-2 Silicones Since 1974

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Product Information

GI-UFC (Ultra-Fast Catalyst)

General Information

This activator has been formulated to dramatically accelerate the speed at which the GI-Series bases cure. Standard working times for the GI-Series rubbers range between one and three hours with demold times between 16 and 24 hours. When used at 10%, **GI-UFC** can give a working time of ten minutes and a demold time of 60 minutes.

Typical Properties

The table below uses **GI-UFC** in place of **GI-1000A**.

Amount of Ultra-Fast Catalyst

GI-1000 Base	5%	8%	10%	12%	15%
Work Time (min)	49	17	13	9	7
Demold Time (min)	210	75	60	35	30
Share A Hardness					
30 minutes	---	---	---	0	1
45 minutes	---	---	0	4	8
60 minutes	---	---	3	10	12
90 minutes	---	3	13	16	17
2 hours	---	11	18	19	19
3 hours	---	20	23	23	23
4 hours	2	24	24	24	25
24 hours	30	30	30	30	30

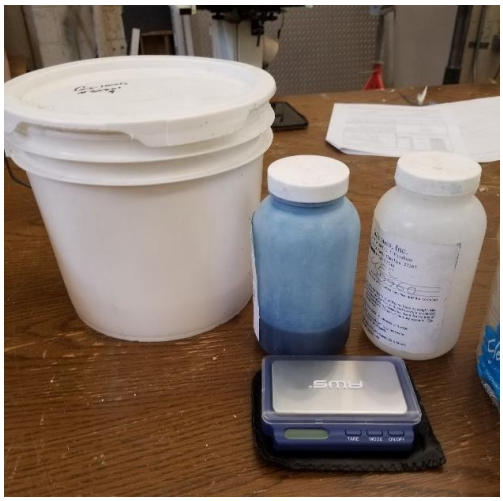
Picture Frame

Mold Material: Silicone

Casting Material: Hot Glue

Technique: Box mold; 1-Part Mold; Gravity Casting

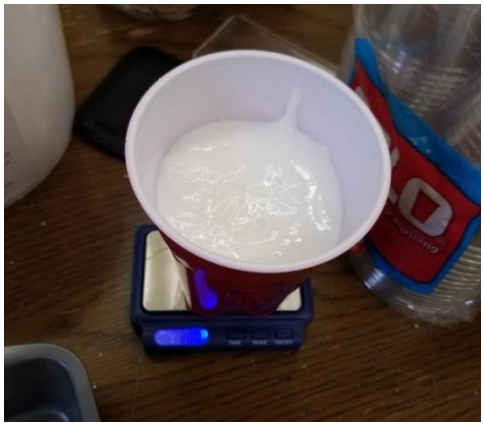
Specific Resource: https://www.smooth-on.com/tutorials/recreating-antique-frame-mold-max-29nv-vacuum-required-silicone/



1) Gather Materials

   For this project I made a one part mold of a picure frame using Silicone for my molding material. I had a small baking pan that I used as the box mold, thinking I could skip the need for foam core board. Later I will explain why this was a mistake.

   The Silicone used UFC and the GI-1000 activator to activate and speed up the molding time.



2) I glued down the picture frame and the wooden block to the cooking tin. I used the wood so that I wouldn't have to use as much silicone for the mold.
3) I measured out the silicone first, made my calculations for the appropriate amount of UFC and GI-1000 activator, and measured each amount out in separate cups. The Table 1 shows the amounts of each material used for each step. The ratios of each item are as follows:

   10 grams of GI-1000 Activator to 100 grams of silicone

   5-7 grams of UFC to 100 grams of silicone, depending on the desired pot time

Table 1	GI-1000 Silicone (g)	UFC (g)	GI-1000 Activator (g)
Part 1	380	23.1	38.0
Part 2	146.0	8.8	4.5
Part 3	45.2	2.7	2.7

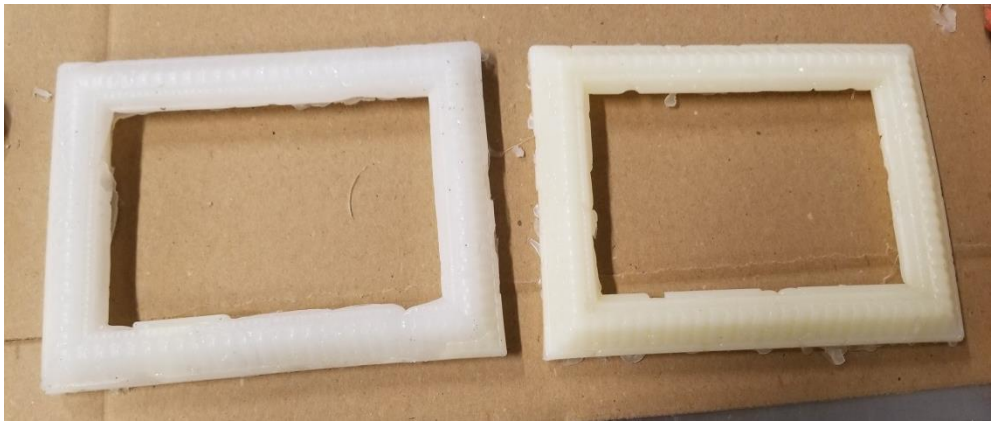
4) I poured in the Activator and the UFC into the Silicone. I stirred the mixture using a wooden tongue depressor, making sure to scrap the sides and bottom. Once the color was a uniform light blue, with no remaining streaks of white, I began to pour the silicone into the pan.
5) To avoid using too much Silicone, I put the material down slowly, and added it in parts. The amount of Silicone, Activator, and UFC has been recorded in the above table.
6) After the mold was full and the silicone was dry, it was time to remove the frame. This is where I ran into trouble.

Because the walls and base were all permanently attached to each other, it was incredibly difficult to demold the frame. I also did not use mold release, which contributed to the problem. I ended up using a box knife blade to cut around the sides of the pan and the wood block. I then had to pry the silicone mold off the frame, which was still glued down. It was difficult, but the silicone held up surprisingly well. Better, in fact, than the original frame which was broken during this process.

7) After demolding, I did need to patch one hole in the inner rim with silicone, made by accident when I was cutting around the block. I did this by mixing a very small amount of silicone, patching the hole while the frame was in the mold, and held it to dry with a tongue depressor piece.
8) The next step to this process was casting a new frame. The material I had decided to test for this project was hot glue. I originally got this idea while attending a session at the 2016 SETC convention. I first tried melting the hot glue in a small sauce pan. This did not work as well as I had hoped, as it was very difficult to pour the hot glue into the mold.

9) Because the pot melting method was so difficult, I ended up going back to using just a simple hot glue gun. This first run of casting the frame was done partially by using glue melted and poured from the sauce pot, and then I layered more glue on top using the hot glue gun. This, however, created an odd looking line of separation in the layers of hot glue from the different sources.

10) The second casting run I only used the hot glue gun to lay down the hot glue, which went surprisingly well. I used a high temperature hot glue gun, which means that I was able to fill the mold relatively quickly using this gun. This was the better of the two runs I did with this mold.



11) I chose the second frame cast to try and paint. The glue cast frame took the brown spray paint surprisingly well. The backing for the frame fit nicely into the replica frame. Unfortunately, during the process of casting I accidently broke the glass for the frame, and subsequently ruined the photo inside when I cut my hand cleaning up the glass.

Mini Ceramic Wolf

Mold Material: Silicone
Casting Material: Polyurethane Resin
Technique: Box Mold; 2-Part Mold; Gravity Casting
Specific Resource:
https://www.smooth-on.com/tutorials/making-2-piece-rtv-silicone-rubber-mold/
https://www.smooth-on.com/tutorials/mold-making-minute-2-mold-star-15-mold/

1) I measured out the square where the wolf would lay down. I put down a layer of clay, then leveled out the wolf so that the dividing line for the mold half followed line of color change. Embedded in the clay along with the wolf were hex bolts that served as keys for the mold half. I also tried to minimize the amount of silicone needed by blocking off a corner of empty space with a square column of clay.
2) After the wolf figurine was fully in the clay, I glued foam core walls around the clay base. This will be the box mold for the figurine.
3) I used mold release on the figurine, clay, and box walls. This will make demolding the first half of the mold easier.

Table 2	Silicone (g)	UFC (g)	GI-1000 Activator (g)
Half 1	222.6	12.3	22.3
Half 2	207.0	11.4	20.9

4) The first half of the mold I did with one step of silicone. In reflection, I would have been better off if I had started out by applying a beauty coat with a brush. The amount of silicone, UFC, and Activator used for each step can be found in Table 2.
5) I cut the foam core walls away from the base, demolding the silicone half from the wolf and clay. I removed the clay base from the wolf, flipped the silicone mold half over so that it sat on its smooth side, and replaced the wolf figurine within the silicone mold.
6) I replaced the box mold walls back around the silicone mold and figurine. I added a clay half-round at the base of the figurine, which would create a pour spout in the mold for casting. I also put a thinner half-round piece of clay going off the wolf's foot, creating an air vent for the later casting process.

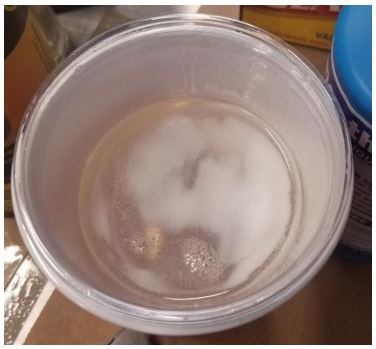
7) I created the second half of the mold once again using a single step of silicone, carefully poured into the box mold so that the clay pour spout would not move out of place.

8) After the silicone was completely dry, I once again cut away the foam core walls, removed the rectangular column of clay, and demolded the two halves of the silicone mold from the wolf figurine.

9) With the mold fully formed it was time to create a casting of the wolf figurine. The material I used to cast the figurine is Smooth-Cast 300, a liquid plastic casting resin. This resin is a two part mixture based on a 1:1 volume ratio of part A and part B. No mold release is needed when using resin in a silicone mold. Part A and part B of the resin mixture have nearly identical densities, so while I used volume as the primary way to measure the amount of resin I was using I also checked that I had similar amounts by weighing the parts A and B individually.

10) To prepare for casting the resin, I put the two mold halves together, wrapped them together in saran wrap (leaving an opening at the top for the pour spout and air vent), then sandwiched the mold between two pieces of lauan cut to size. I used two quick-grip clamps to apply enough pressure so that all of this stayed sealed together, but so the mold itself was not deformed.

11) I guessed at the amount of resin I needed to fill this mold. I measured out equal volumes of part A and part B using small clear cups of equal size.
12) I poured the two parts together in a separate, larger cup, and mixed thoroughly for about 30-60 seconds. Make sure to scrap the sides and bottom while mixing. The pot life of Smooth-Cast 300 is about 3 minutes, so I had to work quickly.
13) I poured the mixed resin into the mold, and quickly realized I had more resin than needed. I poured the excess into a clear cup and observed the resin cure. When resin cures the material heats up and quickly turns from clear to white. I tried to take pictures of this process as is happened. The following photos were taken about 5-10 seconds apart, except for the last one which was after the resin was totally cured. You can see the heat from the curing resin was enough to deform and warp the plastic cup.



14) The resin filled the whole mold and up into the pour spout and air vent. It did not leak anywhere from the seam of the mold so that was successful. The cure time is about 10 minutes, though I left the resin in the mold for about 30 minutes. To demold the resin figurine I unclamped the lauan, unwrapped the mold, easily opened up the two halves of the mold and popped out the wolf figurine.

15) Because there of how much I filled the mold, there was excess resin that hardened in the air vent and pour spout. This excess material needed to be taken off, so I used a Dremel tool with a cutting wheel on it to remove these extra pieces. I then used a sanding tip on the Dremel to smooth the bottom of the replica figurine and any other excess material around the seam.

16) The next step I attempted was to paint the figurine. This is the point where I realized that Smooth-Cast 300 does not take any type of paint well. It will adhere at first, but is easily scratched off. I tried using plastic adhering spray paint, acrylic paint, nail polish, and Sharpie. The only thing that did not scratch off was Sharpie. After talking to my mentor and doing some online research I found out that to color Smooth-Cast 300 you would use something such as SO-Strong, UVO or Ignite colorants. These are concentrated urethane pigments that can be used to color urethane rubber, resin, or foam.

Foam Hammer

Mold Material: Silicon

Casting Material: FlexFoam-iT! V

Technique: Box Mold; 1 or 2 Part Mold;

Specific Resource:

https://www.smooth-on.com/tutorials/mold-cast-foam-props-tested/

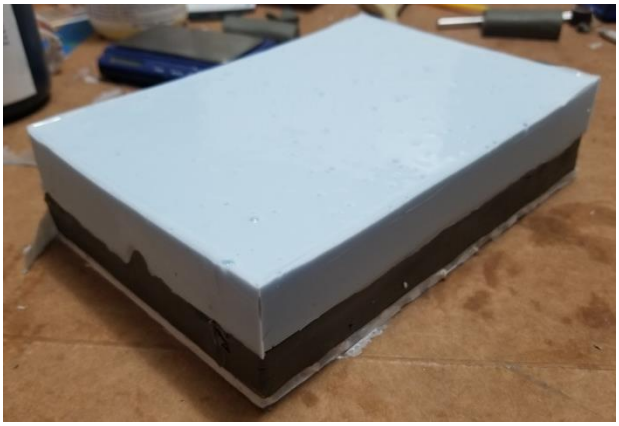
1) The hammer was embedded halfway in a pallet of clay, the size of the mold box. Hex bolts were used to make keys for purchase between the two halves of the mold, and a half-round length of clay at the base of the handle to create the pour spout.
2) I applied mold release spray to the hammer, clay, and box walls.

3) The first layer of silicone, the beauty coat, was put on using a chip brush. The amount of silicone, activator, and UFC can be found in Table 3. I left a small amount of surface area clean on the tip of the claw and on one side of the bell.

4) On these clean surface areas I positioned two pieces of thick gauged wire. When covered in silicone and later removed these wires will have formed an air vent.

5) I layered in the next step of silicone carefully, making sure the metal wires did not shift position. This half of the mold took 3 batches of silicone total.

Table 3	Silicone (g)	UFC (g)	GI-1000 (g)
Beauty Coat Side 1	131.5	7.2	13.2
Side 1 Part 2	344.9	17.0	34.2
Side 1 Part 3	157.1	8.5	15.9
Beauty Coat Side 2	294.1	16.2	29.5
Side 2 Part 2	224.2	12.2	22.5



6) I removed the walls of foam core board from around the mold, and removed the clay from the silicone and hammer. I did not remove the hammer from the silicone mold.

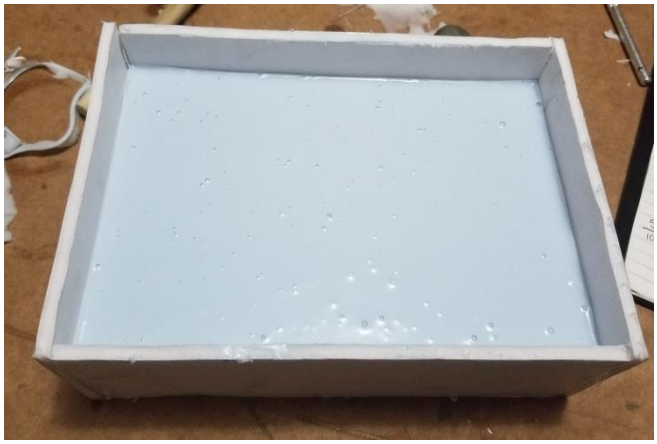
7) By flipping the silicone over so that it rests on the smooth side, the other half of the hammer will be exposed. I glued the box walls back into place around the mold for the next step.

8) To prevent the second half of the silicone mold from sticking to the first half, I used a liberal amount of mold release between the two halves.

9) I applied the beauty coat with a brush and allowed it to dry.

10) I put down another length of thick gauged wire from the other side of the claw, to create another air vent.

11) I poured in the next half of silicone, using two separate batches to complete the mold.



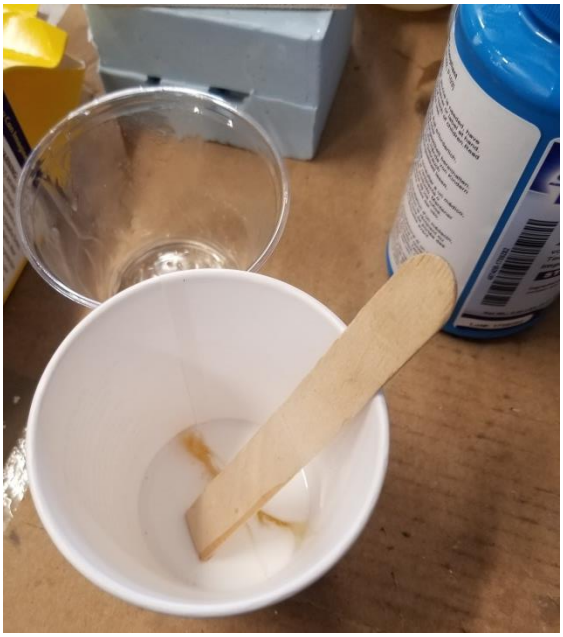
12) I again cut away the foam core board walls and carefully demolded the hammer inside, along with the thick gauge wire used to make air vents. Due to the undercuts of the hammer's claw, I had to be very careful not to tear the silicone as I removed that section of the hammer from the mold.

13) The next step in this process is to actually cast the foam hammer. I closed the mold halves together and wrapped the silicone mold in Saran wrap, leaving the air vents and pour spout unobstructed.

14) I sandwiched the wrapped mold between two pieces of lauan cut to the right size. These were clamped in place by quick-grip style clamps, providing enough pressure to avoid leaks at the seams while also not warping the mold itself.

15) The casting material I used for this hammer is called FlewFoam-iT! V, a type of urethane foam. It is mixed based on a volume

ratio of 1 part A to 1 part B, and the solution expands to about 11 times the original size. It does not need a release agent when used in a silicone mold. The densities of part A and part B differ greatly, so weighing the different parts is unnecessary and unhelpful.



16) Using a very small amount of materials, roughly 2 table spoons of part A and B each, I thoroughly mixed the solution as quickly as possible. FlexFoam-iT! V has a pot life of about 50 seconds, so time is of the essence when pouring your material.

17) I poured all of the mixed solution into the mold, and then quickly inserted a thin wooden dowel all the way to the bottom of the mold. I held it in place as the foam began to expand.

18) As the foam expanded, it eventually filled some of the air vents and came out of the pour spout. I attempted to wipe some of the excess away as it expanded out of the mold. The cure time for this foam is about 2 hours, but I left it in

the mold for about 4 hours while I was working on other projects.

19) To demold the hammer after it had cured, I removed the clamps, lauan, and saran wrap. I then carefully removed the silicone halves from the foam hammer, making sure to slide the claw of the hammer out of the undercut mold carefully.

20) I cut the excess dowel off the bottom of the foam hammer using a miter saw.

21) Immediately upon removing this first foam casting, there was a visible problem. The foam, while having had ample time to completely expand, was not fully formed to the silicone mold. In fact, it looked as if the foam had collapsed slightly while in the mold. After researching the possible cause of this, I found that this can occur if the solution is not adequately mixed, or if the room temperature is too cold. I decided to try another casting run for this hammer.

22) I moved to a slightly warmer part of the building and once again put the two mold halves together, wrapped the mold in Saran wrap, and sandwiched the mold between two pieces of lauan using quick-grip clamps.

23) Again using about 2 tablespoons of both parts A and B, I thoroughly mixed the solution in a whipping motion, scrapping the sides and bottom. I stirred for the full 50 second pot life of this material, and began pouring into the mold when I saw the beginning of expansion.

24) I inserted another thin piece of dowel all the way to the bottom of the mold, and held it in place as the foam began to expand.

25) I left the foam to cure overnight, then came and demolded it the next morning. The result of this run was much more satisfactory, having no instance of collapse with the foam.

26) I cut the extra dowel off using a miter saw. I also removed the excess foam that had formed in the air vents and along the seam.

27) I noticed something interesting when comparing the two replica foam hammers about 24 hours after creation. The first foam hammer, which had slightly collapsed inwards, had slowly re-expanded over the 24 hours to be almost the original size. While the detail had not transferred as well in the first run of the foam hammer, it ended up being a decent replica despite the minor collapsing of the foam after first cured.

Small Animal Figurines

Mold Material: Silicone
Mother-mold Material: Plaster
Casting Material: Smooth-Cast 300
Technique: One part brush up mold
Specific Resource:
https://www.smooth-on.com/tutorials/mold-prop-shield-cosplay/

1) I glued the three small figurines to a base foam core board.

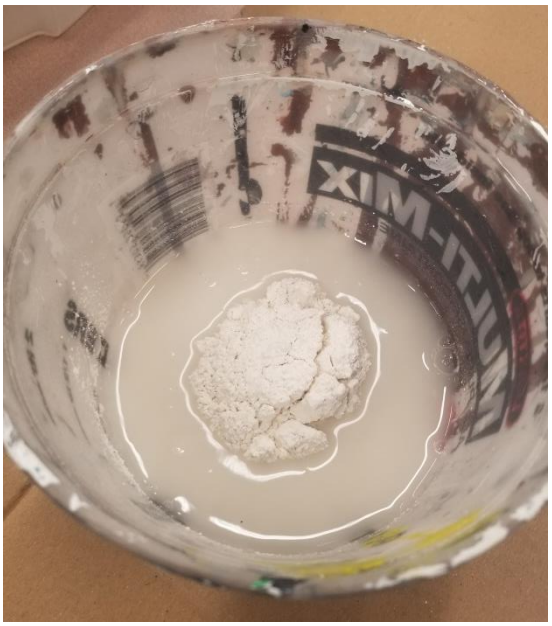
Table 4	Silicone (g)	UFC Ratio (UFC:Silicone)	UFC (g)	GI-1000 Activator(g)
Beauty Coat	149.0	5:100	7.4	14.9
Part 2	132.6	7:100	9.3	13.3
Part 3	84.5	8:100	6.8	8.9

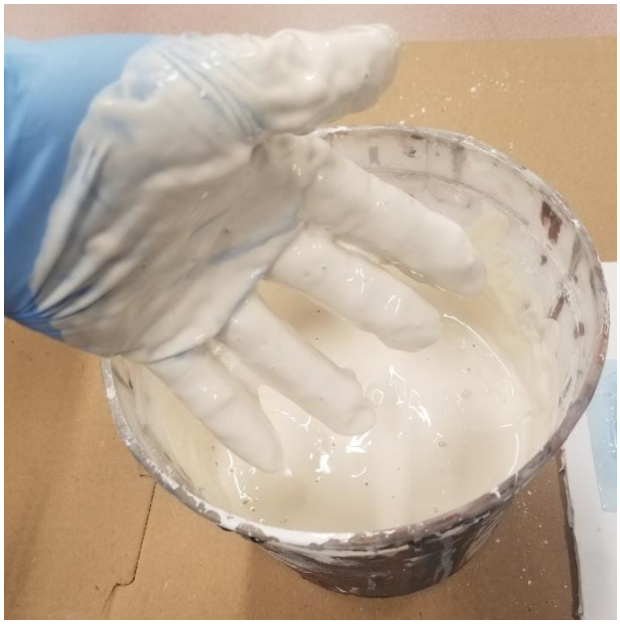
2) The first layer of silicone was applied using a small chip brush. A thin layer is painted around the figurine at this step, called a flange. This helps with building the rest of the silicone up in later steps, along with helping with placement within the mother mold later on. The amount of silicone and its accelerants for each step of silicone can be found in Table 4. Because I experimented with the amount of UFC to use to alter the amount of time it takes for the silicone to thicken and set up, there is an additional column in this table showing what ratio of grams of UFC used to grams of silicone used. Because I did not have a thickening agent for the silicone, which would be more ideal

when making a brush up mold, the UFC and speed of the silicone setting up is how I controlled my ability to pile the silicone on top of each figurine without it sliding off.

3) I mixed the next batch of silicone and piled it on top of the figurines using a tongue depressor. Because I had no thickening agent, the silicone was still fairly runny when I first applied it. However, as I continued to push up the silicone onto the figurines, the silicone thickened and eventually was viscous enough that I could leave it to finish curing. This layer provided more thickness to the silicone mold, but the covering at the tops of each figurine was still too thin, so I mixed up one more batch of silicone.
4) The 3rd batch of silicone I used the most amount of UFC in, so it started curing fairly quickly. I continued with the technique of using a tongue depressor to spread the silicone on and up the already small pile which had formed. After the silicone thickened enough to not slide off of the mold, I left the silicone to set.
5) After the silicone had fully cured, I used a box knife to cut cleaner edges around each of the silicone flanges created.

6) The next step for these little figurines was to make a mother mold to support the silicone mold. I used plaster of Paris as the material for the mother mold. I made short dividers between each silicone mold to help keep the plaster mother molds separate.
7) Mixing plaster is somewhat of an acquired skill. It is hard to have an exact ratio of water to plaster mix and it can vary by manufacturer, but usually it is roughly 1 part water to 2 parts plaster mix. I always start by adding the plaster mix to the water slowly, until peaks begin to form above the water line without dissolving down immediately. I filled a flexible plastic bucket 1/3 of the way up with water, and then began adding plaster mix. I hand mixed the plaster and added more mix until the consistency was smooth and similar to melted ice cream.





8) After getting the plaster to the initially correct consistency, I let the bucket sit for a few minutes and begin to set up. With the thicker consistency of plaster, it is easier to pile the plaster on top of the silicone molds without having it run everywhere. This consistency is similar to a thick paste, and will readily stick to your glove and itself.

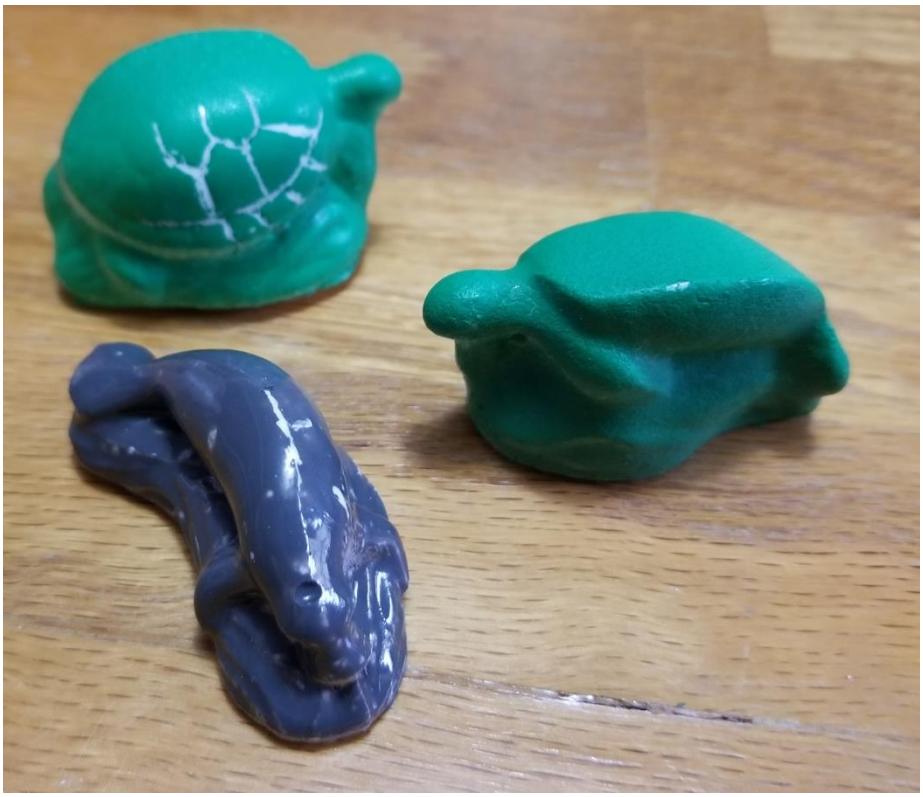
9) I began to pile the plaster on top of the silicone after it reached this thicker consistency. It was easy to pile the plaster on top of the silicone, so this process when fairly quickly.

10) After the plaster had fully dried, I was able to remove the mother molds, silicone molds, and figurines from the foam core board. Now the molds are ready for casting.
11) To avoid mixing too much resin, I measured out the needed amount of material by filling the silicone molds with water, dumping the water into a cup, and then measuring the overall volume of water used. You then let the molds completely dry out before casting with them.
12) To level out and stabilize the molds while they are upside down, with the openings up, I laid down a layer of clay and pressed each mold into the clay.

13) To mix the resin I measured out equal volumes of part A and part B. I poured the two parts into another cup and mixed quickly and thoroughly, scraping the sides and bottom. I poured the mixture into each figurine mold and let the resin cure.

14) Demolding the resin replicas was as simple as taking out the silicone mold from the mother mold and then popping out the replicas from the silicone mold.
15) I again attempted to paint these small resin replicas with spray paint (I was attempting to paint these at the same time as the work figurine replica, and made the same discovery about painting resin with each.)

16) As with the wolf replica, the paint easily scratches off of these small figurines. However, the actual casting of the pieces came out quite well.



Piggy Bank

Mold Material: Silicone
Mother-mold Material: Plaster of Paris
Casting Material: Smooth-Cast 300
Technique: 2-part brush up mold

1) To begin this mold I covered all the openings of the piggy bank with clay until the piggy bank was more like a solid pig. I was not attempting to make a piggy bank, but rather get the shape of the actual pig. I also put the pig on a small clay platform to fill in the space between its belly and the ground, so then when I created the mold the pig would not have an underside to deal with, but rather a flat bottom side.
2) I glued the pig and its platform to a foam core base board. This allows for stability and security while molding.
3) Next I divided the pig down the middle and built up a clay wall. On one side I built in small, square keys to help align the two halves of the mold later on.

Table 5	Silicone (g)	UFC (g)	GI-1000 Activator (g)
Side 1 Beauty Coat 1	70.2	5.0	7.0
Side 1 Part 2	248.5	17.3	24.9
Side 1 Part 3	195.3	13.7	19.6
Side 2 Beauty Coat 1	145.1	8.7*	14.5
Side 2 Part 2	241.4	17.0	24.0
Side 2 Part 3	73.5	5.1	7.4
Side 2 Part 4	71.7	5.0	7.2
			*UFC: Silicone equaled 6:100

4) I mixed up a smaller batch of silicone for the first beauty coat on the pig and clay wall. I applied this with a small chip brush, and created a silicone flange about 4" around the piggy bank. The amount of silicone and accompanying accelerants can be found in Table 5. For the UFC, I used a ratio of 7g UFC per 100g of silicone (except in one step.)

5) After the previous layer had dried, I mixed up a second batch of silicone. Again, I would wait a little between mixing and beginning to apply the silicone to the mold so that the material would begin to tack up. It was often still fairly runny when I began to apply the silicone, so I would need to scrap it back up the piggy bank sides with a tongue depressor and continue to layer the sides as the silicone sets.

6) As the silicone of the second batch dried, I noted that I would have to build out the bottom of the mold a bit more than the top so that a single shell mother mold can slip on and off over the top. With this in mind I mixed a 3rd batch of silicone to continue layering on to the mold, using the tongue depressor method. During this I also built up some small roundish lumps on the flange, to serve as keys for the mother mold to latch on to.

7) After the silicone in the previous step had dried I removed the clay wall from the silicone.

8) Before starting the second half of the 2-part mold, I covered the outside of the first half with tinfoil as a way to protect unwanted contact between dry and wet silicone. I also applied a liberal amount of silicone mold release on the piggy bank and already created mold half.

9) In the first step of the second half of the mold, the beauty coat, I made a mistake and accidentally mixed more silicone than intended. Not wanting to waste materials, I still applied all of the silicone I had mixed with a chip brush. This, however, is not a true beauty coat because it is too thick. This can lead to air bubbles under the silicone which can cause flaws in the mold. There were a few instances of this discovered later on.

10) I applied the next batch of silicone after the first was dry, using a tongue depressor as a way to scrape the silicone up and on the piggy bank sides.

11) After the previous layer of silicone had dried, I applied another and allowed that to dry. I then applied one last batch of silicone to the mold, both as a way to thicken the mold walls but also as a way to make the bottom bell out a bit more than the top.

12) After all of the silicone is dry I remove the tinfoil from the sides and start to peel the two mold halves apart. This can be difficult to do if some of the new silicone adhered to part of the mold lacking mold release, and it can sometimes be necessary to trim those parts away. This happened in a few places along this molds seam, but the spots were easily trimmed and separated.

13) Once it was clear that the two halves of the mold were able to be separated, I left the piggy bank in the silicone mold while the mother mold was made. To start this I first had to mix up an appropriate amount of plaster. I filled a large plastic Tupperware container up about 1/3 of the way. Slowly mixing in dry plaster mix, I eventually got to a melted ice cream consistency, and then waited for the plaster to begin to set up. When it became thicker and easier to work with, I covered the whole of the silicone mold in a layer of plaster, about an inch thick all the way around. I let that dry for several hours.

14) After the plaster had dried completely, I slipped the mother mold off and demolded the silicone from the piggy bank. Once the piggy bank was free, I realigned the two halves of the silicone mold, and then slipped the silicone mold into the plaster mold.

15) I was casting the pig replica out of Smooth Cast 300 again, so as a way to determine how much resin I would need in volume, I poured water into the silicone mold and then evenly distributed that water between two cups. By marking on the inside of the cups where the water line was, I could tell how much of each part A and part B I needed.

16) Once I knew how much I needed, I measured out equal amounts of part A and part B. I poured both parts into a separate cup and quickly and thoroughly stirred the combined mixture. I then poured the mixture into the silicone mold and allowed to cure.

17) After the resin had plenty of time to cure, I gently removed the silicone mold from the mother mold and demolded the pig replica.

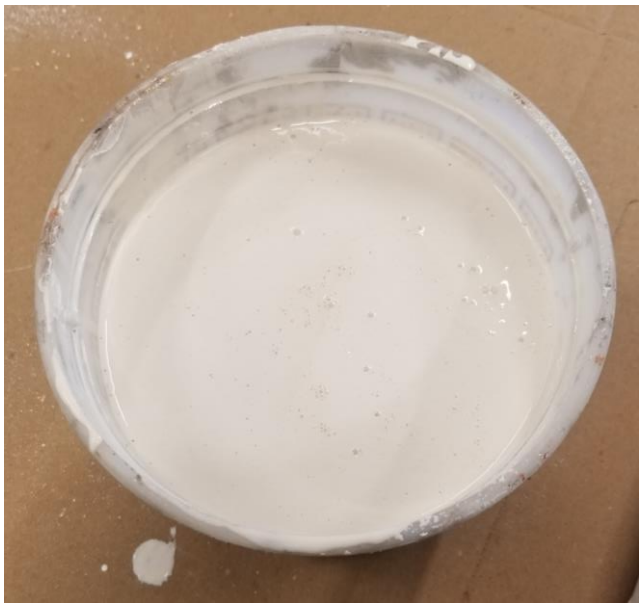
18) After demolding the pig replica, I broke off by hand some of the excess resin that had seeped out along the seam and hardened in a paper thin layer around the pig. I then used a Dremel sanding tool to smooth the seam down, buff some of the imperfections out, and smooth and round the underbelly base that the pig sits on.

19) Finally, because the original piggy bank was all white I decided to leave the final product in its all white form.

Mask

Mold Material: Plaster
Casting Material: Liquid Latex
Technique: Box mold; 1-part mold; Layered slush casting

1) To create a plaster mold of a hard surfaced plastic mask, first the mask must be glued to the base of the foam-core board box mold. Walls are constructed around the mask.
2) For a mold release, I used petroleum jelly (Vaseline). Using a small paint brush, I coated the whole mask, base board, and walls of the box mold with petroleum jelly. This kept the plaster from adhering to any of the surfaces in the box mold.
3) Next I began to mix the plaster for the mold. I filled a flexible plastic bucket about halfway up with water. I poured in plaster dry mix until little mounds began to form about the water level. Mixing the plaster by hand, I added more dry mix to the mixture until the consistency reached that of melted ice cream or a stew.
4) I tamped the plastic bucket against the table for a minute or two as a way to get air bubbles out of the plaster mixture.



5) Starting at the lowest point of the box mold, I poured the plaster mixture until it

sufficiently covered the mask. I let this sit and dry overnight.

6) With the plaster dry, I cut away the foam core board walls and removed the plaster and mask from the base of the mold box.

7) Because the glue holding the mask down did not go all the way around the border, some plaster leaked underneath the lip of the mask. What managed to leak underneath was fairly thin and easily broken off and removed.

8) When I took out the mask most of the rest of the excess plaster went with it, leaving a clean cut face mold.

9) The next step in this process is casting. While I had intended to use neoprene to do a casting, I was unable to acquire the neoprene in a timely fashion. As such, I used liquid latex in layers to create a flexible mask/face instead.

10) I put down the first two layers of latex with my last two chip brushes. After I ran out of those brushes, I ended up just using makeup sponges to spread latex around for the other 10 layers. A total of 12 layers was put down, each layer needing to completely dry before the next one was begun.

11) Above, the first picture is right after the third layer of latex was applied. The second picture is right before the twelfth layer was applied. As the layers built up, the color of the dried latex went from white to a yellowish-beige.

12) After all the latex layers had fully dried, I easily peeled the latex coating out of the mold. Using a pair of scissors I cut around the edges to that they had a cleaner line. Now I had a flexible, lightweight mask cast.

Resource Citations

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4. “Step-by-Step Mold Making and Casting Tutorials.” *Smooth-On, Inc.*, www.smooth-on.com/tutorials.