CHAPTER 9 FAST-BUILD Wing Closeout

REVISIONS

From time to time, revisions to this assembly manual may be deemed necessary. When such revisions are made, immediately replace all outdated pages with the revised pages. Discard the out dated pages. Note that on the lower right corner of each page is a "revision date". Initial printings will have the number "0" printed and the printing date. All subsequent revisions will have the revision number followed by the date of that revision. When such revisions are made, a "table of revisions" page will also be issued. This page (or pages) should be inserted in front of the opening page (this page) of each affected chapter. A new "table of revisions" page will accompany any revision made to a chapter.

ARROWS

Most drawings will have arrows to show which direction the parts are facing, unless the drawing itself makes that very obvious. "A/C UP" refers to the direction that would be up if the part were installed in a plane sitting in the upright position. In most cases the part shown will be oriented in the same position as the part itself will be placed during that assembly step. However, time goes on and changes are made, so careful attention should be paid to the orientation arrows.





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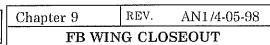
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1. INTRODUCTION

By this time, you've positioned and weighted the bottom wing skin onto the top a number of times. If you performed the release accurately, the bottom wing skin should literally lock into position.

Closing the wing is very straight forward but should not be taken lightly. This is for keeps! If the bottom wing skin bond is unsatisfactory the wing is useless, so think before doing and have a few spare hands available. Practice before closing...





2. SPECIAL PARTS, TOOLS, AND SUPPLIES LISTS



A. PARTS

Top wing assembly Bottom wing skin

B. TOOLS

Felt tipped marker Vacuum cleaner

Protective gloves

Respiratormask

Disposable clothing

Flashlight

Thermometer for measuring air temp in your work area

Weight bags (about 50 or so!)

C-clamps, 4" larger, about a dozen of them

TWO OR THREE HELPERS- This part of the assembly should not be attempted alone.

C. SUPPLIES

2 gallons 9700-1G fuel tank sealer

Epoxy

7781 fiberglass cloth

Hysol Structural adhesive 6 quarts (3 per wing)

Flox

Sandpaper, 40 grit

MC for cleaning

Paint brushes, 1"

Mixing cups

Mixing sticks (tongue depressors)

Instant glue

Masking tape

Duct tape

A piece of 1/2" plywood, about 3" x 10", to make a tool (see Fig. 9:B:3), Piece of MasoniteTM, about 5" wide, 1/8" thick and 12' long (we use masonite here, but you may want to substitute a couple of lengths of 1/4" plywood)

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3. CONSTRUCTION PROCEDURE

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A. SEALING FUEL TANKS

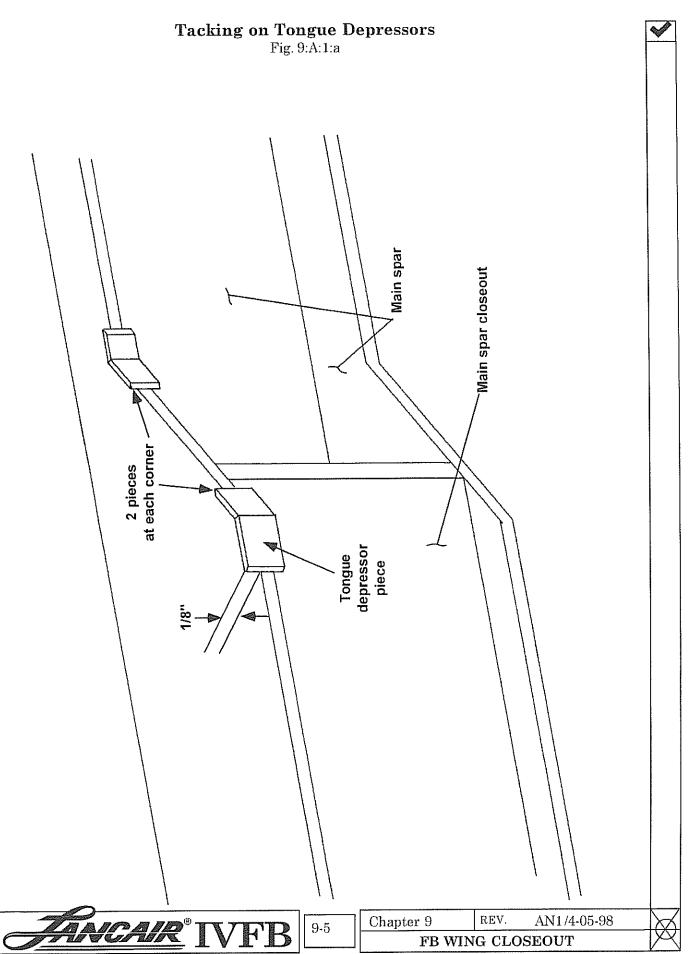
The new fuel tank sealer 9700 by Jeffco is very easy to apply (compared to previous types of fuel tank sealer used). 9700 is a two component epoxy system (the "A" component by itself will not cure as one builder found out).

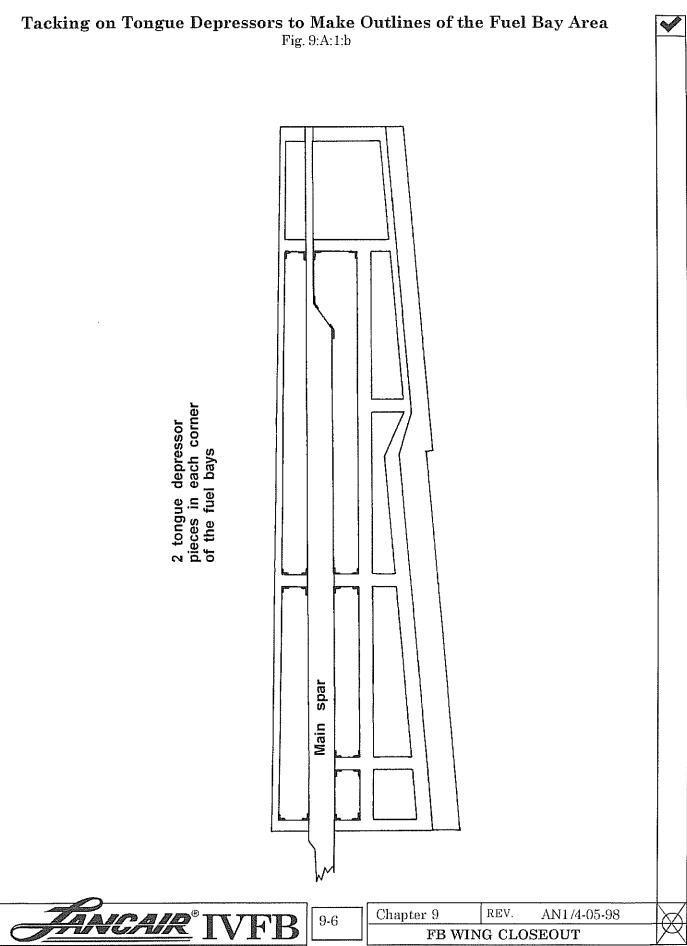
WARNING: The fuel tanks must be sealed with an approved fuel tank sealer. The composites are generally porous and the fuel may penetrate pin holes. Note that the inside of the spar has been sealed at the factory.

A1. An accurate outline of the rib and spar locations must be made on the inside of the bottom wing skin. This is easily accomplished by gluing small (about 1/4" x 3/8") pieces of tongue depressors in every corner where a rib meets a spar, where the spar caps are joggled, etc. See Fig. 9:A:1 for specific locations. Tack glue these wood pieces in place with instant glue so they stick up from the capstrips and spars about 1/8".



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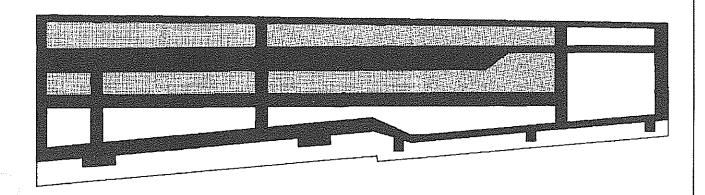




- A2. Mound up some micro on the top edges of the wood pieces. Obviously, this will not require much micro.
- A3. Now carefully lower the bottom wing skin into position so the micro contacts the inner surface. Remove the bottom wing skin.
- A4. Now you should have an impression on the inside of the bottom wing skin in all appropriate corners. Connecting these corners with a felt marker will give you the rib and spar outlines in the fuel bays. Clean off the micro from the bottom wing skin and remove the wood pieces from the rib and spar corners.

Outlines of Ribs and Spars

Fig. 9:A:2.





Bonding area



Fuel sealer



Non-bonded area Note: Be sure to apply sealer up the sides of the ribs, spar, and fuel web

A5. With 40 grit, sand the areas of the bottom wing skin where fuel sealer will be applied and where adhesive will be applied to bond the skin to the capstrips and ribs. If you wait to sand the areas where adhesive will be applied until just before closing the wing, you will get the fuel sealer all dusty (Not good!). So do all the sanding you have to on the bottom wing skin now, BEFORE the sealer is applied.



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- A6. Sand the areas of the top wing skin, ribs, and spars where sealer will be applied. A light sanding with 40 grit is all that's required.

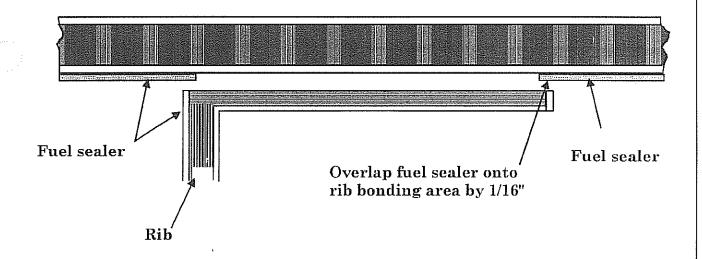
Vacuum all parts and clean the areas where sealer will be applied with MC.

A8. Tape off the areas of the bottom wing skin that will not be sealed for fuel. Protecting the areas which will be bonded with adhesive during wing closing is an important step. It is best to overlap the fuel sealer onto these bonding areas by 1/16" (no more than 1/8"), so apply the masking tape accordingly. The small amount of bonding area you are losing because of the fuel sealer will not harm the structure of the wing. The obvious benefit of overlapping the sealer onto the bonding surfaces is the knowledge that the bottom wing skin is completely sealed (see Fig. 9:A:3). While the fuel tank sealer is still tacky, carefully inspect every inch of the fuel tanks (use a good flashlight). Apply additional sealer to any voids or fish eyes. If you let it cure prior to this, you will have to sand with 120 grit prior to application.

Overlapping Sealer Onto Bonding Areas Fig. 9:A:3.

Bottom wing skin

A7.

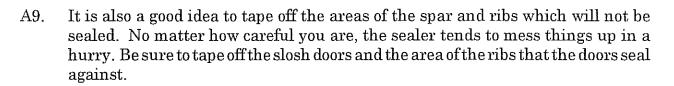


NOTE: Fuel sealer should overlap slightly onto main spar bonding area in a similar fashion as shown for the rib bonding areas.

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- A10. Mix up the fuel tank sealer and paint it on all surfaces that will be sealed. Cure time will vary with temperature, but for safety wait a couple of hours if the temperature is above 65°F and wait at least overnight if below 65°F.
- A11. Remove the masking tape and clean any areas where the sealer has strayed. Now you see why all sanding on the wing was done before you sealed it for fuel, because the sealer acts as a magnet for every dust particle in your shop.

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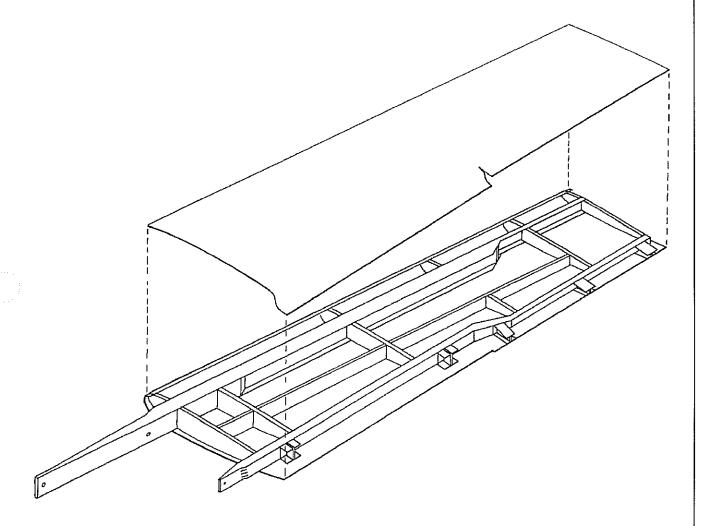
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B. CLOSING THE WING

Finally, it's time! Bonding the bottom wing skin in position can be anticlimactic if you've done you previous steps correctly. This is the way you want it, no surprises.

Closing Wing Fig. 9:B:1



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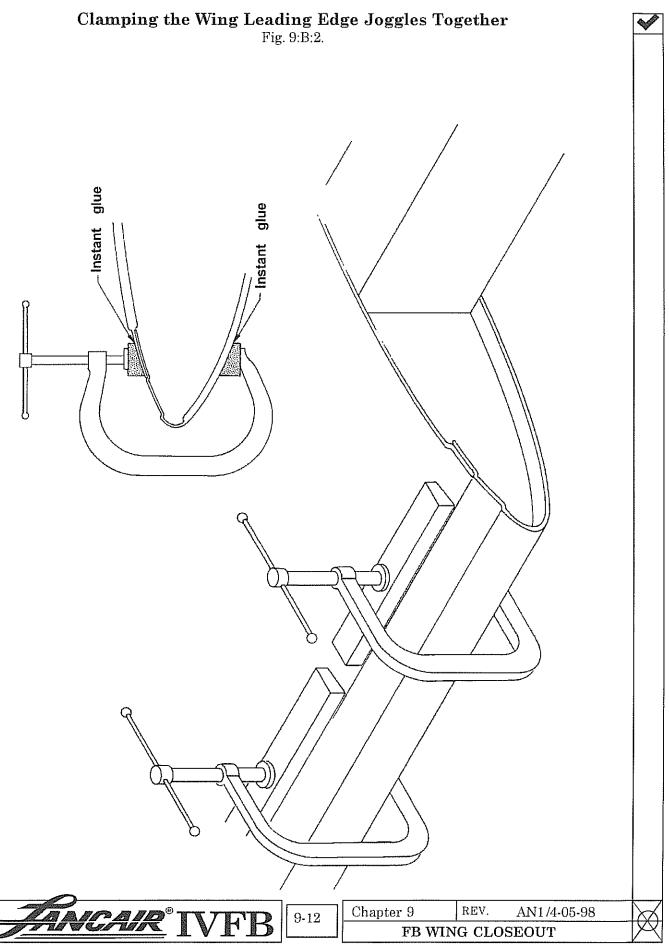
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- VERY IMPORTANT! Close the wing on a cool day or night. At temperatures over 70°F, the time required to properly coat the bonding surfaces with the flox mixture may exceed the working time of the flox. Without three or four experienced helpers to assist in wing closing, it is best to simply not attempt the procedure until the temperature is less than 70°F. Even in cooler temperatures, round up those three or four helpers to help you handle those big wing skins and spread the flox mixture. If you must close the wing when the temperature is over 70°F, it is highly recommended that you use Hysol structural adhesive for bonding the front and rear spars to the bottom wing skin. A flox mixture can still be used to bond the capstrips to the bottom skin. Since the working time of Hysol is at least 45 minutes when the temperature is in the 70-85 degree range, you can first apply the Hysol and then apply the quicker setting flox mixture. Refer to Fig. 9:B:5.
- B1. Place the bottom skin in position and weight it down as you would when bonding. By now you should have good reference points to locate the skin. These references are important when you're about to place the skin in position with gobs of wet adhesive.
- B2. Double check everything. Here's a partial list of things to look for:
 - 1. If there is a dip or bump in the skin now, it will be permanent when you bond the bottom skin in position. Your bottom skin should be straight and true now. If necessary you can still do a flox release to build up any shallow areas.
 - 2. Recheck that the fuel sealer is not contaminating any bonding surface. A small overlap (less than 1/8") of fuel sealer onto the rib or spar bonding area is okay.
 - 3. Be sure the slosh door in rib BL 38 is secured with the proper bolts. You will not be able to access this door after the wing is closed, so make sure it operates freely.
 - 4. Clean dust and debris from the rib bays. Don't pull a Mega-Blunder, like leaving tools inside your newly closed wing (It has happened!)!
- B3. The L.E. joggles of the top and bottom wing skins must be clamped together when the wing is closed. It would be easy just to use clecoes to squeeze the joggles together, but this is a fuel tank area and small bits of Hysol may break off the clecoes when they are removed, contaminating the tank. The solution is to bond angled wood pieces onto the bottom wing skin L.E. joggle and onto the top wing skin. Then you can clamp the joggles together without the clamps slipping (see fig. 9:B:2).

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B4. Use the template given in Fig. 9:B:3 to cut an adhesive shaping tool out of a piece of 1/2" plywood. When you are closing your wing, this tool will cut the time needed to shape the adhesive with a smooth rise in the center of the spar. The rise is needed to eliminate air bubbles being trapped in the spar bond. Speed is very important when you begin applying adhesive to close out your wing, so please use the shaping tool to save a couple of critical minutes. Simply spread a good amount of adhesive onto the spar, (Flox or Hysol, depending on the temperature- see step B7 for clarification), then pull the shaping tool along the spar cap forming the adhesive to the proper contour. Don't spread adhesive yet, just make the tool.



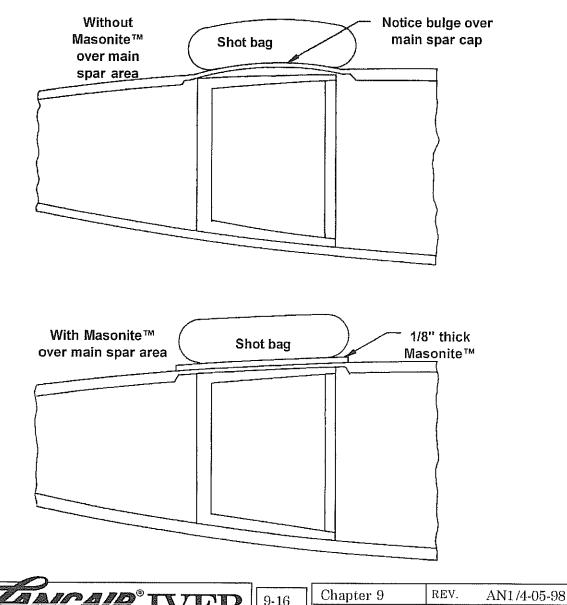
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(NOTE: Pages 14 and 15 are identical so you can remove one for use as a template.) Spar Adhesive Shaping Tool Fig. 9:B:3. Adhesive Chapter 9 REV. AN1/4-05-98 9-14 FB WING CLOSEOUT

(NOTE: Pages 14 and 15 are identical so you can remove one for use as a template.) Spar Adhesive Shaping Tool Fig. 9:B:3. Adhesive Chapter 9 REV. AN1/4-05-98 9-15 FB WING CLOSEOUT

- B5. Be sure the bonding surfaces of the spars, ribs, capstrips and bottom wing skin are thoroughly sanded with 40 grit, and cleaned with MC. If sanding is required at this point, be VERY CAREFUL not to get a lot of dust in the fuel sealer. Cleaning bonding surfaces with acetone may be sufficient in some noncritical areas of the airframe, but DO NOT use acetone for preparing the bonding surfaces to close the wing. Use only Methylene Chloride (MC) for wing closeout preparation.
- B6. Cut a 5" wide piece of 1/8" thick MasoniteTM the length of the spar. This MasoniteTM will be laid on the bottom wing skin over the main spar area to prevent the adhesive from forming a ridge on the skin. The ridge is caused by the reluctance of the adhesive to flow in the 5" wide main spar cap area.

Preventing a Bulge Over the Main Spar Area Fig. 9:B:4.

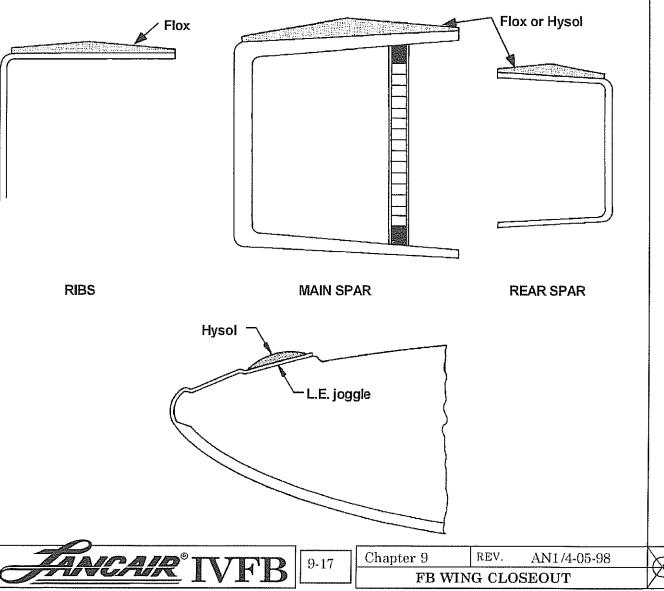


B7. What is the temperature in your shop? If it's over 80°F, it is highly advisable to forget about closing your wing at this time. Preferably, the temperature should be between 55°F and 70°F. After the wing has been closed, try to keep the temperature in your shop between 70°F and 85°F for at least 12 hours to give the resin a good initial cure. If the temperature is between 55° and 70°F, use METHOD #1 for applying adhesive to the spars, capstrips, bottom wing skin, and L.E. joggle. If the temperature is between 70°F and 80°F, use METHOD #2 for applying

adhesive.

Warning: Don't leave your newly closed wing in an area under 65°F. The resin needs a warm room to cure properly. Also, don't cure the wing in an area warmer than 85°F. This could cause the resin to cure too fast (exotherm), loosing its structural integrity.

Amount of Bonding Material for Closing Wing Fig. 9:B:5.



B8. METHOD #1.

Organize your helpers so one or two of them are dedicated only to mixing the epoxy and flox. You and another helper will be dedicated to applying the flox mixture to the bonding surfaces of the wing.

First, paint a light coat of epoxy on all flox bonded surfaces right up to the edges of the fuel sealer. Don't paint epoxy on any surfaces which will be bonded with Hysol.

Mix batches of flox (maximum 6 pumps of epoxy per cup to avoid exotherming) with a medium thickness so the flox will just hold its shape on a tongue depressor. If the flox wants to run, it may run out from your joined surfaces. Mixed too thick. air bubbles might be trapped in the bond because the flox didn't flow properly. Remove the flox from the mixing cups as soon as possible to avoid exotherming. Place blobs of the flox along the spars and ribs, then smooth out the flox to an even coat. Use your adhesive shaping tool to shape the flox in the main spar. Remember to mound the flox in the center of the ribs and spars to avoid air bubbles. Build up flox in the BL 171 rib high enough so it will contact the bottom wing skin.

Mix a small batch of Hysol to bond the wing L.E. joggles together. Spread a thin coat of pure Hysol on the joggles of the top and bottom wing skins. Mix a small amount of flox into the Hysol (1 tablespoon flox per 2 ounces Hysol) and build up the Hysol in the center of the top wing skin L.E. joggle.

The wing is now ready for closing, proceed to step B9.

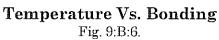


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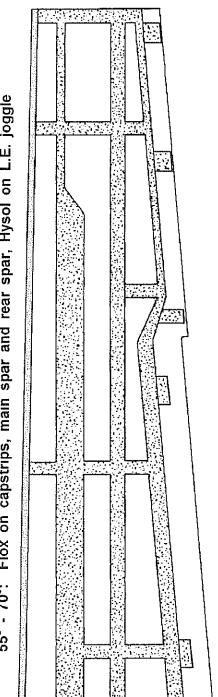
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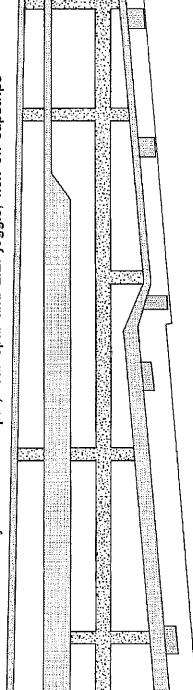




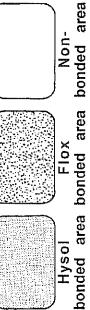
METHOD #1 55° - 70°: Flox on capstrips, main spar and rear spar, Hysol on L.E. joggle



70° - 80°: Hysol on main spar, rear spar and L.E. joggle, flox on capstrips #2 METHOD









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METHOD #2.



Mix a large batch of Hysol (or better yet, mix 6-7 smaller batches). Spread a thin coat of pure Hysol into the L.E. joggles of the top and bottom wing skins, the main and rear spar caps, and areas of the bottom wing that will bond to the spars. Mix flox into the Hysol (1 tablespoon per 2 oz Hysol) and build up the adhesive on the spars and top wing skin L.E. joggle, as always, applying more adhesive in the center. Use your shaping tool to form the Hysol on the main spar.

After you've finished applying the Hysol, paint a light coat of pure epoxy on the ribs and capstrips and the areas of the bottom wing skin which will be bonded to the ribs and capstrips. Remember to paint the epoxy right up to the fuel tank sealer. Mix up small batches of epoxy/flox (4 pumps max) to the same thickness as described in METHOD #1, and apply to the ribs and capstrips. Build up the flox on the BL 171 rib so it will contact the bottom wing skin.

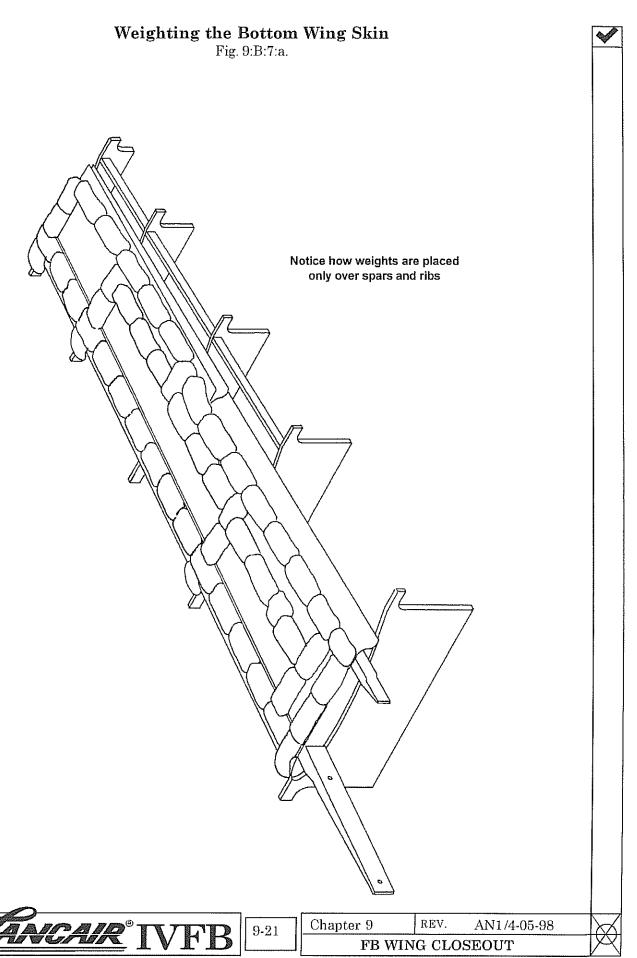
The wing is now ready to close, proceed to step B9.

- B9. Be sure there are no tools, trash or other junk in the rib bays, they would become a permanent part of the wing if left there (trust me, it's happened before). Carefully set the bottom wing skin in position. Weight the skin down for good contact of the bonding areas. Place your weights carefully, only over the spars and ribs. Placing weights over unsupported areas while the adhesive cures could cause depressions in the wing skin. Lead shot bags are by far the best weights to use when closing the wing. They conform to the skin contour and have no pressure concentrations. See fig. 9:B:7 for proper weighting.
- B10. Clamp the L.E. joggle together with your wooden clamp supports. Refer back to Fig. 9:B:2 for proper clamping.

When using Hysol to bond the spars to the bottom wing skin, take into account that Hysol doesn't flow as easily as flox. We've found that Hysol tends to form a ridge down the center of the main spar. You can vibrate the bottom wing skin with a padded orbital or dual action disc sander (with no sand paper, of course) to reduce this bulge over the main spar. Yes, you'll probably have to do some filling and sanding over the main spar, but the work should be minimal.

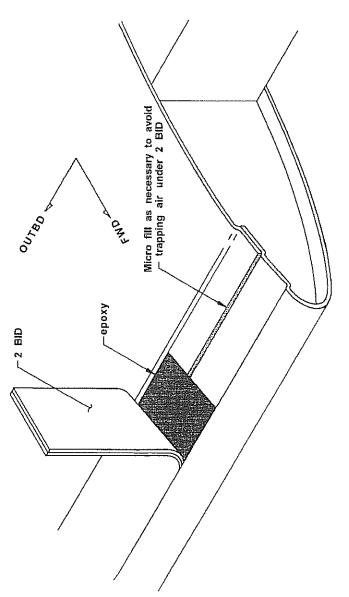






- B11. Scrape the excess flox squeezeout to form a radius where the BL 171 rib joins the bottom wing skin.
- **4**
- B12. After the adhesive in the wing has cured to a solid, you can post cure the wing at elevated temperatures (up to 85°F) without any worry of the flox bubbling. An easy post cure is setting the wing outside in the sun for a few hours.
- B13. Sand the L.E. joggle with 40 grit and clean with MC.
- B14. Apply 2 BID to the joggle as shown in Fig. 9:B:8.

Applying 2 BID to L.E. Joggle Fig. 9:B:8.





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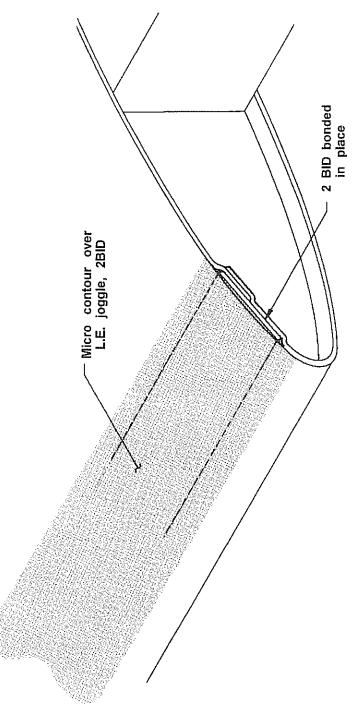
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- B15. Apply micro to the L.E. joggle.
- B16. After the micro has cured, sand it smooth to the contour of the airfoil.

Contour of Micro on L.E. Joggle Fig. 9:B:9.



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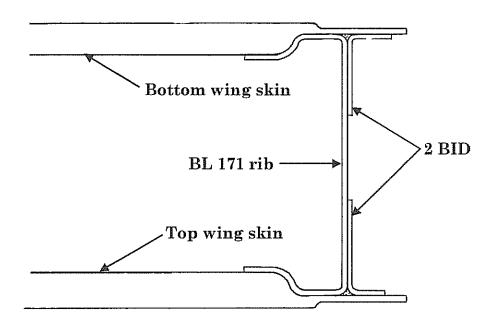
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- B17. Sand the area where the BL 171 rib joins the bottom wing skin. Clean with MC.
- **V**

B18. Secure the BL 171 rib to the bottom wing skin with 2 BID, 2" wide.

Securing BL 171 to Bottom Wing Skin Fig. 9:B:10.



Congratulations, you've finally closed your wings. It is a good idea to apply the first coat of primer to the wings as soon as possible. The primer should have a UV protectant and is should be applied according to manufacturers instructions.

We usually scuff the wing surface with 80 grit, clean the surface thoroughly, then apply the primer coat with a brush. This method off application is much better for filling pin holes. Don't sand this first primer coat yet, leave it until you've finished the fuselage.

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C. PRESSURE TESTING THE FUEL TANKS

You should wait a couple of weeks prior to pressure testing the wing to make sure it is fully cured. If you were careful with shaping your capstrips and applied a sufficient amount of adhesive when closing the wings you should have no problems with fuel leaks. Nothing is more frustrating than a leaking fuel tank.

Pressurizing a fuel tank with air should be done very carefully. Only 1 psi is required to test the fuel areas. Anymore than 2 psi may hurt the wing structure. To pressurize the wing, use a bicycle pump or one of those foot pumps for inflating rafts. You can also blow it up with your mouth. Using an air compressor should be avoided as it is easy to over-pressurize the wing.

Another method is to use low pressure to suck air out of the tanks. This can be safer because it is harder to implode a wing than explode one.

The tools needed to pressure check a wing are simple; something to pressurize the wing with, like the pumps previously mentioned, and a gauge to read the pressure in the wing. The gauge can be a cheap dial type gage, connected to the brass fuel drain with the appropriate fittings. Another method is to attach a balloon. Leave the balloon for a few hours. If you can't detect a change in the size, you are fine. Be aware that some air will actually leak through the balloon skin.

Tape off all tank openings that are not being used to either pump in air or check pressure. Even the fuel caps must be taped over because they are not airtight. When the tank is pressurized, the gauge will usually fall off a little bit just after stopping the pressure air, but should remain steady after that.

Leaks are detected by a drop in the tank pressure. Most of the time, you can locate the leaks by Estening carefully. If you suspect a leak you can brush soap and water around the edges until the bubbles are sighted, just like checking an old inner tube.

Unfortunately only the inboard rib of the Lancair IV is accessible. If you detect a leak along the outside edges of the fuel tank, it is best to create a vacuum on the tank to suck the epoxy into the crack. Use your shop vacuum for suction. Be careful, a powerful shop vacuum may collapse the wing. Just bring the vacuum close up to the fuel cap for a slight pressure drop.

If you detect a leak on a rib or shear web that is not accessible, you have two options, sloshing compound or surgery. Depending on the type of sealer you used, make sure the sloshing compound is compatible, and position the wing so the compound will sink to the edges where you suspect the leak is.



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Cutting holes in your wing is a last resort but not as bad as it sounds. Just be sure that the access hole is completely rebonded inside and out with a 1" overlap onto the original skins with the appropriate laminates. The Nov/Dec 93 newsletter describes how to repair composite skins. (We do have extra copies of all old newsletters). You may have a slight rise on the outer surface of the wing where you reinforced the access hole, but a little micro work can make this practically unnoticeable.

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