

Repair 'Em Don't Toss 'Em



Kart seats are the one of most abused parts on a kart.

First, it gets numerous holes drilled in it to locate it in the chassis and find that "sweet spot" to make your kart handle like it was intended. Then more holes are added to find the proper rain setup and yet another to let water drain out when it finally does rain. Let's drill some more holes to mount lead

ballast, and maybe a few more to mount some of the all important accessories for our shifter karts. Next we'll drive straight over that 4" tall curb during a qualifier lap or maybe by "oops" during a race. By mid season, your new seat is looking pretty hammered and the scrapes on the bottom of the seat are deep enough to see the track surface below.

Fiberglass repair...yuck. It's nasty, it smells bad, and well, when done wrong can make your expensive seat look like your hippy neighbor's home-built camper shell. Fear not. Fiberglass repair doesn't have to be a nasty job, you just need a little instruction and some quality materials. Here's a step by step approach to help you do a quality

About The Author

Steve Frank is a mechanical engineer and designer with 20+ years of racing related experience in the karting and sportscar industries. Starting as a mechanic at the age of 17, Steve worked his way through college and beyond as a fabricator, manager, and engineer for various amateur and professional sportscar teams. Steve's lifelong passion to drive competitively drew him to karting at a young age and he has continued kart racing ever since. Steve founded Apex Designs in 2004, a machine design firm that specializes in custom x-ray and non-destructive testing and inspection machinery. Steve's interest in composite construction began with his desire to produce lightweight parts for his various racing endeavors. Numerous racecars and karts continue to utilize his products on track.

repair job with a lot less mess or hassle than you anticipated. Along the way we'll learn just enough about composites to make you ready to tackle your repair job with confidence.

Get organized

Make yourself a clean, clutter-free workspace. Do not begin this task with your engine disassembled on the workbench nearby. Fiberglass dust will find its way into everything close by, so take a few minutes to put away critical tools, instruments and equipment. Lay out some newspaper on a clean workbench surface. Tape the paper to the bench and organize your supplies.

Assess the damage

Clean the seat with some lacquer thinner to remove any grease, rubber marks, etc from the damaged area. Tape off an area a few inches larger than the damaged area with masking tape. Begin sanding the damaged area with 36 grit sandpaper, removing any splinters completely. A die grinder with a sanding pad works great for this but a little elbow grease and some patience works just as well. Don't be concerned if you sand all the way through the seat, it's more important to remove all of the damaged material.

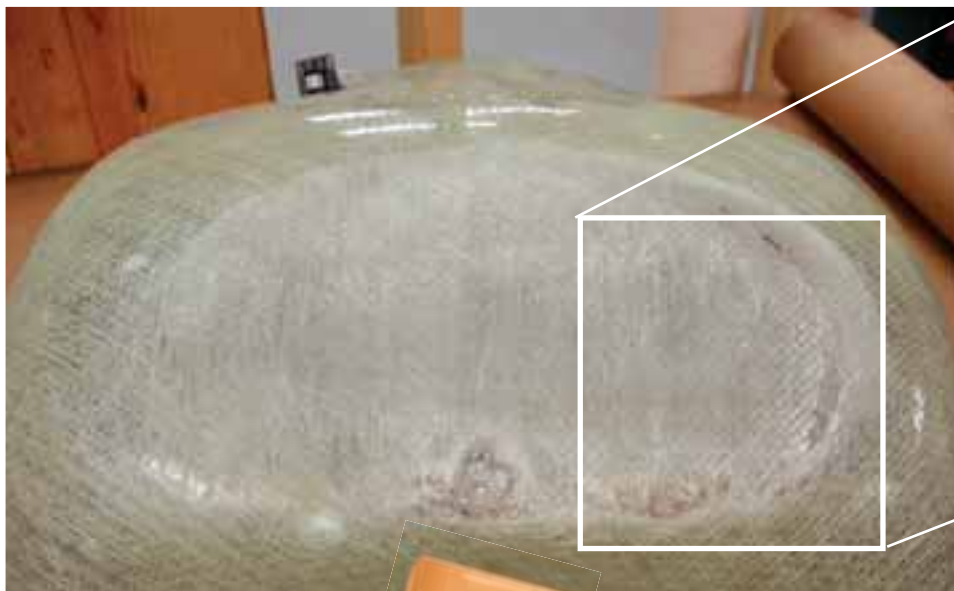
With the damaged area fully exposed and the surrounding 2-3 inches scuffed properly with 36 grit sandpaper, its time for another round of cleaning. Wipe the area thoroughly with a clean rag and some lacquer thinner. If you've cut all the way through the seat during the damage removal process, flip the seat over so the

Supplies needed for the repair job. Note fiberglass strips cut in various sizes to be laid up in order from smallest to largest.

You will need:

- Latex or vinyl gloves
- Dust mask or respirator
- 36 and 80 grit sandpaper
- Sanding block or a piece of nice flat wood
- Disposable plastic cups
- Stir sticks
- Small disposable brush
- A plastic squeegee (cut up pieces of a milk jug will work in a pinch)
- Sharp scissors
- Masking tape, 2" width
- Lacquer thinner
- Woven fiberglass cloth.
- Polyester or epoxy based resin and hardener.





Left, below: Damaged area to be repaired caused by seat scraping on track. Damage extends all the way through the seat.



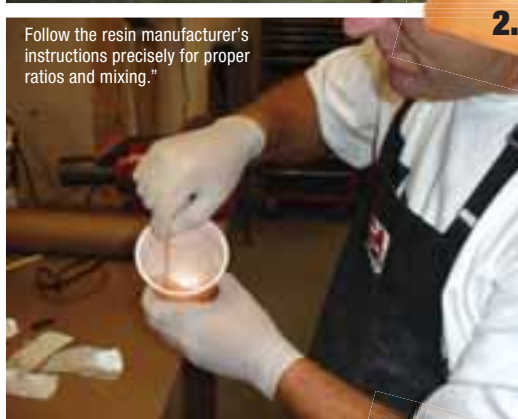
1.

Sand beyond the damaged area to give the resin and fiberglass some rough edges to bond with.



2.

Follow the resin manufacturer's instructions precisely for proper ratios and mixing."



3.

Apply a light coat of resin to the repair area prior to your first fiberglass layer.



inside is facing you and place a few layers of some two-inch wide masking tape over the hole. Masking tape does a remarkable job of acting as a temporary barrier that resin will not stick to when cured. The tape will more or less take the shape of the seat and will act as a temporary mold to support the repair job.

Select proper materials

Here's where most folks go wrong with their repair job. They purchase their fiberglass cloth at the home improvement store simply because it's convenient. Convenient, yes, if you were fixing Aunt Thelma's bathtub on a Sunday evening. But that's not what we're doing here. We're fixing a racing vehicle, so the repair needs to be strong and lightweight. Do yourself a big favor and purchase the right stuff for the job. Among the most important choices is the type and pattern of fabric. We won't get into engineering mechanics, but here's basically what you need to understand about composites. Fibers need to be placed in the same direction as the load that is being placed upon it. Think about gluing 5 Popsicle sticks together side by side to make

a flat assembly. Breaking the assembly apart is very easy along an axis perpendicular to the stick's glued edges. That's because we're only relying on the strength of the glue to keep the assembly from breaking. Now consider breaking the assembly along an axis parallel to the stick's edges. It's considerably more difficult (See illustration, page 55). Imagine you were building an airplane wing from Popsicle sticks. Which direction would you orient the sticks?

Now that we understand the importance of aligning our material with how it will be loaded, it should be pretty obvious that you want to avoid the chopped strand matted material. This material is easily identified by the trows of fabric going in every direction with no apparent care for uniformity. True, these types are less expensive than a woven cloth, but they also do not offer the same strength to weight ratio as a woven cloth. To make up for its haphazard construction, the chopped strand mat fabric must be considerably thicker, and therefore

4.



Add each layer of glass from smallest to largest, making sure to thoroughly wet out each layer and before proceeding to the next. Light dabbing motions with the brush called "stippling" does an effective job of wetting out the cloth and removing entrapped air.

heavier to obtain the same strength as a proper woven cloth. Save the chopped strand mat for Aunt Thelma's bathtub.

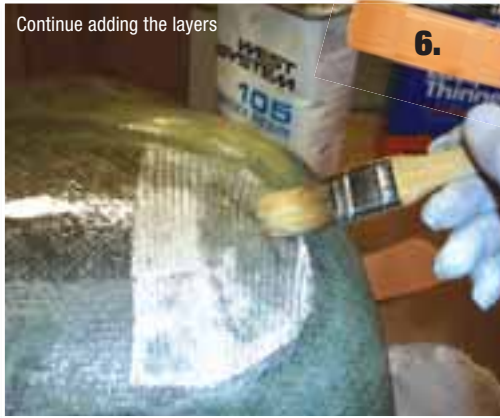
Instead, purchase a woven cloth worthy racecar or airplane construction. Contrary to what you might think, you won't have to spend a fortune either. You should be able to purchase enough cloth to do several repair jobs for less than \$15. Aerospace grade fabrics come in a myriad of patterns, but for our project a plain weave will work just fine. Plain weaves are just what they sound like, one tow of vertical fabric weaves above and below each passing horizontal tow in a 90 degree pattern. These types are used most frequently for relatively simple shapes or flat panels and they are a great choice for the bottom of our seat because it will support the load (of your body) uniformly. Other weaves include twill, crowfoot, satin, and leno, wherein the patterns that skip over and under corresponding tows in a repetitive fashion. These can be more flexible than plain weaves and are good for complex contours and tight radius parts.

Aircraft Spruce and Specialty Co. supplies have a nice selection of aerospace quality materials at a competitive price - even in small quantities. Good deals can also be found on the web, but beware that many web-based suppliers who offer seemingly good prices per square yard will make you pay a premium for their "cutting" or shipping charges. Though there are many good choices available from Aircraft Spruce, the Rutan bi-directional fiberglass cloth is a great choice for its price, strength to weight ratio, and easy of workability. It will also lay down nicely into a pretty tight radius when laid up at 45 degrees to the woven pattern, so it can be very versatile when required.

Prepare your materials

Cut up some fiberglass strips in varying sizes to fill in the void. The key to a sound repair is to start with small strips barely big enough to fill the cavity and gradually increase the size of the strips until you have the void completely covered with maybe an inch or two larger than the damaged area. Starting with small strips allows the glass to lie down nicely into the void, reducing the chances for air entrapment during the lay-up. Air entrapment is the biggest enemy in composite construction, so take your time to make strips that fit nicely into the void and place them in order on your workbench from smallest to largest.

Now that you have your fiberglass strips neatly arranged, let's go over the basics of the resin system. Resins are typically comprised of two separate parts, the liquid resin and a catalyst (hardener) that are mixed together in proper ratios to form a solid. In composite construction, the resin is merely the bonding agent that does little more than hold the



Continue adding the layers

6.



Final, and largest layer ready to be wet out.

5.

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Squeegee excess resin from each layer of the fabric before adding the next ply. Excess resin only adds weight, not strength."

7.

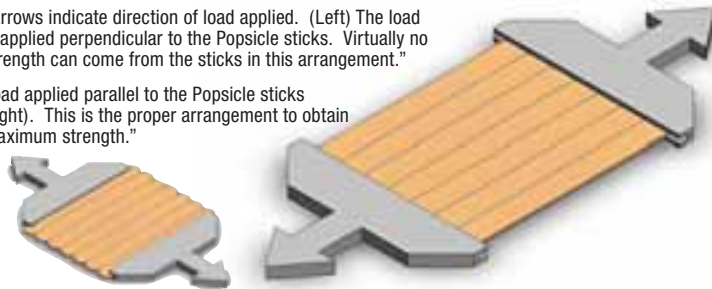
fiberglass cloth in its proper orientation. Resins have very little strength compared to the fiberglass cloth, (Popsicle sticks example, below) so don't get fooled into thinking more resin will make a stronger part. Excess resin only adds weight to the part and can make a real mess.

When selecting a resin system, consider the environment it will be used in, temperature and humidity, time it takes to cure, mixing requirements, and cost. There are many resin systems available. Most of us are familiar with the polyester based systems. These are the inexpensive types found at hardware stores and produce the familiar odor that we associate with boat repair shops. Polyester systems are pretty thick (viscous), and don't "wet out" the cloth as easy as some of the epoxy based systems, so you end up with a heavier repair job. They can also cure very quickly – sometimes in a matter of minutes making them a good choice for performing emergency trackside repairs. Epoxy systems produce stronger bonds than polyesters, and are designed for higher performance applications. We selected the West Marine epoxy resin #105 and #206 hardener for our project because it's a high quality system that is aerospace proven and easy to use for even a novice. The West System utilizes a mini pump kit that precisely meters the proper ratio of resin and catalyst without the need for expensive scales. Epoxies are much more sensitive to proper ratios than polyester resins so follow the manufacturers' mixing instructions carefully.

Regardless of the type of resin you use, keep in mind that once the resin and catalyst agent are mixed, the mixture has a specified amount of "open time" before it begins to cure. Ambient temperature can change the amount of open time so be sure to follow the manufacturers instructions carefully. Once you've mixed your resin, the clock starts ticking, so it's important to have all your tools and materials ready and organized ahead of time.

"Arrows indicate direction of load applied. (Left) The load is applied perpendicular to the Popsicle sticks. Virtually no strength can come from the sticks in this arrangement."

Load applied parallel to the Popsicle sticks (right). This is the proper arrangement to obtain maximum strength."



Do the lay-up

Having followed these easy steps, you are now ready to start the lay-up. Disposable, lightweight, latex or vinyl gloves are an absolute necessity from this point on. Meter out the proper ratios of your resin system in a plastic cup and mix thoroughly with a wooden stir stick according to the manufacturer's instructions. Avoid stirring too quickly so as to "whip" air bubbles into the mixture; we're not making an omelet here. Stir the mixture uniformly while occasionally scraping any resin off the sides of the cup. Also, it's always preferable to mix up small amounts of resin at a time and make new batches as needed. Mixing up one large batch of resin that fills up the cup full will often cause an "exotherm," a chemical reaction that generates excessive heat and causes rapid, premature curing of the resin system. Exotherms can ruin your lay-up, and can even be a fire hazard in extreme cases. For small projects like this, a good rule of thumb is to only mix up batches that are about 1/3 the cup's capacity.

Using a small brush, apply enough resin into the cavity of the seat to lightly cover the repair area. Begin laying your fiberglass strips into the cavity, starting with the smallest piece. Press the glass into the cavity with a series of light

dabs from the brush. This technique is called "stippling" and is intended to push the glass into the void while forcing out any trapped air. Make sure the glass is uniformly covered with resin and that there are no white areas visible in the glass. The glass should be completely translucent when properly wetted out. Continue adding the layers of glass using the stippling effect on each layer. As you work your way out with larger pieces of glass, you can begin using the squeegee to draw out excess resin from the lay-up while forcing the glass down against the seat and further removing any trapped air. Continue using the squeegee until you can no longer see any "waves" of resin being pulled out in front of the squeegee.

Examine the repaired area for any remaining air bubbles or for any areas of the glass that still appear white, indicating dry areas that will have to have some additional resin added by stippling action. Allow the lay-up to fully cure according to the resin manufacturer's instructions. Avoid the temptation to poke at the lay-up. Be patient. If you want to get an idea of the curing progress, check the leftover resin inside the mixing cup.

Finish the repair

After the lay-up has fully cured, remove the masking tape and use your sanding block to smooth the repaired area. There will likely be some very sharp daggers of fiberglass out at the edges of the repair, so be careful handling the seat until you have the area sanded smooth. Be certain to use a dust mask or respirator while sanding. The sanded particles are very fine and can become airborne while sanding, causing you to inhale them. Keep in mind that the seemingly harmless fine particles are actually tiny shards of glass and resin. Start sanding the area with course sandpaper to remove excess material quickly and work up to some finer sandpaper to provide a nice smooth surface. Once sanded smooth to your satisfaction, wash the seat with warm soapy water to remove any leftover sanding dust. Finish the repair by applying a protective clear coat such as spray painted lacquer, or enamel based clear. Clear coating the part will restore the discolored repaired area to its original glossy finish to match the rest of the seat.

Fiberglass repair doesn't have to be a real mess, take your time, use proper materials and methods and you can take satisfaction in keeping your seat looking and performing like new. **NKN**

Sources:

Aircraft Spruce and Specialty, (877) 4-SPRUCE, www.aircraftspruce.com

Rutan bi-directional fiberglass fabric, West Marine, (800) 685-4838, www.westmarine.com

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