CHAPTER 25

FINISHING

Finishing the composite airplane is more important than simply obtaining an attractive paint job. The finish on a composite aircraft serves to protect the structure from weathering and deterioration from ultra violet radiation (sunlight). The finishing materials also give the aiplane its final aerodynamic shape. Using the proper materials and techniques, the finishin9 process is fast, pleasing (both aesthetically and aerodynamically), and provides for long maintenance-free service. Use of sub-standard materials can limit the life of the finish, result in an overweight airplane, or even limit the service life of the airframe. Sanding is done constantly during the finishing process and **extreme** caution must be exercised to avoid damaging the structure. A poorly executed finishing job can destroy the structural integrity of the airframe. Even the finished **color** of the composite aircraft can effect its structure. Proper techniques must be adhered to for safety as well as to obtain an attractive airplane.

FINISH COLORS AND HEAT

Epoxies and foams are all sensitive to high temperatures. Room temperature curing epoxies soften and loose their rigidity at only moderate temperatures (160 degrees F). Foams are also heat sensitive and tend to soften and swell with moderately elevated temperature (250 degrees F). The sun is a potential source for heat. In still air, on a hot sunny day it is possible to obtain surface temperatures that approach 220°F on a black airplane. Color of the surface determines how much solar heat it will absorb. White surfaces absorb very little (10%) of the sun's heat while a black surface (95% absorption) will heat up tremendously. The accompanying graph shows the relationship between color and surface temperature. White has been chosen as the only color for fiberglass sailplanes to preclude any possibility of excess temperature due to solar heating. The same criteria apply to the Long-EZ. White is the only recommended color for these aircraft. Trim colors in non-critical areas are acceptable as desired. Such as the fuselage, vertical winglet surfaces, and the underside of wings and canard. Dark trim colors are definitely **not approved** on the upper surface of the wings and canard. Do not stripe wing or canard with trim, except at the canard tip where structure is not critical.

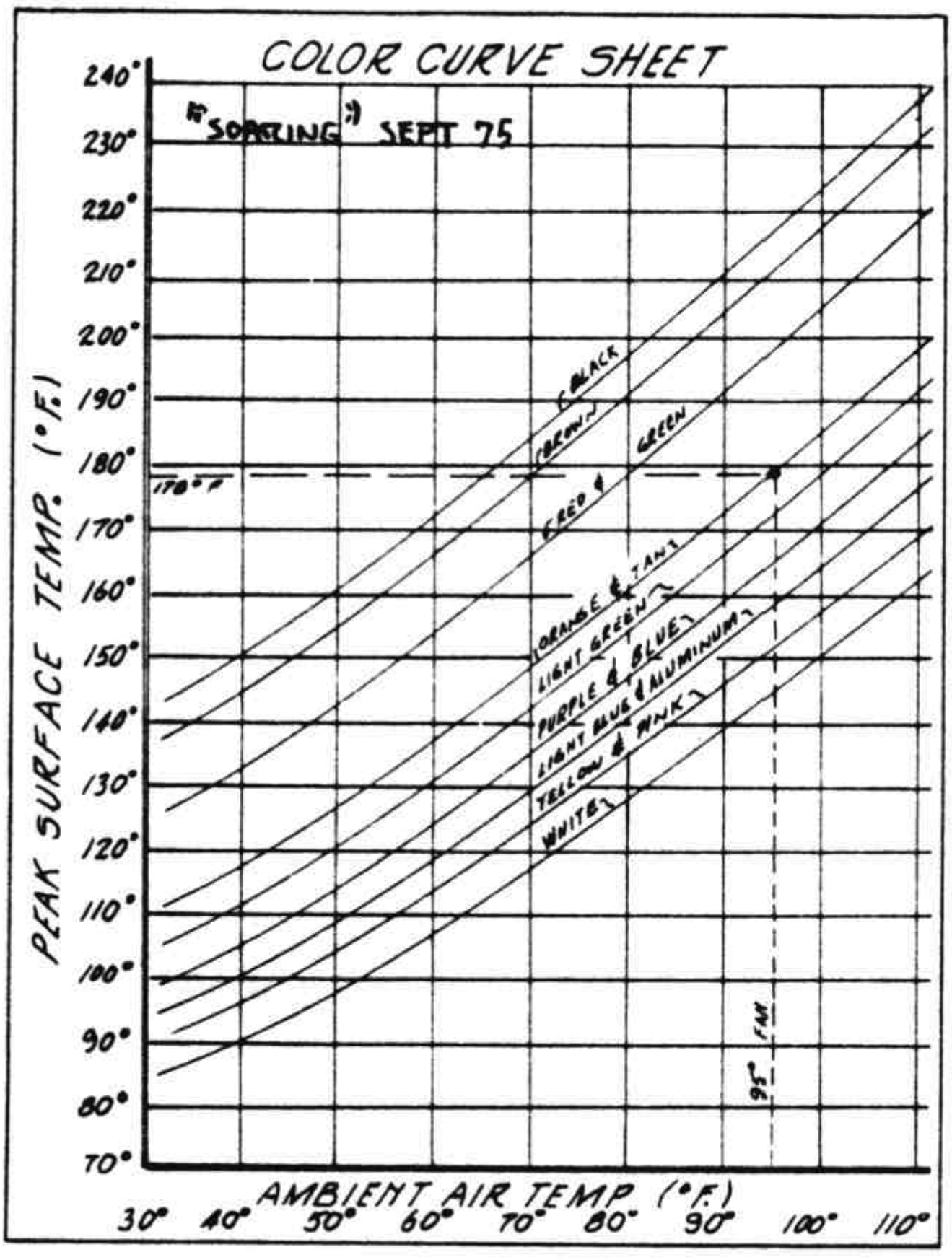


Figure 25-1: Surface colors effect on surface temperature

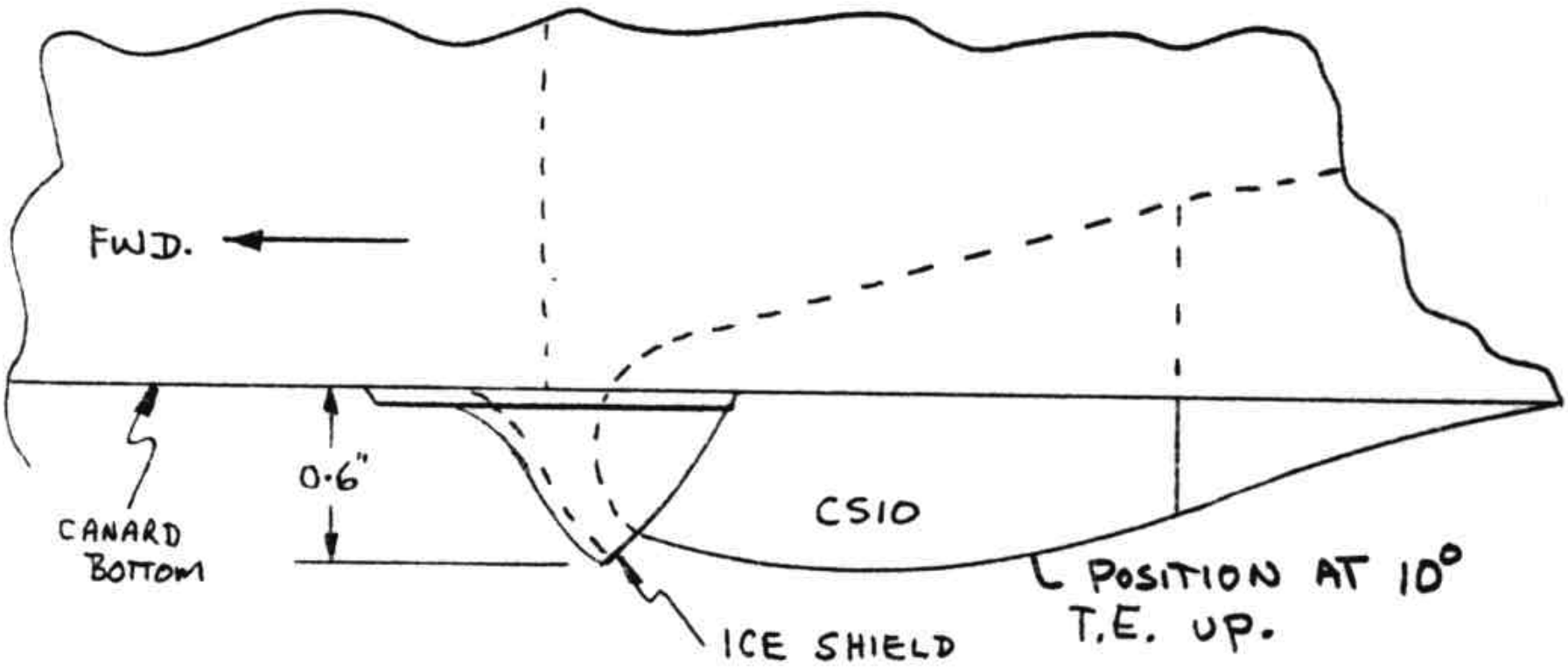
TOOLS AND MATERIALS

A low density microsphere/epoxy mixture (dry micro) is used for coarse filling requirements. Automotive type polyester body fillers (Bonda) are very heavy and not rec01T111ended for aircraft finishing work. One product that works fast like Bonde, and is light like dry micro is Stitts micro putty. It can also be used for contour filling, but is not a replacement for featherfill. Medium to light surface filling (less than .030 in) is done with a light weight polyester spray (or brush) filler/primer called Feather- Fill. Feather-Fill is note-worthy for its ability to fill medium thicknesses in a single spray or brush coat and for its easy sanding to a smooth surface, when mixed with micro balloons prior to application. Dupont 70S, 100 S or if using enamel paint, 3011S dark gray lacquer primer/surfacer provides an effective ultra violet radiation barrier. The actual finish paint type is largely a matter of the builder's personal preference. Automotive finishes in lacquer, ename1, acrylic lacquers, acrylic enamels, and the polyurethanes are all acceptable. We find the acrylic lacquer is easy to work with, easily patched and readily polished to a high gloss. The enamels and acrylic enamels are low cost and easy to apply, however, they are not readily repairable if chipped. The polyurethane finishes offer the best gloss for the longest life, but they are high cost and virtually impossible to repair. Also, the fumes present when spraying polyurethanes are dangerous to your health.

Sanding will occupy a large percentage of the time spent finishing the composite aircraft. Sand paper in 36 to 60-grit, 100- grit, 220-grit and 320-grit roughness will be used. Standard 9" x 11" sheets are the most versatile. Use a good quality aluminum oxide, or silicon carbide sandpaper. Don't waste your money on the cheap flint-type sandpapers. Power sanders are not recommended; it is too easy to damage the structure while using them. Hard (wood) and soft (foam) sanding blocks and the sanding spline shown on page 2 will be your primary finishing tools. A paint spraying setup will be.needed for the U.V. barrier primer and finish painting. Some hand brushing of feather fill and U.V. primer will also be done.

Optional Ice Shields.

The Long-EZ was not designed to fly in icing conditions. No de-ice nor anti-ice provisions have been made. The aircraft has **not** been tested in icing conditions. However, we do have some limited icing experience in the Defiant. An aircraft with similar structure and configuration. We found that this aircraft handled ice quite well, with no decernable trim changes. However, we found that ice forms on the blunt leading edge of the outboard elevator balance weight, and could restrict elevator travel. We installed ice shields on the Defiant to correct this problem. If you are contemplating IFR operation of your Long-EZ you should install the ice shields detailed below. They are merely a 3- ply BID shield in front of the balance weight. Wait until after the featherfill application so the shields don't interrupt your ability to smoothly contour the canard surface. Install the elevator with 2 hinge screws. Tape it in the 10 degree elevator position (use template on page 11-6). Sand away any featherfill down to bare glass on the canard skin out to ½" from the balance weight. Apply at least 8 thicknesses of gray duct-tape to the balance weight sides and front to provide clearance .. Then layup 3-plies BID as shown over the weight lapping ½" onto the canard skin. After cure, remove elevator and gray tape.



Trim the shield to the 0.6" dimension.

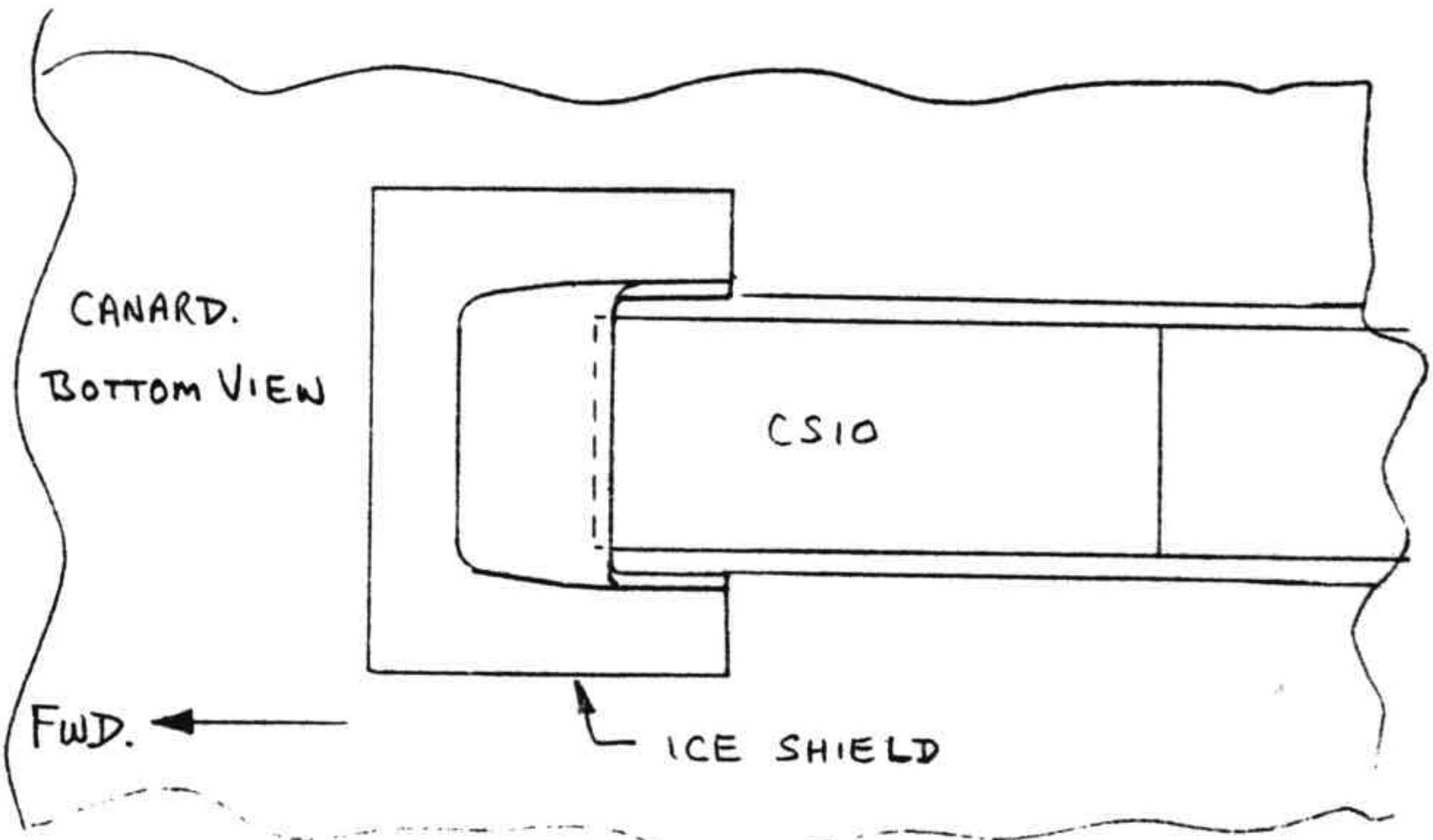


Figure 25-2: Ice Shield

The Spline

The sanding spline is a finishing tool common to the sailplane industry. It is an easy tool to make and does an excellent job of contouring. You may find it handy to make two, one for coarse grit sandpaper and one for medium or fine sanding. The spline is an easy tool to use but it may require your close attention at first. The spline is always held with handles parallel to the leading edge of an airfoil surface (wing, canard, etc.) as shown in the sketch. The sanding motion is on a diagonal to the leading edge while the spline's handles are held parallel. This takes a little getting used to but becomes second nature after a little practice.

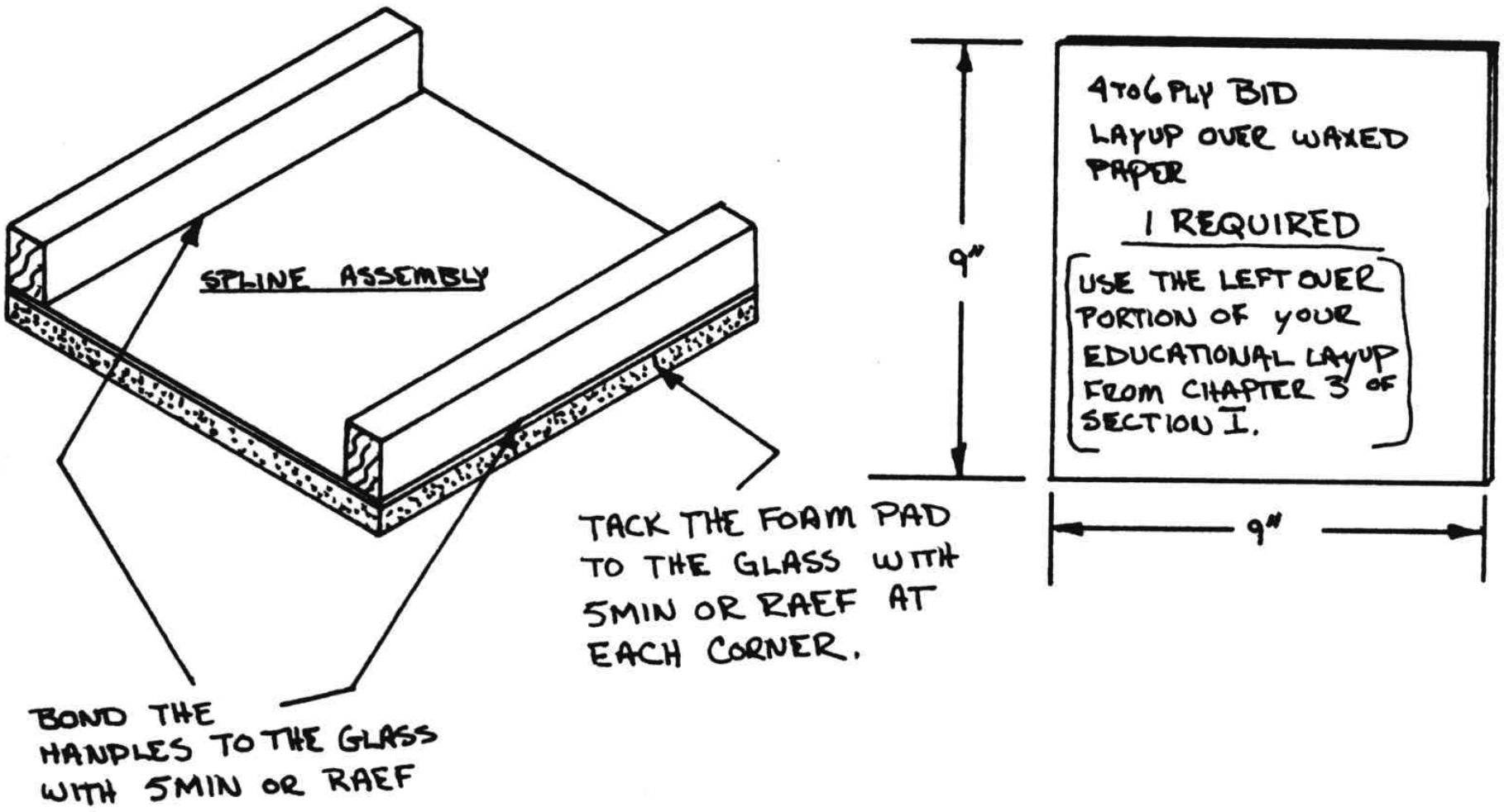


Figure 25-3: Sanding spline construction

THE FINISHING PROCESS

Finishing the composite airplane is a five step operation. Repairs or rework of structure must be completed first before the obscuring finish is applied, and final structural inspections must be complete. Second, coarse contour filling is done with micro /mixed with epoxy (dry micro) as required in areas requiring .03 inch to .20 inch of fill. Any exception- ally gross filling (over .20 in) is also accomplished at this stage using a foam filler. The initial contour sanding begins with the cured microsphere filler, and exceptional caution must be exercised to avoid damaging the structural skins while sanding. Third, featherfill is applied to fill medium sized surface defects up to .03, and as a general fill of the glass surface weave. The fourth step is the application of an ultra violet barrier primer. Fifth, the final finish paint is applied. The following sketches are descriptive of the finishing process and its potential pit falls. The sketches are grossly exaggerated scale to show details more clearly.

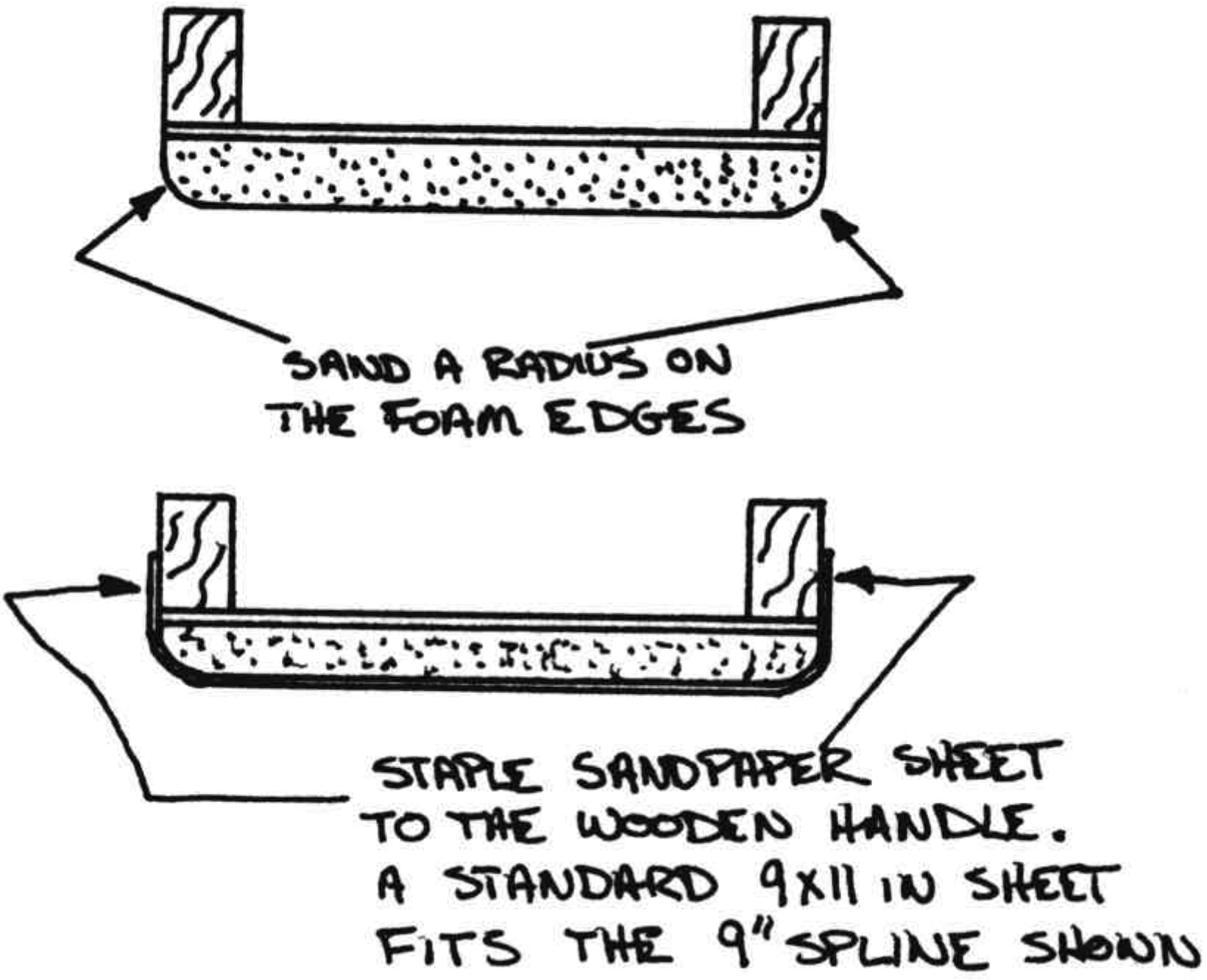


Figure 25-4: Spline end view of assembly

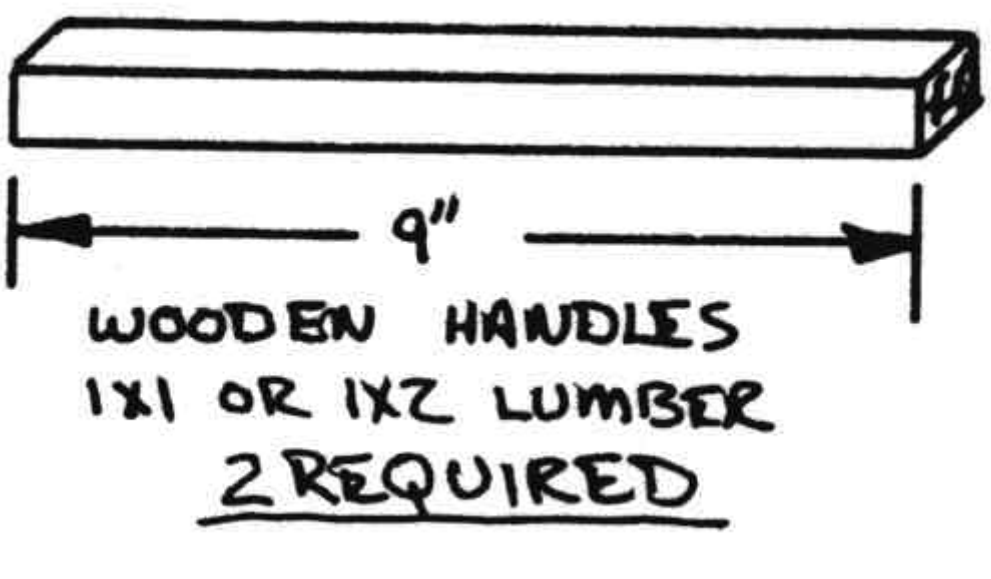


Figure 25-5: Spline wooden handles

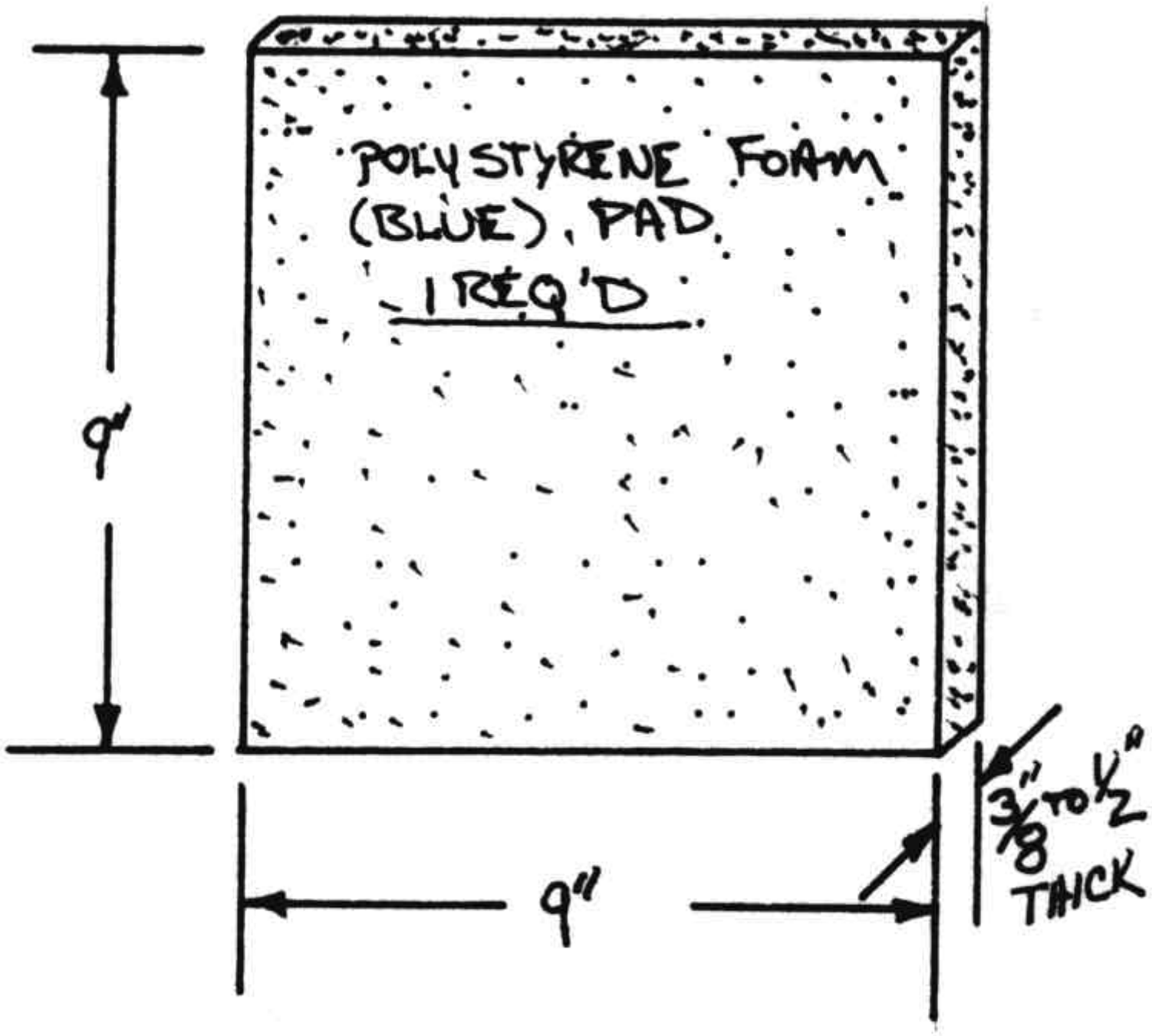


Figure 25-6: Spline foam pad

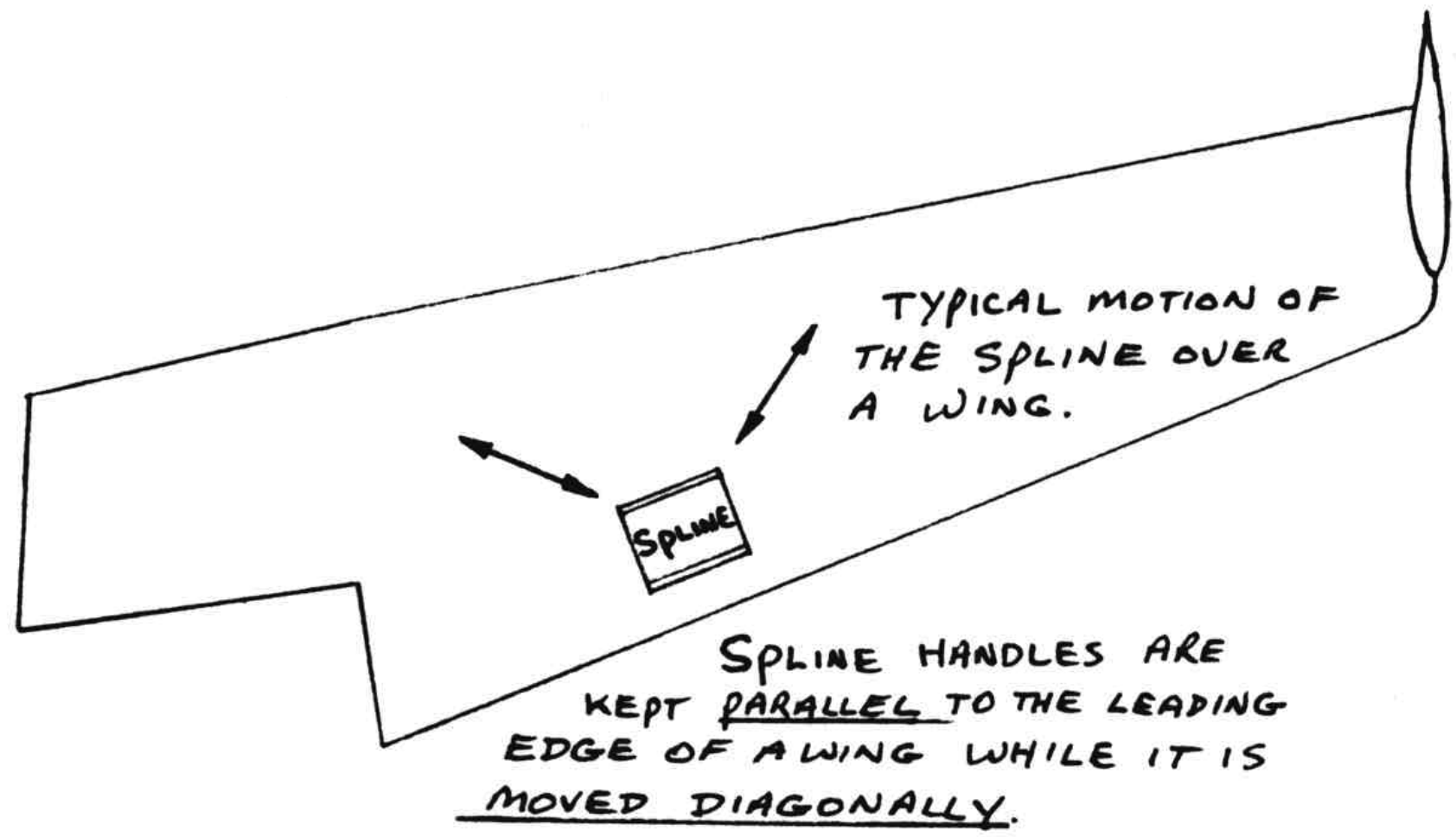


Figure 25-7: Spline movement sanding the wing

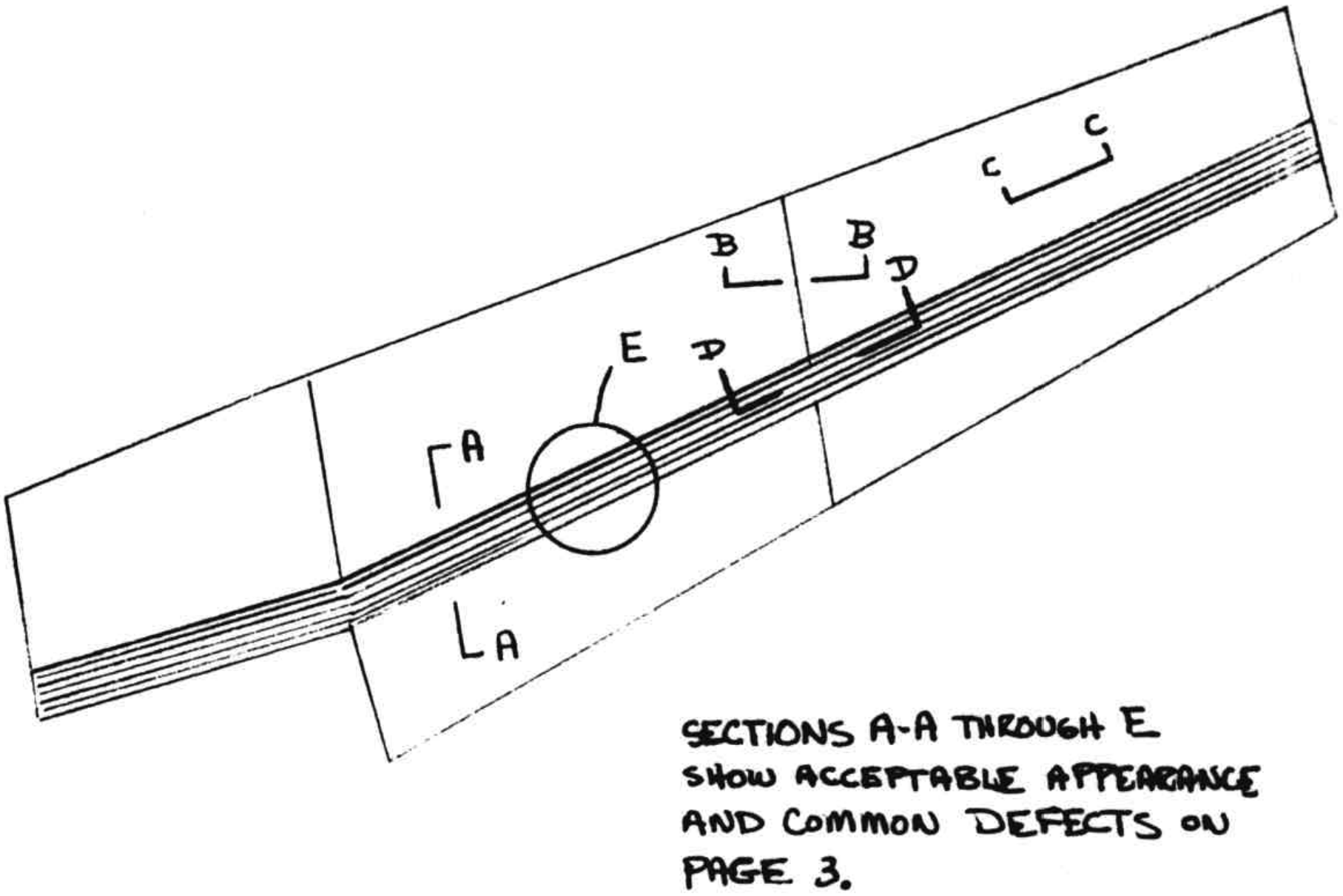


Figure 25-8: Wing quality criteria

Step One: Inspection/Repairs

When you begin finishing, the entire structure must be airworthy. You can hide poor workmanship from your own eyes and from the inspector who will finally approve your first flight, but you can't fool mother nature! Everything has to be structurally sound before finish materials are applied. The following sketches are a review and clarification of the quality control criteria found in chapter 3, Each airplane must have a thorough inspection and required repairs completed as the first step in finishing. Comply with the 12" ruler check before continuing (PAGE 3-13)

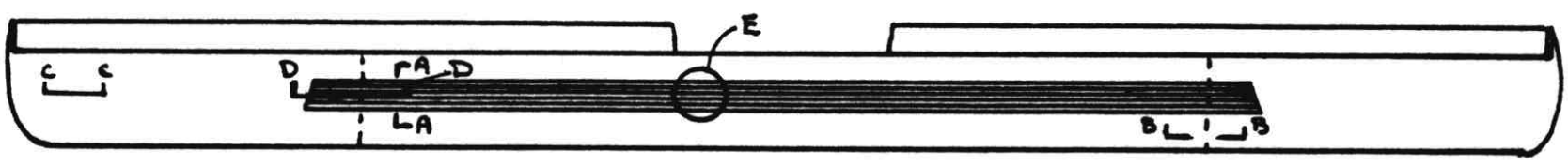


Figure 25-9: Canard areas and types of concern

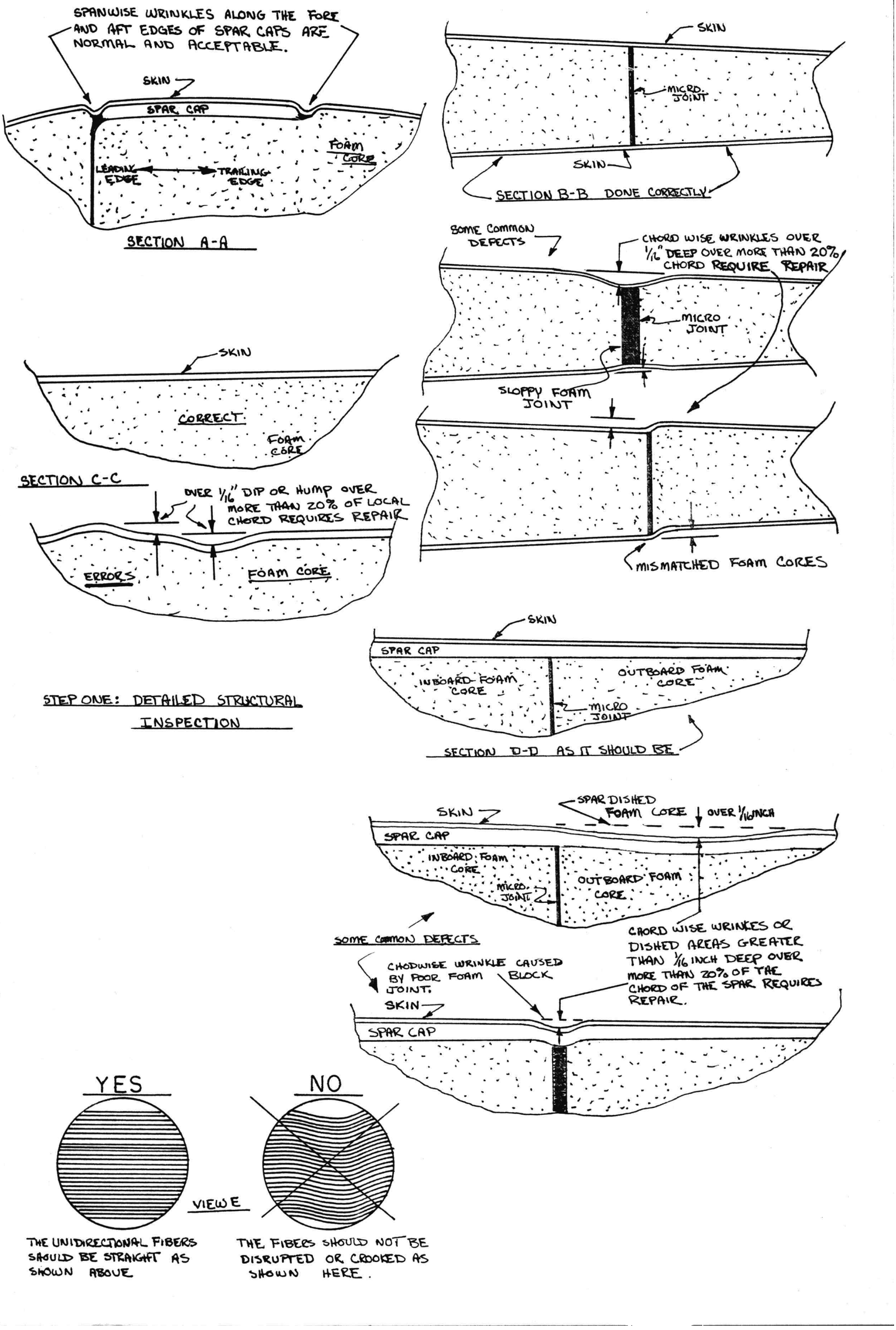


Figure 25-10: Issues in surfaces

Step Two: Coarse Filling

You must be extra cautious in this step or you may destroy your structure. When you take a piece of sandpaper and start grinding on your composite structure it's like using acid to clean a metal wing spar, It must be done carefully!

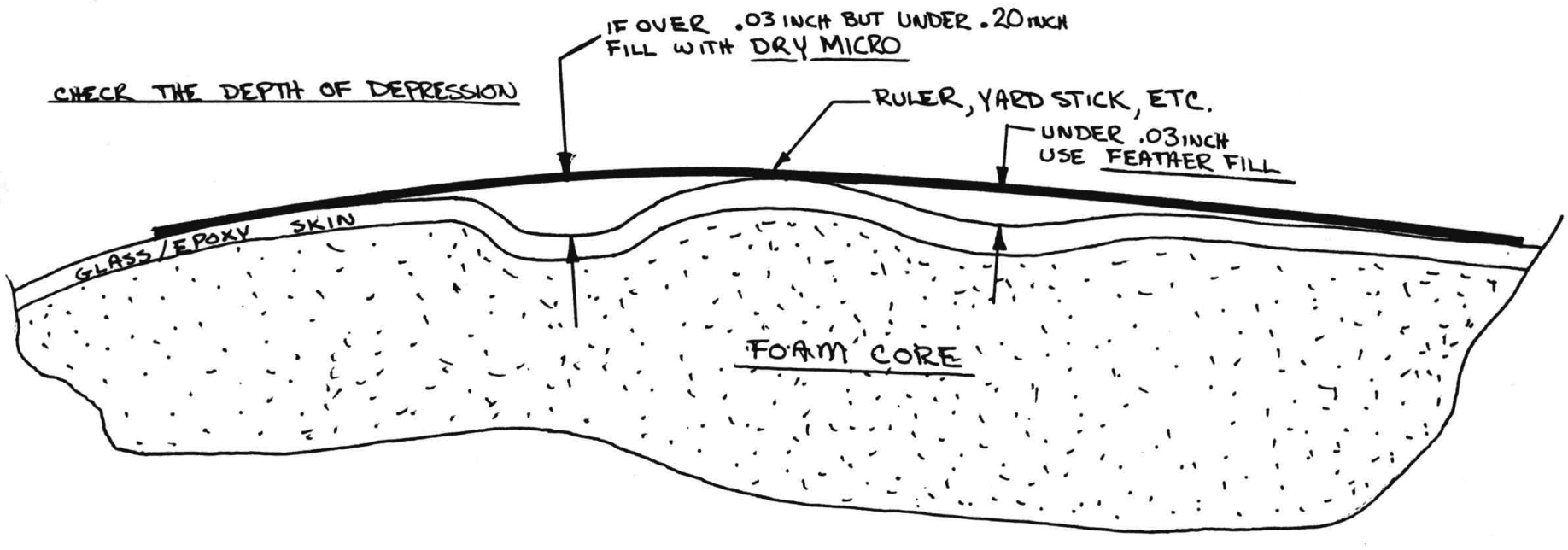


Figure 25-11: Finding voids and bumps

Start by determining which areas require micro filler as shown using a flexible yard stick and a scale. Prepare the areas to be filled by hand-sanding lightly. Do not try to use a sanding block or spline on these areas.

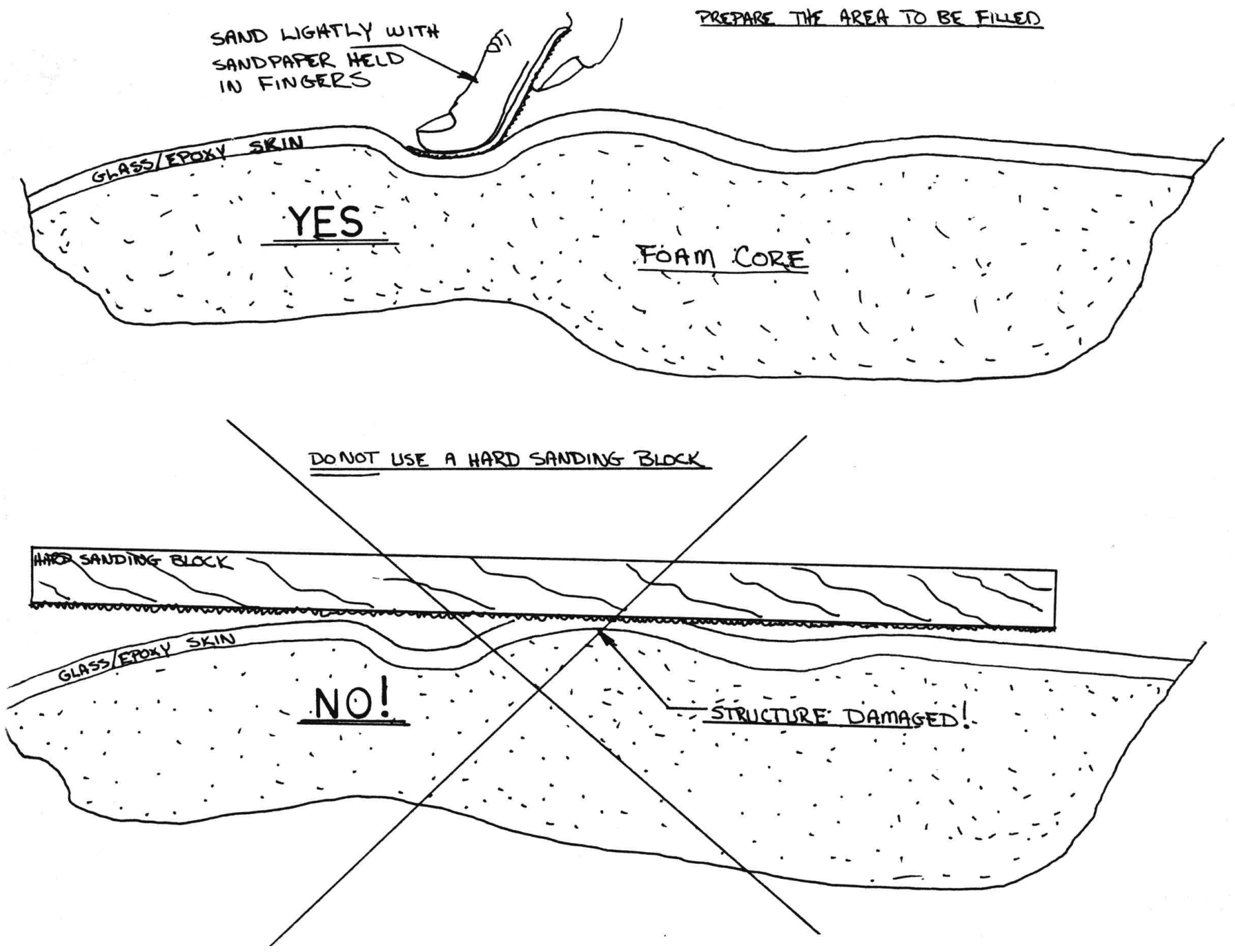


Figure 25-12: Proper sanding technique inside voids

Paint a **thin** coat of epoxy over the area to be filled. Dry micro is then lumped over the area. The fill must be high, such that material is sanded away to bring the area into contour. The micro should be mixed very dry (lots of microspheres to save weight). Let the micro cure at least 24 hours. Be sure to use glass bubbles, not microspheres with Safe-E-Poxy.

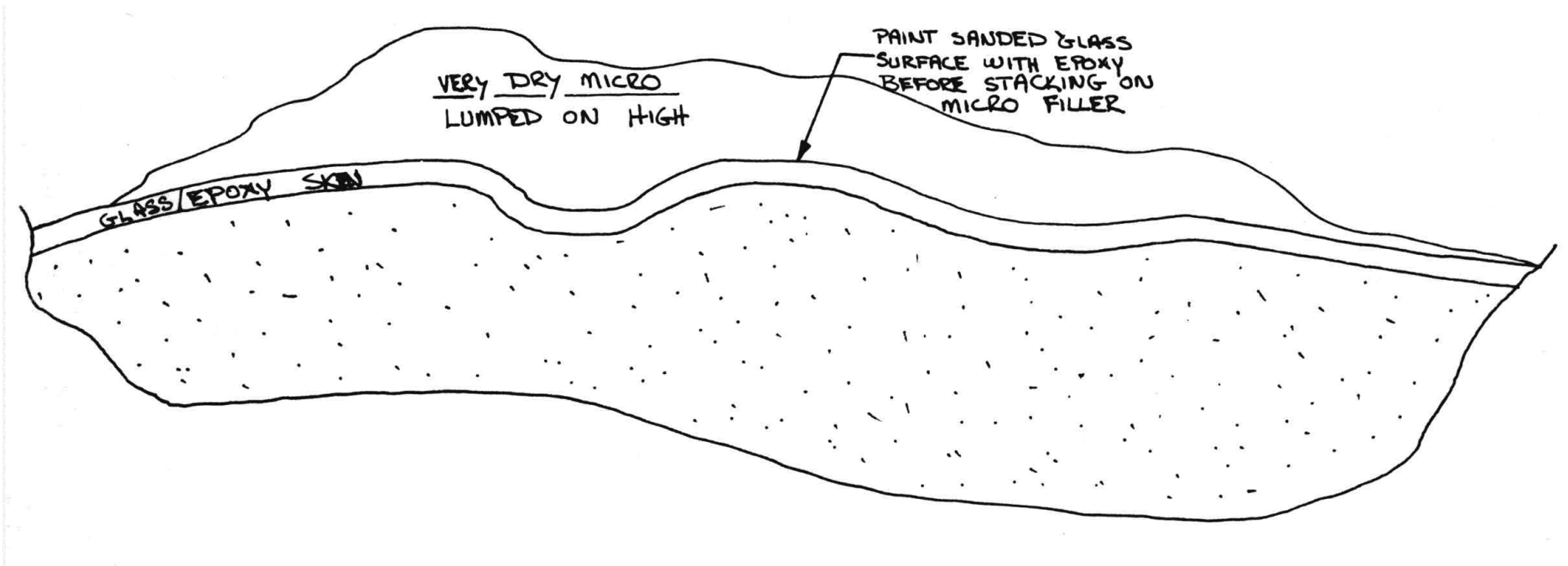


Figure 25-13: Using Micro to level surface

Sand the micro overfill into contour using a hard sanding block,or spline with coarse (35 to 60-grit) sandpaper. Exercise extreme caution while sanding A few careless strokes with coarse paper can ruin your structure!

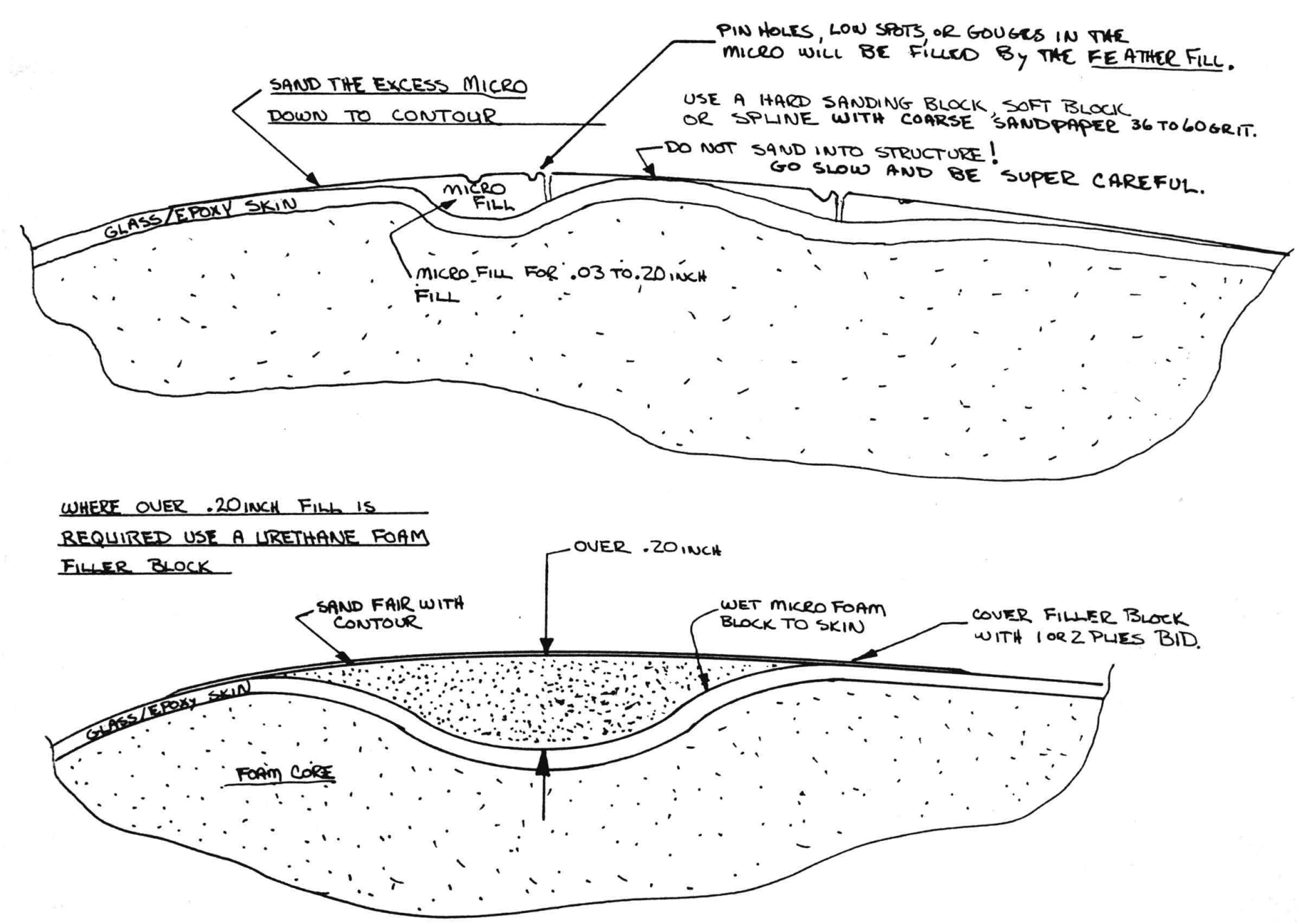


Figure 25-14: Filling in voids

STEP 3 - Feather Fill

Sand the surfaces lightly by hand or with a soft foam sanding block in preparation for feather fill. A brush coat of feather fill will build up .02" to .03" thick, fill the glass weave and any medium size out of contour spots. Feather fill will require several hours curing time before it can be sanded. The cured feather fill is sanded to contour using a spline of soft block and 100-grit sandpaper. Do not use 36-grit on feather fill. Again, extreme caution must be exercised not to damage the glass structure in pursuit of a good finish. The contouring must stop immediately when the highest glass peaks begin to be visible as the feather fill is sanded away. If you find that you have underestimated the fill required or just have a thin coat, don't hesitate to use a second coat of feather fill. A well prepared surface generally won't need more than one coat. When you have finished contouring the feather fill, the surface should be basically smooth and fair. The primer to follow· is not intended to be contoured heavily, just smoothed with finer sandpaper for a smooth finish while leaving a substantial ultra violet barrier. Be sure the surface is dry, dull, and clean. Be sure the Feather Fill a□d shop is at least 70° F. Mix the catalyst with a paddle or wire on your electric drill motor. After mixing catalyst, mix in about 25% by volume of micro balloons, and brush on. Micro balloons makes it go further, fill better, and sand easier. Feather Fill catalyst is extremely dangerous to sensitive tissue. Use eye protection. A small amount in the eye can cause vision damage. When finishing glass in preparation for Feather Fill, use coarse 36-grit paper, since Feather Fill requires a

mechanical bond, not a chemical bond. Do not wet sand Feather Fill, it absorbs moisture. Feather Fill cannot be used over primer. 3M sanding screen type 18N FABRICUT WET0RDRY silicone carbide 180 works excellently on Feather Fill. It is available at lumber yards.

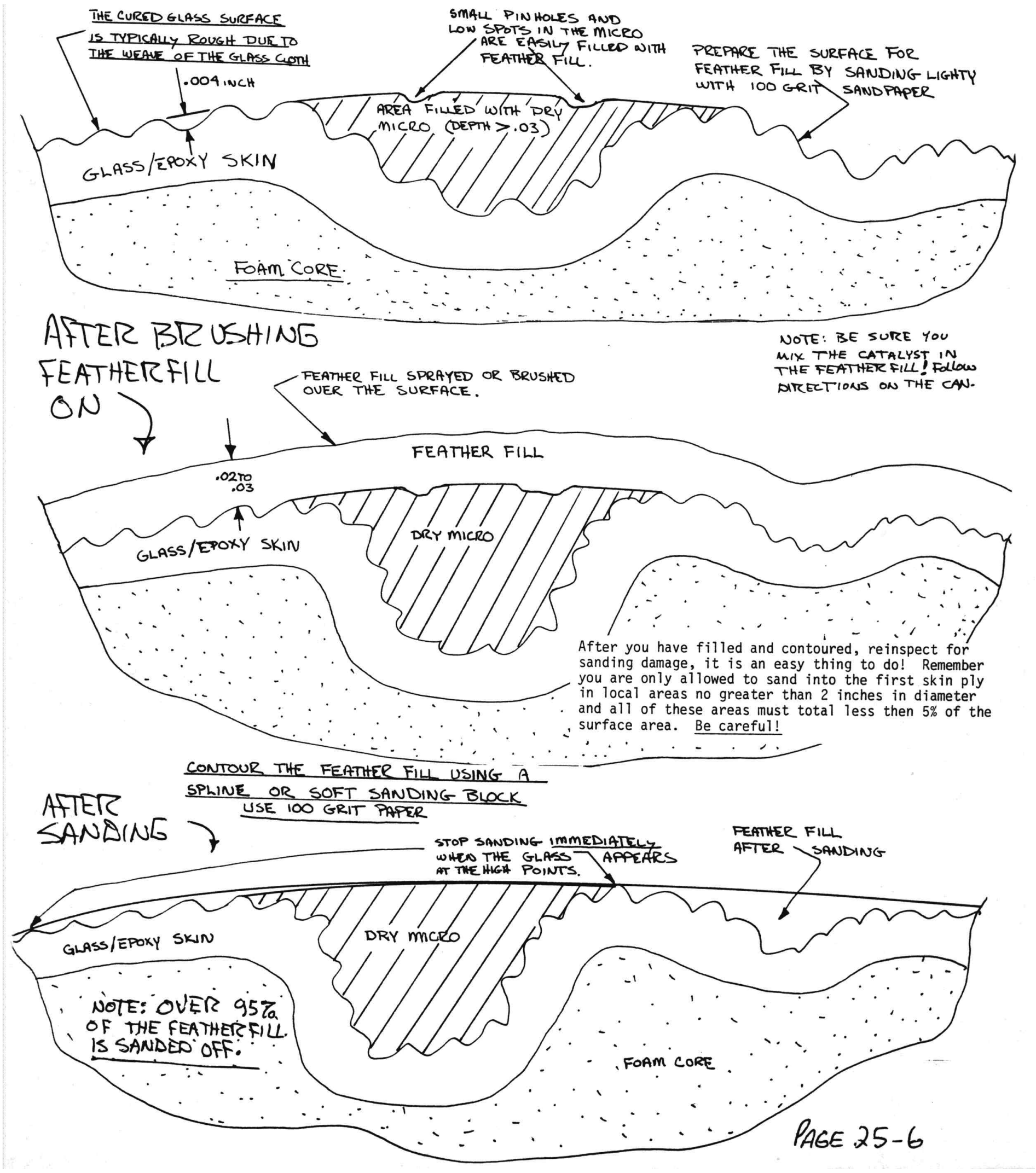


Figure 25-15: Steps to smooth out surface

STEP 4 - Primer

The ultra violet radiation barrier is provided by the heavy carbon black content of the dried primer. The primer give the whole surface a flat black or dark gray color and the sanding should never remove it completely, exposing the light gray Feather Fill below. The primer is sprayed on, allowed to dry, and sanded lightly to achieve a smooth surface. The first primer coat is sanded using 220-grit and the second coat very lightly wet sanded with_320-grit. When complete, the primer is very smooth, dark, and ready for finish paint. Inspect for imperfections or pin holes. Fill with lacquer spot putty (in a tube) and feather with 320- grit.

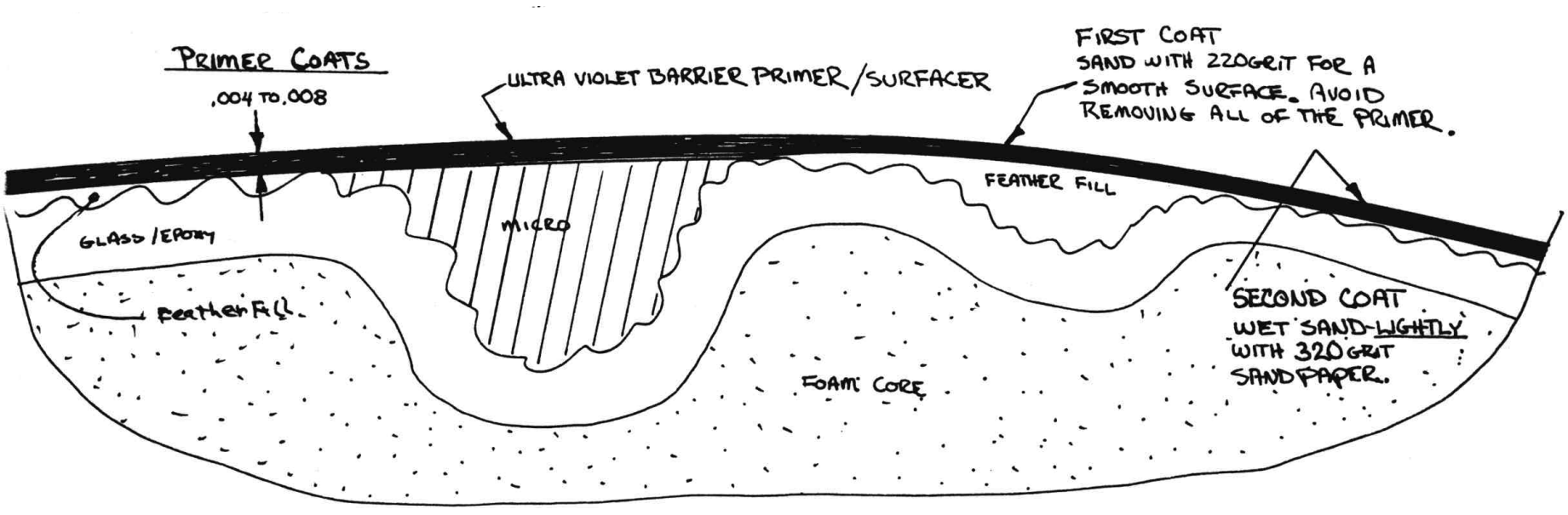


Figure 25-16: Primer paint on top of smoothed surface

Step Five: Finish Paint

Follow the manufacturer's directions for the type of finish paint that you have chosen.

MISCELLANEOUS

Seals

Where a flexible, durable seal between two assemblies is required, white silicone rubber (RTV) is recommended. For a removable seal, such as between the wing root and fuselage, or canard and fuselage, one side of the seal is bonded to the part and the other side is treated before application of the sealant so that it can't adhere. A simple release can be achieved by taping Saran Wrap tightly over one side of the joint. The seal is installed by assembling the two components with Saran Wrap protecting one side, lightly sanding the other, and then wiping the wet silicone into the gap. Remove all excess silicone at the surface. This assembly has to dry for at least two days before the parts are disassembled. The Saran Wrap will easily peel off of the cured silicone.

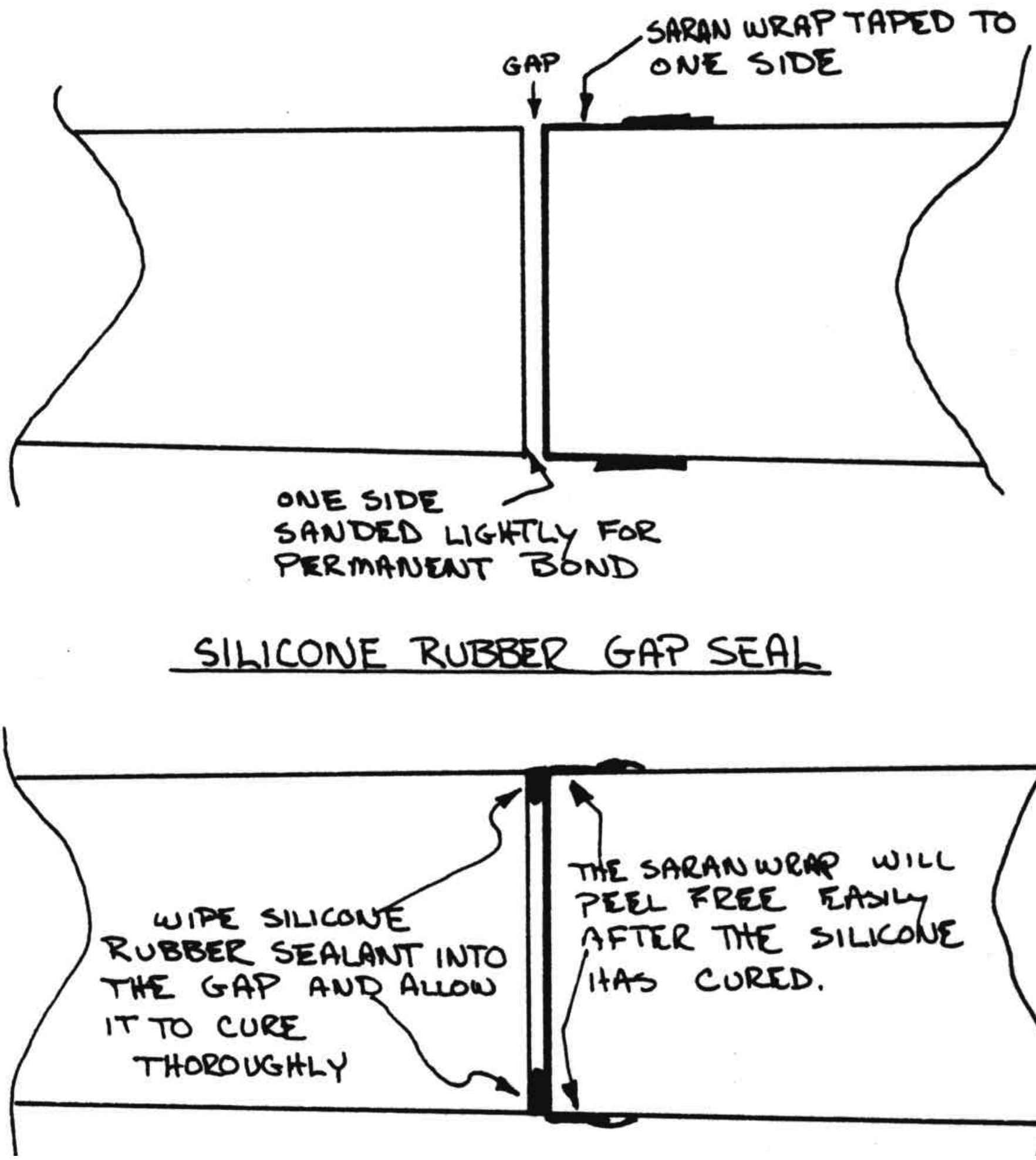


Figure 25-17: Sealing gaps with silicon rubber

Mismatch Treatment

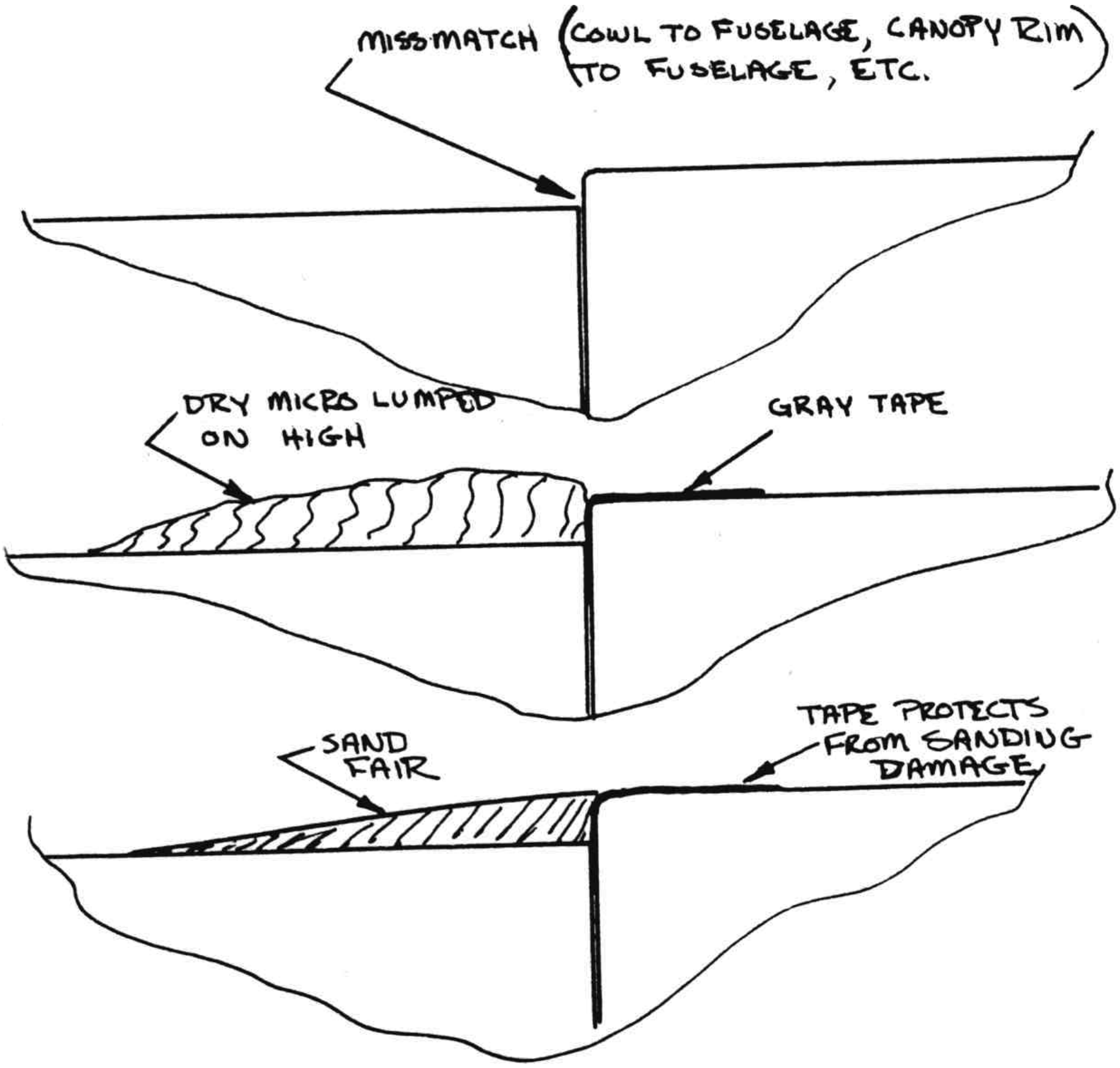


Figure 25-18: Fairing in mismatch segments

Cockpit Interior Paint

You may use colored cockpit interior paint to suit your own taste. For example, gray was used on the prototype N79RA. It is not necessary to fill the glass weave and some very light sanding may be done to smooth the surfaces slightly. Apply one coat of the primer to the interior glass surfaces for ultra violet protection and color to suit over that. Be sure to mask the nose gear window and fuel gauges before painting. A light color (light gray, green, or blue etc.) is recommended on the cockpit interior to avoid high heat buildup when the airplane is parked in the summer sun with the canopy locked. The instrument panel is shaded and can be black.

N-Numbers (Registration Marks).

You may use adhesive type letters and numbers or paint your registration marks directly on the airplane; your choice. Some simple hints may save some trouble on either method. When installing the self-adhesive tape, first use Windex window cleaner to wet the area where you want the markings, strip the protective backing off the letter or number, and apply it to the wet surface. The Windex will allow you to slide the markings around for perfect positioning, and then when located properly, just press them down lightly. The pressure squeezes the Windex out and allows the adhesive to bond to the airplane. If you paint the registration marks directly onto to your airplane, first mask off the outlines for painting, then sand **lightly** with 320-grit sandpaper, then paint and remove the masking tape.

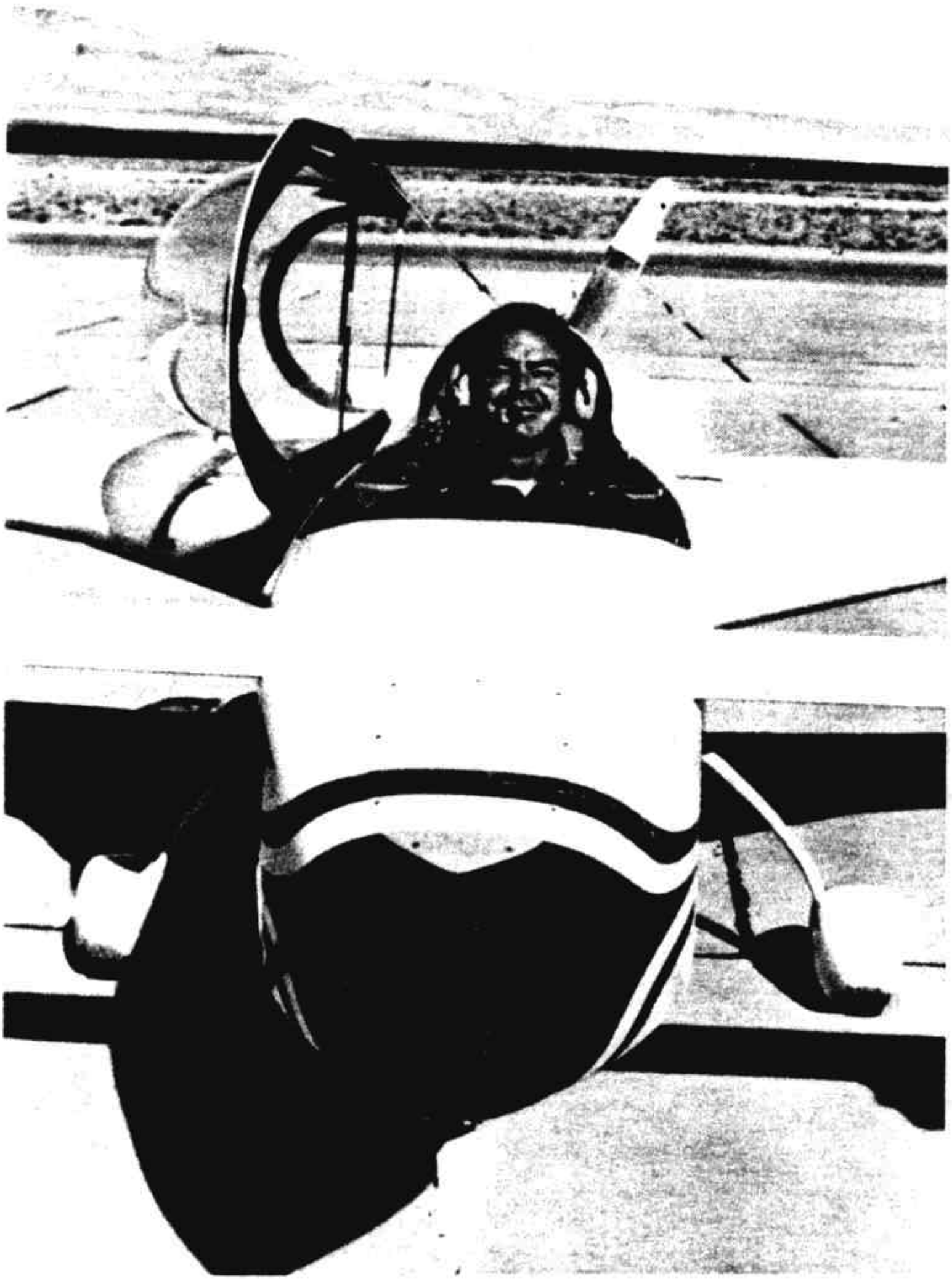


Figure 25-19: Nicely finished aircraft

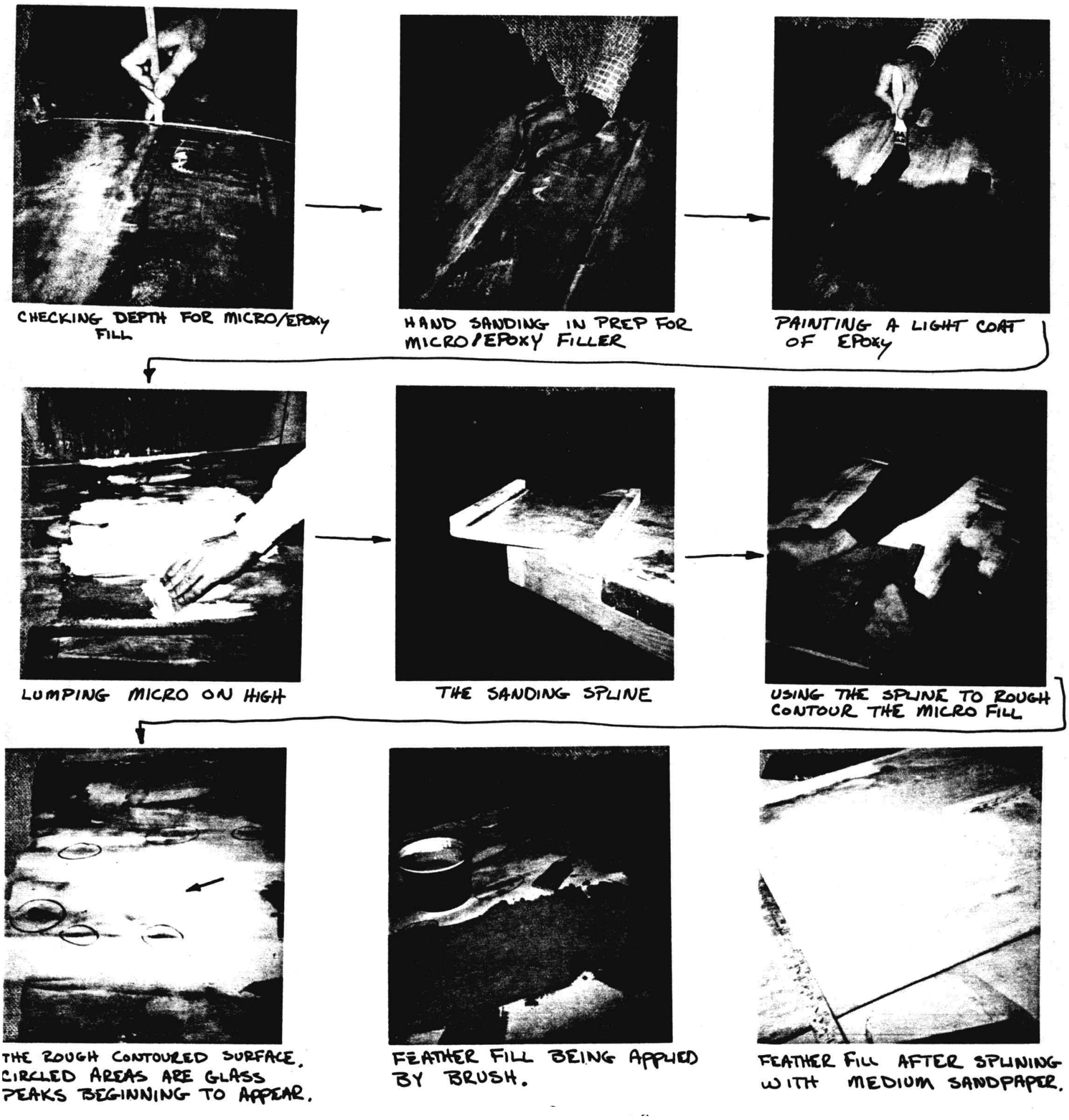


Figure 25-20: Steps in preparing for paint