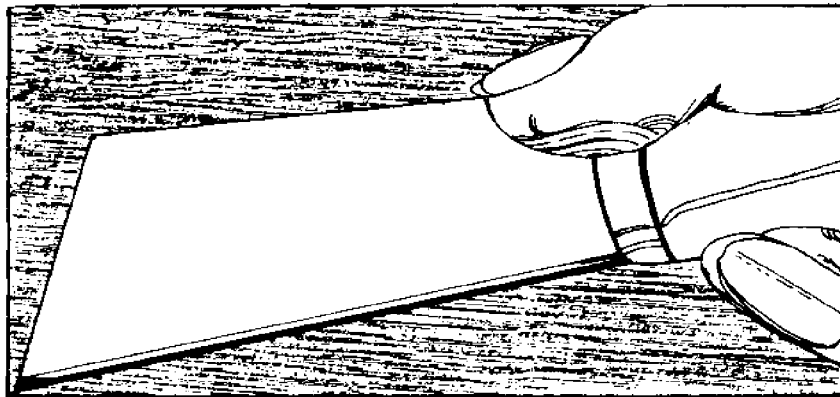
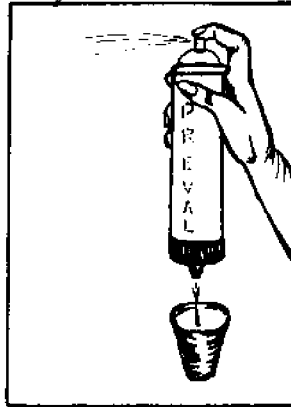
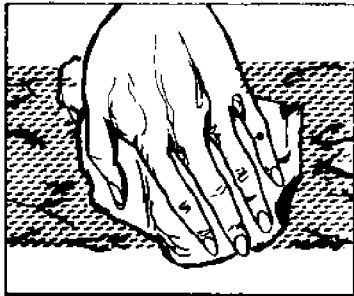


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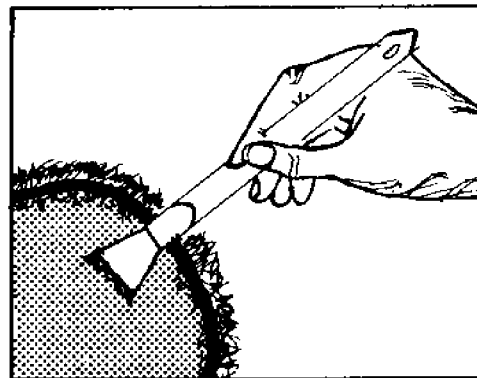
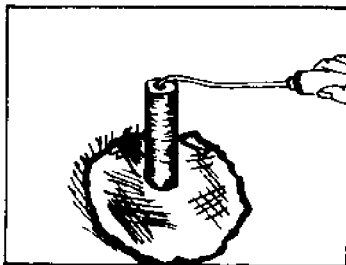


# FIBERGLASS BOAT REPAIR

by

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August 1977



**UNIVERSITY OF HAWAII  
SEA GRANT COLLEGE PROGRAM  
Marine Advisory Program**

# introduction

Of the 63 million households in this country, almost one of ten has a boat of some kind. Many of the privately owned boats in the US are maintained by their owners. In the past 20 years, fiberglass boats have become the most numerous type. There are now over 20 million fiberglass hulls of all shapes and sizes in the US.

Where does a person find out how to care for and maintain a fiberglass boat? For serious damage a good fiberglass repair shop is the place. There are books on the subject in the local library. This pamphlet gives some guidelines for basic repairs which the boat owner can do himself and also suggests some maintenance techniques for longer fiberglass life.

Except for steel, fiberglass is stronger than any other boat construction material. It takes abuse better than any other material; it requires maintenance less often; and it is simple to repair when damaged. Although this material can resist the kind of damage that would be more visible on boats made of wood or aluminum, it, too, can become scratched, dented, gouged, and even stoved in through the hull.

Fiberglass is only half of the material used in a boat. The other part is thermosetting liquid resin, which, after being mixed with the glass fibers or cloth, is cured into a hard plastic by chemical action and heat. Fiberglass-reinforced plastic, or FRP, is a combination which has superior characteristics over either material individually. For boat construction, the US Coast Guard specifies the combination of 40% fiberglass and 60% resin. This combination is relatively impervious to the marine environment, although it does not prevent marine growth. FRP surfaces must be protected by anti-fouling paint below the waterline. However, a great advantage of FRP hulls is that marine borers (worms, etc.) do not penetrate the hull itself (a major problem with wooden hulls), even when the paint weakens with age.

There are two basic types of resin, polyester and epoxy. Each has advantages for numerous applications, but polyesters are used almost exclusively in FRP boat construction. Polyester is cheaper, identical chemically with the material in most boats, and

good for major repairs where the bearing surface area (damage) is large. Epoxy has properties which make it good for minor repairs, especially those which can be spread like putty.

## outer surface

The outside visible surface of the FRP boat is the gel coat. It is a specially formulated resin mix applied to the mold prior to layup of the first layer of reinforcement. This coating duplicates the mold surface, forms the outer cosmetic surface of the boat, and provides protection against weathering. But the gel coat is not maintenance-free. It is easily marred and its color eventually fades in sunlight, especially intense tropical radiation. Dark colors are more susceptible to fading than light colors. It is difficult to mix and match the repair gel coat color with the original, even on a new boat. If possible, FRP hulls should be covered with tarps or stored under a roof for protection from sunlight. The gel coat of an FRP boat is similar to a car; for maintenance purposes it should be waxed occasionally. Special gel coat waxes are available but a good car wax will do.

## glass fiber types

1. Cloth--a plain, square, open-weave material used primarily in small boat construction for surfacing and exposed areas of hulls and super-structures and for repairing laminate defects.
2. Woven roving--flattened bundles of continuous strands woven into a heavy plain weave, commonly used as a reinforcement for marine applications.
3. Mat and chopped strand--a pre-fabricated mat made from short randomly oriented chopped strands of fiberglass held together with a soluble resin binder. A chopper spray gun can be used to make this process rapid and efficient.

A composite fiberglass reinforcement consisting of alternating plies of mat and roving is used extensively in commercial small boat hull construction. The most common such composite consists of 24-ounce woven roving (per square yard) and 1-1/2-ounce mat (per square foot) that builds up thickness at the rate of about 12 plies per inch. The resultant weight-strength and weight-stiffness characteristics are ideal for small boat hulls except where minimum weight is required for high performance.

# core materials

Many materials are used as structural cores for stiffeners and sandwich panels in FRP boat construction. These include wood, foamed plastics, and honeycomb. Those in your boat have been chosen for good sheer strength and rigidity, ability to bond adequately with FRP, light weight, resistance to deterioration, and sufficient crushing strength to withstand loading. When making repairs, it is critical to allow core materials to dry out, particularly wood. FRP will bond well to the core material only if the area is dry and clean. If you are making a repair which includes exposing the core material, allow the area to dry before applying new FRP. Use an infrared heat lamp or home hair dryer, if necessary. Adding small amounts of acetone will help to dry the work.

# planning the job

FRP small boats can be repaired by the boat owner with readily available materials and ordinary hand tools, and without torches or other high-heat producing equipment. Reasonable care is needed, however. This includes maintaining the repair area at 60 to 70 degrees Fahrenheit (no problem for Hawaii) using heat lamps if necessary, cleaning the repair surface thoroughly, and following manufacturer's directions on the FRP product you are using. Once the resin is mixed with the hardener (catalyst), a chemical reaction begins and will proceed whether you are ready or not. Make sure the resin is new; when resin gets old, it is hard to work with. LAY OUT ALL THE MATERIAL YOU WILL NEED BEFORE YOU START THE JOB. This includes surfacing tools, solvent, cleaning rags, mixing containers, etc. Good planning and preparation of the repair area are the most important parts of the job.

# tools and materials

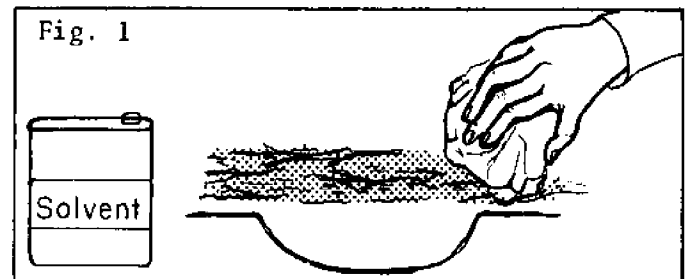
- Breathing respirator or mask
- Power saber or hand keyhole saw
- Power sander (disc type with attachment for buffing pad)
- 1/4-inch electric drill
- Carbide drill burrs
- Assorted carborundum drill tips
- Lamb's wool buffing pad
- Sanding block
- Scissors
- Rubber squeegee
- Putty knives

- Paintbrushes
- Clean white cloths
- Cellophane (or waxed paper)
- Masking tape
- Single-edge razor blades
- Fiberglass rubbing compounds
- Fiberglass wax
- Milled fibers or patching putty
- Acetone or fiberglass washing solvents
- Cardboard
- Brown wrapping paper for masking
- Sanding discs: 24, 60, and 100 grit
- Aluminum oxide production paper: 50, 100, and 220 grit
- Wet or dry sandpaper: 400 and 600 grit
- Matching gel coat
- Fiberglass mat, woven roving, and cloth
- Resin
- Catalyst
- Heat lamp (infrared) or hair dryer

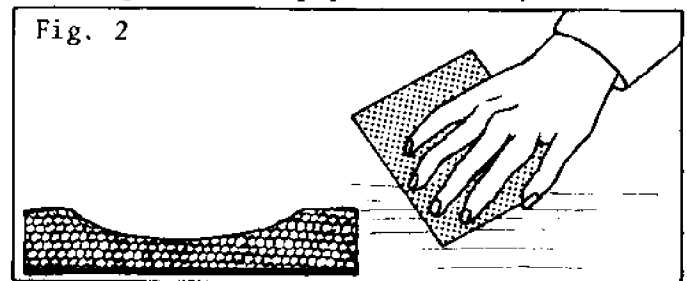
# minor repairs

## SURFACE DENTS AND GOUGES

1. Clean the area thoroughly. You can use a scouring cleanser or a special solvent sold specifically for this purpose (Figure 1). Make sure there is no wax remaining on the surface.

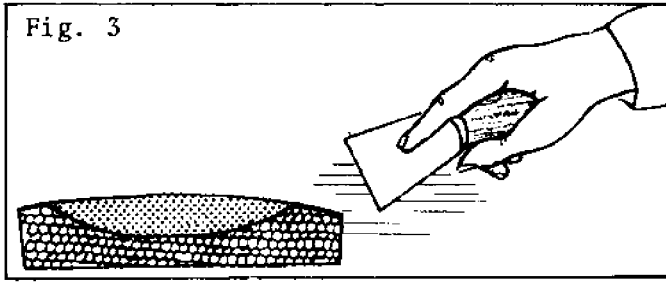


2. Sandpaper the area to provide for adhesion of the repair compound. Enlarge damaged area and feather edges if needed (Figure 2). Wipe the sandpaper dust away.



3. Mix resin and hardener (catalyst) to manufacturer's directions.
4. Using a clean stick or putty knife, work the mixture into the hole. Apply more than you need to fill the hole--about 1/16 inch higher than the surrounding surface, overlapping onto the feathered edges

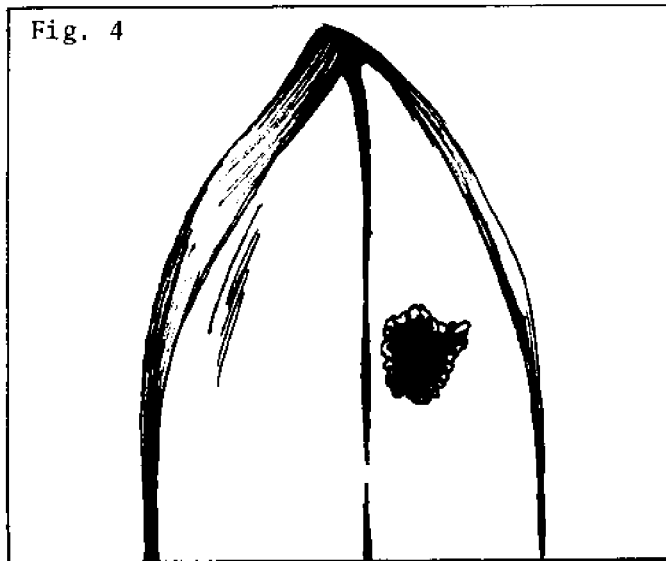
(Figure 3). If you are using masking tape, remove the tape while the resin is still tacky.



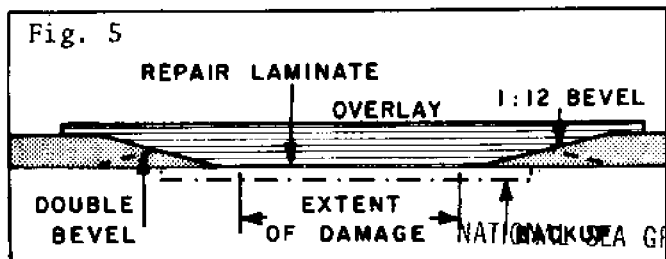
5. Cure overnight. You can use a heating lamp if necessary. Sand with finishing paper flush with the original surface and finish with rubbing compound. Remember, for both minor and major repairs, laminating resin is used for buildup and finishing resin (gel coat) is the last (cosmetic) layer.
6. Repaint if the pigment is not part of the regular gel coat or the boat has been painted with a different color. ALWAYS USE PAINT COMPATIBLE WITH FRP. Some paints will not adhere well to FRP, and some will even react chemically and make a gooey mess that won't dry.

## serious repairs

A HOLE IN A BOAT (Figure 4)



1. Cut away the damaged FRP and level to a slope of 12:1 (Figure 5).



2. Make a temporary backup plate of metal, wood, or even cardboard and attach to the back of the panel (masking tape works fine to hold the backup plate). Cover the backup plate with paste wax (or waxed paper) so it will not stick to the patch.
3. Mix the batches of resin and progressively larger size glass roving, mat, or glass cloth pieces (depending on thickness needed) to fit the hole. With a hole in the hull or deck, you probably can't do the whole job with one or two batches of resin. Remember, your boat is built up with multiple layers of FRP; REPAIR IT THE SAME WAY.
4. When the material is flush with the surrounding area, cut and attach several plies of cloth which overlap the sound laminate by several inches. The finished patch will be slightly higher than the surrounding area. A patch consisting of a double bevel which is layed up from both sides of the panel is preferred.
5. Allow to cure overnight. You can use an infrared heat lamp if necessary.

The biggest drawback in cosmetic repairs to fiberglass hulls lies in the extreme difficulty of obtaining a good match with the original gel coat. Manufacturer-supplied gel coat will often vary from batch to batch, while weathering of the hull usually makes a difference in shade in old and new (repair work) gel coat. For an extensive patch, a complete paint job on the hull may be the answer.

When making a repair, no matter how small, take some time to study the problem and work out the necessary steps ahead of time. It is always good practice to mix a small batch and test it on something else first. Remember, FRP strength comes from thorough saturation of the cloth or mat with resin, not the buildup of extra layers of resin. Patience is the key to good FRP work. Don't hurry!

For more information, contact the University of Hawaii Sea Grant Marine Advisory Program Office at 948-8191.

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