

Plug Construction for Fiberglass Molding



This Manual Covers The Construction Of A Hood Scoop Plug From The Drawing Board....



...Through Construction...



...To Final Fitting.

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Introduction:

This manual is intended to give you some insights into building plugs for fiberglass molds. While I don't suggest that this manual covers all the proven techniques of plug construction, it does provide some basics to get you started. As with any skill, the more you do, the more you know and the more versatile / creative your work will become.

For this manual, I am going to chronicle the construction of a plug that I will mold in order to build a hood scoop for my Jeep. It isn't that I don't like any other scoops on the market, but what I wanted I couldn't find. This is the beauty of working with fiberglass.

Plugs can be made from steel, resin, foam, wood, clay or any material that is heat resistant and is either non-porous or can be made non-porous with paint or resin. For the construction of this plug, I used a variety of materials including wood, bondo and foam.

This manual is not intended to teach the reader how to build anything in particular, rather it was written to convey specific concepts that can be applied to a variety of building projects. The concepts of plug building that are exposed in this manual can be applied to automotive, hobby, marine and many other applications.

Plugs can be made with very little expense or great expense. For this project I purchased a piece of scrape wood for .51 cents, a can of bondo for about \$8.50, a tube of glazing putty for \$3.69 and some floral foam for \$1.99. The other materials that I used, namely paint, I had lying around my work shop from other projects. The only other materials that you will need to build a plug are brain power, sweat equity, patience and creativity. On the other hand, you can pay someone to build your plug, this can become costly, probably more than the \$14 and change that I have in this project.

If you are new to plug construction, make sure to start with a simple project so you can begin to grasp the concepts. Once you have the "big idea", more difficult projects will come easier and easier.

Please read this manual carefully - several times before you begin. The basic concepts are simple but critical to your success.

Making a plug for a customized product.

So you have this great idea for a specialized part for your car. Or you have an idea for your hobby, perhaps a model boat or car or an airplane fuselage. Something that maybe you have seen before or perhaps something that you have an image of in your head. If you can't locate one, what do you do?

You make it...from start to finish.

If your item garners enough attention from others, you can start selling your pieces for a nice little profit. I have built many items out of fiberglass and sold the pieces for profits that far exceeded the expense of building the plug and the mold.

The question is, where do you start?

For this tutorial, I am going to show how I built a scoop for the hood of my Grand Cherokee. Why build a scoop some may ask? I decided to build my own because I couldn't find one that I liked. So what do I do? I build.

I am no artist, but I like to draw a sketch that I can follow during my building process. I don't always follow my sketch once I start, but a sketch gives me direction. I always look at my sketch for several days and sometimes weeks before I start building. Usually, during this time period, my perspective changes as does my vision of my final product.

Once I have the vision, I start by laying out a full size base for my project. In order for any custom part (or model) to look good, it must be symmetrical. Lack of symmetry will destroy your project in the end. Lack of symmetry will waste your time, money and efforts. Now is the time to start being meticulous with your measurements and alignments.

For this project, the first thing that I will do is find the exact center line on my hood. To do this I will use a measuring tape, a length of string and some small clamps. Begin by clamping the string down to the hood while eyeballing the center line. Use the measuring tape to check the distance from each side of the hood to the soon-to-be center line.

Figure 1: Finding the Center



My string is on the exact center of the hood. This was confirmed with a tape measure.

I will then tape several pieces of graph paper together and then attach these with tape to my hood covering the area where I would like the scoop to sit. Make sure that the center line of your graph paper is in line with the center mark of the hood.

Figure 2: Begin Marking the Boundaries



Graph paper taped to my hood. With the graph paper in place, I will draw in the center line and the lines of the indent on the hood that I want to follow. I also draw in the shape of the front of the scoop as well as the back and the sides.

I clearly mark the center line of the graph as all of my measurements will be based on this center line. It doesn't take much of an error here to make your finished product look twisted or visually unattractive. The last thing that you want to hear is some rock head saying "where did you get that? It looks like something you made yourself."

Beginning construction: Cutting the base and framing the general shape.

Now that I have my layout drawn on the graph paper, I can cut this pattern out and trace / transfer this shape to my base material. I like to use mahogany door skin for most of my projects and this is no exception (Mostly because it's cheap. The piece I am using for this project cost me .51 cents from Home Depot's scrape wood box).

Figure 3: Tracing the Base



Figure 4: Base & Lines



Remember symmetry. I maintain symmetry by scribing a straight line on my base. Now I trace the pattern that I made on the graph paper onto my material. Then I carefully draw in the major lines that I want to maintain during the build of this scoop. This process maintains symmetry.

My hood has a center groove whose theme I want to continue through my scoop. I mark these lines on my base right away. Everything on my hood will play off of these markings. These lines should be equidistant from my center line. Symmetry.

Now I cut out the base of my scoop with a scrolling saw.

Figure 5: Cutting the Base



Cutting out the base. Be very careful to follow your lines when cutting.

Once all of my lines are drawn, I can start to build the top of the scoop. Before I begin cutting pieces for the top, I will recheck all of my measurements.

With a project like this, I like to work from the center out. I will begin by determining the shape of the scoop from the front to the back. I like to use a stiff but flexible material that will be consistent in its flex in order to obtain a shape for the sweep of my scoop. In this case, I use a ¼ inch square stick of maple wood. This will give me a nice, consistent bend for a smooth sweeping line. To accomplish this, I lay my material on the work surface and clamp the maple on top of the material and to the work bench. Using my left hand I flex the maple creating a nice consistent arc that I will use to shape the top surface of my scoop. I then trace along the edge of the maple and prepare to do some cutting. This technique is inexpensive and can be applied to many different types of projects.

Figure 6: Creating a Sweep

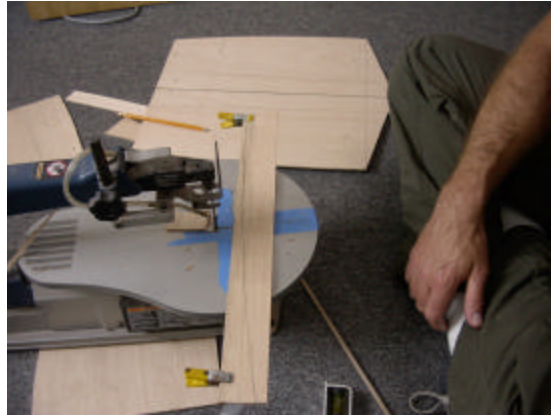


I cut strips of mahogany to the length of my scoop and then I draw my shape onto the material. Now I am concerned with symmetry again. I get symmetry by tacking two pieces of material together in the region that I won't be using (the corners) on my plug.

With the two pieces tacked together, I cut them out with my scrolling saw. I get two nearly identical pieces like this. Now I finish these two pieces by clamping them together and smoothing them down with my belt sander.

Please Note: I know that some of my methods, in particular using the ¼ ' maple to create an arc are not very sophisticated. However, one doesn't need a high end CAD program to create an arc either. This approach works with most steps of this and many other projects. I always try to make due with what I have around the garage before I spend money on a new tool or measuring device.

Figure 7: Cutting Duplicates



These are the pieces that will form the shape of the top of my scoop. I have drawn my lines and carefully tacked the two pieces of wood together with epoxy. This allows me to make one cut and produce two identical pieces. I will follow this protocol for every piece that I make that has a counter-part on the other side of this plug.

Outside of the piece that I will make for the center filler of this scoop, every piece will be made as described above. This is how I will maintain the symmetry of this custom scoop.

Now I will frame in the rest of this scoop. I build the center first and then the perimeter.

Figure 8: Building the Frame



Figure 9: Frame Almost Complete



In order to glue a thin, flexible piece of mahogany to the base, I will use a piece of angle aluminum to provide stability. I cover the aluminum with tape to ensure that my epoxy won't stick to it. I then clamp the frame piece to the aluminum and then the aluminum to the base, carefully lining up the frame to exactly where I want it. With this piece in place, I epoxy the frame to the base and let it dry. I like to use 5 minute epoxy to keep things moving.

The frame work that I build will serve as a guide to produce consistency between the two sides of the project. I will use the frame to attach the top pieces and as dividers to help support any foam I may use during construction.

At this point of this project, the only materials that I can guarantee will be used are mahogany, epoxy, bondo and heavy build primer. I will use foam to fill in certain areas if necessary.

With the main pieces of the frame in place, it is now time to add the top. I use the same 1/8 inch mahogany that I have used in the rest of this project to skin the top. I begin with the center piece and work my way out. The left and right side pieces will be glued on top of the frame pieces. The center section will have to be glued atop wooden tabs that I carefully attached to the inside of the center frame pieces of the scoop. These pieces were spaced 2 inches apart from the front to the back with their top edges exactly 3/8 inch below the top of the frames.

Figure 10: Building the Top



Figure 11: Completing the Top



The photograph on the left shows the center piece attached while the photograph on the right shows the scoop with all the pieces attached. I use epoxy, tape and clamps to hold the pieces while the glue dries.

Now is a good time to trim all of the wood from the top that over-hangs the side frames. This is best done with a belt sander or a Dremel Tool.

For the perimeter, I have to decide on a radius that will round my scoop down to the hood. A soup bean can serves my purpose for this project. I will use this same radius (from the can) throughout this project as needed. You can see in the previous photographs that I have already used the soup can to determine the radius of the forward outer pieces of the face of this scoop.

Figures 12 A,B,C: Making a Radius



To obtain a consistent radius, I use a piece of card stock to mark the two edges that my radius will span. I then trace around the can from point to point which gives me the

necessary shape. I cut this out, trace it to my material and proceed to cut it out with my scrolling saw. I will make a form like this, in duplicate (one for each side) for each location in which I want to attach a radius.

I like to have a radius that I will use as a guide every 4 to 6 inches around the perimeter of my scoop. Remember to make these 2 at a time, one for the left and one for the right. These building principals apply to all projects, hobby, marine and automotive.

Figure 13: Radius Detail



Figure 14: Radius Complete



The photographs above show the spacing / placement of my radius guides. These will come in handy when I am applying and sanding bondo a little later. At this point, the framing portion of this project is complete.

Finishing the Plug: Using Filler Materials:

With the framing of my project complete, I can turn my attention towards filling the voids in the perimeter. I like to use foam for this. For small projects like this, I use dry floral foam from the craft store. It shapes easily, is inexpensive and it won't absorb much resin or bondo.

I begin the foam application by using a sharpie to mark the foam for cutting.

Figure 15 A, B, C: Filling With Foam



Mark both edges of the foam. This doesn't have to be exact. Remember, the foam is just filler material.



With the foam marked, I use an old steak knife to cut my shapes. Repeat this process with each area that you will be applying foam to. I like to cut all the pieces of foam that will be necessary to finish my project before I begin gluing them in place.

Figure 16: Foam in Place



This is my frame work with all of the foam in place. Now I will attach the foam permanently with bondo so I can easily shape and sand it.

Figure 17 A,B, C: Attaching the Foam



The series of photographs above shows how to use bondo to attach foam to my project. I mix the bondo and then dip the edge of the foam that will be pressed against the framework into the bondo. Bondo makes a great adhesive as it is thick, very sticky and

dries very fast. Because of the quick dry time, I only mix enough bondo that I can use within a few minutes.

Figure 18 A,B: Shaping the Foam



With the foam securely in place, I can begin shaping the foam with a sanding block. I like using a sanding block because it helps ensure a smooth final surface.

Figure 19: Foam is Shaped



Now that my foam has been sanded to shape, I have to cover it with bondo in order to create a solid, non-porous surface. To do this, I will remove approximately 1/8 inch of foam to allow for a nice layer of bondo. See the photograph below.

Figure 20: Removing Foam for Bondo Application



Figure 21: Applying Bondo Over Foam



Begin to spread bondo on the surface of the foam. Work slowly to ensure good coverage. Once the bondo begins to cure, I can easily remove the excess bondo with a putty knife. It is much easier to remove excess bondo at this point versus waiting for it fully cure.

Figure 22: Bondo Begins to Cure



First coat of bondo applied. I will scrape off what excess I can, let it get to a semi-hard state and then do a very rough sanding with 60 grit sand paper. Then I will apply more bondo, building and shaping with each layer. This process can be tedious but it is essential to producing a smooth, nice looking plug. Please note: it is critical that I don't remove too much of the material that is used for making the radius guides. Sanding should be done perpendicular to these forms (front to back in this case) and more bondo should be applied to the low areas when the bond has been sanded off the surface of the radius forms.

Figure 23: Bondo Taking Shape



Keep applying bondo to the low areas and sanding smooth with a sanding block. I use the radius guides that define the edges as gauges to help control how much material I remove.

As with most projects that I start, I am starting to see something that I don't like. I am not wild about how the front center of my scoop is taking shape. It looks to abrupt to me and this shape will cause trouble with molding and pulling parts. Therefore I have to make a change. Below is a picture of where I intended to go and where I want to go.

Figure 24: Old Shape



Figure 25: New Shape



Notice the sharp angle between the left side of the scoop and the center section in the photograph on the left and the gradual sweep between the right side of the scoop and the center section in the photograph on the right. I like what I see on the right much better. I will show you how to get this type of design quickly and easily while maintaining the symmetry that I have tried to retain.

Begin by selecting an object that you would like to see on your final product. This is obviously a personal choice. I checked several items and decided to use a jar that contains makeup. I am going to shape this curve with bondo and I don't want to get bondo all over this jar. In order to keep the jar clean, I am going to hold a piece of wax paper on the outside of the jar when I am shaping the bondo.

Now it is time to do the job. I only mix enough bondo to do one side at a time. I mix the bondo and smear more than enough into the angle that I want top change. Then I use the jar, wrapped in wax paper to push the bondo into the shape of the jar. I then remove the jar while leaving the wax paper on the surface of the bondo until it cures.

Once the bondo has begun to set, I peel the wax paper off and use my putty knife to remove the excess. Repeat these steps on the opposite side and you will have nice consistent shapes on either side. See photograph sequence below.

Figure 26: Materials for Special Shape



This is the stuff I will use to do the job, bondo, wax paper strips and a makeup container that will shape my surface.

Figure 27: Bondo Application



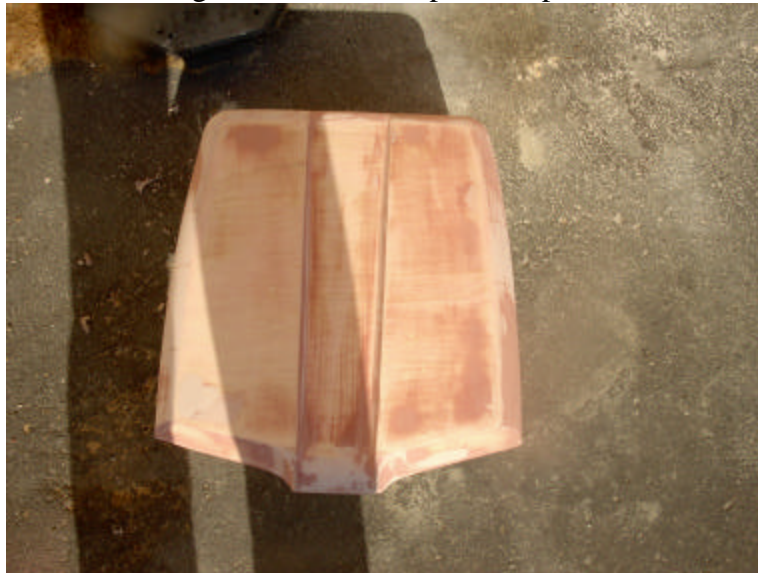
In this picture the bondo has been mixed and applied to the plug. Notice too that I have placed a can under the plug to raise the front edge. This simply makes it easier to work on. I will now push the wax paper covered jar against the plug to form the curve. Once the bondo has begun to set, I can remove the wax paper, scrape the excess bondo, and reveal my new shape, see below.

Figure 28: Shaping the Nose of The Scoop



One Side finished & one side to go.

Figure 29: New Shapes Complete



Both sides modified and complete.

The final structural step for this plug is to taper the elevated left and right sides of the plug to the center section. I will accomplish this task with bondo and a putty spreader (in this case, a discount card) that has been cut at the appropriate angle. I tried to approximate the angle of the sides of the depression in my hood. This kind of thing I just eyeball.

Figure 30: Creating a Special Shape



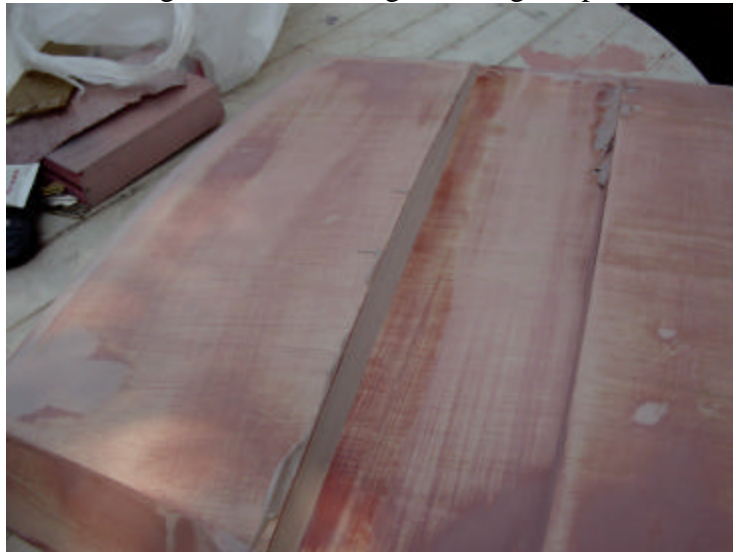
I will use the angle that I cut on this card to shape my taper between the center section and each side.

Figure 31: Shaping the Bondo



I apply bondo to the corner of my plug and use the angle that I cut on the card to shape the material. I like to use the card as both a tool to push the bondo into the area that I am filling and as a tool to shape my final product.

Figure 32: New Edges Taking Shape



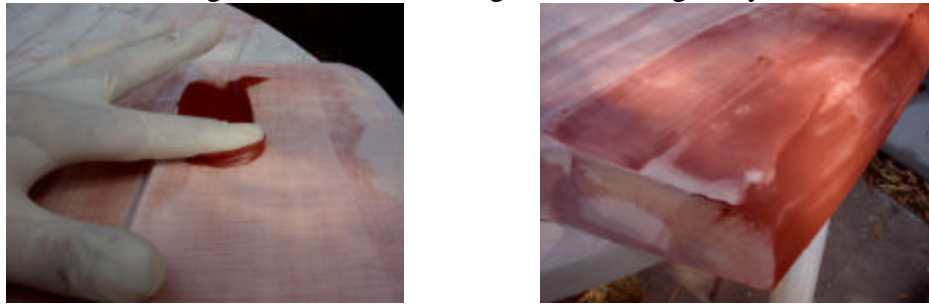
One side is done and the other one is started. I tried to use extra bondo left over from the left side to fill the right. It started to set, however, and became uncooperative. If this happens to you, scrape it out and try again.

Figure 33: Final Inspection



Both angles have been filled and shaped. Now I will do a final inspection of my surface and get ready to “skin” it with glazing putty. Note the beer on the table. I have found that a cold beer on a hot day helps me keep my perspective. After all, this is fun and a hobby.

Figure 34 A,B: Skinning With Glazing Putty



In the photographs above, I am “skinning” the plug with glazing putty. Glazing putty will fill any minor defects in my surface. Once this dries, I will use a sanding block with 220 grit paper to sand it smooth.

Figure 35: Plug is Ready For Guide Coat



The plug is sanded smooth and ready for a “guide coat”. A guide coat is a medium-thick coat of primer that will expose any flaws in the surface.

Figure 36: Plug is Primed



A light coat of primer helps me find remaining flaws that were not filled with the glazing putty. It is difficult to see defects when your plug is multiple colors without defined borders. I simply fill the flaws with glazing putty and sand them smooth with a sanding block.

Fitting a plug to a body panel: Automotive application

I like to test fit my plug to my project, in this case my hood, to see how it looks. Overall, I am happy with the look but I will need to fill the gaps between the hood and the perimeter of the plug. Once this filling process has been done, this project can be painted with automotive, high-fill primer, polished and called complete.

Figure 37: Fitting the Plug to the Hood

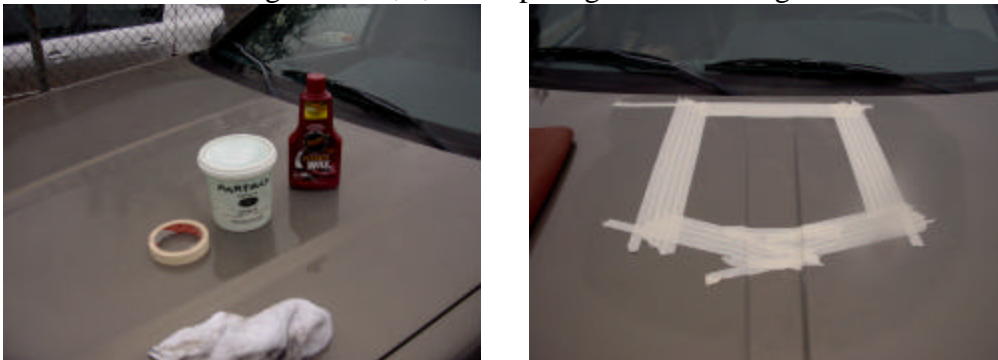


I like the look of this scoop. I will fill the gaps between the hood and the plug and get ready for a final coat of automotive primer.

Now I will begin to do the final fitting of this scoop to the hood. I begin by applying a good coat of my favorite car wax to the hood of my car. A good coat of automotive wax will help protect my paint from what I have in store for it. After the automotive wax has been applied, I cover the area of my hood where the scoop will sit with mold release wax. Mold release wax will further protect my hood.

After the release wax has been applied, I lay masking tape on the hood completely covering the area (approximately 4 inches on either side of the perimeter of my scoop). The tape will help prevent the bondo from sticking to the hood. The final step in preparation of the hood in this case is to apply a coat or two of mold release wax on top of the tape. This will allow me to easily remove the plug from my hood during the fitting process. I anticipate having to remove the plug at least two or three times in order to add material to fit the plug properly to the hood.

Figure 38 A,B,C: Preparing to Fit the Plug



Materials needed.....wax and tape applied.



Another test fit / alignment. I align the part and trace its' outline onto the tape. Then I coat the tape with mold release wax. The outline helps me put the part in the exact position that I need it.

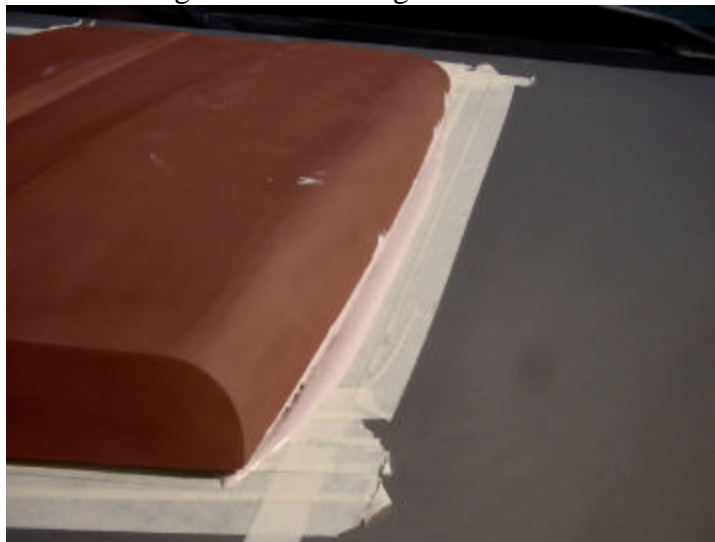
Figure 39: Making a Seal



In this picture you can see the bottom side of my plug. I have begun to run a bead of bondo around the perimeter. The bead will be thick enough to seal any gaps between the plug and the surface of the hood. Since bondo sets fast, I only do two sides at a time. The process goes like this:

- 1) Apply bondo to the plug
- 2) Align the plug with the lines on the hood
- 3) Set the plug onto the hood and forcefully press it downward
- 4) Let the bondo begin to set and trim the excess with a plastic spreader
- 5) Remove the plug from the hood and repeat these steps with the remaining sides

Figure 40: Building a Foundation



Notice how the bondo squeezes out from underneath the plug. This will be trimmed while the bondo cures.

Figure 41: Trimming Extra Bondo



Trimming the excess bondo with a plastic spreader. If you catch the bondo early enough, very little force is needed to remove the excess material.

Figure 42: Examining For Final Flaws



When I am finished with sealing the plug to the hood, I inspect the bondo perimeter for flaws. I have plenty. The first thing I do is sand down the bondo that I just added. Then I place the plug back onto the hood and apply more bondo to any defects that remain from my first application.

Figure 43: Filling the Voids



With the plug back on the hood, I use an old credit card to press more bondo into any defects. Notice that I taped around the plug for this bondo application. This helps prevent any excess bondo from sticking to my plug. I am getting close to finishing this plug and I would rather pull tape off my plug than do any more sanding to it.

Figure 44: The Final Fitting



This is the final test fitting of my plug. It appears to sit on the hood fine. I will now do one last sanding (primarily to the recently added bondo) and apply a thin layer of glazing putty. After the putty dries, I will sand it down again and primer it. I am very close to finishing this project.

The final step in finishing this plug is to apply a nice thick coat of heavy build automotive primer. This can be purchased in a spray can but I have a spray gun and a compressor so I will use that.

Figure 45: Plug is Ready For Molding



This is my final product. This piece is ready for molding.

The final preparation of a plug like this and building the mold is covered in my other manual, “One Piece Fiberglass Mold Construction”. In this manual you will learn how to use a plug (built by you or otherwise) to build a mold and pull pieces for the manufacturing of custom fiberglass parts.