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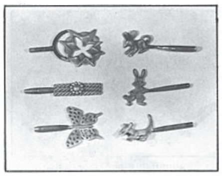
The Choice of Experience

For the Home Hobbyist and Craftsman:

An Easy and Inexpensive Way to Make Jewelry Molds at Home

Instructional Datasheet

Well, so far we have described and demonstrated simple inexpensive methods of wax molding for small quantity wax models, so it's inevitable that we do a little commercial rubber mold making for large volume production. Since some of the readers requested a description of the process, we will give it the home workshop twist, and do it without too much elaborate equipment. First of all let's talk about the metal master used to make the mold. The vulcanizing process, which cures the rubber, takes place at about 300 degrees Fahrenheit [149o C], so the lowest melting point temperature metal you can use is pewter, which melts at 500 degrees Fahrenheit [260o C]. Other metals which work are silver, gold, aluminum, brass, nickel, and just about any high temperature material. That means coins, shells, fossils, etc., all can be used to make a rubber mold, provided they don't melt at 300 degrees. [149o C]. The difference between materials lies in the surface finish of the master model. The rubber will capture every detail of the original and produce it on the wax model, therefore you must



1. Sterling silver master molds with metal sprues soldered to the ends in preparation for mold making.

decide beforehand on the finish you want. As an example, at home in your workshop, without elaborate equipment, a silver master can be polished well and gives a pretty good finish to the mold. There is a slight loss in shine due to the reaction of the sulfur in the rubber and the formation of sulfides on the surface of the silver model, but this is the least problem. You can see the discoloration of the sterling silver masters in Photo 1. All have been used to make a mold.

The ideal metal master would be polished brass with a chrome plating, but unfortunately we lack the equipment at home, so we settle for hand buffed silver. Aluminum can't be polished too well, but it makes a good master that doesn't react with the rubber, and releases excellently. If you haven't tried it already, you can steam cast aluminum with a little practice and the usual precautions. Pewter works well, but it takes a little effort polishing it, and you have to be sure and not exceed its melting point. The metal master can also be textured or given a brushed finish. It's up to you to experiment and decide your own technique for finishing models, the same as you do in wax model making for this is what makes your creations different from the next person's.

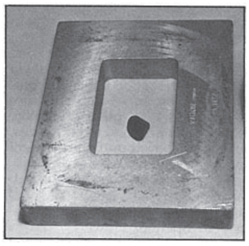
The next step, when making your master, is determining size. The choice of the metal used to cast the wax models determines the size of the master. This doesn't mean you can't make any size; it just means that you wouldn't want to make as large a casting in gold as you would in pewter. Gold items would be kept smaller in size and thin, to keep the weight down. That is, unless you are part owner in a gold mine. The sterling models shown here vary between one and three pennyweight, which is sufficient metal for a good charm or stick pin.

Naturally, when the mold is made there must be some way to inject wax into the cavity. You will also notice in Photo I that the metal masters have rods attached. These are the sprues which permit the melted wax to be forced into the cavity. If the design is complex more than one sprue may be required The sprues are short lengths of 3/32 brass rod, silver soldered to the casting.

These are attached at points on the model where the least amount of disfigurement will occur when the sprue is removed. In the case of the lower temperature pewter, the sprues are attached with hard tin lead solder.

The mold frame and wax sprue former are shown in Photo 2. The frames are machined from thick aluminum, to withstand the stresses of the vulcanizing press applied to the rubber. It is possible to bend your own frames in heavy gauge aluminum, but the frames will eventually deform. The purchased mold frames come in various thicknesses with a standard size cutout. Special size cutouts are also available. However, for the most part, this size cutout is sufficient. The most you do is vary the thickness, depending on whether you are making a mold for a small earring or large ring. Using the correct thickness for the mold has a two fold advantage. You save on rubber, and have more flexibility if you do not make the mold any thicker than necessary. Incidentally, the frames are aluminum so the rubber will not stick during and after vulcanizing.

2. A heavy aluminum mold frame shown with sprue cone button.

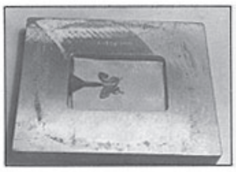


In Photo 2, located in the center ofthe mold frame cutout, is a brass former with a conical shape and a hole through the center.This is slipped onto the brass sprue attached to the model, and forms a mating port for the wax injector. These forms are available from casting supply houses.

Most of the rubber is available in strips the width of the mold frame cutout, with a plastic sheet on both sides.The rubber must be clean, and free of foreign matter adhering to it, or else these imperfections will turn up in the rubber mold and prevent the layers of rubber from adhering to each other.Therefore the plastic is attached to both sides, and should be left until the moment you use it in the frames.

Now let's jump ahead to the vulcanizing process.A commercial vulcanizer is indeed a plus, and easy to operate. However, unless you are well into production, you might find it difficult to justify purchasing one. Shown here is a simple means for vulcanizing which I have been using for some time.All my vulcanizing has been done in a small electric table top broiler.The center has been bent up slightly to give more room for the molds, and the element is the single loop glow rod type, not the nichrome coil type of broiler with electrically "hot" coils.

3. The mold frame half-filled with rubber, metal moldel and sprue cone button in place.



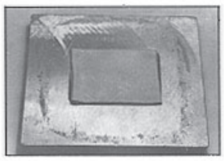
The broiler is unplugged whenever the frames are placed inside or removed, eliminating any possibility of shock.The thermostat of the broiler is set to the highest setting, so that the broiler is always on, and the power to the broiler is adjusted using a speed control such as used with a drill or power tool. An oven thermometer is placed in the broiler, and a metal plate placed over the front of the broiler.The voltage control on the speed control is adjusted slowly, starting at zero, waiting each time for the temperature to rise until the correct setting is found that gives the 300 degrees[149o C] vulcanizing temperature continuously.Then this setting is used every time.

Usually a grill of this type has a current rating of 6.6 amps at 800 watts, when used for cooking at full power with a half open front at 500 degrees.[260o C]. Since I keep the front closed by placing a metal plate over it, the heat is confined, and it can operate at lower power at 300 degrees [149o C], and it's possible to use a five amp speed control without burning it out, provided I always start at zero and never exceed the 300 degrees [149o C] voltage setting.The current times the line voltage is the wattage of the broiler.The speed control also has a fuse built into it.To put it more simply, the broiler is being operated at half power of 400 watts. I have been doing this for many years, and neither the speed control or grill has burned out, and the grill life is probably extended, since the internal thermostat is never used and the heating element is never heated to the head heat point.

I could also use a standard oven, provided I don't exceed 300 degrees Fahrenheit [149o C].Aluminum foil could be placed under the mold frame to prevent rubber from touching the oven.The rubber when vulcanizing has a very mild aroma, not very offensive, but I do advise plenty of ventilation wherever the vulcanizing is performed. I use an exhaust fan and open windows. The rubber will not burn or smell if it doesn't touch any metal hotter than 300 degrees [149o C]. In the grill, this would be the heating element and the stove sides. Normally, the vulcanizing rubber does not drip. It merely oozes out of the mold at 300 degrees [149o C] and stays attached.

In Photo 3, I start the mold .It's necessary to estimate how many layers of the rubber (approximately 1/8 inch thick) are required to form the mold. Divide this number in half and this number of sheets are placed in the bottom half of the mold frame. All plastic backings are removed from the rubber, and the strips are placed one on top of each other to half the depth. Each strip of the rubber will adhere Next the conical sprue former is slipped onto the sprue rod, and the metal master is positioned in the mold frame on the rubber, so that the former will be accessible from one end of the mold.Very gently the precut sheets, enough to form the second half, are placed on top of the master till the rubber is level with the top surface of the mold frame.

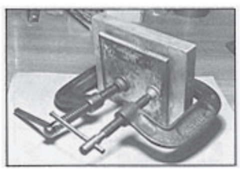
4. The mold fram shown completely filled with rubber.



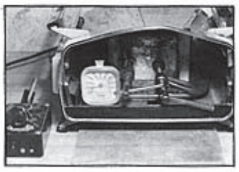
Now we want to be sure that the rubber will be compressed into all little crevices in the frame, and into the detail of the master.Therefore, I usually cut one extra piece the size of the cut out and place it on top.The complete filled mold frame is shown in Photo 4.

Now to compress the mold, two small sheets of thick aluminum are required and two large C-clamps.The aluminum sheets are placed on each side of the mold frame, and the clamps placed at each end and tightened securely as in Photo 5. Due to the addition of the extra rubber, the plates will not contact the mold frame. Instead, the plates will be open on one side and rubber will be forced out between the frame and plate.This opened side will be positioned pointing upward in the broiler, so that the rubber will not touch the element as it is forced out of the mold.

5. The aluminum plates and 2 "C"clamps are used to compress the rubber into the frame.



6. A table-top broiler or toaster oven converted to cure or "vulcanize" the rubbermold.



After the mold is assembled and the clamps tightened securely, the entire assembly is placed into the disconnected broiler, the power turned on, and the control set to the predetermined 300 degree [149° C] setting. The broiler, voltage control, molds and thermometer are shown in Photo 6. The mold is kept at this temperature for about 10 minutes, at which point the rubber has begun to soften and flow within the frame. Now the broiler is turned off and the mold removed with pliers. With the aid of two pairs of pliers, the two clamps are given a second final tightening to firmly compress the rubber. While tightening, it's possible to hear air escaping as the rubber is compressed into all crevices. The mold is now returned to the oven, a plate is placed across the front, and the power restored and adjusted to 300 F [149o C].

The vulcanizing process for a typical 5/8 inch to 3/4 inch thick mold [15 - 19 mm] will take 45 minutes to one hour at this temperature. During the process, the surplus rubber will be forced out the gap between the side plate and frame.

7. cutting is done carefully so as to reach the center line of the metal model.

When the vulcanizing period has ended, the mold is removed from the oven with pliers and allowed to cool to room temperature. The frames are quite heavy, therefore retaining the heat for some time. Also, since the rubber is a poor thermal conductor, the internal rubber mold will be hot when the frames are warm.

The mold must be cut into two pieces to remove the model and make the cavity accessible. There are many ways to cut a mold, and I will show the most widely accepted method, which was taught to me some time ago. There are three points to remember: Each mold must have some type of alignment or keying cut into its corners or sides, to enable the two halves to be aligned properly before injecting wax. Second, the rubber must be cut with a very sharp blade, typically a surgical knife with disposable blades, and the rubber stretched when cut. And third, the cut (or "parting line") between the two halves should be at the center of the model, so that the wax duplicate can rest in either half of the mold when the other half is flexed as the mold is opened.

Cutting the mold when the rubber is still warm has a particular advantage; the rubber is more flexible. So the mold is pressed out of the frames and the surplus rubber cut off with a scissors. Next an initial parting line cut is made 1/8 inch [3mm] deep around the entire rubber mold at the midpoint of the edges.

8. The finished mold is cut into two halves, shown here with the master model.

After this cutting, the mold is clamped securely in a small bench vise for cutting. Using the parting line as a guide, alignment domes are cut in each of the four corners of the mold. The domes are kept at each corner so as not to interfere with the cavity. In order to cut the alignment domes, the rubber is pulled apart while cutting up into the opposite half of the mold. Another possibility for alignment would have been diagonal cuts at the corners of the mold, the alignment system being a matter of the mold maker's preference.

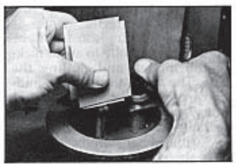
After the alignment domes are cut in each corner, the mold is positioned with the conical sprue upward and cutting is continued across the sprue, going deeper and deeper until the model is reached. The process consists of stretching the rubber with the fingers and making long cuts with the tip of the blade from the sprue to the edge of the mold, where the 1/8 inch [3mm] cut was made. The results will produce a parallel sliced appearance as shown in the mold pictures.

As the cutting progresses, the edge of the butterfly master is reached and cutting must now be approached carefully to avoid nicking the model, and dulling the blade. The aim is to cut at the midpoint in the model's thickness. In Photo 7 the butterfly is visible, and the holes through the wings are filled with rubber strands. The rubber is stretched and each strand is also sliced.

The pattern of the butterfly is followed all around the mold, rotating the mold 180 degrees in the bench vise. Each cut is continued to the edge of the mold except at the ends, where the alignment domes appear. The mold is reversed and, starting at the opposite side of the sprue, the mold is cut, following the model, until the previous bottom cut is reached and the mold is in two pieces. Photo 8 shows the two halves of the mold separated, and the tarnished master.

After the mold has been separated, common powder is dusted on the two halves to prevent the cut surfaces from adhering. Now we have the finished two piece mold. Photo 9 shows the two sections pulled apart at the side to reveal the alignment domes. The two halves of the mold line up perfectly, ready for wax injection. The alignment cannot be emphasized too much, because without it the model will be distorted and wax will flow between the two sections during the injection process, resulting in a mess.

9. Held tightly, the rubber mold is filled with wax by a piston - type injector.



Let's talk about mold cutting for a moment. The description makes the process sound simple, and in reality a mold of this type is easy to cut, but it does take practice and some mistakes to acquire the knack. As an example, initially the first dozen molds should take about 30 to 45 minutes to cut if you are learning by yourself, and, within this number the more mistakes you make the quicker you will grasp the technique. After the first dozen, or perhaps sooner, it will average about five minutes to cut a simple mold. Then as you progress to more complicated models it will take longer, more time being spent planning and drawing the intended cuts than the actual cutting. For an intricate model, it may take two or three molds to get a good cut that will release the wax model without damage, or even a three or four piece mold. That's the reason why when you go to have a mold made of some of your work, it's either difficult to get a cost estimate or the estimate is rather high. Whether you make your own or send them out, remember the vulcanized molds last for years and produce many models, so that's some consolation with regard to work or cost.

10. Alignment domes insure that the two halves will mate prefectly.

The simplest method of injecting wax into the mold is with the small plunger type wax pot injector. Photo 10 shows one of the molds being filled with injection wax. The pot consists of an electrical heater with a built in thermostat to control the temperature of the wax. At the center of the pot is a wax injector nozzle, where the wax comes out under pressure when the plunger on the piston is pushed down. Examining the function of a hand injector, you can see that if extreme pressure is exerted on the piston, wax can hit the ceiling, and if the wax is too hot, the operator can be sprayed with hot wax when the piston is pressed. Therefore, when the pot is used to inject wax, 1) The wax should be thick, and only hot enough to inject; approximately 150 degrees [65o C] ,no higher. 2) A metal can should be placed over the vertical nozzle when testing and cleaning the injector. 3) Only a very slight pressure should be used, not excessive pressure that will cause wax to run out the sides of the mold. 4) A glove should be worn, and the rubber mold should be placed between two plates and pressed together. Some injector operators wrap the mold with the plates in cloth to prevent wax from squirting out at them, and/or position the cuts sideways so in the event wax pressure is too high, the escaping wax will not strike them. The best alternative for safety is goggles, or working on the other side of a Plexiglass sheet, until the technique is learned and the wax is perfectly under control.

If the wax is the correct temperature when injected into the mold cavity, it will not stick to the rubber and the only model release agent necessary is an occasional dusting with talcum powder or a spray silicone release agent. One application should be sufficient for several models. If the mold is opened too soon and the wax is still molten, or if the wax is too hot, the model will stick to the mold. Usually, bubbles in the wax casting indicate too high a wax temperature, and incomplete castings indicate too low a wax temperature.

When the piston type of wax injector shown here is used, and the wax temperature is on the low side of 150 degrees [65o C], the wax will be thick and little pressure or movement is required on the piston to fill a small cavity. Excessive pressure will force the wax out between the mold halves and ruin the casting In order to estimate the amount of travel required on the piston, it's possible to move the piston slowly and observe the quantity of wax ejected, and compare this with the bulk of the wax model.

The description of the mold making and injection processes have been lengthy, but there is one more item: the wax. Most casting supply houses advertise a variety of injection waxes, sold by the pound [kilogram], which range from expensive to inexpensive. Midway between the two extremes the waxes perform very well, with variations in rigidity, flexibility, and detail production. The selection is up to the preference of the caster, operating temperature, mold detail, and operator technique. The most important consideration is probably flexibility, since it's desirable that the wax model flex at least slightly when handled cold. The other consideration is removal of the wax model from the mold.

11. Wax reproductions of the original models ready for use in lost-wax casting.

The model should be removed while still hot enough to flex and bend slightly without breaking. One half of the mold should be curled between the fingers to release the wax model leaving it seated on the other half. Then the second half can be flexed, releasing the wax model. Defective castings, if clean, can be returned to the pot for recasting. Photo 11 shows an assortment of wax models injected as described, some of which still have the sprue attached.

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