$3.00

How To: Make Molds & Castings

And Live To Tell About It!

Making a flexible mold of an original model will let you make one or many reproductions of that original in a very short time. However, some have described making flexible molds as a tedious and frustrating process that is better left to the pros.

Smooth-On is here to take the guesswork out of making flexible molds and reproductions (castings) by offering this informative overview that will introduce the reader to basic techniques as well as materials available to make flexible molds and rigid castings.

Smooth-On also offers mold making and casting seminars on a regular basis at its facility in Easton, PA. Our website is packed with even more tips on a wide range of molding & casting techniques. Questions about these materials, the mold making process or your specific project can be directed to a Smooth-On distributor or directly to Smooth-On.

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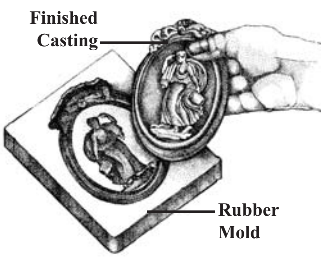
What Is A Mold, Anyway?



Simply put, a mold is a negative impression taken from a positive model (similar to the negative of a photograph). **Your objective** in making a mold is to reproduce an original model **as true to the original as possible.** The mold rubber should capture every last bit of detail, texture, dimension, etc. of the original. And human nature being what it is, we'll assume that your objective is also to make a mold **(a)** in the least amount of time possible, **(b)** with a minimum of difficulty and **(c)** with as little expense as possible.

What Are Molds Used For?

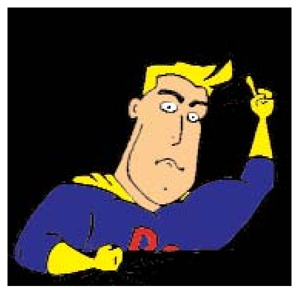
Whether or not you are aware of it, molds touch every facet of our daily life and are used for an endless variety of applications. Molds are used to create food / dessert designs (jello mold), for reproducing original sculpture or ancient carvings. Fossil hunters and museums and taxidermists make molds of dinosaur fossils, alligators, fish, etc. to make their reproductions for display. Candle makers use molds to make an infinite variety of wax candles. Special effects creators use molds to make models and figures that make movies spectacular.

Industry uses molds to produce the shoes you wear, the dashboard in the car you drive, tires on your car, cups you drink from, your porcelain bathroom sink (sanitaryware), the telephone you use, decorative moldings that adorn homes, religious and office buildings, and concrete panels used to construct buildings, etc. Get the idea?

You Can Make A Mold Of Almost Anything - *Really!*

Whether you are interested in reproducing a sculpted figure, an antique picture frame, an industrial pattern, an architectural molding, a fossil, animal skin (taxidermy), the texture of a piece of fabric, or a toy, you start by making a rubber mold.

Whether you want to make one or one thousand reproductions of an original, you can do it using a mold. Whether your original model is made from clay, wax, plaster, sand, concrete, stone, metal, bone or almost any material, making a rubber mold makes it possible to reproduce that model – exactly.



Our goal in presenting this overview is to get you to try making your own molds by showing you how easy it is.

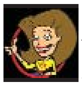
Mold Making Materials

MOLDMAKING, B.C. - People have been making molds for thousands of years, dating back to ancient Egypt and China. Through the years, a variety of materials have been used to make molds including sand, wax, glue, animal fat, gypsum, alginate, metal, plastic, re-usable vinyl, gelatin and others.

MOLDMAKERS TODAY still use a variety of materials, but a majority uses one of four different flexible rubber products for the following reasons: **1)** these rubbers **reproduce exact detail**, **2)** flexibility allows for **easy removal (demold)** from the original model and the cast piece, **3)** they generally give long life, allowing for **multiple reproductions** and **4)** because they generally yield many reproductions, which also makes them **cost effective.**

These rubber products are **latex, polysulfides, polyurethanes, and silicones.** The next few paragraphs review these common mold rubbers along with advantages/disadvantages of each.

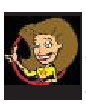
I. Latex is natural rubber extracted from rubber trees found mainly in Southeast Asia. To make this rubber usable as a mold material, the raw rubber is usually processed with ammonia and water. Latex is almost always brushed onto an original model (not poured).



Advantages -- Latex is a **one-component system** (no weighing necessary) that is ready to use right out of the container. Latex is **relatively inexpensive**. Latex is an **elastic mold rubber** and molds are generally thin-walled, strong and exhibit **good abrasion resistance**. Because of its high elasticity, a feature unique to latex is its ability to be removed from a model like a glove. A latex mold will retain its shape after being repeatedly rolled up and away (and turned inside out) from an original model or casting – like a glove. Because of this feature and its resistance to abrasion, latex is commonly used for making **"glove molds"** in the reproduction of ornamental concrete (lawn ornaments and statuary). Latex molds are also good for casting wax and gypsum.

Disadvantages -- Low-cost latex products generally **shrink** – on the order of 10 to 20% depending on product. Making molds with latex rubber is **slow and time consuming**. Brush-on molds made with latex require as many as 20 brush coats, with 4 hours of drying time between each coat. Time factor for making a brush-on latex mold is ten days or more. Many latex products have an **ammonia odor** (however, there are new latex products on the market with lower shrinkage and no odor). Latex molds are generally **not suitable for casting resins.**

II. Polysulfide rubbers (Permaflex's Black Tufy, Black Stretchy and Smooth-On's FMC Series) are **two-component systems** (base plus curative; A+B) that have been the favorite mold rubber of bronze foundries around the world (for casting wax) for years. They are available for making molds that are poured or brushed on.

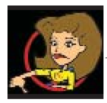


Advantages – polysulfide molds are very soft, "stretchy" and long lasting (some molds still in production are over 40 years old), and are good for making molds with severe undercuts and/or very fine detail. Unlike other mold rubbers, polysulfide rubber is **not inhibited by sulfur or water based modeling clays.** Model preparation is minimal. Once cured, polysulfide molds are good for casting wax (lost wax process) and gypsum plasters.

Disadvantages – the most common polysulfide rubbers with lead curatives have an **offensive odor.** Newly made polysulfide molds **may stain plaster**. Polysulfides have **poor abrasion resistance** (not good for casting concrete), and are **not suitable for production casting of resins.** Polysulfides (A+B) must be mixed accurately by weight **(scale required)** or they will not work. They are of moderate cost; higher than latex and urethanes but lower than silicones.

III. Silicone rubbers (***Smooth-Sil*** Series) are **two-component systems** (base plus curative; A+B) available in a hardness range of very soft to medium. Silicones can be cured with either a platinum catalyst or a tin catalyst. They are available for making molds that are poured, brushed or sprayed on to a model and have performance characteristics that no other mold rubber has.

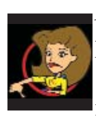
Advantages – Silicone rubber has the **best release properties** of all the mold rubbers, which is especially an advantage when doing production casting of resins (polyurethanes, polyesters and epoxy). No release agent is required, so there is no post-production cleanup. Silicones also exhibit **very good chemical resistance** and **high temperature resistance** (400°F / 205°C and higher). High temperature resistance makes silicone the only mold rubber suitable for casting low melt metal alloys (i.e. tin, pewter, lead). The combination of good release properties, chemical resistance and heat resistance makes silicone the best choice for production casting of resins.



Disadvantages - Silicones are generally **high in cost** - especially platinum-cure. They are also sensitive to substances (sulfur clay for example) that may prevent the silicone from curing (referred to as **cure inhibition**). Silicones are usually very thick (high viscosity), and **must be vacuum degassed** prior to pouring to minimize bubble entrapment. If making a brush-on rubber mold, the **time factor between coats is long** (longer than urethanes or polysulfides, shorter than latex). Silicone components (A+B) must be mixed accurately by weight **(scale required)** or they will not work. Tin catalyst silicones will shrink somewhat and do not have a long library life.

IV. Polyurethane rubbers (**PMC** Series) are **two-component systems** (base plus curative; A+B) that cover a wide variety of applications at a relatively low cost. They are available for making molds that are poured, brushed or sprayed onto a model.

Advantages - polyurethanes are easy to use, with many having a simple mix ratio **by volume (i.e. 1A: 1B) – no scale required.** Flexible urethanes are available in a **wide hardness range** from gel-like to harder than a car tire and everything in between. Urethanes have relatively low viscosity and "de-air" themselves – **no vacuum degassing required.** Urethanes have **good abrasion resistance** and are used to cast abrasive materials like concrete. They are **less expensive** than silicones and polysulfides.



Disadvantages – As silicone rubber has the best release properties, **urethane rubber has the worst release properties** and will adhere to just about anything. Thorough model preparation (we'll cover this topic later) is essential to successful mold making with urethane rubber. **Urethanes are moisture sensitive** and may bubble if exposed to too much moisture (making molds outside on a very humid day, for example). **Limited shelf life after opening** – remaining product may be affected by ambient moisture in the air. (Smooth-On makes a product called *"Xtend-It™"* that greatly extends the shelf life of unused urethanes).

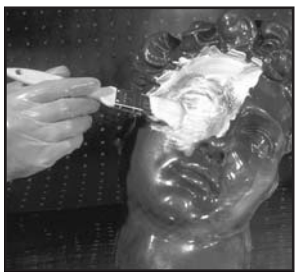
What Are 2-Component Rubbers?

Polyurethane, Polysulfide and Silicone are all mold rubber ***"compounds"*** that come in **two parts: (A + B).** To make things simple, we always package **Part A** in a **yellow container** and **Part B** in a **blue container.**

PART A = YELLOW

PART B = BLUE

Part A is mixed with Part B in some proportion **(mix ratio)** and either **poured, brushed or sprayed** onto a model.



Mold Rubber can be applied by pouring, brushing or spraying onto a model.

Liquid Rubber

To better understand and evaluate mold rubber for your own use, you need to know a few important terms:

• Mix Ratio - Expresses the correct proportion (in either weight or volume) of Part A to be mixed with Part B before applying. Mix ratios will vary from product to product and are always listed on the technical bulletin for that product. For example:

1A : 1B by volume	1A : 10B by weight
2A : 1B by weight	26A : 100B by weight
1A : 2B by volume	100A : 8B by weight

If a mold rubber requires a scale to weigh out A+B, use an accurate **gram scale** or **triple beam balance**. If you are not accurate, the rubber will not cure. If using a mold rubber that is mixed by volume, try to be as accurate as you can in your measurements.

Moldmakers Tip - A common mistake that people make is to assume that the mix ratio of one product is the same as another. **Read the Technical Bulletin and know the mix ratio for the specific product you are using.**

Important: Not all products are packaged the same. The mix ratio of a product will determine how that product is packaged, which can affect your cost.

• Pot Life - Lets you know how long you have to mix and apply the rubber before it becomes unworkable. At room temperature, most mold rubbers allow for 15 to 30 minutes to mix and apply the rubber.

Moldmakers Tip - Know how much time you have to mix and apply. If you are not careful, a rubber or plastic will set up and become unworkable in your mixing container.

• Durometer - Technically, durometer refers to the hardness of a mold rubber and ranges from a skin soft 0A to a harder-than-a-car-tire 95A.

A rubber's **Shore A hardness** generally has bearing on other properties including tear strength, abrasion resistance, etc. Most often, "flexibility" is associated with a rubber's Shore A Hardness; the lower the durometer, the more flexible the rubber. Conversely, the higher the durometer, the less flexible the rubber.

Moldmakers Tip - What "durometer" means to you in selecting a mold rubber: Selecting a rubber with a particular Shore hardness depends mainly on two factors: **(1)** the configuration of your model and **(2)** what you are casting into the finished rubber mold.

A model that has deep **undercuts** and/or severe angles (deer antlers, for example) will pose a problem in both removing the mold rubber from the model and removing the cast piece from the finished mold without breakage. For a model like this, you will want to select a **soft and flexible** mold rubber (*PMC-121/30* - Shore 30A, *Smooth-Sil 910* Silicone - Shore 18A, *FMC 205* Polysulfide - Shore 15A) that will allow you to bend and flex the rubber mold from around the model.

If your model has few undercuts, you can use a harder mold rubber (PMC-121/50 or Brush-On 50 - Shore 50A). If your model is relatively simple and you want to do production casting of concrete, you can use a very hard rubber (PMC-780 - Shore 80A) that has good abrasion resistance and will give longer mold life.

• Viscosity - indicates how well a material flows (or does not flow) and is measured in centipoise (CPS). Water has a viscosity of 1 cps and flows easily. Molasses has a viscosity of 100,000 and is thick.

VISCOSITY = HOW WELL A MATERIAL FLOWS	
• 1 cps = Water	**• 10,000 cps = Honey**
• 500 cps = Cooking Oil	**• 100,000 cps = Molasses**
• 2,500 cps = Motor Oil	

Moldmakers Tip - What viscosity means to you in selecting a mold rubber: Generally, the higher a rubber's viscosity, the harder it is for the rubber to de-air itself without help (vacuuming). Most silicone rubbers have a high viscosity (20,000 cps to over 150,000 cps) and vacuuming the material after mixing is usually recommended. If the mixed silicone is not vacuumed, you risk air entrapment and bubbles that will be reflected in the cured mold. Polyurethanes have relatively low viscosities (800 - 4,500 cps) and de-air themselves well. Vacuuming the material is usually not necessary.

For this overview, we will feature molds made with polyurethane rubber, but will offer tips along the way for using silicone rubber.

Read The Technical Bulletin

Whether you choose a Smooth-On silicone, polyurethane or polysulfide, read the technical bulletin for that product. Every Smooth-On technical bulletin has important information about that **specific product's use** (most common applications), **technical information** (mix ratio, Shore hardness, viscosity, cured strength, etc.), and much more. There is also information about safety, general moldmaking techniques and how to get the most out of your cured mold.

Safety First = These materials are safe if used properly and as directed.
Follow these general safety tips:

* **Moldmaking and casting is not for children.** Keep all materials out of the reach of children.

* **Good ventilation is essential.** You must use these products with *at least* room-size ventilation. Do not inhale fumes of rubber products, release agents, sealers, fillers, resins, plaster, etc.

* **Wearing rubber gloves** and long-sleeve garments will help minimize skin contact. If skin contact occurs, wash off immediately with soap and water. Uncured rubber can be removed from working surfaces with acetone.

Other Moldmaker's Tips

* **Be aware of your temperature.** The workshop and all materials (including your mold) should be maintained at, or near, room temperature (77° F / 25° C). The colder the environment, the longer mold rubber will take to cure and if the temperature is too cold, `(50° F / 10° C), the rubber will not cure at all. Warmer environments will reduce the amount of time you will have to mix and pour or brush on rubber.

* **Humidity should also be kept at a minimum.** High humidity will react with polyurethane mold rubbers .

* **Working surfaces should be accessible** from at least two sides and should be level in all directions. To protect the surface from spills and stains, you may want to cover the tabletop with wax paper or brown wrapping paper. Also, if you are like most people, you will want to wear "disposable" clothing. These materials will permanently stain clothing.

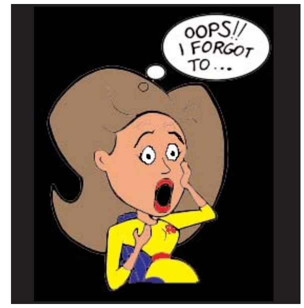
* **Don't risk a valuable model. . .** If you are unsure about compatibility between the mold rubber (sealer, release agent, etc.) and the model surface, test the material in question on a similar surface before applying to the model.

* **Make good use of your time.** While you are waiting for a sealer or release agent to dry, or for a layer of brushed -on mold rubber to "tack up"prior to applying a next layer, make good use of your time by cleaning utensils or performing other tasks. Uncured rubber can be removed from working surfaces with acetone or alcohol.

Materials Needed For Making A Mold Using Pourable Rubber

Before you begin, acquire all necessary materials and supplies:

- **An original model**
- **Wood or acrylic pieces for retaining walls to contain rubber**
- **Clamps**
- **Scale (if measuring by weight)**
- **Modeling clay**
- **Mixing containers**
- **Stirring sticks**
- **Sealing agent**
- **Release agent**
- **Mold rubber**



Oops! Make sure you have everything before you begin. Save time and money!

Making A Flat-Back One-Piece Block Mold

To illustrate, we will start by making a simple flat-back one-piece block mold of a simple model. We have broken down the moldmaking process into its basic elements. If you take each step one at a time and *follow instructions carefully*, you will be successfuI.

Step 1: Start With a Model - As stated earlier, your model can be made of virtually any material: wax, clay, plaster, stone, concrete, paper, metal, bone, fabric, etc.

Our model is a simple decorative piece made of **terra cotta,** a hard brownish-red pottery which is baked. The model measures 12" x 9" x 1".

Step 2: Build a Containment Field - The purpose of a containment field is to prevent the liquid rubber from leaking out the sides or bottom and "contain" it until the liquid turns to a solid, flexible mass ("cures").

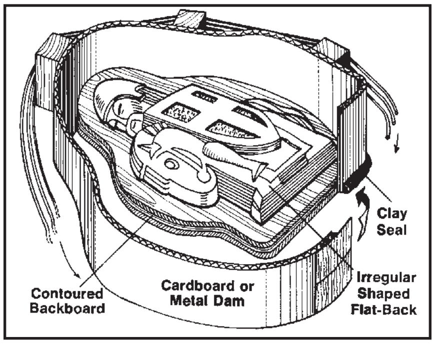
The size and shape of the containment field depends on the size and shape of your model. If your model is small, the containment field can be something as simple as a paint can, cigar box, cake pan, coffee can, etc. If it is large or of an irregular shape, you will have to construct a **" mold box."**

For step-by-step details on constructing a mold box, contact Smooth-On and ask for the *Mold Box Technical Bulletin.*

We begin by centering our model on a platform of plastic that is at least twice the size of the model. (Wood can also be used. We selected acrylic because mold rubber easily releases from it). Pre-cut pieces of acrylic are assembled around the model and are tightly secured with clamps. These are the retaining walls. Finally, everything should be **level**.

Note that there is ample room surrounding the model (at least 1/2" or 1 cm in all directions, including up and over the highest point of the model). These spaces between the model and the walls of the mold box define the wall thickness of the finished mold. The space above the model defines the foundation thickness of the finished mold.

For molding irregularly-shaped molds, the baseboard can be cut to the desired contour. Use light gauge sheet metal, linoleum or cardboard for the side wall. Overlap and tape pieces toge-ther. Hold in position with cord and wedges.



Step 3: **Secure the Model -** Using silicone caulk, a glue gun, *Super Instant Epoxy*™, or clay, **you must secure the model to the baseboard.** We have rolled modeling clay into thin beads and pressed the clay around the back perimeter of the model. We then center the model in the mold box and press firmly on the piece in all directions. This flattens the clay and creates a tight seal under the model to prevent rubber from leaking underneath. You can also nail or screw the model to the baseboard, but this damages the model. **If the model is highly porous, it should be vented from underneath to prevent trapped air from forcing bubbles in the rubber.** Drill 2 or 3 holes (1/4"-3/8" through the baseboard and into the back of the plaster model.

Step 4: **Seal the Seams -** To prevent the liquid rubber from leaking out the sides or bottom of the mold box, all seams are sealed. You can use silicone caulk, a glue gun, *Super Instant Epoxy*™ or modeling clay. (**Remember,** if using silicone rubber for your mold, do not use silicone caulk.) For this demonstration, we have rolled modeling clay into thin beads and pressed it into all seams (**horizontal** and **vertical**) that might leak rubber.

Step 5: **Apply Sealing Agent -** Models made of **porous** materials (plaster, stone, concrete, wood, etc.) require a sealing agent to seal surface porosity. Clays that are water-based or sulphur-based must also be sealed. Suitable sealers include shellac, paste wax, and petroleum jelly thinned with mineral spirits. Smooth-on ***SuperSeal***™ is a non-intrusive sealer that does not interfere with surface detail and can be removed with warm water. For this demonstration we apply two coatings of SuperSeal™ and let dry. **Note:** if using **silicone** rubber, do not use shellac to seal the model. Use *SuperSeal*™, petroleum jelly or an acrylic spray.

Step 6: **Apply Release Agent -** After sealing the model's surface, applying a release agent will allow our model to be easily released from the cured rubber. ***Use a release agent specifically made for moldmaking and casting.***

Using the wrong release agent will result in the mold rubber sticking or bonding to your model--**AND YOU WILL NEVER GET IT OFF!** (Or the mold rubber will not cure).

Wrong Release Agents	**Right Release Agents**
Spray Vegetable Oil (Pam)	Universal Mold Release
Mineral Oil	Mann Ease Release 200
Petroleum Jelly	Mann Ease Release 2300
Motor Oil	
Spray Lubricants (WD40)	

Mold release agents come packaged in both convenient aerosol sprays or economical liquids that can be brushed on or sprayed on using a non-aerosol sprayer.

Note: If using a silicone rubber, such as *Mold Max™ 30,* do not use a silicone-based release agent to release the mold rubber from the model. It is not necessary. If releasing silicone rubber from silicone rubber (making a two-piece block mold, for example), use ***Mann's Ease Release***™ ***200*** non-silicone-based release.

Proper Application Of The Release Agent

Warning! Failure to properly apply a release agent will result in the rubber completely sticking to the model, or sticking in some places but not in others (spot sticking).

The proper way to apply a release agent is to:

1) Apply a light mist coating over the entire surface of the model and surrounding forms (any surface that will come in contact with the rubber).

Do not over-apply!

2) Use a clean paint brush to brush the release agent over the surface of the model and surrounding forms. Make sure that intricate detail, undercuts and hard-to-reach areas are **coated as thoroughly as possible.**

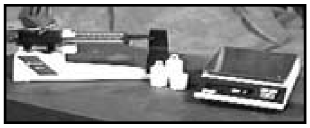
3) Apply another light mist coating and let dry for 10 minutes.

Do not soak your model with release agent. Over-applying release agent will result in tiny bubbles on the working surface of your finished mold (pin-holing) and will be reflected in castings taken from the mold. This is undesirable.

Once "sealed" and "released," our model is now prepared. The next step is to measure, mix and pour the mold rubber over our model.

Measuring Mold Rubber

As stated earlier, some mold rubbers require accurate weighing of components **(A + B)**. These include most silicones (Smooth-Sil series), polysulfides (FMC series) and some polyurethanes PMC series). If you are using a mold rubber that requires a scale, use an accurate scale such as a gram scale or a triple beam balance.



Moldmakers Tip - **Do not** use a dietary scale, postal scale, etc. They are not accurate enough!

If you are using a mold rubber that is mixed by volume (such as 1 cup of Part A + 1 cup of Part B), try to be as accurate as you can.

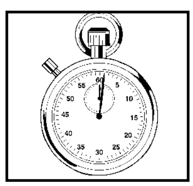
Important: If so directed, you must pre-mix Part A and/or Part B before dispensing into the mixing container. Failure to do so may cause improper curing. **Read the technical bulletin.**

For this demonstration, we are using **PMC-121/30** urethane rubber. The mix ratio is a convenient 1A:1B by volume. Fill a measuring container to the top with Part A and empty into a mixing container. Repeat with Part B.

Mixing Mold Rubber

One of the most common reasons for mold rubber not properly curing is improper mixing. It is imperative that you develop and practice a good mixing technique.

Mix Parts A + B for **at least three minutes.** If you are mixing rubber for the first time, use a clock or stopwatch to monitor your time.



- ***Be Thorough, Not Fast!*** Most mold rubbers give you plenty of time to mix and apply.

- Do not whip the material or create a vortex -- this will introduce air into the mix that may result in air bubbles on the working surface of the finished mold.

- Stir slowly and deliberately, making sure that you **scrape the sides and bottom of your mixing container several times.**

Moldmakers Tip - **When you think you have mixed the rubber enough, mix it again just to make sure.**

Vacuuming Rubber

Note: As stated earlier, urethane rubbers generally have low viscosity and de-air themselves readily. After mixing most **silicone rubbers** that have high viscosities, you would now place the mixing container in a **vacuum chamber** to remove entrapped air.

Vacuuming Rubber: How It Works

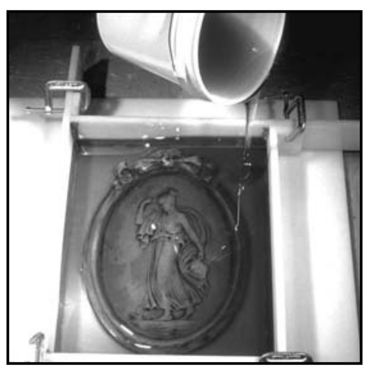
Once inside the chamber, a lid is placed over the chamber and a hose is attached to an opening at the top. The vacuum pump is activated. All of the air in the chamber (including air that is entrapped in the high-viscosity rubber) is removed from the rubber after about three minutes. As the air is sucked out of the mixed rubber, it will rise and expand three times or more its normal volume.

Once the air is removed, the rubber falls back to its initial volume and it is ready to be poured into the mold--virtually bubble-free. If bubble tolerance is low, vacuuming a mold rubber is one way to minimize bubbles.

The other is a technique called **pressure casting**, and it involves subjecting the mold rubber (or plastic) to pressure after it has been poured over the model. See "pressure casting" explained in the "casting" section of this presentation on page 16.

Pouring Mold Rubber

With the mold rubber thoroughly mixed, it is now time to pour it over our original model. Do not pour rubber directly onto the model as this may entrap air. Instead, find the lowest point in the mold box and pour the rubber there -- in a single spot and at a slow, constant rate. Let the rubber rise up and over the model. This will displace air from the lowest point and help minimize air entrapment.

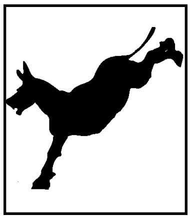


You will notice tiny air bubbles rising and dissipating on the surface. You can further dissipate these bubbles by lightly passing a heat source (hair dryer or heat gun) over the surface.

Let the Rubber Cure...

The next step is easy . . . let the rubber turn from a liquid to a flexible solid (cure) overnight (16 hours) at room temperature (77° F /25° C).

Accelerating the Cure



If you want to **reduce the cure time** of the rubber, you have two options:

1) *KICK-IT*™ cure accelerator can be added to most Smooth-On urethane rubbers and will reduce the cure time from 16 hours **to as little as one hour**. *KICK-IT*™ is added to Part B and mixed thoroughly before adding Part A. Consult the *KICK-IT*™ Technical Bulletin for more information. (*Accel 'T'*™ will accelerate silicones and *FMC Fast Curative* will accelerate polysulfides.)

2) Apply Heat. Warmer temperatures will cause the rubber to cure faster. After the rubber has gelled (one hour), place the mold box in an oven at 150 °F / 66°C for four hours. Let the rubber cool for one hour before demold. Caution: do not use your kitchen oven, as accidents and spills can happen.

Demold

After the rubber has cured, it is time to remove our original model from the finished mold, or **"demold."** The clamps and retaining walls are removed from the sides of the solid rubber.

If all went well . . . The rubber flexes easily and the original model should release from the cured rubber. The mold should reflect every last bit of detail (down to a fingerprint) of the original model.

Option: Post Cure the Rubber for Better Performance

Although not necessary, post curing the mold will increase the physical and performance properties (better tear and abrasion resistance, for example) of the cured mold. Place the mold in an oven for 4-6 hrs. at 150° F / 66° C. Let cool to room temperature before using. Follow the recommended post-cure schedule given on the back of the mold rubber's technical bulletin.

If All Did Not Go Well . . .

Universally Recognized Signal:
"My Mold Rubber Did Not Cure!"

What Can You Do?

- **Remain Calm!**
- **Contact Us -** We can help you figure out where you might have gone wrong.
- **Try Again.**

? ? ? What Went Wrong ? ? ?
Most Common Reasons For Unsuccessful Mold Making Attempts

1) Problem: Mold Rubber Did Not Cure

Did Not Cure At All . . . Still Liquid Or Gel-Like

A) Wrong Mixing Proportions (Mix Ratio). For example, rubber was mixed 1A:1B by volume instead of the correct mix ratio of 2A:1B by weight.

B) Did Not Use An Accurate Scale. Example: A bathroom scale was used to weigh A+B instead of an accurate gram scale or triple beam balance.

C) Room Temperature Too Cold. Example: After pouring rubber at 4 p.m., heat in shop was turned off before leaving for the night.

2) Problem: Partial Cure (Soft Spots)

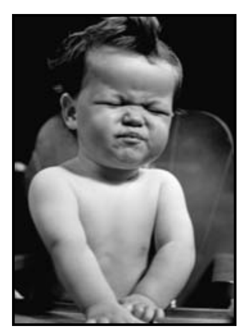
A) Not Mixed Thoroughly Enough.

B) Not Accurate Enough In Measuring A + B -- either by weight or by volume.

C) Did Not "Pre-Mix" Either Part A or B (as directed by the technical bulletin).

D) Model Was Not Properly Prepared (sealed and released) resulting in contamination that inhibited the cure of the rubber.

3) Problem: Mold Rubber Stuck To My Model



A) Model Was Not Properly Sealed- Either the wrong sealer was used or not enough was applied to the model.

B) Model Was Not Properly Released - Either the wrong release agent was applied, not enough was applied, or it was not applied properly (as directed).

Other Common Pourable Mold Configurations And Techniques

The next few pages offer instructions on making other types of molds using pourable mold rubber. These molds include:

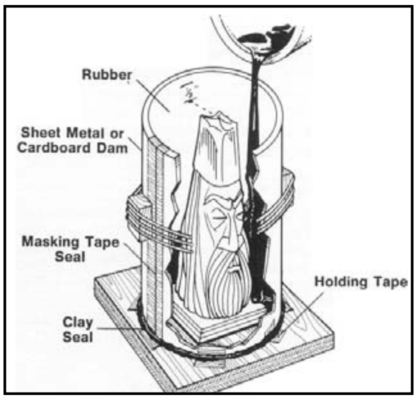
A) Cut, one-piece mold, unshelled (without a support shell).

B) One-piece mold, shelled (with a support shell).

C) Split one-piece mold, shelled (with a support shell).

D) Multi-piece mold, unshelled or shelled.

Split, One-Piece Mold, Unshelled
(Without A Support Shell)

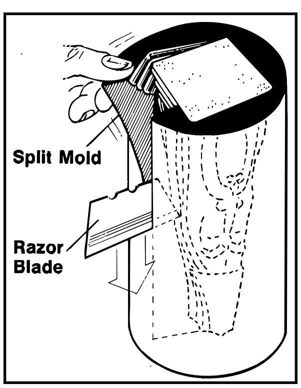


Models that are three-dimensional, having one long axis and one short axis, or those that are somewhat conical in shape without deep undercuts (candles, for example) can be molded in one piece and cut with a razor blade or sharp knife.

The containment field can be a paint can or bucket. If you need to construct, you can use sheet metal or cardboard and contour to any shape model provided that the baseboard is shaped to allow proper thickness of rubber between the model and sides.

Again, make sure that the model is fastened and sealed securely to the base board with clay or a glue gun. Apply sealing agent and/or release agent to model as necessary, and secure containment field walls with tape or a glue gun.

Moldmakers Tip - When pouring the rubber, pause to tilt the whole assembly in all directions to move out entrapped air.



After the rubber has completely cured and the containment field has been removed, use a razor knife to carefully cut the mold down one side and half way across the bottom, on a line that will facilitate ease of removal.

Rubber bands or mold straps can be used to hold the mold tightly together and, if it will not support its own weight, the containment field can be used as a support.

Shelling A Mold

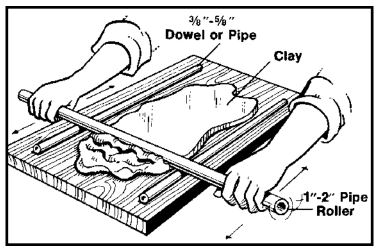
The biggest advantage to "shelling" a mold is that it minimizes the amount of rubber used. This saves you money.

"Shelling a mold" refers to the use of plaster and clay to fill space that would otherwise be occupied by rubber. The greater the difference between the peaks and valleys on the surface of the model, the greater becomes the savings realized by shelling rather than by pouring around a model, using only perpendicular flat or round retaining walls. Had we made a "shelled" mold of our first cameo model, rather than pour rubber around it, **we would have used much less rubber.**

Additional Materials Needed for Shelling A Mold:

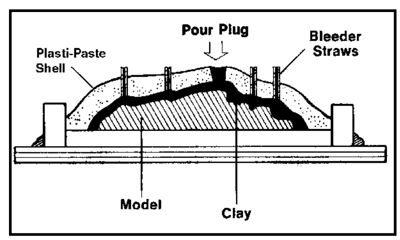
- Molding plaster and water
- Water clay or other soft modeling clay
- Aluminum foil or cellophane plastic wrap
- Plywood or acrylic sections for foundation

One-Piece Mold, Shelled
(With A Support Shell)



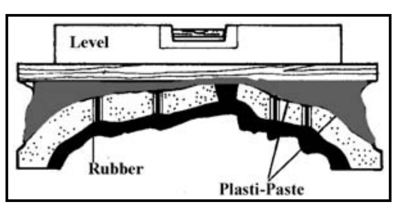
Example: Rolling soft clay into thin sections.

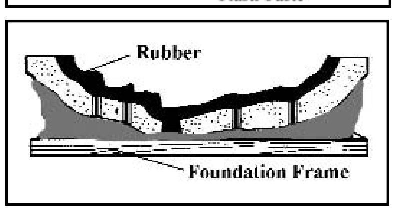
A mold box is constructed and our model is centered and secured to the platform. Aluminum foil or cellophane plastic wrap is then laid over the model. Roll clay to the desired thickness (3/8"/ .95 cm) between 2 dowels or pieces of pipe cut up into small sections and laid over the model. Close clay joints, and apply release agent.



Add a clay plug to the highest point, to form the pour hole for the rubber. Set pieces of soda straws or small removable dowels in all high points of the clay. These will serve as air vents and allow air to escape while rubber is being poured. Mix and apply ***Plasti-Paste***™ from Smooth-On to form the shell.

Once the *Plasti-Paste*™ has cured, remove the shell and clay strips from the model surface. Apply release agent to inside of *Plasti-Paste*™ shell, and fit exactly over model. The next step is to mix and pour rubber. Pour rubber slowly into pour plug. Air will vent out through the bleeder straws. The liquid rubber will fill the space previously occupied by the clay.

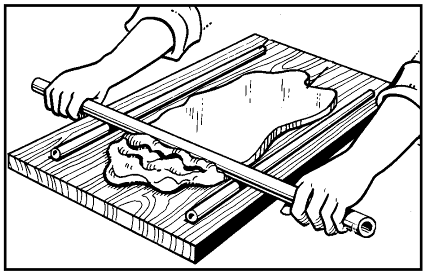




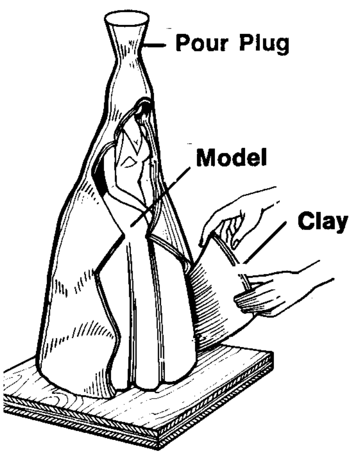
When the rubber has cured, build a level foundation frame on the shell. Mix *Plasti-Paste*™ and build a suitable support for the foundation frame. Using a carpenter's level, build the framework so that the mold will be perfectly level when casting into it.

The Cavity Pour Technique

The split, one-piece shelled mold is another technique that minimizes the amount of rubber used. To illustrate, we select a three-dimensional figurine that has a relatively long vertical axis, is narrow at the top and larger in circumference at the base. The model is secured to the base with clay or a glue gun.

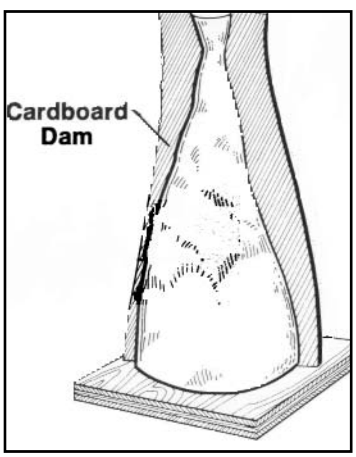


As was done with our one piece-mold (shelled) that was illustrated earlier, modeling clay is rolled into thin sections. A clay blanket is layered over the model, and a "pour plug" is formed at the top. (As you will see, once our support shell is formed and the clay blanket removed, the liquid rubber will be poured through this pour plug).



The next step is to identify or "map out" where the segments of the support shell will be applied. The number of shell segments depends on the complexity of the model (angles and undercuts). This model is relatively simple and therefore requires a two-piece support shell.

A vertical center line is lightly inscribed up one side and down the other. This line identifies the two halves of the shell. Cardboard templates, of width equal to the thickness of the support shell, are cut to conform to the contour of the center lines. The templates are gently affixed (pressed into the clay along the center lines).

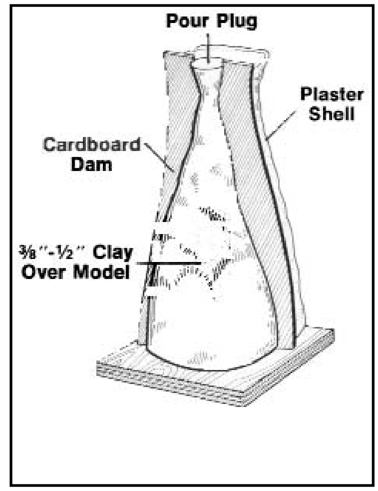


Applying The Support Shell

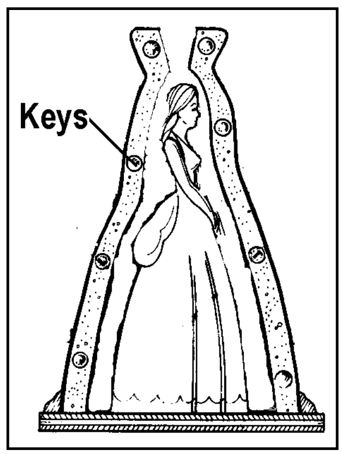
The purpose of a support shell is to maintain the shape of the cured rubber mold and prevent distortion when casting (pouring) into it (making a reproduction). There are a variety of support shell materials to choose from.

The most common is straight plaster or plaster mixed with chopped fiber. It is inexpensive, easy to work with and versatile. A disadvantage to using plaster is that it is heavy. Large support shells are cumbersome to handle.

Alternatives include fiberglass and polyester resin--also cheap and very lightweight, but noxious fumes are a problem. *Smooth-On* makes a mother mold material called **"Plasti-Paste™,"** a fiber-filled, two-component plastic that is easy to use, lightweight and has no odor. It is more expensive, however, than both plaster or polyester.



For this illustration, we mix plaster and water. While waiting for the plaster to thicken to a "workable" consistency, vaseline is applied to the cardboard templates to release the plaster once it is set. Chopped fiber is mixed with the plaster to thicken and the first half of the plaster shell is then built up, working away from the templates.



When the plaster has set, remove the cardboard templates. What remains is the first half of the support shell. Using a knife or screwdriver, carve out circular notches--or registration keys--at regular intervals around the inside perimeter of the shell. As we will see later, these "keys" provide a locking mechanism when both halves of the shell are complete and everything is assembled for casting.

Petroleum jelly will separate the second half of the shell from the first half, and is applied to the inside perimeter. Make sure the key notches are well-coated.

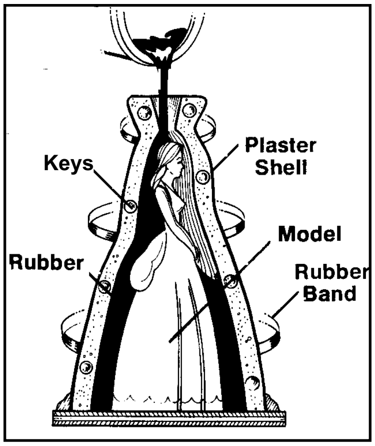
Plaster and water are again mixed with chopped fiber and built up to form the second half of the shell. Make sure that the negative key notches are filled with the plaster mix.

Once the plaster is dry, it should separate easily from the first half of the shell. Note that the positive keys fit exactly into the negative notches, providing the desired registration effect.

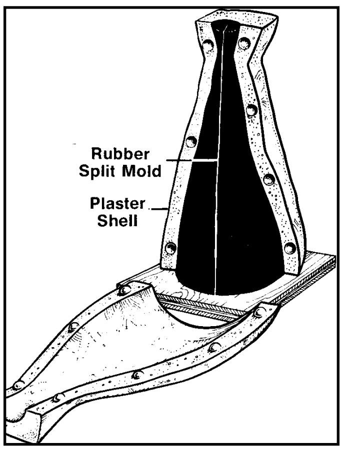
Next, both shell halves should be removed, and the clay removed from the model surface and perimeter.

Seal the inside of the plaster support shells with Smooth-On's **SuperSeal™** or shellac and let dry. Follow with a thorough application of **Universal Mold Release™**. If pouring silicone rubber, use **acrylic spray only** as the release.

Apply sealer and release agent to the model surface as previously directed, and assemble the shell halves over the model. Be careful to position the shell halves exactly as they were when the clay was present. Use the keys to align and secure the shell tightly together with mold straps, elastic bands or tape.



Mix mold rubber as previously directed and pour slowly into the pour plug. If necessary, seal any leaks along the shell seams with modeling clay. Let the rubber cure as directed on the mold rubber's technical bulletin.



After the rubber has fully cured:

__Demold__-- Separate the two halves of the plaster shell and remove from the cured rubber. Using a razor knife, cut the rubber vertically from top to bottom at a single point (preferably on the back of the model so that any seam that might be reflected in the casting will be on the back). Cut slowly and carefully. Don't cut yourself!

For More Complicated Models. . .

The techniques covered thus far address making molds of relatively simple models. These techniques fall short, however, if the model is moderately complex. These include:

Figurines with spaces between the arms/and or legs and the body. *(Courtesy Maslyn Studios)*

Models that have severe undercuts.

Models that have severe reverse draft, such as an hourglass.

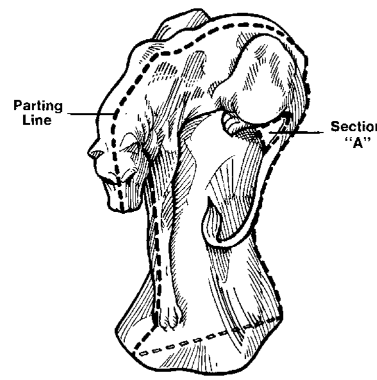
The main issue in considering these three examples is **ease of demold.** You must develop a ***plan of attack*** for making a mold of your piece, and consider how much of a challenge demolding it will be--either in removing the original model from the cured mold, or removing a casting from the finished mold.

Plan Ahead . . . Avoid "Mechanical Lock"

The risk in not properly "engineering" your mold for easy demold: the model can become "mechanically locked" inside the mold structure. The only remedy you have if your piece becomes mechanically locked is to destroy the mold to remove it.

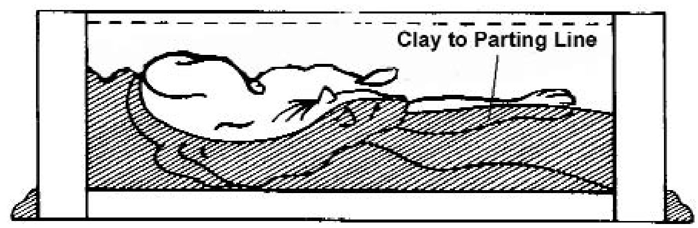
Two-Piece, Open-End Mold

To illustrate making a two-piece, open-end mold, we will use a model ("Jungle Cat") that has some reverse draft, a difficult undercut (under the mouth) and a space between the tail and the back left foot (Section A).



The first step is to **visually divide the model** into two halves.

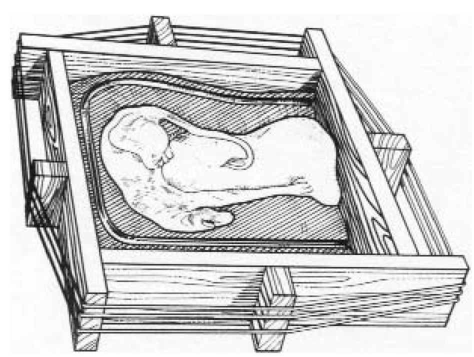
The parting line is inscribed (as illustrated) and the model is laid horizontally into a moldbox. Modeling clay is then built up from the platform to the parting line. The model should be as level as possible and parallel to the base.



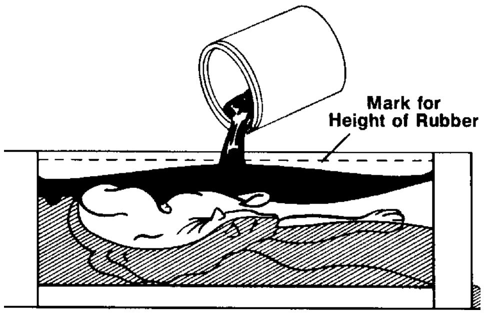
Mold box side walls are then adjusted, giving enough space around the model to allow for suitable rubber mold wall thickness.

When there are openings through the model (Section A), they must be __cored__, and this is done by laying out the center line about midway between the top and bottom side of the opening and building the clay up to that line.

After the clay is fully built up to the parting line, the top surface is smoothed with fingers (use alcohol or other solvent). Keys and/ or a registration line can then be inscribed around the perimeter of the model.



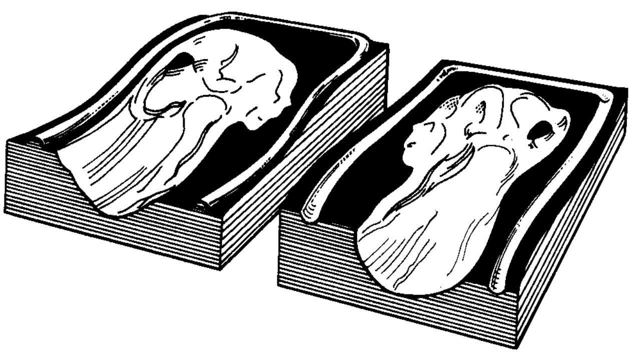
Apply a sealing agent and release agent as directed (depending on the mold rubber you are using) over the model, clay and sidewalls of the moldbox. Mix and pour rubber as directed, making sure to have at least a half-inch (1.27cm) of rubber over the highest point of the model. Let the rubber cure overnight.



After the rubber has fully cured, remove the side walls and all clay **without separating the model from the rubber.** Thoroughly clean the side of the model that was embedded in the clay (acetone works well to remove clay), and remove any residual clay from the cured rubber.

Place the cured rubber with model face up into the moldbox. Level and secure sidewalls on all four sides, again making sure there is at least a half-inch (1.27cm) clearance above the highest point of the model. Apply a sealer (*SuperSeal*tm*)* to the model, if necessary, and let dry.

Apply a release agent over the model and mold rubber. If using polysulfide or urethane rubber, use *Universal Mold Release*tm. If using silicone rubber, use *Mann Ease Release*tm *800* or vaseline thinned with mineral spirits for separating silicone from silicone. **Do not use silicone-based release agents, as this will cause the silicone to stick to itself.** Mix, pour rubber, and let cure as directed.



Demold-- After the rubber has fully cured, remove the model from both halves. Assemble the mold by aligning the positive and negative keys. Use heavy rubber bands or mold straps to hold both halves together when casting into the mold.

Smooth-On offers a variety of economical trial-size kits that allow the user to "test drive" the products. Also called "lunch boxes," these kits are available from your Smooth-On distributor. Shown here is the Universal Mold Release / Super-Seal combo-pack.

Making A Mold By Brushing Rubber Onto The Model

So far, we have described techniques for making molds using mold rubber that is mixed and poured. But, what if your model is 8' high by 8' long by 4' wide (2.4m x 2.4m x 1.2m) such as a horse figure or even larger. What if your model is multi-faceted with severe undercuts, such as an octopus. Demolding such a model would be very difficult, indeed.

You could pour rubber over the above and make a multi-piece mold, but the amount of material required would be considerable and very expensive. Sections of the finished mold, once assembled for casting, would be very heavy and cumbersome to handle.

And what if your model is permanently affixed to the side of a building (such as is the case with architectural restoration applications)--20 stories in the air. Or perhaps you want to make a mold of a model that is inverted (hanging upside down), such as an ornate ceiling medallion surrounding a light fixture? You can not, of course, pour rubber over models such as these.

The only answer is to make a mold by brushing (or spraying) rubber onto the model. Rubber is brushed onto the model in layers until a suitable thickness is "built up." The rubber is allowed to cure and a support shell is applied prior to demold.

The advantage of making a mold by brushing rubber onto the model is that it minimizes the amount of rubber used, saving you material costs. Making a brush-on mold, however, requires more time and labor vs. pouring rubber.

Brush-on rubbers come in different forms and may be mixed one-to-one by volume (urethanes such as ***Brush-On 40*tm*, Brush-On 50 or EZ~Mix 45***tm), or may require an accurate scale for weighing components (***PMC-724***tm urethane, ***Mold Max***tm ***30*** silicone, or ***FMC-200***tm polysulfide).

Making A Brush-On Mold Step-By-Step

The process for making a brush-on mold begins much the same as making a pour-on mold. Having all necessary tools and materials on hand before making the mold will ensure a pleasant mold making experience:

Mold Rubber (i.e., Brush-On 40)	**Mixing containers (Bowls)**
Glue Gun or Silicone Caulk	**Mixing Sticks**
Measuring Containers (cups)	**Sealing Agent (SuperSeal or Shellac)**
Release Agent (Universal Mold Release)	**Latex Gloves**
Liquid Paint Pigment (optional)	

The model we will use to illustrate the brush-on process is a three-dimensional bust of Joseph Brown, former Professor of Sculpture at Princeton University. The bust was sculpted by Tim Maslyn (Maslyn Studios) out of modeling clay and measures 22" x 10" x 10" (55.9 cm x 25.4 cm x 25.4 cm). We will be featuring **Brush-On 40** urethane mold rubber to make the mold and **Plasti-Paste** Trowelable Plastic to make the support shell.

Step 1: Mount Base To Platform - The model should be mounted to a base (using a glue gun or silicone caulk) and accessible from all sides. A platform that rotates 360 degrees makes brushing rubber onto the model very easy. Simple platforms are usually available at ceramic or sculpture supply stores.

Step 2: Seal All Surfaces - Because the model is made of plaster, it must be sealed using either *SuperSeal* or spray shellac. Also, apply sealer to the baseboard. **Remember:** Failure to seal the model may result in the mold rubber sticking.

Reminder: If you are using silicone rubber (such as *Rebound 25*) to make your mold, do not use shellac as a sealer. Instead use either *SuperSeal* or acrylic spray.

Step 3: Apply A Release Agent - *Universal Mold Release* is essential for releasing the mold rubber from the model and baseboard Remember the proper way to apply release agent:

- Apply a light mist coating to the model surface and surrounding forms including mounting platform.

- To ensure thorough coverage, use a soft brush to brush the release over the model's surface, into undercuts and over areas of fine detail.

- Apply a second light mist coating and let dry for 10 minutes prior to applying the mold rubber.

[If using silicone rubber, do not use Universal Mold Release. Instead use **Ease Release 200**].

Measuring Mold Rubber

The mold rubber we will feature for this demonstration is *Brush-On 40*. Part A is a liquid and Part B is a paste. When combined in equal amounts (by volume--no scale required), Brush-On 40 self-thickens and can be applied to a vertical surface without sagging.

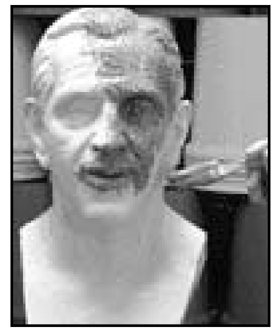
Dispense the paste (Part B) into the measuring container. Using a spatula or stirring stick, be sure to eliminate any air voids. Use a spatula to level off at the top and thoroughly empty contents into a mixing container. Fill the same measuring cup to the top with the Part A liquid and empty into the the mixing container.

Mixing the Rubber

Moldmakers Tip - Add a drop of "SO-Strong" tint or similar liquid pigment before mixing Parts A & B. Coloring every other layer of rubber will ensure thorough coverage and minimize "thin spots" in the finished mold.

With Parts A and B now properly measured and dispensed into the mixing container, **mix thoroughly** for at least three minutes, making suring that the sides and botton of the container are scraped several times. Parts A + B should blend thoroughly to a uniform color without and signs of streaking in the mix.

Applying The Rubber

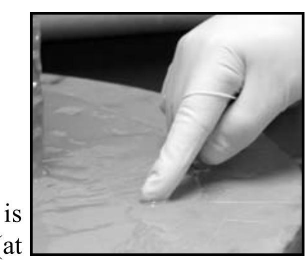


At least four thin layers of *Brush-On 40* are necessary to build a suitable mold thickness. Generally, 3/8"-1/2" (.95 cm - 1.3 cm) is adequate.

The first layer is known as the **"detail coat,"** and is applied thinly to the model surface with short, dabbing strokes. Subsequent coats can be applied with more fluid strokes and will give the mold strength and durability.

In applying the first coat, you should strive to cover every last bit of detail on the model surface, and coat hard-to-reach areas and undercuts. In this case, care is taken to ensure coverage of all features, particularly the eyes, nostrils and in and around the ears. The base is also covered.

Bare spots at this point will result in a ruined mold. Once the model is covered, carefully examine all areas to make sure that there are no bare spots.



Let The Rubber Become "Tacky"
Once the model is covered, it is allowed to dry for 30-40 minutes (at room temperature) until ***"tacky."*** Tacky means that the rubber has started to cure and is no longer "wet." It is sticky to the touch, but will not come off on your finger (use only a gloved hand or a spatula to touch the rubber). **Note:** *Colder temperatures will prolong the cure time, while warmer temperatures will accelerate it.*

Do not apply the second coat if the first coat is still wet!

When the first coat has become tacky, it is time to mix and apply the second coat. Directions for proper measuring and mixing are followed as before, only this time no pigment is added to the mix and you'll be brushing white rubber over colored rubber..

Applying The 2nd Coat

The second coat is applied without pigment and with longer, more fluid strokes, completely covering the first coat.

After the model is covered, the rubber is again allowed to become **"tacky"** prior to applying the next coat. ***Do not apply the next coat if the rubber is wet!***

Making a "Cut Seam"

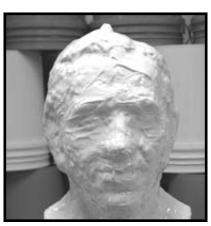
Thickening the rubber allows you to make a "cut seam" down the back of the model that makes cutting the rubber easier when it comes time to demold. It also helps align the rubber seam halves during casting.

Cab-O-Sil (fumed silica) is added to a pigmented batch of rubber by volume until the rubber becomes a thick paste (like bread dough). A thick bead of rubber is applied beginning at the top of the head and running down the center of the model to the end. The thick rubber is also used to fill in undercuts (i.e. eyes, nostrils, behind the ears) to reduce chances of mechanical lock between the model and the rigid support shell.

Applying The 3rd Coat

Mix and apply the third coat (this time, add pigment so you are brushing colored rubber over white) using fluid strokes. Let the rubber become "tacky" before applying more rubber.
Repeat the cut seam procedure.

Applying The 3rd Coat



Mix and apply the 4th coat without color, covering the entire model.

Let all rubber layers cure overnight (16 hours at room temperature.

Applying The Support Shell

Do Not Remove the Rubber Mold From the Model Yet!
With the rubber fully cured and still on the model, a support shell (mother mold) must be applied to the model. The purpose of the support shell is to maintain the shape of the rubber mold when casting into it. For this demonstration, Smooth-On's Plasti-Paste™ is used to make the shell**.**

Planning The Support Shell

As stated before, you must study the model carefully to determine the best way to apply the support shell so that it releases easily and does not mechanically lock onto the model.

Potential "problem areas" on the model where the mother mold might lock on include under the chin, behind the ears and at the base. For this model, a three-piece shell will mechanically release easily and offer support to the rubber mold.

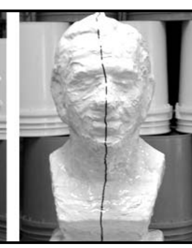
Drawing Parting Lines

Using a marker to illustrate separations, the model is divided into three sections:

The first parting line starts at the top of the head and runs down the right side head over the right ear (just behind the ear) to the base. **The next line** runs from the top of the head down the left side of the head over the left ear (just behind the left ear) to the base.

The final parting line starts at the highest point of the head, and runs down over the forehead and nose, under the chin and to the base--essentially dividing the face into two parts.

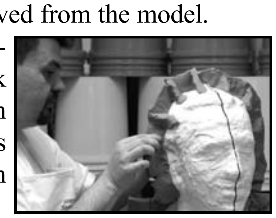
Mapped Out And Ready To Go



With our parting lines drawn, we identify the three sections of the support shell as the right side of the face, the left side of the face and the back of the head from ear to ear.

Applying Clay Shims to Separate Shell Segments

Before applying the Plasti-Paste support shell, it is necessary to apply clay shims along the parting lines to separate the shell into three sections. This avoids mechanical lock and allows the shell to be easily removed from the model.



Apply clay supports to the back of the shim, opposite the side to which you will be applying Plasti-Paste. This assures that you will not accidently push the shim off of the drawn parting line.

Once the shim is in place apply Sonite Wax to both shim and rubber mold . Allow to dry and follow with the application of Universal Mold Release.

Applying The Plasti-Paste Shell

Plasti-Paste™ is then accurately measured out by its 1:3 by volume mix ratio. The Parts A & B should be carefully combined in the mixing container and stirred until thorough consistency is achieved. No color striations or unmixed material should be seen.

The mixed Plasti-Paste is then brushed or trowelled onto a section of the model and up against the installed clay shims. Care should be taken to avoid having "thin" areas of the shell. Edges of the shell should also be thickened to secure maximum strength

Once the back section of the shell has hardened, the clay shim is removed from both the rubber mold and the edges of the support shell. A new clay shim is installed as before along the parting line down the center of the model's face. After applying Sonite™ Wax and Universal Mold Release to the mold rubber and shim, Plasti-Paste is measured, mixed and applied to form the second segment of the support shell. Allow the second segment of the support shell to set up and harden.

When the second half of the shell has hardened, the clay chim is removed and the shell edges and rubber mold are cleaned of excess clay particles. Once again, Sonite™ Wax and Universal™ Mold Release are applied to prepare the model, and Plasti-Paste is mixed and applied to form the third and final segment of the support shell. Once the shell is completed, it should be allowed to cure overnight to achieve maximum hardness before the three segments are separated.

Removing The Support Shell

Using a hammer and screwdriver, lightly tap and create perforations along each parting seam. The screwdriver is then inserted into the perforations and the shell segments are gently pried away from the model and each other.

The visual mapping process (plan of attack) done prior to applying the mother mold has paid off, as the three shell segments are easily removed. Carefully place each segment aside until all three portions of the support shell have been removed from the model.

Removing The Rubber Mold From The Model

Using a razor knife, the rubber is carefully cut beginning at the base. The cut proceeds directly upward (up the middle of the back of the head) all the way to the top.

The rubber is then easily removed from the model (demold). Notice that the rubber captured every last bit of detail from the model surface. In addition, the original model is completely unharmed.

Casting Into A Finished Mold

As stated before, there are a variety of materials that can be cast into a finished mold. These include:

Wax - For candlemaking, reproducing jewelry, and sculpture (the lost wax process).

Gypsum Plaster - For architectural restoration, reproducing sculpture.

Modified Gypsum (*duoMatrix*™) - For making exterior or interior achitectural elements, sculpture, metal coldcasting.

Concrete - Statuary (ornamental) and architectural elements.

Modified Concrete (*duoMatrix-C*™) - Exterior architectural castings, ornamental concrete, sculpture reproductions.

Urethane Resins - Reproducing sculpture, jewelry, special effects, tooling & prototyping, general purpose interior/exterior applications, industrial parts.

Polyester Resins - Plastic castings, architectural elements, sculpture, laminations, reinforcement.

Epoxy Resins - Vacuum form molds, production tooling, foundry patterns, forming dies, hard rollers, industrial parts.

Urethane Foams (Rigid--*Foam-iT!*™, Flexible--*FlexFoam-iT!*™) - Arts & crafts, industrial uses and special effects. Straight casting, backfilling, encapsulation, cushioning.

Low-melt Metal Alloys - Sculpture, jewelry (cast in silicone molds only -- Smooth-Sil™ Series).

Apply A Release Agent

Applying a release agent to the mold before casting not only helps release the casting, it minimizes wear and tear on the mold. This is important if you are using the mold to make many reproductions (production casting).

Although silicone rubber (such as **Smooth-Sil™ 930**) requires no release agent when casting most materials into it, it will lose its release properties over time. Using a release agent will lengthen the life of the mold. The type of release agent you use depends on what you are casting into the mold. **See appendix for proper casting material / release agent combination.**

For this demonstration, we will mix and pour a liquid plastic urethane resin (**SC 320**™) into the one-piece block mold made from the cameo model. The mold was made using **PMC-121/30**™ urethane rubber; therefore, a silicone spray release agent is required to facilitate demold.

Moldmakers Tip - Use a release agent made specifically for mold making and casting such as **Universal Mold Release** or **Mann Ease Release™ 200, 300**, etc.

Moldmakers Tip - ***Proper Application of Release Agent: Spray -- Brush--Spray Again.***

To ensure thorough release agent coverage, 1) Spray a light mist coating over all mold surfaces - any place that might contact the plastic. 2) Brush the release agent over mold surfaces, into detail and undercuts. 3) Apply second light mist coating, and let dry for 10 minutes before casting.

About Liquid Plastics

Smooth-On offers a variety of liquid plastic products, each with different characteristics and properties. Why so many? Like our rubber products, the applications for these plastics are almost endless.

Applications include:

- **Making Models and Prototypes**
- **Reproducing Sculptures or Patterns**
- **Industrial Such As Making Vacuum Molds**
- **Special Effects (Plastics can be pigmented or painted)**

Liquid Plastics

<u>Viscosity Review:</u> 0=water; 2,500=motor oil; 100,000=molasses.

(**Viscosities for liquid plastics are generally lower than viscosities of liquid rubber products.)** Unfilled resins can have viscosities as low as 60 cps (such as **Smooth-Cast™ 300 & 320**). These resins pour like water and do not entrap air. Cured castings are virtually bubble free. Resins that are filled (**C-1508™ and Smooth-Cast™ 385**) have higher viscosities (3,000 - 4,000 cps), but give superior physical performance. If you require high impact or heat resistance, you would choose a filled system. Ask *Smooth-On* or your distributor which resin is best for your application.

<u>Pot Life (Working Time)</u> - *Smooth-On* makes resin systems that have very short working times (**Smooth-Cast™ 300 and 320** each give a pot life of no more than 3 minutes), or resins with long working times (**Crystal Clear™ 204** gives a pot life of 90 minutes).

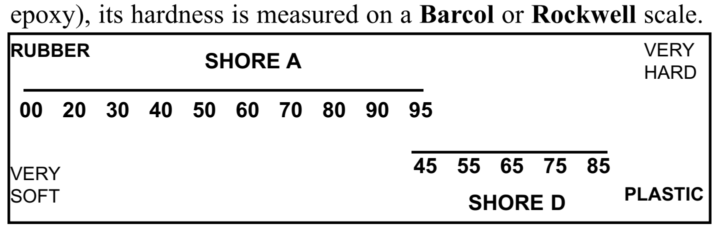
Be Aware! Know the pot life of the plastic product you are using. If you are using a fast-cast resin such as **Smooth-Cast™ 320**, you have 2 ½ - 3 minutes to mix and pour liquid into the mold. If you are not careful, your liquid plastic could set up in your mixing container! Read the technical bulletin.

<u>DUROMETER</u> (The 'Shore D' scale) - As the '**Shore A**' scale is used to measure the hardness of rubber, the '**Shore D**' scale is used to measure the hardness of most plastics.

The 'Shore D' scale begins at **45**, which is the equivalent of Shore **95A**. At this hardness, the plastic is semi-rigid and has some flexibility. These plastics have exceptional impact resistance.

General purpose casting resins (**Smooth-Cast 300, 320**) have a Shore hardness of **70D-75D**. Tooling resins (**C-1508, Smooth Cast 385**) have a hardness range of **80D to 90D.**

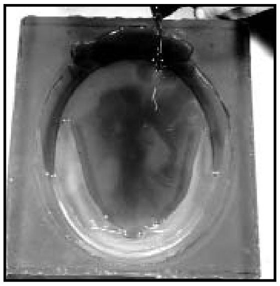
If a material is harder than 90D (such as a Smooth-On castable epoxy), its hardness is measured on a **Barcol** or **Rockwell** scale.



Mixing & Pouring SC-320

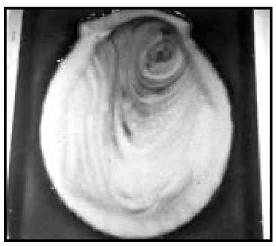
SC 320 (mix ratio is 1A:1B by volume) is a fast cure general-purpose casting resin. *Pot life is about 3 minutes and demold time is about 10 minutes.* As the technical bulletin will tell you, do not delay between mixing and pouring.

Parts A and B are dispensed in equal amounts and mixed for 90 seconds. Using the same mixing technique as used for mixing rubber, we scrape the sides and bottom several times.



After thorough mixing, pour resin into the mold at the lowest point. Letting the mixture rise from the lowest point in the mold will displace air and help minimize bubbles in the cured casting.

After 5 - 7 minutes, the resin will change color and solidify (depending on mass). In about 10 minutes, the casting can be removed from the mold (again, depending on mass).



Notice that the casting reflects all of the detail texture, etc. from the mold. A perfect reproduction of the original.

Pressure Casting

Although Smooth-On resins pour like water and readily de-air, bubbles can sometimes occur due to mold configuration or other factors. **The only way to ensure 100% bubble free castings every time is to pressure cast the resin.** Needed: Air Compressor with hose, Pressure Tank large enough to accommodate your mold and withstand 100 PSI.

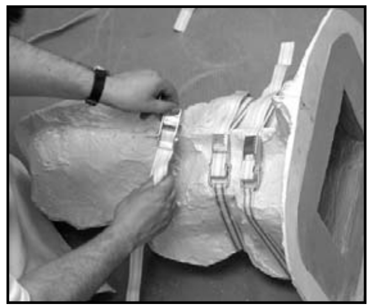
How It Works - Mix and pour resin into the mold as directed above. As soon as the mold cavity is full, place the entire mold into a pressure tank. Place the lid on the pressure tank and attach air hose. Apply pressure by turning on the air supply.
(60 PSI - 4.22 kg./mc2 or 4.15 bars). Let resin cure. Instead of vacuuming the air out of the mixture, the bubbles are pressurized out of the resin. The cured casting is 100% bubble free. Every time.

Painting The Finished Casting

• Remove the release agent using acetone (or sandblast).
• Wash with a strong dishwasher detergent.
• Apply two coats of an auto body primer (we recommend PlastiKote™ and Bulldog Adhesive Promoter™).
• Paint with acrylic or other suitable paint.

Making A Hollow Casting Using 3-D Brush-On Mold

We'll now demonstrate how to make a hollow casting using Matrix™ NEO™. First, Ease Release 200 is applied to the inside of the mold . This will aid in releasing the casting from the rubber. Next, the rubber mold is "seated" inside the support shell. Make sure that the parting seam of the rubber mold is aligned and even.



The pieces of the support shell are then assembled. They should align and fit together easily. Elastic bands or "mold straps" are then used to secure the pieces, and will hold everything together during casting. Matrix™ NEO™ is then mixed (as directed) and poured into the mold cavity.

A Word About Rotational Casting - The goal of rotational casting is to build layer upon layer of casting material against the interior mold surface until a suitable thickness is attained (usually plaster or a fast cast resin such as Smooth-Cast ROTO - cast to a thickness of 3/8" or 1 cm).

Castings that have been rotationally cast are hollow (which saves on material cost), lightweight and yield a virtually flawless surface finish. The key to success in rotationally casting a piece is to rotate the mold (held in place by the support shell) at 360 degrees and at a constant rate. Rotational casting can be done by hand or by machine.

The mold is rotated by hand to build a uniform coating on the mold surface. The working time of this material is about 10 minutes, and the mold is rotated until the material no longer flows. A second batch of Matrix™ NEO™ is mixed and poured into the mold cavity, and the mold is again rotated for about 10 minutes. This layer of plaster bonds to the first. This process is repeated twice more, and an ultimate thickness of about 3/8" (1 cm) is attained.

Demold

After one hour, the support shell is removed and the rubber mold is easily removed from around the casting. Again, we see that the finished casting reflects every last bit of detail taken from the original. And, as stated before, you can make one or many castings from this single mold.

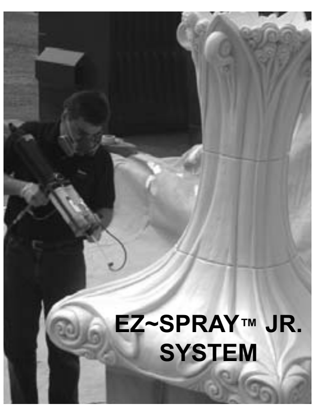
Spraying Mold Rubber

If making a mold of an exceptionally large model or making large molds on a regular basis, you want to consider investing in a system that will spray mold rubber. Smooth-On customers have been spraying rubber since the late 1970s.

Smooth-On's EZ~Spray Jr. system is a versatile, convenient and easy-to-use spray system for spraying EZ~Spray rubbers and plastics.

The EZ~Spray Jr. system saved the contractor 20 days on this restoration project vs. brush-on rubber molds.

The Advantages Of Spraying Mold Rubber:



Mold rubber is mixed and dispensed by machine automatically. It is applied to the model surface in a uniform thickness in a fraction of the time it takes one or more people to brush-on the mold rubber by hand. The labor and time associated with mixing and applying is greatly reduced. Also, with the EZ~Spray System, there is no machine to clean and no maintenance is required.

Free CD-ROM available. See how EZ~Spray™ Jr. can work for you.

Mold Making Review

We have covered a lot of information about mold making and casting, but have offered relatively few of the many techniques available for making molds and castings.

1. The first rule of mold making: You will make mistakes. Be patient with yourself and be willing to learn. Professional mold makers will tell you that they did not learn moldmaking overnight and are still refining their craft. Also, you can call on us anytime for assistance.

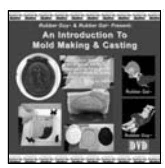
2. Remember, there are different ways to make a mold of any original model. Study your model and develop a strategy or "plan of attack" for applying the mold rubber and support shell (if necessary). Design the support shell so that it does not mechanically lock on to the model. "Map out" the sections of the support shell to avoid potential problems.

3. Read the technical bulletin for each product that you are using. Know the mix ratio, working time, demold time, etc. for the rubber or plastic product you are using.

4. Use only recommended release agents and sealers for mold making and casting.

5. Mix thoroughly, not fast--scrape sides and bottom of the mixing container several times before applying rubber or plastic.

You're Not Alone! **Our Toll-free Technical Help Line receives hundreds of calls each week, and we answer every question. You should call, fax or e-mail us any time with your questions.** ***<u>We're here to help!</u>***



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