COMPOSITE ENVISIONS KNOWLEDGE HUB
PRACTICAL AND INSIGHTFUL COMPOSITES INFORMATION

CRACKED PARTS & HOW TO FIX THEM

COMPOSITE ENVISIONS

CRACKED PARTS REPAIR

INTRODUCTION

Unfortunately, at some point you will run across an instance when your composite part cracks or is damaged in some way. All is not lost though and this paper will run through some information on repairing cracked and damaged parts. We've also included some common, specific scenarios one may run across and how to get those parts looking like new again. Lastly, there is a section on knowing when a part is unsalvageable and when it's time to move on from it.

GEL COAT REPAIR

Small gelcoat cracking itself is not a serious issue, however these small dings can lead to moisture build up in the structural plys below which will in time degrade the composite structure. When it comes to repairing any gelcoat, the goal is to have a seamless repair that will be watertight. In most cases, the repaired area will be unnoticed when proper application procedures are followed.

Surface Preparation

Wipe down surface of existing gelcoat/clear coat around the desired repair area with acetone. This will rid the surface of any foreign contaminates, wax, or dirt, that could possibly cause bonding issues in later steps.
Differing areas of repair may call for use of different tools. Some areas, such as simple surface cracks will be prepped easiest with a pencil grinder to grind away existing gelcoat around crack. In this case, grind the gelcoat surface carefully, do not sand into underlying structural plys.

Sand small area around the gelcoat repair area using a random orbital sander or sanding block with 180 grit sandpaper to make a uniform surface. Again, using caution to only sand away the gelcoat for that area, do not grind into the structural plys.

Sand small area around the gelcoat, using caution to only grind /sand away the gelcoat for that area, do not sand down into structural plys.
Clean sanding debris area using shop vac, if available. If not wipe surface clean using a few additional lint free cloth soaked with acetone or isopropyl alcohol to provide a clean bonding surface.
Tape around perimeter of repair with Flashbreaker (1) Tape to contain gel coat that will be applied. This will also mitigate the chance of getting excess gelcoat onto a surface that is not needed for repair. Generally, going ~1-2" beyond repair area in all directions for small repairs.

Repair Application

Pour a small amount of unmixed gelcoat or clear coat into a paper cup. Pre-colored gel coat

is available and usually is the easiest way of making small repairs. If using a clear gel coat, tint can be used to match the shade of existing repair area.

Once the color of the gelcoat is satisfactory, add catalyst to the gelcoat. Be sure to use the exact amount of catalyst according to the manufacturer's instruction or datasheet. Mix the catalyst and gel coat using a mixing stick. (Tongue depressors / popsicle sticks)

Using the mixing stick, apply gel coat into the cracked area. Gently tap into repair area lightly, ensuring there are no trapped air bubbles in repair area within the gel coat. If there is slightly too much gelcoat applied, there is no issue. In this case it is better to have too much than too little.

Wet Sanding & Finishing of Repaired Gelcoat / Resin Surface

Allowing gel coat or resin to cure or harden overnight or per manufacturers specification before continuing to the next steps. Remove masking tape from repaired area. Using a sanding block with 180 grit sandpaper, wet sand the repair area flush with the existing surface.

Note: Use of wet sanding techniques are better than only dry sanding. If a spray bottle is available, fill with water and mix a drop or two of soap into the bottle. This will change the surface tension of the water applied to the surface and ease the process of wet sanding. A sanding block is recommended to keep the area that is being sanded tangent (flat) to the original surface. Using hand sanding techniques are known to create uneven ridges along the repair surface.

Once sanding is completed using the 180-grit sandpaper, the repair area should still be able to be felt by fingertip but be almost unnoticeable. Wipe surface clean and place 600-grit sandpaper n the sanding block. Wet sand surface with light pressure, back and forth motion with the block, removing coarse scratches left by 180-grit sandpaper application.

Wipe sanding residue off using a lint free cloth. At this time the repair area should be nearly invisible. There are a couple of techniques that can be used together to achieve a matching surface to the surrounding gelcoat. Wet sanding with finer grit sandpaper will yield a surface matching the existing gelcoat. Wet sanding starting with 800 and increasing to 1500 / 2000 / 3000 grits will yield a high shine to gel-coated surfaces. In addition, application of rubbing compound to the surface using a low speed buffer will being the repaired area to show room condition. Finally, polish repair area and apply coat of wax to protect repair.

PATCHING OLD SCREW HOLES

For holes smaller than 1/4" an epoxy filler will suffice. For areas larger than 1/4" diameter holes, use of epoxy and a thickening agent will be necessary to compete a proper repair. The

steps taken are generally the same, just a different prep/mixing for filler being applied. It is advised to use an epoxy-based filler as the epoxy will shrink less than other choices. After the surface is cleaned properly with acetone, tape under the hole using masking tape. The filler will simply escape if nothing stops / dams it.

For smaller holes or vertical surfaces: Mix and prepare filler and apply to small screw hole using a plastic scraper.

For holes 1/4" or larger, it is advised to use an epoxy resin that is thickened with "cabosil" or other means of finely chopped fiberglass. This will reinforce the filling epoxy and provide a long-lasting repair that will often outlast the part itself. Add enough thickening agent to the epoxy resin until it has the viscosity of approximately, toothpaste by mixing a small amount at a time to be cautious. It may seem like it takes a lot of fiberglass to achieve this. Once the filler is properly mixed, use a syringe to "inject" the reinforced filler into the hole(s) until it becomes even with the repair surface. Note: Slight overfill is not a problem as it will be sanded away later in the process.

As an option, a layer of fiberglass may be applied over repaired hole using similar resin in a traditional layup technique.

Allow for resin and repaired area to cure properly per manufacturers specification and reference Wet Sanding & Finishing of Repaired Gelcoat Surface above to complete repair. If surface is gel coated, prep as above, mix and apply gelcoat using a foam brush and cure. If the surface in which the repair is taking place is vertical (wall) place a clear mylar film over the gelcoat repair area after filler application to ensure that the filler will stay in place and cure uniformly. After cure, wet sand & finish as above.

CRACKS IN PARTS, THROUGH LAMINATE

For composite parts, repairs are generally made best using the layup mold surface. It offers a mating surface to hold the part for bonding and allows for general repairs to be made in many different scenarios. However, original molds are not always available for several reasons. Unless making the part from "scratch", most don't have a mold when a composite part develops a crack or delamination. Even without the original mating surface, composite repairs can and have been made to part delamination, fiber damage, cracking, and many other composite discrepancies.

If the part is not structural, reference the above gel / clear coat section to place resin into the cracked areas and apply a skin over part if desired for surface finish.

For more extensive repairs, there are many different viable ways to achieve a structural and visually appealing composite part. Many of the repair cases are dependent on the need for surface finish and structural integrity. On a side skirt or hood for example, a carbon fiber part

is probably going to be left unpainted with a layer of clear coat being applied. This makes the repair process a challenge but does not necessarily make the repair process harder. Developing a plan beforehand makes all the difference in the world.

Start by removing the part needed for repair, in addition removing all mounting hardware screws, nuts, and bolts. Note: all hardware may not be able to be taken off, some are bonded with resin or inserted into the component itself. If it is mechanically held it is good practice to remove all variables from the repair.

Note: Composite components are sharp! When components become cracked or delaminated there is a chance that exposed / loose fibers will stab / cut into skin. When handling composite components safety is of utmost importance. Use cut resistant gloves when handling pieces and during sanding operations below.

Once all the hardware is off, the part will need to be placed into its original position to begin the repair process. In most senses this will be easy. However, for thinner / longer / more complex components, some creativity will be involved in getting the part into a correct orientation for repair.

When the part is in position and stable, place clear tape over the side in which the repair will not take place. This is likely the shiny, finished side of the part. Apply as much is needed to ensure the part's crack does not move and the part stays in position during prep and application of repair plys. This will provide a damming surface for any resin that may run out the part.

Sand repaired area using 220 grit sandpaper on the side of the part that will be least noticeable or not on the original tooling surface. For a hood or side skirt, this is easy. If the surface is tight, over a radius, not flat, use hand sanding techniques. It is important to use care not to cause anymore fiber damage than what is needed for repair. If having flat surface or area that it will fit, use of an orbital sander or right-angle sander will aid in this process. Using sandpaper, go ~6" beyond the desired repair area as the component allows. Use feathering technique to only take out as much of the component as needed. Remove all "flash" from the part's repair surface.

Prep with sandpaper will give repair area's plys something to "grab" onto. This also increasing the surface area of the bonding surface of the repair providing better adhesion to the part.

Clean prepped surface a lint free cloth soaked with acetone.

Perform a "water-break test" of the prepped area by using a spray bottle of water. Spray the water on a non-prepped area of the part. Notice that the water will bead up, this is not an area that would see a bond but will provide what a failing water break test would look like. Spray water onto the prepped area, notice a single, well defined line or no line? The part is

likely ready to apply structural plys.

Wipe area tested area dry then wipe again with a lint free cloth soaked in acetone. Measuring and cutting of patch repair plys are needed. Start by cutting fabric that relatively matches the contour of the desired repair area's surface, going beyond the crack by one inch. (This can also be achieved by placing masking tape over the surface and cutting the masking tape to the desired repair dimensions and taking it off to get the ply dimensions.) Once that is covered, place ply onto another piece of fabric and draw an outline of the ply ~1/2" beyond the perimeter of the first. Generally, repeat this process until you match the number of plys in the component to begin with, growing 1/2" larger in each ply as the part allows. If the part is only skinned with carbon fiber, then fiberglass will suffice for repair fabric. However, if the component is all carbon fiber, it is best practice to keep the CF and material properties the same. (Same for Kevlar parts)

Remove all contaminants from the repair area and ensure a clean working surface for layup of the repair. Most repairs are achievable using epoxy resin but using same resin type to the original part will suffice. However, polyester or vinyl ester resins will not adhere to epoxy surfaces. Mix enough resin for the layup of the needed plys as prepare as needed.

Place the plys onto the surface one at a time and apply resin as any wet layup technique. Place additional patch repair plys over the center of the first ply until all have been applied. Apply mechanical or vacuum pressure (optimal) if available. Use of a release film in conjunction with a sandbag is an option to provide conforming pressure to slightly curved surfaces and slight angle changes. Note: Any additional means to underlying plys of pressure is going to aid the secondary repair bond as it does in any layup technique.

Allow repair area to cure to manufacturer's specification. Remove any pressure application used until the part is clean. Note: Wear proper cut resistant gloves during stripping process, especially if repaired area is around the edge of the part. Once all is removed, ensure a proper bond to the original surface. By passing of a coin tap test, the part is now structurally integral. Turn the part over, the parts repaired area will probably still be visible when up close.

Dependent on the needed surface finish criteria, simply filling the small tool side area with a resin to match the existing surface, as explained in the gel coat / clear coat repair will suffice. Filler may need to be applied but in most cases are not necessary. If the surface finish needs to be exact to the beginning part an additional "skin" layer of CF will need to be applied.

GIVING UP ON PART

The beauty of composites is that if it can be imagined and built it can likely be repaired some way, somehow. There are usually means to repair a part for any given scenario once the part is delivered from the supplier. Issues such as porosity, misalignment during machining,

mistakes during stripping, the list goes on for reasons the original manufacturer would scrap a part. However, there are a few scenarios in which scrapping the part is a more viable option for end users or fabricators. Below are some examples of when to scrap or give up on a composite component for its original use.

The most common reason to scrap a composite component is that it will be more expensive than the component itself. The materials alone for large repairs can sometimes be more than the part itself. Be sure to estimate the cost of a given repair before performing. Also factor in the cost of time, resources could be used elsewhere in some cases. Many composite repairs take time and a high attention to detail to complete. This often causes many to simply scrap the part.

For businesses, many times a part is scrapped and written off as a loss for these reasons.

The part cannot be placed back into its original position. If a part is mangled so bad that the contours cannot be matched back up properly, there is no use in attempting a repair. There's little to no way to ensure the quality of the repair from a dimensional standpoint.

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