

Reforming, Repairing & Reinforcing Plastic

By Dennis Wolter



In the last article I pretty much laid out all I knew about the good and bad characteristics of that less-than-perfect material Cessna used to fabricate our cabin plastic trim components. Armed with that information, the repair and refinishing techniques used to recondition these interior trim components should make more sense.

Dealing with the plastic renovation process involves five basic steps: evaluation, cleaning, reforming, repairing, and refinishing (filling and painting). Since we covered the evaluation process in last month's article, let's get started with the cleaning process.

The first step in the cleaning process is to remove any oil, grease, or window sealer. We use mineral spirits for this process. As with most chemistry, give the product you are using time to work. Spray or brush the solvent onto the contaminated area and let it soak for several minutes. Most of you are probably saying, does Dennis think I'm stupid or what?! But I'm speaking from experience here. We use entry level employees to do most of our components cleaning here at Air Mod. If we don't specifically show them how the soap or the solvent can do the work for you, we end up with parts that are less than thoroughly cleaned. Paint and adhesives won't bond to dirt. Need I say more?

With the grease and sealer removed, allow the solvents to gas off and thoroughly spray both sides of the part with Fantastic, 409, or other similar detergent product of your choice. After soaking for several minutes, use a soft short natural bristle scrub brush to aggressively scrub the textured surface of the plastic. We like an old fashioned floor scrub brush with a buzz cut of approximately 1/4" bristles. For tight spots, an inexpensive 1" natural bristle paint brush trimmed to about 1/2" bristle length is the tool of choice.

Once thoroughly scrubbed, the part is rinsed with lots of hot water, ensuring that no soap residue is left on the plastic. On a related subject, I know there are readers out there



"High-tech" Air Mod cleaning brushes.

who are waiting for me to talk about that sticky mess of film that has developed on some of your molded headliners. Before I tell you how to clean it off, let me tell you what I know about why it formed to begin with (you knew I would!).

As mentioned earlier, all plastic has a certain amount of chemistry in it that keeps the material soft and flexible. It turns out that some aggressive one-step cleaners, if not thoroughly rinsed off, will remain on the surface of the plastic and start a chemical reaction that begins to extract the plasticizer in the plastic onto the plastic's surface. When this gaseous chemistry mixes with oxygen, it dries to the thin sticky film we fight with on those formed plastic headliners.

Okay, so much for the background, here's how to clean the stuff. If the headliner to be cleaned is still in the airplane, we use the aforementioned brushes and ALC6100 isopropyl alcohol available from Aviall. Don't waste your time with drug store rubbing alcohols – they are diluted with water and literally won't cut it! Some people have had good luck with strong alcohols available at paint and building supply stores.

We use the Aviall stuff. Be very careful not to get this strong alcohol on any other interior or instrument panel components, as it is a solvent for many of the paints used to finish plastic and metal trim pieces. Always use rubber gloves, eye protection, a charcoal mask and lots of ventilation. As with all petroleum and distilled solvents, be very careful about the fire hazard. Alcohol is particularly tricky because it burns clear, meaning that the flame is nearly invisible.

If the headliner has been removed from the aircraft, you can use lacquer thinner and a soft brush to remove the sticky residue. In both cases, use a pan of thinner or solvent and frequently rinse your brush and clean-up rags. Since isopropyl alcohol and lacquer thinner are strong solvents, do not soak the parts as you would if you were using soap or mineral spirits. The plastic surface can be



Typical dimpled deformation caused by misfitting plastic.



Acrylic shim/doubler bonded to a re-formed and repaired hole.

damaged if it is exposed to lacquer thinner or isopropyl alcohol for too long. A quick scrub with the brush and thorough rinsing with a solvent-laden cloth will do the job.

Enough about sticky headliners; let's get back to the main subject at hand.

Once the part you're repairing is cleaned, it's time to re-form the component back to its designed shape. Heat can be your best friend or worst enemy in this part of the job. Success in reheating and re-forming these parts is all about control, control of both the heat and the flimsy plastic once it has become soft and moldable.

Here at Air Mod we have developed several techniques to pull this off. Heating this material to the point of malleability falls into two categories. The first is localized heat application, as is needed to reform a hole that has become

success in this process are a means to control the shape of the material until it cools, and a way to quickly cool the material such as a wet towel or a Windex spray bottle filled with water.

I'll first discuss how to reform the often-dimpled plastic mounting holes. As usual, I want to discuss what caused the problem. When new, the plastic often did not lay flush against its mating mounting surface. This caused the plastic to deform around the tight screw at the mounting hole. To avoid this, an appropriately sized plastic shim should have been bonded to the back side of the plastic at the mounting hole. Two good things would have happened had this been done. First, no deformation would occur, as the screw would not have to close a gap between the plastic and its mounting point. Second, the bonded plastic shim would serve as a reinforcing doubler and viola!, no cracks at the screw holes.

Moving on to the fix, one of the clever guys in our shop, Travis, came up with the idea of using a flat blade soldering iron (available at hobby and craft stores) to apply very localized heat at the hole. The flat blade is perfect for pushing the dimple back to its designed flat shape as the plastic becomes ductile. We use various sizes of flat bucking bars as both a backing surface and a press to hold the material in its designed shape



Flat blade soldering iron used to apply concentrated heat at a deformed mounting hole.

dimpled. The challenge here is to only heat the area immediately around the hole without distorting the general shape of the rest of the part. The second type of heating problem is heating a larger section of a part that is deformed over a substantial area, if not all, of the component.

Two additional tools necessary for



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as it cures. The pictures show it all. We use poly-fix to bond these shims in place. Plumbers PVC cement and homemade acetone and ground plastic powder adhesive (more on that later) also work well. One final advantage of this bonded shim process is that many of these holes will be cracked. The bonded shim acts as a reinforcement to repair the crack as well as eliminating the old one getting bigger or allowing a new one to start. I love it.

So much for holes; it's on to warped, often compound-shaped trim pieces. These babies can be very tedious. The challenge here is to control the shape of the plastic once it is heated. To compound the problem, as this plastic ages and loses some of its chemistry it will shrink if heated beyond an unknown temperature. I know that sounds vague and scary but it's true. The trick here is to use as little heat as necessary to get



Two bucking bars being used to press and cool a heated deformed hole.

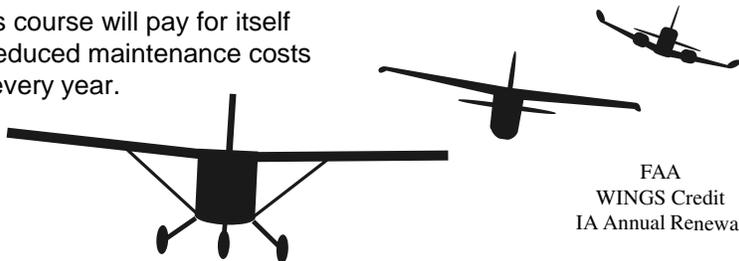
this stuff to do what you need it to do. At Air Mod, we very carefully use 750° heat guns. I would recommend that a beginner use a tube type hair dryer or a heat lamp and practice on a piece of unusable plastic. If ever practice were to make something perfect, this is it.

We are most careful when heating an area close to an edge. We will form a piece of wood or aluminum to the desired shape of the part and hold the part against this shape as we carefully apply the heat. Once the part is ductile enough to be pushed into shape we will use a cold rag or a hard form to press the part into shape and hold it while it cools. Often we will use paint sticks and spring clamps to do the job. Sometimes we will use bendable pieces of sheet aluminum to create the inner and outer curved shapes required to form the part.

Here's the tricky process used to re-form complex parts such as compound shaped window frame sections. We install the part in the airplane, then put a thick piece of edge-formed cardboard against the glass. This cardboard becomes an insulating heat shield that will protect the acrylic window from the heat required to re-form the plastic trim. Heating one side of acrylic windows can cause crazing and cracks. Trust me, my tuition for this lesson was a new 210 windshield – ouch!

With this setup in place, we begin to heat the plastic. As soon as the plastic is soft, we will use a .025" piece of aluminum with soft felt bonded to the forming side to carefully push the plastic into its desired shape. Spraying water

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Paint sticks and clamps holding the heated edge of a straight section of plastic window frame.



Felt-lined curved aluminum holding a re-formed window frame corner as it is being cooled off by a water spray.

from the Windex bottle provides instant cooling and rigidizing of the now-correctly shaped plastic. I know this sounds tricky, and it is, but it's the only option other than a new plastic part, so it's worth a try.

If the newly re-formed part is likely to deform again, three things can be done to help prevent this. First, bond aluminum behind the part to keep it supported by a non-thermally sensitive material. Second, add additional mounting points to

hold the material in its designed shape. Third, in very compound shaped pieces where aluminum forming won't work, bond fiberglass cloth to the back of the reformed component with polyfix adhesive. In an extreme case, bondo can help fill and stabilize the back-side cavity of a compound shaped part.

Here's a little but important side note that fits well into this article at this point. The shimming, reinforcing, and mounting techniques discussed here apply as

well to the installation of new plastic. If the original trim piece warped and cracked, the new stuff will likely do the same. Take the time needed to avoid that same old problem. More on this next month.

Another bit of information is that there are some approved fiberglass trim components available from Selkirk Aviation (208-665-9597) for most of the 170, 172, 180, 185, and 200-series airplanes. We have used these parts at Air



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Using heat and felt-lined formed aluminum to re-form an ill-fitting window frame corner while in the airplane. Note the heat shield cardboard – important window protection!

Mod, and with some trimming and fitting the result is a beautiful and durable finish-out. Being fiberglass, these components do not require as much of the reinforcement and mounting efforts necessary in the vacuum formed components.

Before moving on to the repairing process for this plastic, I want to harp on one final reforming point. I see a lot of nicely renovated interiors where the plastic was repaired before it was reformed. Since the repair process involves bonding semi-rigid adhesives in a typically cracked and deformed place, that area being repaired must first be correctly shaped. Once the repair is made, no reforming of that now rigid area can be done.



Bonded aluminum reinforcement that stabilizes those long aft side window frames. Helps to eliminate cracks too!

Repairing this plastic involves dealing with cracks, missing sections, and filling unwanted holes. Two different chemical adhesives are generally employed to implement these repairs. The first method uses an instant curing cyanoacrylate adhesive (super glue) and a spray-on activator (acetone). This system allows for an instant-cure adhesive of substantial strength that presents a sandable surface. Combined with a fiberglass reinforcement, a strong and aesthetically appealing repair can be made. The fine model-makers fiberglass cloths can be molded

into almost any compound shape. All of these products are available from suppliers such as Lone Star Models (972-218-9663).

The second repair process uses a homemade adhesive (we mentioned this earlier) made by grinding some surplus trim plastic into a fine powder and mixing it with acetone to create a color matched adhesive paste. On flat or single-bend curved areas, a plastic doubler can be bonded to the back side of the repaired area to create a strong reinforced repair. Once the repair is dry, the finished side can be sanded and primed for good looking results. Compound shaped surfaces, and places where



An extra mounting tab at the center of the bottom of a 182 rear windshield. Eliminates the often seen distortion in this area.

material thickness is critical, cannot be as effectively repaired with this process due to the obvious problems in forming a compound-shaped plastic doubler. The thin fiberglass cloth reinforcement is a better option here. In places where the thickness of the repair can create a problem, the plastic doubler is also not practical.

Often a perfectly usable part may have an unwanted cut-out or a missing corner. These areas are easily repaired using the cyanoacrylate adhesive system. Begin by fabricating a filler piece out of a scrap piece of plastic of the same thickness.



A new 182RG headliner reinforced with bonded-on .020" 2024T3 aluminum – this baby will never sag!



Polyfix and fine fiberglass being applied to a cracked sub panel section. Quick, light and strong.

Often we will heat and pre-form the filler piece to a mating contour before cutting it out of the donor plastic sheet. Then we trim and fit the filler piece to precisely fit the damaged or missing area. A little of the water-thin adhesive is applied to the seam. Capillary action draws the adhesive into the seam. A quick shot with the activator and the filler piece is bonded in place. A plastic or fiberglass doubler is applied to the back of the repair for extra strength. Sand and fill the front, and when painted the part looks as good as new.

Small holes of 3/16" or less are easily repaired by using the acetone plastic powder mix. Mix a thicker than usual batch of the paste and use a thin putty knife to smooth it into the hole from the back side until it oozes out of the front side, enough to create a slight dome. Once dry, a little sanding and you have a perfectly repaired hole.

I could go on and on about all the little tricks that can be employed to repair the seemingly endless supply of situations we face with this plastic. Reading a complete repair manual on this subject would be like reading War and Peace. Armed with the techniques depicted here, any of you can venture out on your own and do what works best for you. I often learn a new trick from the technicians here in our shop who venture to try some different methods.

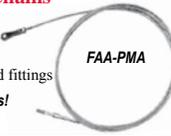
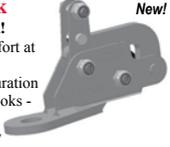
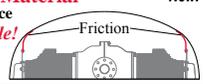
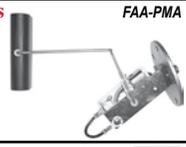
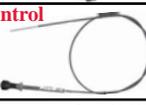
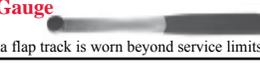
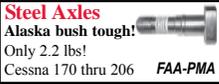
The final step in this plastic renovation process is refinishing. Being that this plastic is solvent sensitive, aggressive That means that if you properly prepare and spray these coatings on plastic, a durable, protective and attractive finish will be the result.

The three most important steps in ac-

complishing this are preparation, preparation, and most importantly, preparation! Once all the structural repairs are made and reinforced, we turn our attention to the finished side of the repair. The mission at hand is to fill over the damaged area or crack so that once it is primed and painted you cannot detect the repair.

We will begin by applying layer of 3/4 oz model-maker fiberglass to the sanded surface of the finished side of the repair. Next we apply and sand a thin coat of automotive body filler. We then do the final filling using a sandable lacquer primer. When painted with a semi-flat lacquer, the repair becomes nearly invisible.

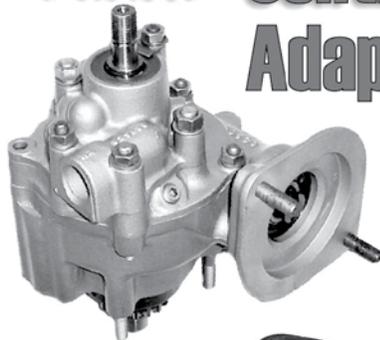
Finish painting this plastic is normally the easy part. However if someone has previously painted it with an enamel or

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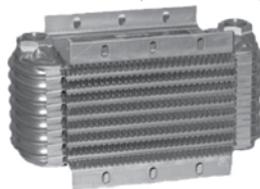
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urethane finish some extra prep steps must be taken. If existing coatings are well bonded to the plastic, you must deal with it accordingly. When the existing paint is enamel, a water based barrier primer must be applied before the SEM or lacquer is sprayed on. This is because the solvents in lacquer and SEM will cause the enamel to lift off of the plastic surface. The technique is pretty straightforward. First, wipe all the plastic down with prepsall to remove any contaminants. Next sand with a scotchbrite pad, then wipe it down with prepsall one last time. Now you can apply the water base barrier primer, which can then be sanded and top coated with the SEM or lacquer finish coat.

If the existing finish is an acatalyzed urethane, the problem is getting the SEM or lacquer to stick to the impervious surface of the urethane paint. We scrub the urethane surface with a scotchbrite pad and 409 or Fantastik. This one-step process will both sand and clean the surface. After a thorough rinsing with warm water, the sanded surface will allow as good a bond as is possible with the new finish. It's important to mention that all of the old paint must be sanded off in an area that needs to be repaired. Adhesives and fillers will not thoroughly bond to old paint.

I would like to give the first time do-it-yourself repairers a piece of often stated advice: practice, practice, practice. Try these techniques on a junk piece of plastic first. You'll be surprised how much better you are the third time you do something that is new to you. Even a professional ball player gets at least three tries at the plate.

Painting aircraft plastic is quite straightforward. Once reformed, repaired and reinforced, we re-finish this plastic with an automotive acrylic lacquer. I recommend that a little flattening base be added to the paint to dull the finish slightly to what paint folks refer to as semi-gloss. This slight dullness will help to hide the repairs and give the finish an elegant appearance. Thin the paint with a slow thinner (such as Dietzler DTL105 acrylic lacquer thinner) that does not flash off quickly. The thinner will remain on the surface longer allowing the paint to dissolve into the plastic, which creates a much better bond.

As we begin painting the many plastic

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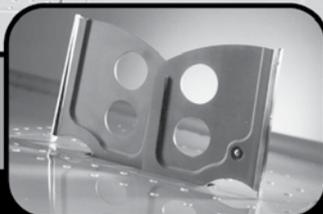
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A missing corner replaced by a polyfix, bonded-on formed piece of new plastic, reinforced with fine model makers fiberglass cloth.

pieces, we keep a pan with some fresh thinner and a rag near the booth. Just prior to spraying the first light coat of paint, we wipe the part with the thinner-soaked rag, avoiding any filled and primed areas. This softens the plastic surface enough to improve the adhesion of the finish. We use the same technique when using the spray can SEM products. A two-coat system is used to spray these coatings, the first being a light tack coat, followed by a full flow cover coat.

Well, you now know just about everything we know about renovating Cessna plastic. I wish some of these new glass radios were as easy to figure out. Until next month, fly safe.



A damaged area with a thin layer of polyfix-bonded fiberglass cloth and bondo filler, sanded to hide the repair.



Re-formed, repaired, reinforced, filled, sanded and painted corner of a '62 182 window frame – looks new!

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