BEFORE YOU TRY YOUR HAND WITH FIBERGLASS...

BY TONY BINGELIS

It is a rare homebuilt that doesn't have a few fiberglass parts and components installed somewhere.

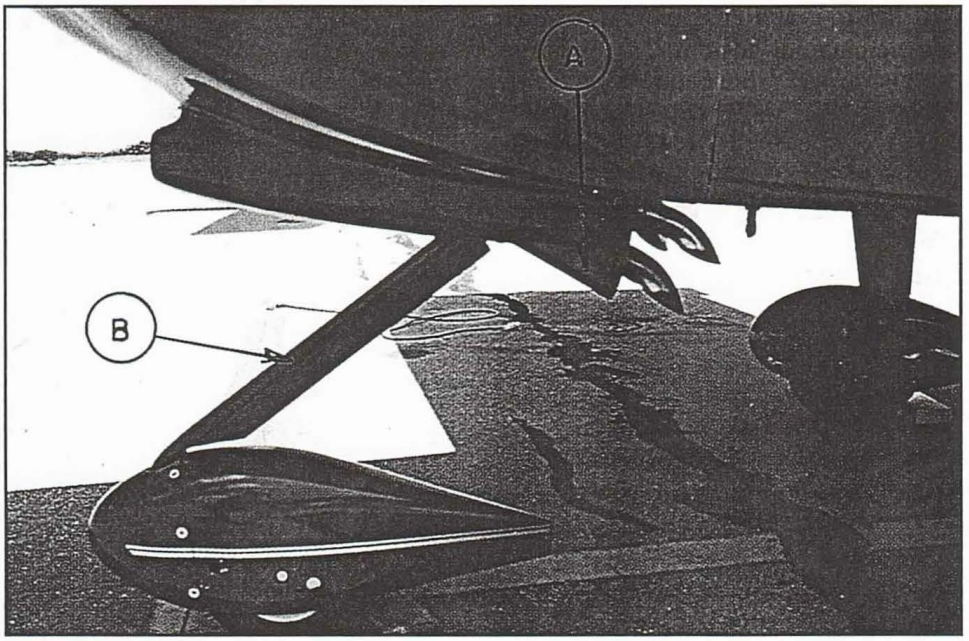
Typically, these components might include the cowling, wheel pants, tail and wing fairings, landing gear fairings, cuffs, and other less conspicuous parts installed to hide various openings and drag producing intersections.

Such a rather extensive use of fiberglass is deemed to be a good way to enhance the overall appearance of the aircraft and, at the same time(hopefully), to reduce drag.

Anyone building a kit plane can, therefore, expect to receive many of the aforementioned pre-molded fiberglass components, along with the basic structural materials and parts normally included in such kits.

The kit manufacturers, in many instances, furnish the molded fiberglass components with the assumption that you would know how to prepare and install them so they look good and fit good. They provide very little information explaining how to finish the parts or, if necessary, how to modify them to fit your particular project. Am I implying that, sometimes, the parts you receive may not fit your project? That's right, amigo.

Every homebuilt built is different and, certainly, none of them are exact copies of the original prototype. Even the FAA realizes this because it officially considers each homebuilt to be uniquely different — even though hundreds of a particular type may have been built using the same kits and plans.



This photo identifies a couple of places where the builder has to do a bit of fiberglass work in the interest of drag reduction.

Each airplane will differ slightly, in spite of the most conscientious efforts expended by the average builder to duplicate the exact design dimensions, contours, and tolerances. Furthermore, additional differences crop up with the engine and equipment selections.

Nevertheless, one would naturally assume that the stock fiberglass parts provided will fit properly. Unfortunately, this is not always so. Consider these possibilities:

1. The fiberglass parts you receive may have been improperly supported during storage or shipment and may have become warped.

2. The fiberglass components may be so fresh that they were not given time to cure properly before shipment.

3. Your engine selection will not fit the design cowling.

At any rate, builders do get warped and poorly fitting fiberglass components on occasion. What to do? Fix them, usually. Sometimes the application of heat (heat lamp, hair dryer or heat gun) can be used to "unwarp" and restore the component. Otherwise, you as the builder will have to correct the deficiency surgically. That is, cut, rework and modify the parts you receive if you are dissatisfied with their fit or appearance.

Tail fairings are unique in this regard as the fiberglass fairing must fit

around both the vertical stabilizer and the horizontal stabilizer. Naturally any change in the angle of incidence of the stabilizer or in the offset of the fin will definitely alter the fit of a molded tail fairing. When that happens a drastic rework of the part may be necessary.

All this points up the need for you to become familiar with some basic information for working with fiberglass.

I feel extra compassion for the builder who has to redesign or rebuild his cowling to accommodate that special, somewhat bulkier, auto engine conversion. He, too, certainly should know and understand what is involved when working with fiberglass.

WHAT YOU SHOULD KNOW ABOUT FIBERGLASS

Fiberglass, in my estimation, is a hostile material (medium?).

The term "fiberglass" is a rather ambiguous one. Because of popular usage the term "fiberglass" is equally applicable to the fiberglass cloth alone, as it is to a completed fiberglass cloth/resin impregnated part.

For example, fiberglass (cloth or mat) to be useful must be saturated with a polyester, polyvinyl ester, or epoxy resin. When the resin saturated fiberglass cloth cures, it solidifies into a rigid glass-like shell that will permanently retain the shape of the form or mold used in the layup. In this state it is technically referred to as FRP (fiberglass reinforced plastic).

Incidentally, increasing the number of glass cloth layers increases the rigidity and strength of a layup more so than increasing the number of coats of resin applied.

A completed fiberglass part is a strong, long lasting, hard, shiny-surfaced product. It is absolutely waterproof, rot-proof, inset-proof, and immune from the effects of most solvents and fuels. Best of all, it is fairly easy to keep clean and to maintain.

YOUR CHOICE OF RESINS

These choices might include the polyester resins, the vinylesters and the epoxies. All are excellent when properly used. However, due to space limitations I will concentrate primarily on use of the less expensive polyesters.

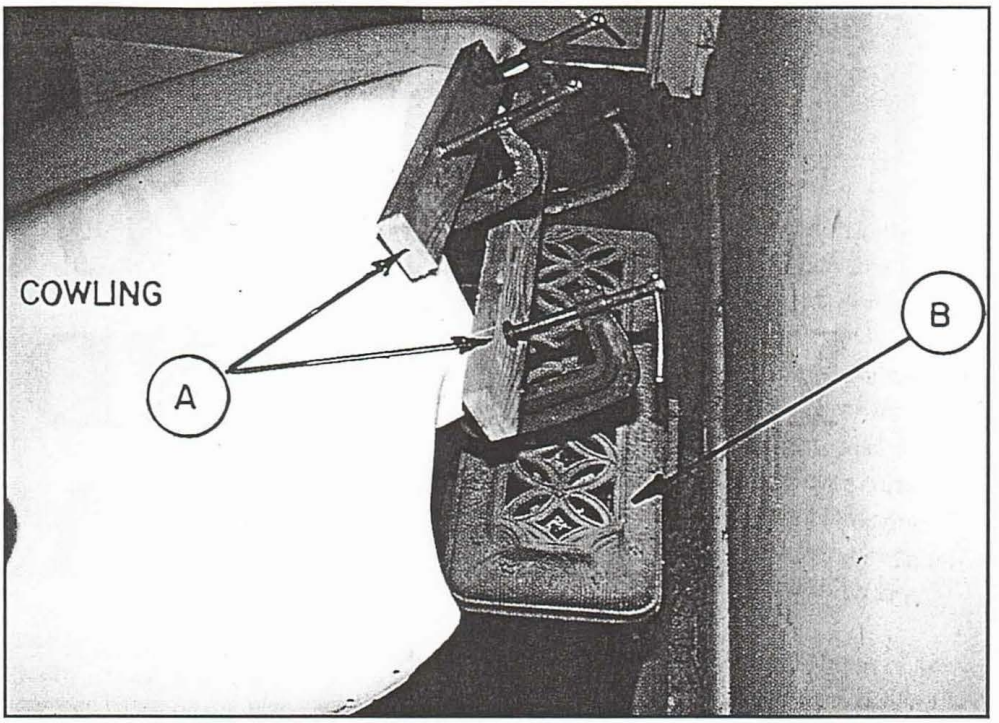
1. Polyester bonding or laminating resin (PRB).

This resin is chemically formulated to remain tacky (sticky?) after it has hardened. This characteristic allows you to later add other layers of glass without the necessity of sanding the original layup to ensure a good bond. However, a sticky final surface finish is not what you want or need, is it?

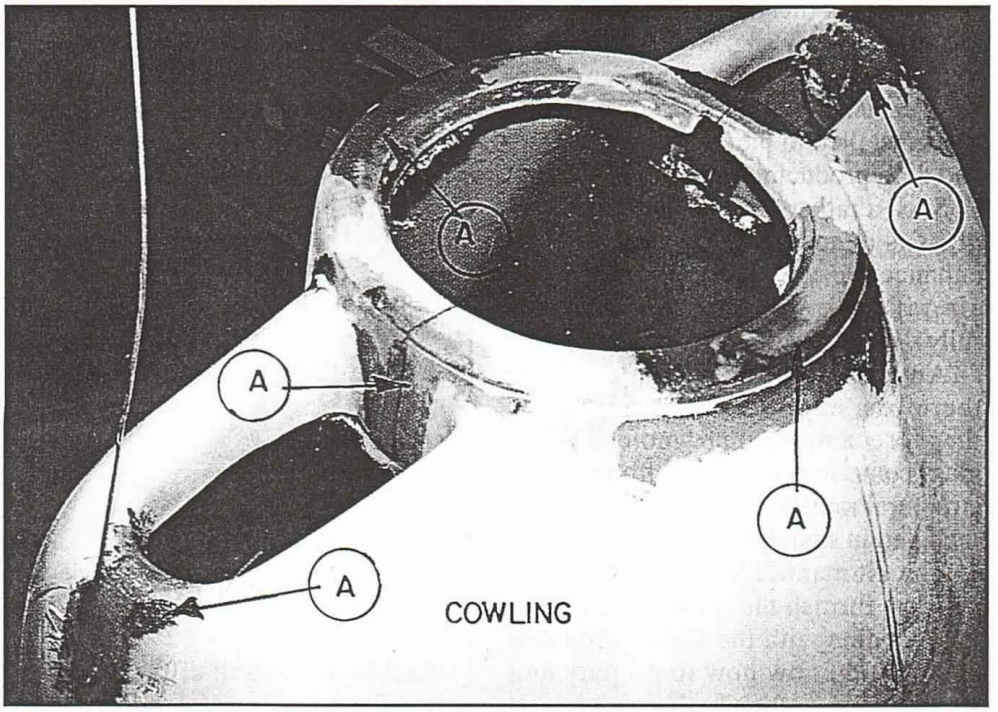
2. Surfacing or sanding (finishing) resin (PRS).

This polyester resin contains wax which rises to the surface and cures to a hard tack free finish. You can readily sand this surface without gumming up the sandpaper.

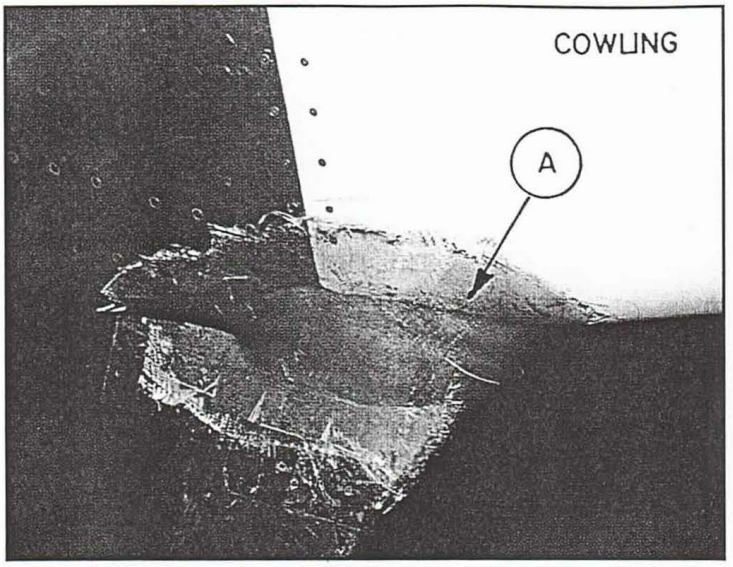
It does have a drawback. If you later want to add additional layers of resin and fiberglass (after the initial finishing resin layup has completely cured), you must first sand the surface until all traces of surface glaze are removed. If



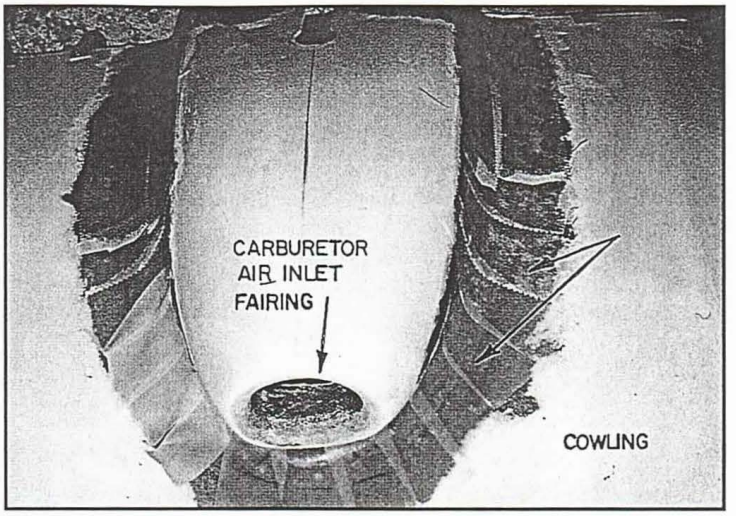
A space heater (B) is being used to heat the cowling to make it pliable. The blocks and clamps are used to force the cowling into alignment. After it has heat soaked a while, the heat was shut off and the cowling was allowed to cool. After cooling it retained the corrected contour.



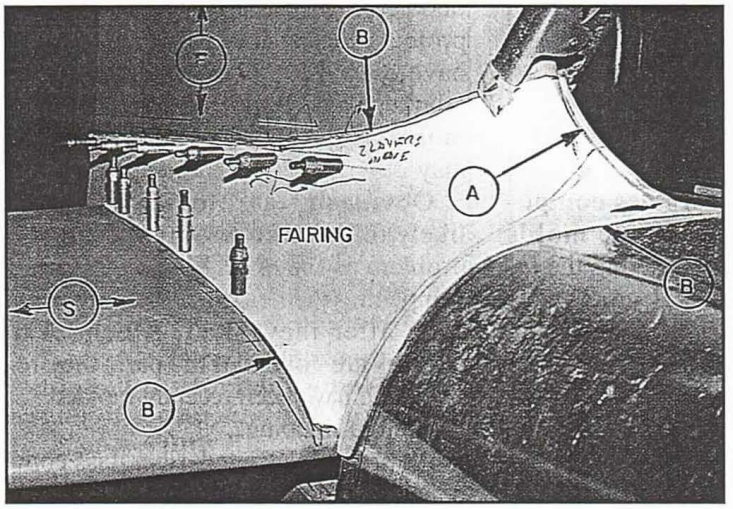
When this builder received his cowling, he found it to be badly warped and mismatched in the areas marked (A). He applied heat and pressure but failed to "unwarp" it completely. In the end, he had to add additional layers of fiberglass as shown to effect the necessary corrections.



Shown here is a typical small fiberglass job, the making of a gear leg to cowl fairing.



This carburetor air scoop had to be replaced to provide the necessary clearance at the carburetor air filter box. 3" fiberglass tape (A) was used to blend in the contours. You can see that a lot of sanding work lies ahead.



Here is another example of a molded tail fairing that did not fit. The builder had to cut it apart at (A), and add fiberglass layers to the underside areas marked (B) to obtain a perfect fit.

you don't do this, any additional resin or fiberglass layers you may add will not adhere very well and could separate.

3. Vinylesters provide good adhesion, impact resistance, and have mechanical properties which fall between those of polyester and epoxy. These resins are not as commonly available as are the polyesters or, for that matter, the epoxies which are commonly used in boating and automotive applications.

4. Epoxy resins are available in a variety of special formulations.

What is the difference between epoxy resins and polyester resins? Actually, there are many differences.

Epoxies do not use MEK peroxide for a catalyst. They have their own special hardeners. These are mixed in various ratios depending on the particular resin formulation.

The epoxies that have a 1:1 mix are the easiest to measure and use. Epoxies are super strong adhesives and are excellent for all woods, metals, glass and many plastics.

Epoxies require little or no clamping pressure to achieve super strong joints. They can be applied to Styrofoam™ or any other kind of foam without destroying it.

Epoxies adhere well when applied over polyester surfaces, however, do not attempt to use polyester resin over an epoxy surface. Another important characteristic is that they do not shrink as they harden.

In addition to the extra cost of epoxies, most builders feel it has another drawback. It is that epoxies take much longer to harden, often as long as 24 hours.

In contrast, polyester resins mixed with their MEK peroxide catalysts cure (harden) quickly — often within 30 minutes when the temperature is above 70 degrees F.

Amazingly little MEK catalyst is needed to activate the resin — about 14 drops of MEK peroxide per ounce of resin, depending on the grand you are using.

Too much MEK and/or higher temperatures will kick off the cure quickly . . . sometimes too quickly. When that happens, the resin gets hot in the can and starts to gell before you can finish using it.

It's too bad but polyester resin will dissolve Styrofoam™ and some plastic containers. Therefore, avoid making your molds of Styrofoam™ and mix your resin in small tin (soup) cans . . . or coffee cans.

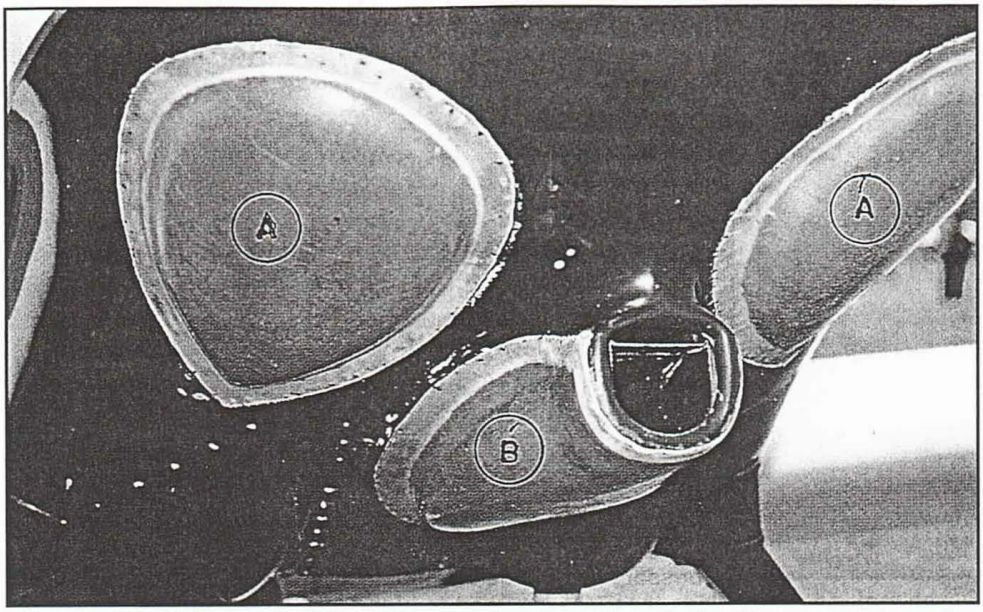
Polyester resin is bad to use on Plexiglas™—*so don't make the mistake of using polyester layups next to Plexiglas™*.

When mixing the resin, try to work in a well ventilated area because both polyester and epoxy fumes must be considered to be toxic.

Mix only small amounts of polyester resin. Check the clock, and don't piddle. Work fast but carefully. Polyester resin will kick off (start to gell) as quickly as 20 minutes at 70 degrees F. Much sooner if temperatures are higher in your work area.

Don't try working in the sun; the stuff will set up before you can do much.

Don't become upset if that new polyester fiberglass layup doesn't set up hard as soon as you think it should. Sometimes it may take half an hour, sometimes a day, and sometimes several days. It all depends on the temperature and the humidity (especially humidity) during and immediately after making



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the layup. Don't worry, polyester will continue to harden and gets tougher with time.

When working with fiberglass resins, you will learn that they seem to have a way of getting all over your tools, shoes, clothing and practically everything else in the area. Acetone will do a good job of cleaning up the stuff before it cures and hardens — however, cleaning your hands with the solvent is not recommended . . . use gloves and obviate that need to do so.

SANDING FIBERGLASS SURFACES

The fiberglass dust kicked up by a disc sander — and there will be a lot of sanding you will have to do — can irritate your skin and nostrils. Naturally you should wear a dust mask during all sanding operations.

Adding to the sanding problem — fiberglass sanding dust can be likened to shredded razor-sharp glass particles — so, if any of that sanding dust gets on your unprotected hands and arms, it will penetrate the pores in your skin. You will then experience an irresistible urge to rub and scratch your hands and arms relentlessly to relieve the itch. Much of this itching misery can be avoided by wearing a long sleeved shirt and using a protective cream (like Invisible Gloves #1211) on your hands. Long rubber gloves also work well.

WHAT YOU SHOULD KNOW ABOUT GEL COAT

Factory made fiberglass components are laid up in female molds which are prepared by spraying the inside surface with a gel coat layer (usually white) before laying in the resin soaked cloth and mat. This gel coat ensures a uniform smoothness and a hard glossy surface finish to the completed fiberglass component after it has been removed from the mold. Unfortunately, gel coat is also quite heavy and increases the weight of the completed fiberglass part.

Before you can paint a cowl or any other fiberglass part that has a gel coat surface, you should dull the surface by sanding it with #180 and #320 grit wet/dry sandpaper. All of the gloss must be removed, otherwise the paint will not adhere reliably. Ordinarily, no primer is needed if the surface is in good condition.

Here is an interesting phenomenon that bothers some builders.

If not immediately, then weeks or months after he has completed a very nice glass-like finish on his airplane, one day he just happens to notice that he can faintly detect the weave of the fiberglass cloth under that beautiful paint finish. This bothers some builders and they manage to become quite upset when they first notice "IT." The problem, if you want to call it that, is not really the builder's doing. It is characteristic of polyester resins.

Most kit furnished molded fiberglass components are made not with the more expensive epoxy resins but with the more economical polyester resins. Unfortunately, polyester resins will continue to shrink slightly after they have cured initially.

This shrinking process may continue for months. As the cured resin shrinks, the fiberglass fibers become more prominent because the glass fibers in the layup do not and cannot shrink. The result . . . a somewhat noticeable presence of the fabric's weave in the surface finish — you really have to be looking for it to see it.

What can you do about it? At this stage, nothing much short of undertaking a major refinishing job.

If you are a builder who is going to take several years to complete your project, the "shrinking" will probably have ceased long before you will get around to finishing and installing your molded fiberglass parts . . . and you may never experience that "problem."

Obviously, fast builders are more likely to be faced with that cosmetic problem as they will be installing and completing their fiberglass components soon after they receive them. The chances are good that the parts they receive will have been recently molded . . . just before shipping.

As previously stated, fiberglass components made with *epoxy resins do not shrink in curing*, therefore, are not as likely to suffer from that characteristic common to polyester resin layups.

Nevertheless, in spite of it all, most builders prefer working with polyester resin which sets up in a matter of minutes rather than put up with the overnight cure normally required for epoxies.

A FINAL CAUTIONARY NOTE . . .

The catalyst (fluid) used with polyester resin is a strong irritant and is corrosive to your eyes so always use protective glasses while mixing a batch of polyester resin. That MEK peroxide (catalyst) may cause blindness if any splashes into your eyes.

Flush immediately with lots of water for 15 minutes and call your physician. It also is harmful or may be fatal if swallowed. Don't let this precautionary note scare you out of working with fiberglass materials and

resins . . . just be careful. After all, the experience you acquire can be as rewarding as it is educational.

REFERENCES: TONY'S BOOKS

1. **THE SPORTPLANE BUILDER** — Check the index under "Fiberglass" for info on fiberglass basics/overlays/fairings.

2. **SPORTPLANE CONSTRUCTION TECHNIQUES**—Check the index under "Fiberglass" for info on fiberglass tanks/cowlings/wheel pants mods.

HANDY SHOPPING LIST

For doing small fiberglass jobs:

Fiberglass cloth, 6 ounce O.K., and/or 3" glass tape.

Polyester (finishing) resin with MEK peroxide catalyst.

Large scissors.

Razor blades (single edge).

Masking tape and/or duct tape or aluminum tape or electrical tape.

Brush, inexpensive, bare handle, 2" wide.

Acetone, 1 gallon for tools cleanup.

Mixing sticks.

Floor wax or similar paste wax.

Clean empty soup cans or unwaxed paper cups.

Scale for weighing resin in ounces.

Half round file, 10" -12", bastard cut.

Disc sander with foam back-up pad/#80 grit sanding discs.

Sanding Block, hard rubber

Sandpaper, Black floor paper #80 grit and #320 wet/dry.

Hacksaw blade, 18T and 32T, use as handheld scraper.

Modeling clay/solid foam/plaster for making simple molds. ◆