How to Build Your Own Fuel or Smoke Tank
By Andy Herold

Have you ever built an airplane and wished that it held more fuel, or had a production tank that just does not fit well or conform to the planes available space? This is a common issue with jets-wanting to carry more fuel or to add the option of a smoke system in limited space. Most of the time is an odd-shaped compartment). Why not build your own? This is a step-by-step of how I built a custom smoke oil tank for my C-ARF CT-114 Tutor. C-ARF uses a 40-50 oz tank from another kit that fits in an area below the fuel tank. This kept the smoke oil close to the center of gravity.

This is ideal but the tank just did not hold the volume of smoke oil I wanted to carry. The option was a commercial tank that held 64 oz but was a very heavy plastic and still did not give me the volume I wanted. The Jet Central variable speed smoke oil pump that I am using to supply the 8-12 oz per min. of smoke oil to the (2) 4mm stainless steel injectors that inject the oil into the hot exhaust gas stream. These tubes exit at the rear of the thrust tube outside of the jet's tail. We will build this tank in 3 phases, phase #1 making of the plug of the custom tank. Phase #2, making the mold. Phase #3 actually making the tank. I will add the suppliers' website list at the end of this article. Now lets get started building a custom fitted tank.

You will need a few items to get started; a block of white foam, a hot wire or hand-saw, latex or Nitrile gloves, laminating epoxy, fiberglass mat, fiberglass cloth in several weights (3 oz E glass and 5.7oz S glass), polyester resin and hardener, Bondo polyester filler, Duratec polyester primer, tooling gel coat, mold release wax or PVA, or Pol-Ease 2300 release agent, Dremel tool, paper towels, several different sandpaper grits, (80, 120), and wet or dry in several grits from 120, 220, 400, 800, 1200, 1500 to 2000, 1/4 inch luan plywood, Formica, 1 dozen 1-inch disposable paint brushes, three or four 1 1/2 inch foam disposable brushes, denatured alcohol and acetone.

The first thing that you need to do is figure out where in the plane you want to fit a custom tank. Measure the area you want to put the tank in remembering to check for any servo wires, wire routing, landing gear bolts, screws, wing bolts, fuel and vent line routing.

When you measure don't fit it tight but allow about a 1/4 to 3/8 of an inch clearance of the foam to allow for the plug's layup material and Duratec primer. When you have your tank's measurements, then add a ¼ inch to the height or width depending on how you plan on assembling the tank to allow for the overlapping glue joint. This tank required a top and bottom because there is a step-down in the tank allowing it to fit into a notch under the wing tube, so I added the ¼ inch to the overall height. Some tanks may require that there be left and right halves. This step-down is how I added 25-30oz of smoke oil capacity by filling this dead space. Sometimes the shape of the tank will dictate where this glue joint will be. Remember you must be able to remove the parts from the mold after the epoxy has cured.

Now rough cut the foam to the approximate size and shape as shown in photo #1, #2, #3. When you shape the tank, radius and round all of the edges and corners to a diameter about the size of a quarter. The fiberglass cloth will not layout correctly if the radius is too tight causing air pockets in the lay-up. In Photo #2 the 2 black, lines show the ¼ inch added to the plug for the glue seam. Once you have the tank rough shaped, trial fit the foam into the airframe and adjust the foam shape for a perfect fit. I had to sand a slight curve into the bottom of the foam plug to match the bottom of the fuselage. The sides and top remained


Photo #1


Photo #2

Photo #3

square. When you are happy with the fit, take 5.7 oz glass cloth and cut it to the rough shape, allowing the edges to overlap, and covering the entire foam plug.

When the epoxy has cured lightly, sand any burs or stray fibers around the corners, blow off the dust, then wipe the surfaces down with denatured alcohol and apply a layer of 3oz cloth in the same manner as before. (See photo #3.) When I was test fitting this tank after applying the epoxy and cloth to the foam, it did not fit because of the ¼ inch allowance for the glue joint. Now spread a thin layer of Bondo body putty and fill in the weave of the cloth and indentations, while; also blending the overlap of the cloth. You also want to blend the corners and the overlapping areas around

Photo #4

the corners. Now with a tee bar sand this layer off being carful not to sand through the fiberglass cloth. (See photo #4 & #5.) Mark any low spots and apply a second very thin layer of Bondo body putty to fill and final level any low spots. this does not need to be perfect. (see photos #4 & #5). Now that we have the fiberglass

Photo #5

weave filled and all the low spots filled and high spots sanded off, we can spray on the Duratec Polyester primer. This primer will give us a tough hard finish that

Photo #7

we can wet-sand and polish to complete the plug. Duratec wet sands very easily and is nice to work with but Polyester resin STINKS so work in a well ventilated

Photo #8

area. To spray the primer I use a sprayer called a "dump gun" with interchangeable tips for different viscosity materials. This type of gun has no stop on the material flow. When you tip it down it dumps the material by gravity and siphon effect into the airstream. I use about 60-80 PSI for these thick materials but different tips; smaller for the Duratec than the gel coat. We will use this same spray gun with the orange tooling gel coat also. In photos #7 & #8 it shows the rough wet block sanding (wet & dry sandpaper 600-800 grit wrapped around a rubber hand block sander was used to sand them flat . Photos #9 & #10 were wet sanded with 2000 grit paper by hand. They will now be waxed and buffed to a mirror finish. (See photos #9, #10, # 13 & #14.) Now we need to put at least 6 to 8 coats of

Photo #9

Photo #10

mold release wax on the plug and buff it to a mirror shine to get it ready to make the mold. This is the final step of the first phase of the three phases to making a custom fuel or smoke oil tank.

Photo #11

In the first phase we made the plug for a custom tank. Now we will make the mold. The first thing we will do is to make a parting board to hold the plug while making the actual mold. This board will be where we create the top and bottom to your mold and will be where the glue joint in your tank will be. You will need two 1/4 inch pieces of luan plywood about 6 inches larger than the plug's dimensions. One will create a flat edge all the way around the plug. The other will just act as a flat base to work on making them one unit. You

Photo #12

will need a piece of Formica (countertop material) some Home Depots have 2 ft X 4 ft pre-cut pieces. The Formica is not glass smooth and may have a sandy texture to it. Using 3M spray adhesive or contact cement, laminate it to one of the pieces of luan plywood. Next you will cut an opening in the luan/Formica for the plug. You want this to be a very close fit, 1/8 inch max. When laying out the cut-line use masking tape to mark the lines on. This will prevent the Formica from chipping. Using a hand jig saw and a sharp fine-toothed blade, cut on the marked lines. Go slowly to prevent

Photo #13

chipping. You may need to sand the rounded corners for a perfect fit. You will need to support the plug firmly in the parting board so that it does not shift during the lay-up process. You can use white foam or blocks of wood like I have. (See photo #12.) Once you have the parting board and the plug fitted to each other, you will need to seal any gaps between the plug and parting board. To do this, modeling clay is pushed into the small gap with a popsicle stick. Sand one end of the

Photo #14

stick square and a taper to cut the clay after pushing it into the gap all the way around the plug (See photos #13 & #14.) If the tank is symmetrical and you need to be able to tell front from back, use a few small blobs of clay on the flat mold surface to create humps in the surface. Now that we have the plug fitted to the parting board and all the gaps filled, carefully apply 6 coats of mold release wax to the plug and parting board being careful not to move the plug while applying or removing the wax. Make sure to get wax on all surfaces including the clay. While applying the wax and while it is drying, I cut the fiberglass mat in preparation for the lay-up process. We will need 4 layers of fiberglass mat for each side. Cut the fiberglass mat making 4 pieces. Two for the flat area of the parting board one for the plug the sides the parting board, and one for the bottom of the plug. Cut each of the pieces about 1 1/2 inches

Photo #15

oversized for overlap and waste. We will be fraying the edges of the mat so that they will lay-up into the 90 degree corners better. The pieces that will be used on the parting board will only be frayed on one side. The pieces that will be making the ends, sides and bottom or top will be frayed on all sides. Now that the fiberglass mat is cut, using pliers or your fingers pull the edges of the mat creating the frayed edge. (See photos #15 & #16.) Once all the wax has been applied and

Photo #16

buffed off, we can apply a coat Pol-Ease 2300 or 2 -3 very thin coats of PVA with a spray gun (I like the Pol -Ease 2300.) Coat the whole area that was waxed following the instructions on the can of release agent. We are now ready to apply the orange polyester tooling gel -coat with the dump gun. Mix the gel coat with the hardener using the correct amount for the ambient tem-

perature you will be working in. (Hot temp use less hardener- cool temp more, follow the mfg. recommendations.) This is a messy process and should be done outside due to overspray. Spray the entire plug and parting board surface making sure that you get all corners of the plug to parting board well coated. You want to put it on heavy but not to the point of running. It does not have to be pretty just well covered. If you get


Photo #17

it too heavy the air pressure will blow the gel-coat around and cause it to ripple. Try to avoid this but don't panic if it does. (See photo # 17.)

After the gel-coat has cured for about 4-6 hours, it should be hard but still tacky to the touch. We will be applying the first two of four layers total. We are doing this in two steps to avoid building up heat and pulling the gel-coat away from the plug. Now measure out a cup of polyester resin, (I started with 3oz for this mold) then a separate cup of hardener of the proper amount for the resin and set it aside. Mix a small amount of the gel-coat (about 2 oz) with hardener


Photo #18

then add phlox into it to make a peanut butter consistency. Now spread this mixture into the corners on the parting board with a tongue depressor, creating a filet

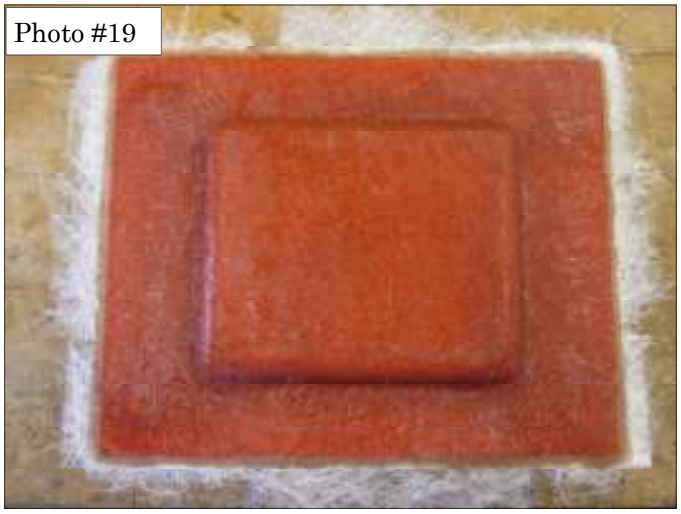


Photo #19

in the corners. Make sure there are NO AIR POCKETS. (See photo #18.) Once that is done, mix your first cup of polyester resin. Using a 1 inch disposable paintbrush lay the first piece of mat around the parting board, allowing the frayed edge to overlap up into the filet you just created. Don't worry if the mat overhangs the parting board. Wet this glass completely out all the

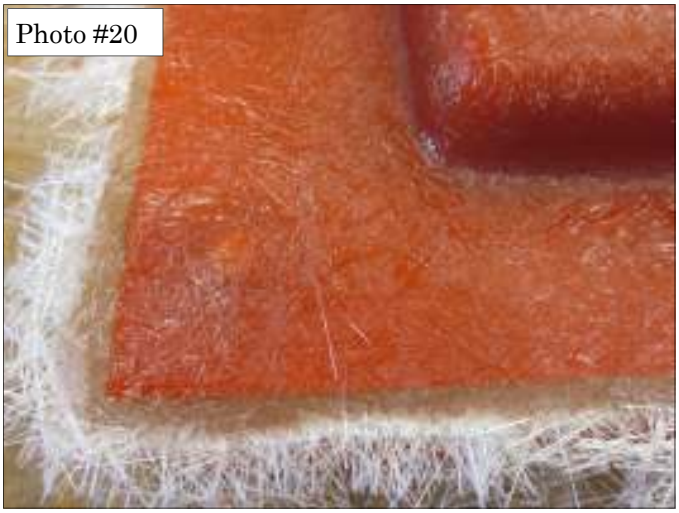


Photo #20

way around. Now do the sides of the plug in the same way allowing the sides to wrap down over the glass mat that you just wet out and to wrap up over to the bottom of the plug. Wet this glass mat out. Then add the bottom to finish covering all the gel-coated surface. Once you have that done, immediately add the second layer. You can reverse the order of lay-up working down to the parting board. The second layer will soak up some of the polyester resin from the first layer. These layers should be completely wetted but not soaking wet, (See Photos #19 & #20.) Let these layers cure overnight. Scuff sand the first layers and then apply layers three

and four in the same manner as the first two. Then let them cure overnight. Carefully pull and separate the mold half that you just created from the parting board. (Watch out for the sharp shards of fiberglass mat. They


Photo #21

will draw blood.) The plug should come out of the parting board and stay with the new mold half (See photo #21.) Trim the edges of the fiberglass mat. Use the edge created by the parting board as a guide and remove the excess glass mat, leaving a smooth edge. Now we need to create the glue joint recess to the plug that is required in the tank top for the tank seam, using 1/4 inch fine line vinyl tape. Wrap the tank 4 times around as close to the new mold's edge as possible. (See Photo #22 the purple tape.) This will allow the bottom to slide up into the top for assembly of the tank later. Now apply 6 layers of wax to the whole top or bottom as before. Apply the PVA or Pol-Ease 2300 to


Photo #22

the entire surfaces as before. Cut the glass mat to necessary sizes for what was the parting board surface, plug sides and top. These can be one piece, even for an odd shaped mold like we are working with. They will just overlap a little more. Fray the edges as before. Follow the same steps as before, puttying the corner of the mold over the tape and creating a filet over the tape. Lay out the first layer of mat right on the new mold half (just like we did on the first half) to the parting board.


Photo #23

Lay the second layer just like before and let it cure overnight. Scuff the glass mat surface and apply the third and forth layers as before and let them cure overnight. Trim the top of the mold to match the bottom and clean up the edges with sand paper. Now we get to separate the 2 mold halves. Gently work a screwdriver


Photo #24

into the seam just a little and twist. Do this in several locations (just a little not all at once)., working your way around the mold. This should give you a way to grab the mold and gently work one half off the other. Work them apart carefully by hand. If necessary use a soft piece of wood. Once you have the mold halves separated, carefully work the plug out of the mold. This can be a challenge if the plug was not waxed enough, or the PVA or Pol-Ease 2300 was not applied evenly. I have had to damage the plug (jam a screwdriver into it)

so I could get a grip on it to get it out of the mold. On this project it pulled right out by hand. (See Photo #23 for all the parts separated.) Photo #24 shows the seam that the vinyl tape made into the top half of this mold for the assembly of the tank halves. Now start applying the next 6 layers of mold wax to all the orange mold's smooth surfaces in preparation for laying up a tank

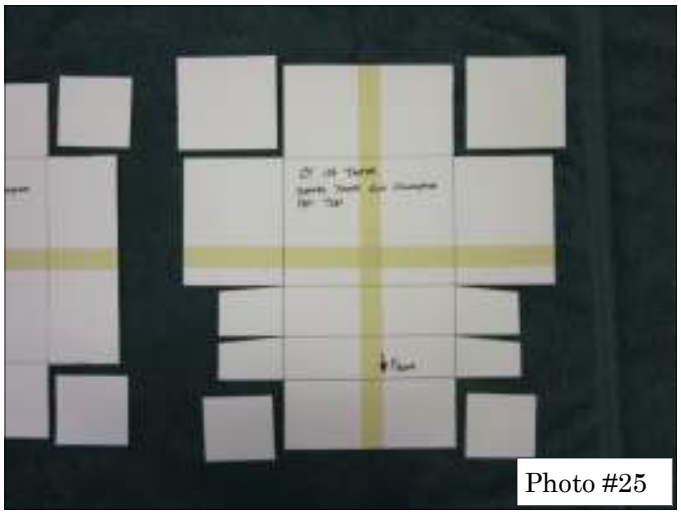


Photo #25

h a l f .

In the last phase we made a mold off of the plug of the custom tank that we built in the first segment. In this final segment we will make and assemble the custom tank. After you have applied the six layers of wax, spray the mold with Pol-Ease 2300. You will need to cut the two fiberglass cloths we will be using. I

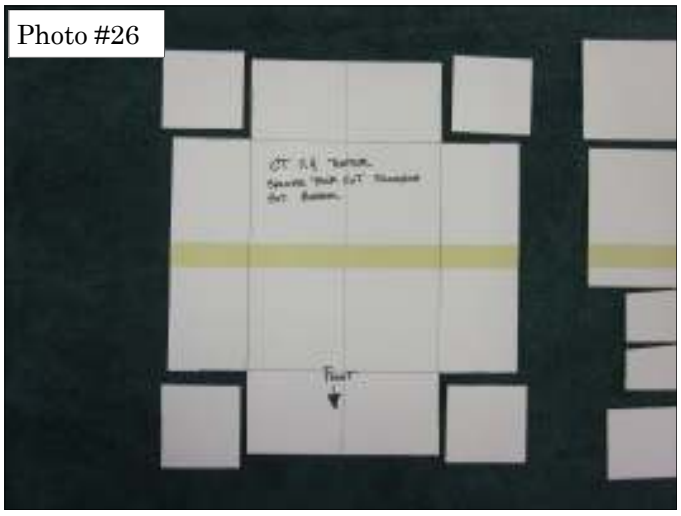


Photo #26

have found that it is easier to measure and make a card stock pattern to cut by. When measuring, make sure to add about an inch to all sides for ease of trimming later. (See Photo #25 & #26.) We will be using two layers of 3 oz E glass because it has a fine, tight weave and can be worked into the corners easily. Also the epoxy fills this tight weave helping to seal the tank. We will also use one layer of 5.7oz S glass because is stronger than normal fiberglass. You may have to experiment with more layers of 5.7 oz S glass if your tank is larger. I have had to use two layers of 3 oz E glass followed by two or three layers of 5.7 oz S glass then another layer of 3 oz E glass. I always start and finish with 3 oz E glass. When cutting fiberglass it is best to cut the cloth at a 45 degree angle to its edge to keep it from unraveling. We will be sandwiching the 5.7 oz S glass between the layers of 3oz E glass during the lay-up to help seal the tank inside and out. I have cut enough fiberglass in this photo for 3 tanks and have laid them out in sequence before starting the fiberglass lay-up.(See Photo #27.) I have cut the fiberglass so that it fits the bottom and sides, cutting away the corners. Save the corners for later. You may want to cut a few extra corners from the scraps. It is hard to cut with sticky gloved hands. I

Photo #27

have saved the corners and will be using those small pieces during the lay-up. This just makes the corners easier to work the fiberglass into and not have to worry about air pockets. Now we are ready to start the lay-up so we will need a few tools. I use a 1 inch disposable paint brush to apply the epoxy and then use a 1 1/2 inch disposable foam brush to pull the excess epoxy out after the final layer of 3 oz E glass. You may want to invest in a 1/2 inch fiberglass cloth roller to help work out bubbles. I mixed up 3 oz of epoxy for the top of this tank and 2 1/2 oz for the bottom. I use a commercial bulk epoxy system to dispense epoxy but you will want to pre-measure the resin and add the hardener when you are ready to start each half. Pour about 1 oz of epoxy into the mold and spread it around with the 1 inch brush, wetting the surfaces to help wet the glass and hold it to the sides while wetting and working out air pockets with your brush. I fold the first layer of E glass

sides onto itself to place it into the mold. Open it quickly before it starts soaking up too much resin. Work out any air pockets from the center to the edges.

Photo #28

Then I add the small square back into each corner that we cut out before and saved. This will add extra strength in the corners. (See Photo #28 & #29.) Wet this all out and work out any air pockets. Next lay in the 5.7 oz S glass the same way. Do not add any epoxy at first. Use your brush and dab the glass, working it into the first layer and absorbing any extra resin from the first layer. Only dip your brush to add epoxy when the resin is necessary to finish wetting out the 5.7 oz cloth. Now add the corners back in (like the first time) after you have wet out and removed most of the air pockets in the main glass first. The roller is a big help here if you have flat surfaces. Don't forget the sides.

Photo #29

Now add the final layer of 3 oz glass the same way the first two were done. When you have all three layers and the corners in and have rolled out all the air pockets go back and use your 1 1/2 inch foam brush to dab any excess resin out of the fiberglass. Use a folded paper towel to remove resin from the foam brush. Do this until the fiberglass is wetted out but is dry enough that you can see the weave in the final layer. Now do the same thing for the other half. **Note which ever side has the indentation for the tank glue joint. It will be difficult, if not impossible, to remove all the air from the seam area. Just do the best you can working the air

Photo #30

out. Resin will fill most of the voids but not all of them. When it is all dabbed out It should look like the photos.

Photo #31

(See photos #30 & #31.) Now set them aside for the epoxy to set up a little. You want the epoxy to get to a sticky but firm condition so that we can trim the extra fiberglass from the tank halves before the epoxy sets up completely. When the epoxy has cured to a point where you can touch it and is sticky (but will not get your finger wet) it is ready to trim. Start with a new single edge razor blade and from inside the mold work the razor blade into the fiberglass layers flush with the mold (see


Photo #32

Photo #32), pushing the razor carefully into the glass at a 45 degree angle. Be careful that you do not pull the fiberglass away from the mold. Pull the razor blade 360 degrees around the mold as shown in the photo. You may have to push with a sawing motion around the corners a little due to the doubling effect of the squares we added in the lay-up. If the glass pulls away from the mold edges a little don't worry just push it back into the mold with your finger. Once trimmed let them cure overnight. Using a tongue depressor or popsicle stick, push in the center of one side to separate the fiberglass tank away from the mold. Once you get it started push the Popsicle stick down into the mold carefully and sweep back and forth. Do this on all the sides and as far into the corners as possible but do not push too hard. when all the sides are free, the bottom may have popped loose in a few spots also. Hold the tank and pull and tug all the sides, working the tank lay-up free of the mold. Once the halves are out of the mold, here is what they should look like. (See Photo #33 & #34.) Let the tanks cure for another 24 hours. Sand all the edges


Photo #33


Photo #34

lightly and then wash all the release agent off with warm soapy water. The halves will not fit together without sanding the edges inside the tank. The corners will need the most work due to the small the small corner square during lay-up. Scuff up the and taper the outside edge of the tank without the indent so it will slide up into the other half with the indent. You will also need to sand the inside gluing lip area and the cor-


Photo #35

ners of the half with the indent during the fitting of the halves. Take your time and carefully sand until they slide together the full 1/4 inch. They should be a sung fit. (See Photo #35.) Wipe everything off with denatured alcohol to remove the dust and any leftover release agent. Once you have the two halves fitting using 1/4 tape to put small pieces in each corner of the bottom half flush with the top of the fiberglass. Then wrap another piece all the way around using the small pieces as your guide. (See Photo #36.) Re-wipe the joint with the denatured alcohol. We will be gluing the halves together with Loctite/Hysol-9462 epoxy glue using this tape as a depth gauge. Before we glue the tank to-

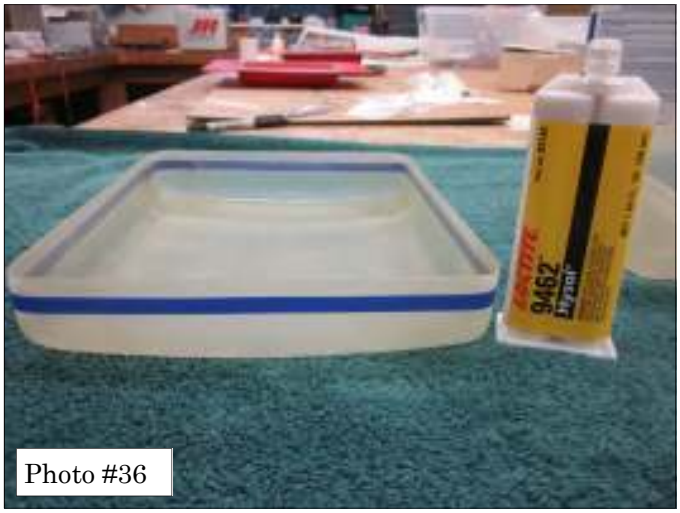


Photo #36

gether we will need to make a hole in the tank to allow the pressure to be equal and not push the glue out of the joint. Figure out which type of fitting you want to use (a Bob Violet Models or a Model Aviation Products fitting) and where in the tank the fill and vent fitting will be. BVM tank fitting & vent must be installed be-


Photo #37

fore the tank halves are joined. If you are using a MAP fitting, decide where it will be and using the fitting draw the inside of the fitting on the tank. Drill a hole in the center of that mark for a 6/32 tap if using the MAP fitting. (We will use a 6/32 Dubro muffler tap to pressure test the tank later.) Now apply a bead around the bottom half, right on the edge and a bead inside right on the edge of the top halves. (See Photos #36 & #37.) Then carefully slide the two together until they are even with the 1/4 inch tape. Wipe the glue joint with your finger pushing the glue down into the joint all the way around. If there are any voids add a little glue to fill the joint so no air pockets are left. If there is too much glue wipe it off with your finger. Do not wipe with the because you will remove to much glue. Now take a paper towel and wipe the glue joint down like you did with your finger to clean up the excess again. Remove the tape carefully and wipe down the joint all the way around again with your finger and light pressure just to clean the little edge that will be left by the tape. When the glue has cured this is what the glue joint will look like inside the tank. (See Photo #38.) After the joint has cured overnight scuff up the outside of the

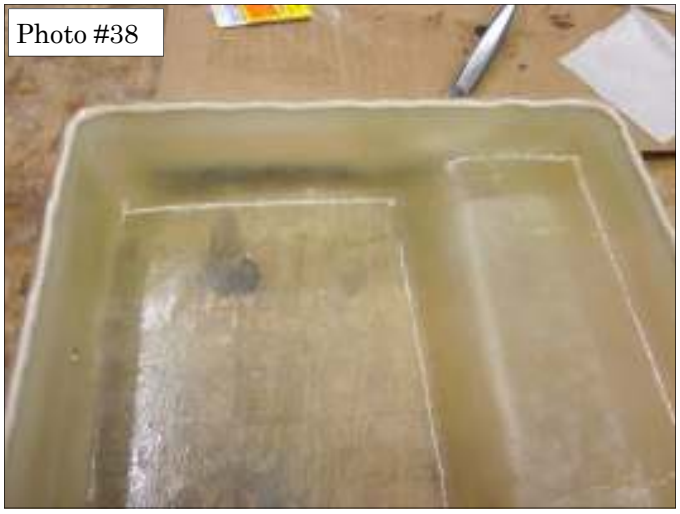


Photo #38

tank about an 1 1/2 inch wide all around the joint for the reinforcing tape, Use a coarse sand paper to scuff the epoxy only; you do not want to cut into the fiberglass cloth. Once you have it scuffed, wipe the joint down with denatured alcohol. Cut a length of 1 inch fiberglass tape to wrap around the joint allowing it to overlap about 1 inch. Mix up 1 oz of epoxy and mix it with Cab-O-Sil to a peanut butter consistency to create a filet around the joint top and bottom. This filet is there so there will not be any air bubbles under the reinforcing tape. It will not take much epoxy to do this. When this is done, mix up another 1oz of epoxy resin and stick one end of the fiberglass tape centered on the joint right on top of the epoxy filet you just made and


Photo #39

wet the tape with epoxy and an acid brush, dabbing,

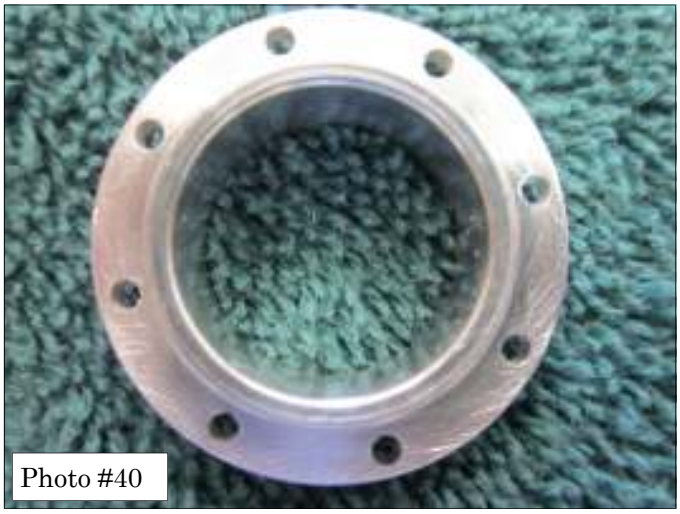


Photo #40

wetting and leveling the filet, tape, and epoxy all in one motion. Work on one side at a time until you have completely wrapped the tank. Wipe the area clean with dry paper towels to remove excess epoxy and any of the putty that may not have been covered with the fiberglass tape. Let this cure overnight. You can sand the joint tape after it cures to smooth it out and get rid of any sharp edges or shards. Tap the hole that you drilled for the 6/32 tap and thread in a 6/32 muffler pressure fitting by hand that has a small length of tube attached. Using an air compressor and a bucket of water hold the tank underwater and pressurize the tank VERY VERY SLOWLY AND ONLY TO ABOUT 2-3 psi MAX or until the tank is stiff not, rock hard but stiff when you squeeze it. Look for any bubbles indicating an air leaks in the fiberglass and in the joint there should be no


Photo #41

leaks. For this tank we will be using a Model Aviation Product fuel tank fitting for the rubber stopper which is installed after the halves have been joined. The aluminum fitting will need to be scuffed up so the epoxy can stick better. The fitting has small holes drilled through it for the glue to protrude through and lock it in place.


Photo #42

Open up the hole that you marked out before for the tapped hole to fit the MAP fittings for a snug fit. Scuff up the glass around this hole and wipe both the fiberglass and aluminum fitting with denatured alcohol. Apply a bead of Loctite/Hysol 9462 to the fittings glue

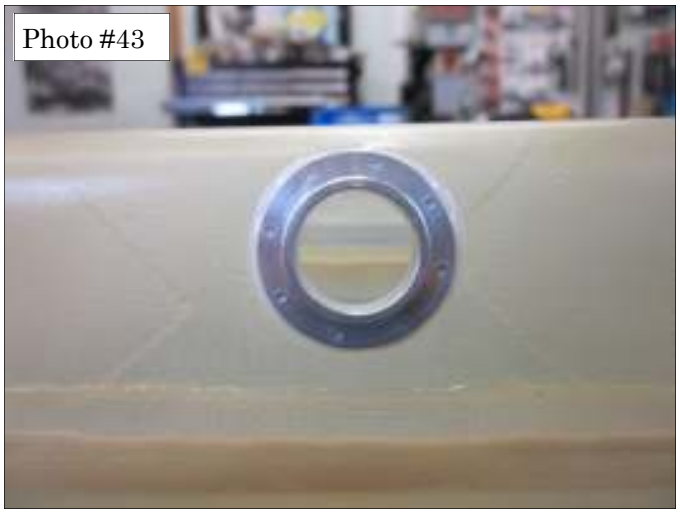


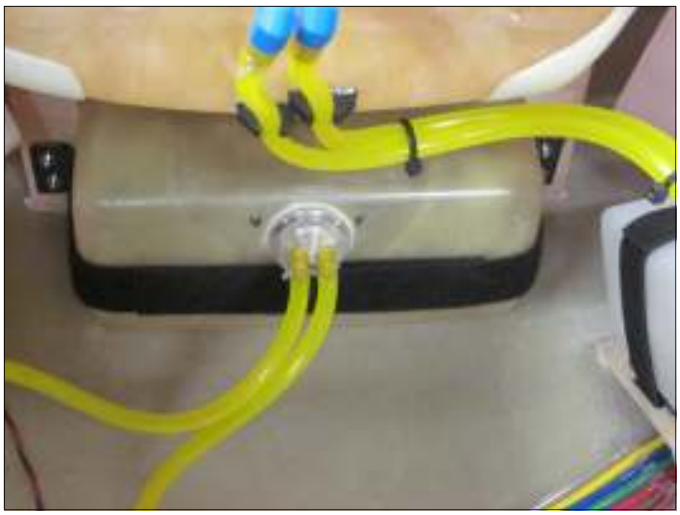
Photo #43

surface, pushing the glue into the small opening and also a thin bead on the fiberglass right on the edge. (See Photos # 39, #40, #41, #42.) Press the fitting into the tank with light pressure. You want the glue to squeeze out around the fitting but not all of it. Wipe the glue with your finger around the fitting to create a filet. With a Q-Tip lightly but completely wipe the glue off the fitting where the glue has squeezed out of the small holes. Do not wipe the glue out of the hole. Let this cure overnight. Build the fuel and vent fitting using the proper type of plug and tubing for the four plane. You can use Velcro or epoxy mounting brackets to the tank to anchor it in place. If gluing brackets to the tank just be sure to scuff the glass before gluing to it. I would

recommend using Loctite/Hysol 9462 for these brackets

Now you have a fuel or smoke tank that is custom fitted. It is a lot of work to build a custom tank but other pilots will notice the craftsmanship when the hatch is off. I hope you enjoyed this step by step article on how to build a custom fuel or smoke tank.

Complete and installed smoke tank in the CARF Models CT-114 Tutor.



Suppliers web site list

http://www.aircraftspruce.com Fiberglass and hand tools

http://www.uscomposites.com/index Epoxy and fiberglass

http://www.modelaviationproducts.com Fuel tank fittings

http://www.bvmjets.com Fuel tank fittings

http://www.dreamworksrc.com Fuel tank neck and fittings

http://www.mcmaster.com Loctite/Hysol glue gun & tips

http://www.ellsworth.com Adhesives source