

Multi-Piece Fiberglass Mold Construction

Now You Can
Learn to Mold
Complex Shapes
With A Multi-
Piece Mold
Approach

MANUAL



By Steve Jones

Clickable Table Of Contents:

<u>Clickable IMAGE INDEX</u>	<u>3</u>
<u>PLUG SELECTION / CONSTRUCTION:</u>	<u>4</u>
<u>PREPARING THE PLUG FOR MOLDING:</u>	<u>6</u>
<u>MOLDING OVER YOUR PLUG:</u>	<u>9</u>
<u>CONSTRUCTION OF THE SECOND HALF OF YOUR MOLD.</u>	<u>10</u>
<u>RELEASING YOUR MOLD FROM THE PLUG / BASE:</u>	<u>12</u>
<u>MOLDING YOUR FIRST PIECES:</u>	<u>14</u>
<u>JOINING THE TWO HALVES OF YOUR MOLD:</u>	<u>16</u>
<u>REMOVING YOUR PART FROM THE MOLD:</u>	<u>17</u>

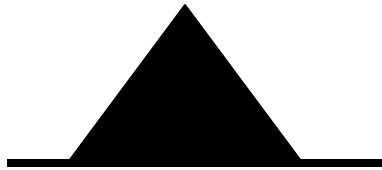
Page#	Image	Page#	Image
4	Draft Angles	16	Figure 38 & 39: Joining the Parts
4	Figure 1& 2: Cowl	17	Figure 40: Releasing the Part
5	Figure 3& 4: Cowl	17	Figure 41: Separation Begins
5	Figure 5& 6: Holes Plugged	17	Figure 42: Part Separates From 1 st Side
6	Figure 7 & 8: Using A Form Gauge	18	Figure 43: Removing Part From Side 2
6	Figure 9: Divider Pieces	18	Figure 44: Finished Piece
7	Figure 10, 11, 12: Divider Assembly		
8	Figure 13: Applying PVA		
9	Figure 14: Tooling Gelcoat		
10	Figure: 15 & 16: 1 st De-mold (Divider)		
10	Figure 17& 18: Separating Plug from the Mold		
10	Figure 19 & 20: Plug Separation		
11	Figure 21: 1 st Half of Mold Complete		
11	Figure 22 & 23: Beginning 2 nd Half		
12	Figure 24: Release the Mold		
12	Figure 25: Release the Mold		
13	Figure 26 & 27: Release the Mold		
13	Figure 28: Completed Mold Halves		
14	Figure 29: PVA Applied		
14	Figure 30 & 31: Apply Gelcoat		
14	Figure 32 & 33: Laying Glass for the Part		
15	Figure 34 & 35: Detail of Resin Application		
15	Figure 36: 1 st Parts Done		
16	Figure 37: Mold Halves Joined		

Multiple Piece Fiberglass Mold Construction

Plug Selection / Construction:

Multi piece molds are necessary when dealing with plugs that will produce deep cavities or objects that have locks or undercuts that would make a one piece mold impractical.

While one piece molds are useful for molding objects that have a positive draft or would produce a shallow cavity, multi piece molds are necessary for molding objects with a negative draft or deep cavities.



Positive Draft Angles
(One Piece Mold)



Negative Draft Angles
(Two Piece Mold)

For the most part, the use of multi piece molds will allow you to mold plugs with undercuts and detail parts that would not be possible with a single piece mold.

For this bonus tutorial, I have decided to mold the cowling of my radio controlled trainer airplane (I figure that this part will be nice to copy based on my prior flying experiences).

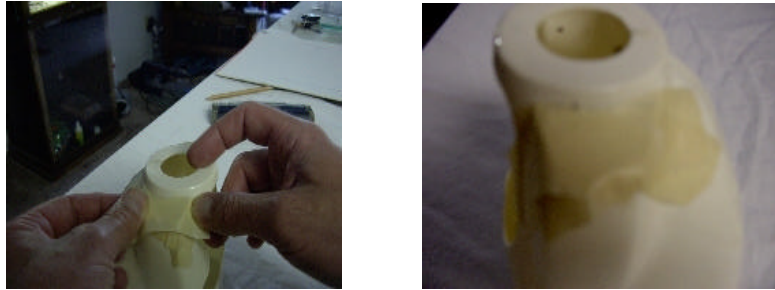
This piece will work much better with a two piece mold because of the cavity depth that this part will produce (depth greater than the width). Below are photographs of the cowl that I will make a mold of.

Figure 1& 2: Cowl



As you can see from the pictures above, I have some issues to deal with in molding this part. First, I have to do something about the openings in the cowling. They must be sealed before I begin. To seal these openings, the first thing I do is tape them closed from the outside. Make sure that the tape is securely pressed against the edges of the openings. See the photographs below.

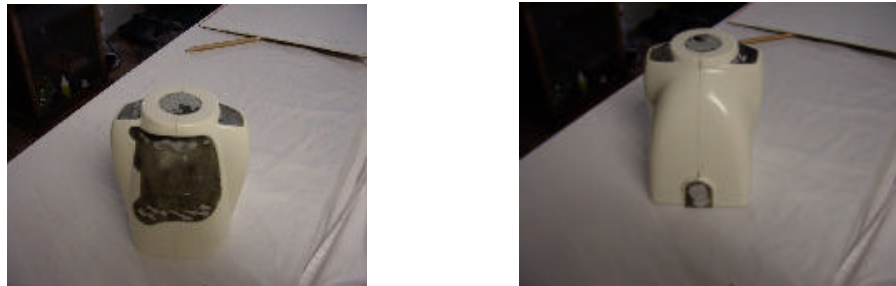
Figure 3& 4: Plugging Holes



Once the openings are sealed with tape, I like to use regular old clay to plug the openings from the inside.

When using clay like this, I like to build the thickness of the clay to about 1 inch. This makes your clay plug durable enough to withstand the molding process. See photographs below.

Figure 5& 6: Holes Plugged



The photographs above show my cowling with the clay plugs in place. Trying to mold this piece without plugging the openings would be a nightmare and would more than likely ruin my original. At this point we can move on to preparing the plug for molding.

Preparing the plug for molding :

Materials needed: Silicone sealant, mold release wax, PVA

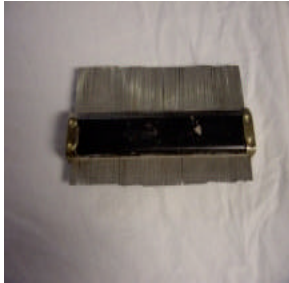
Follow the steps in the main manual modifying as necessary for the two piece mold.

Because of the fragile nature of my plug, the first step is to apply mold release wax to the surface.

If you filled openings with clay, as I did in this tutorial, put very little pressure on the clay filled areas. You can easily pop the clay filler out of position with too much pressure.

Now that the plug has been waxed, I have to determine a suitable parting line where the two halves of my mold will join. Remember, the point of a two piece mold is to eliminate locks and undercuts from your project. This cowling comes as a two piece unit so I will part it down the middle like it came from the factory. To do this, you will need a form gauge. These can be purchased at Home Depot for about \$10.00. Use this gauge to map the contours of your object. See photographs below.

Figure 7 & 8: Using A Form Gauge



Form Gauge



Making an impression.

I use the gauge to trace the shape of my cowl onto a piece of 1/8 inch mahogany door skin. I then cut this out with my scrolling saw to the top and bottom shape that you see below.

Figure 9: Divider Pieces



These pieces are clamped to a center joining piece and glued together. Use the plug that you are molding to align the parting divider during the gluing process. See photographs below.

Figure 10: Divider Assembly



Now you should stabilize your divider by attaching a 90 degree support to the backside of the divider. See the photograph below.

Figure 11: Divider Support



Once the glue has dried, remove the divider from your plug and apply a few buttons of clay to the front surface of the divider.

Figure 12: Divider Detail



Above is a photograph of my plug and parting plane mounted to the parting board with silicone sealant (see text below). The gaps have been sealed with clay and several “buttons” of clay have been placed on the surface of the divider as alignment points.

You will mold over these and they will act as alignment points for the two halves of the finished mold.

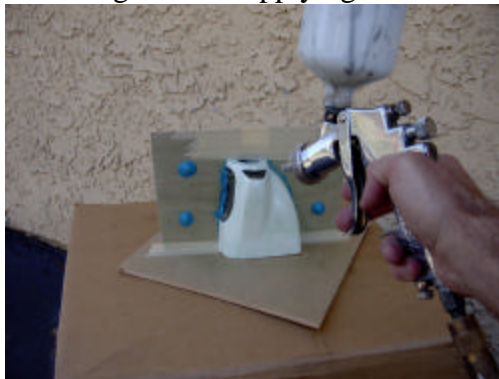
Now apply a liberal amount of mold release wax to the surface. Since I used mahogany to make my divider, I need to use plenty of wax. I don’t want my resin to stick to the wood and ruin my efforts with this project. If you use a porous material for a divider you can cover the surface of it with masking tape before you apply the clay buttons and the release wax. This will also help ensure an easy release

Now I will use silicone sealant to stick this plug to a piece of melamine (you can also use MDA as a base). I have to use silicone in this case because of the thin edge of my plug. I prefer to screw my plugs to the base when the plug allows for this.

Allow the silicone to completely cure and then trim the excess around the outside edge with a razor blade. Now you are going to need to affix your parting plane over the plug, fill the gaps between the parting plane and the plug with clay and attach it (the parting plane) to the base. Just use a little dab of epoxy or silicone to tack the parting plane to the base... you want it to come off without too much of a struggle.

Once you are happy with the alignment of the parting plane to your plug and all of the gaps are filled, you can apply a mold release agent. Poly Vinyl Alcohol (PVA) is the release agent of choice. PVA can now be applied to the surface of the waxed plug and the base using either a spray gun (preferred) or a soft, lint-free cloth.

Figure 13: Applying PVA



Applying the PVA. Notice that in final preparation for molding I covered some seams with masking tape. This method works well.

Molding Over Your Plug:

Materials Needed: Air Compressor (optional), Dump Gun (optional), Tooling Gelcoat, Micro Balloons, Fiberglass Mat, Laminating Resin, MEKP Hardener, 16oz Paper Cups, Paint Rollers, Paint Brushes, Latex Gloves, Respirator, Acetone
Follow the steps in the main manual, modifying as necessary for the two piece mold.

Tooling gelcoat will be applied by brush because of the small size of this mold.

Figure 14: Tooling Gelcoat



Complete, even coverage of the plug with tooling gelcoat. I have also covered my parting plane and a nice sized flange area around the parting board as well.

Once you are satisfied that your plug is sufficiently covered with gelcoat, you can prepare for application of the first layers of fiberglass.

For my current project, I use pieces that are anywhere from 2"x 2" to 4"x4". I lay these pieces on the work surface and thoroughly saturate them with resin using my roller one piece at a time.

For a larger mold, like a 5 foot long, 20 inch wide, 18 inch deep model boat plug that I made, I like to make the mold 4 to 5 layers of mat thick. For a smaller project, like this cowling, 5 inches long and 4.25 inches wide, I like to make the mold 2 to 3 layers of mat and resin thick.

Once the fiberglass lay-ups on the first side are complete, the mold must be cured (left sitting) on the plug for a period of one week at room temperature to avoid warping.

Construction Of The Second Half Of Your Mold.

Materials Needed: Laminating Resin, Tooling Gelcoat, Gelcoat, MEKP, Microballoons, Mold Release Wax, PVA, Mat

Follow the steps in the main manual, modifying as necessary for the two piece mold.

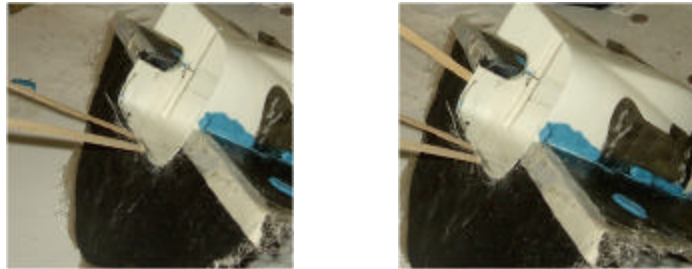
Construction of the second half begins with the removal of the parting plane from the completed first half of your mold. If you properly prepared the parting plane, it should easily release from the mold. I simply stabilized the mold with my hand and pulled the parting plane away from the mold. It easily separated. Do the same with the parting board. See photographs below.

Figure: 15 & 16: 1st De-mold (Divider)



To remove the mold from the plug, small wooden or plastic wedges are used to separate the edges. I also like to use plastic putty knives to help separate the plug from the mold that I have created.

Figure 17& 18: Separating Plug from the Mold



Use small wedges to separate the plug from the mold. Due to its small size and fragile nature, I used wooden coffee stirrers to separate the plug from the mold

Figure 19 & 20: Plug Separation



Continue this process until the plug separates as in the photograph above.

Now that I have removed the original from the first half of the mold, I can clean the completed half of the mold of any PVA and clay. This is also a good time to trim the edges of my mold.

Figure 21: 1st Half of Mold Complete

In the photograph above, you can see the first half of this project in its complete state. It has been cleaned, trimmed, coated with mold release wax and sprayed with PVA.

We can now prepare the plug and the completed side of the mold for the construction of the second part of this project. Begin by re-fitting the plug into the completed side of the mold and reattaching the flange of the mold to the parting board. I use clamps for this when possible. Carefully inspect the area where the plug edges up against the mold. Fill any gaps between the plug and the mold with clay. See photographs below.

Figure 22 & 23: Beginning 2nd Half

These pictures are of the mold prepared for construction of the second side. The mold is clamped to the parting board. Gaps around the plug / mold junction have been filled with clay.

The flange that was created against the parting plane during construction of the first side of the mold will act as the base for the flange that you will create with the second half of your mold. Therefore, you must apply several coats of mold release wax to the exposed flange of the first half of the mold. Next, I apply PVA to the second side of the mold just as I did during earlier during construction of the first half of this mold.

Now I can apply tooling gelcoat, microballoons mixture, laminating resin and fiberglass mat just as I did in the first part of this molds construction. Do nothing different; follow the same procedures as described before, making sure to build a nice flange around the perimeter of the plug.

Releasing Your Mold From The Plug / Base:

Materials Needed: You will either need wooden or plastic wedges, a chisel and possibly a rubber mallet.

Follow the steps in the main manual, modifying as necessary for the two piece mold.

It is now time to remove the mold from the parting board and separate the two halves of your mold. I like to start by removing the mold from the base board. This can be accomplished in a variety of different ways.

The first option involves flexing the base board over the edge of your work surface to separate the flange of your mold from the base board. See photograph below.

Figure 24: Release the Mold



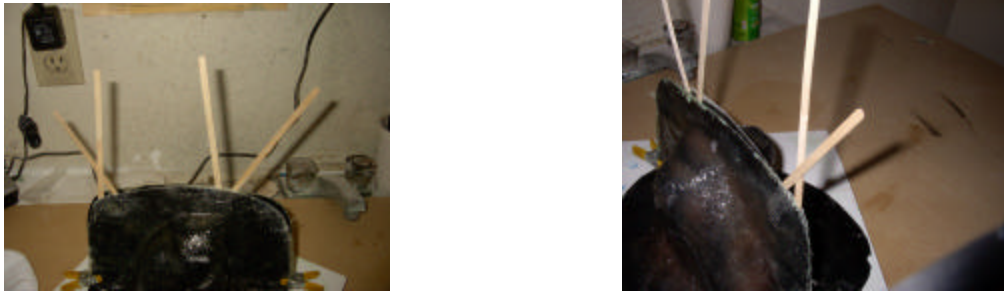
Flex the board over the edge of the bench. The mold will pull away from the parting board. Once separation begins, complete release of the mold should come easy. If it is stubborn, you can begin inserting sticks between the mold and the base to continue separation. You may have to start separation with a chisel or similar tool. See the photograph below.

Figure 25: Release the Mold



Once the mold is released from the parting board, I can begin to separate the two halves of the mold. I use coffee stirrers, plastic putty knives and sharpened paint stirrers to separate the two halves.

Figure 26 & 27: Release the Mold



The photographs above show the separation process between the two halves of this mold. I begin by inserting one stick to begin the separation process. I insert additional sticks at the edges of separation caused by sticks that are already in place. I continue this process until the two halves separate.

Figure 28: Completed Mold Halves



The photograph above shows the two halves of my mold. We are now ready to make some parts.

Molding Your First Pieces:

Materials Needed: Air Compressor (optional), Dump Gun (optional), Gelcoat, Fiberglass Mat, Laminating Resin, Hardener, 16oz Paper Cups, Paint Rollers, Paint Brushes, Latex Gloves, Respirator, Acetone

Follow the steps in the main manual, modifying as necessary for the two piece mold.

Begin by applying wax and PVA as described in the mold building section.

Once the PVA has dried to the touch, gel coat can either be sprayed or brushed on the surface of your mold.

Figure 29: PVA Applied



PVA is dry and we are ready for the first coat of gelcoat.

Apply the gelcoat the same way that it was applied to your plug.

Figure 30 & 31: Apply Gelcoat



Because of the small size of this project, I use a brush to apply the gelcoat. For large projects I prefer to use a dump gun for gelcoat.

Once the second layer of gelcoat has cured to a tack, you can begin to lay fiberglass mat. I like to use 1 oz. or 1 ½ oz. mat to make my parts. For projects like this (many contours), small pieces of mat are easier to work with.

Figure 32 & 33: Laying Glass for the Part



I use a brush to work the resin soaked mat into the curves and depressions of my mold. Make sure to remove all of the air bubbles. Air bubbles will create unsightly flaws in your final product

For this lay-up, I only used one layer of 1 ½ ounce fiberglass mat. This will make for a strong, yet light part* (see below). I like to continue “working” the mat with my brush and roller until the resin starts to gel or until I am convinced that all of the bubbles have been removed and the mat has conformed to my mold.

Figure 34 & 35: Detail of Resin Application



The photograph on the left shows the process of dabbing resin to the mold. Keep pushing the mat to the contours of the mold. Your time now will pay off later. The photograph on the right is of my mold halves with the lay up of the first pieces complete.

If you can catch the resin in the “trim stage” you can easily trim the overhanging fiberglass from your mold with a razor knife.

The only thing that you can do now is let it cure.

Figure 36: 1st Parts Done



The photograph above show my first lay ups after they have been trimmed and are curing in the mold.

*Please note: for RC boat hulls I will use 2 to 4 layers of mat depending on the size of the hull. For hood scoops and fender flairs on full sized vehicles I will build 3 to 6 layers in order to hold up to wind forces and body flex.

JOINING THE TWO HALVES OF YOUR MOLD:

Materials Needed: Spring clamps, laminating resin, mat

Once my pieces have cured in the molds, I can begin the process of turning two into one. I will first have to clamp the two sides of your project together. Ordinary spring clamps are fine for this. If your piece that you made with the mold prevents the two sides from joining, sand down the high spots with a dremel tool or a sanding block.

Figure 37: Mold Halves Joined



Once I am satisfied with the alignment of the two halves, I can prepare to join the two sides. I used one inch wide pieces of mat saturated with resin to lay over the seem of the two sides. On a small project like this, small pieces of mat are much easier to handle. This process is just like all the other times that resin saturated mat was used in this tutorial.

Figure 38 & 39: Joining the Parts



The photograph on the left shows the application of resin soaked mat along the seem of my project. On the right I am pushing the mat flat with the brush.

REMOVING YOUR PART FROM THE MOLD:

MATERIALS NEEDED: WEDGES, PUTTY KNIVES, PAINT STICKS

If you waxed your mold well and applied a good coat or two of PVA, your part should easily pop out of the mold. I like to use wooden coffee stirrers, tongue depressors and plastic putty knives to accomplish the removal of my part.

Figure 40: Releasing the Part



First stick in place.

Figure 41: Separation Begins



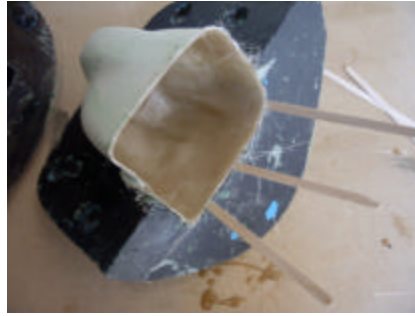
The first stick will cause slight separation. Insert a second stick near the outer edge of the separation caused by the first stick. Insert this stick as deep as possible without forcing it or risking fracture of your part. This second stick will expand the area of separation between the mold and your part. Continue this process until the halves separate.

Figure 42: Part Separates From 1st Side



This part completely separated from the mold with the insertion of five sticks.

Figure 43: Removing Part From Side 2



To remove the part itself, use the same procedure as described above.

This is my finished part as it came out of my mold. The edges can be trimmed with a Dremel tool or with a sanding block. Be careful, the edges will be sharp.

Figure 44: Finished Piece



This is my finished product. The pieces were trimmed and joined.

This completes this bonus tutorial. Before beginning your first mold, be sure to read through this manual several times.