Riley Model B - Series 18 - Wing Construction

July 1, 2024

Some of the pictures in this manual are from an earlier build. The text has been updated to the Series 18. When in doubt, always refer to the plan.

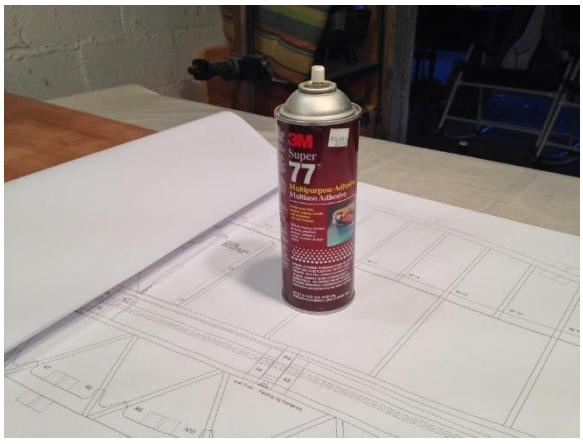
The RIGHT wing panel is built in the normal “right side up” manner. The LEFT wing panel is built on the same plan using the same jigs but built “upside down.”

It is CRITICAL that you use a FLAT building board to avoid building a wing with unwanted twist. A warped building board will mean you will build *two* warped wings which do not cancel out but double the twist! Use a level to check each end of the building board. If they are the same, you're good to go. Allow yourself about 25 hours to build *each* wing panel sanded and ready to cover.

It might be advantageous to delay attaching the plan and setting up the jigs until after you have built both right and left wing hinge assemblies. That way, the jigs will not be in the way.

Apply Plan to Building Board

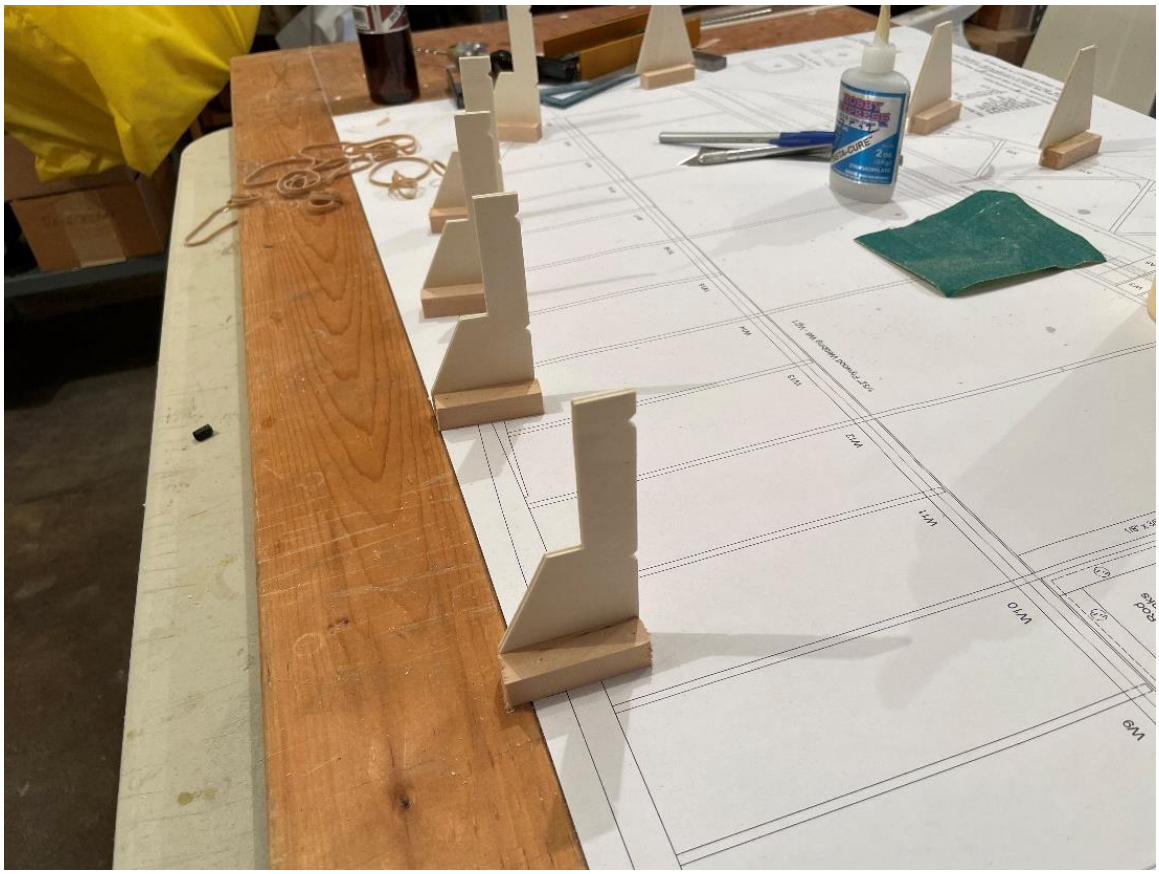
Apply the wing plan to a flat building board. Spray 3M#77 on the plan, not the building board. If the plan is difficult to remove after construction is completed, a lite coat of ordinary paint thinner will easily soak through the plan and allow it to lift off the building board without difficulty. It isn’t necessary to spray adhesive on the entire plan. If you spray adhesive where the jigs mount, that will be sufficient.

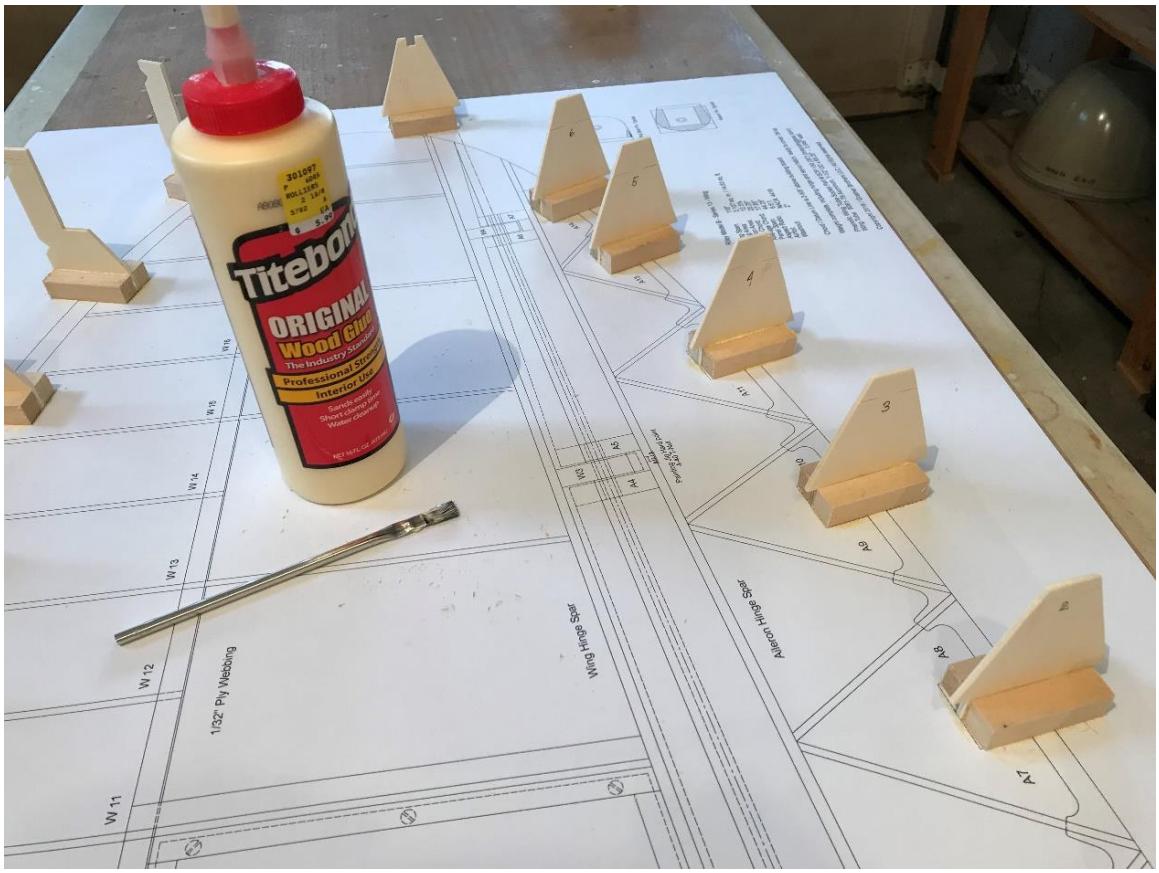


Mount Jigs to Plan

Glue all jigs to the plan as shown using (38) 1/2" x 1/2” x 2” Basswood stock to hold the jigs in position. Titebond glue applied with an acid brush works well as it does not soak through the paper plan (as CA glue does) and unintentionally bond to the building board which will make the plan difficult to remove.

Note that the jig at the end of the wing spar should align *on-center* with the wing spar. The leading jigs have kerf marks at the bottom to insure correct alignment. The leading-edge jigs should mount to the inside of the leading edge. Mounted this way ensures that any slight deviation in the leading edge thickness will not affect rib alignment.





Making the Aileron Hinge

The aileron hinge and the stabilizer and rudder hinges are designed in the same way. A nylon spacer is inserted into a balsa hinge block. The nylon spacers are available from McMaster-Carr, part number 94639A355. These spacers are inserted into the 5/16” hole drilled through the balsa hinge block. Usually, you can just push them in with your finger. A better way is to chuck a short length of 3/16” dowel (metal or wood) into your drill press and using the dowel as a guide, press the spacers into the balsa hinge block. There is virtually no side force on the hinge, so just a little thin CA at each side of the hinge block is sufficient.

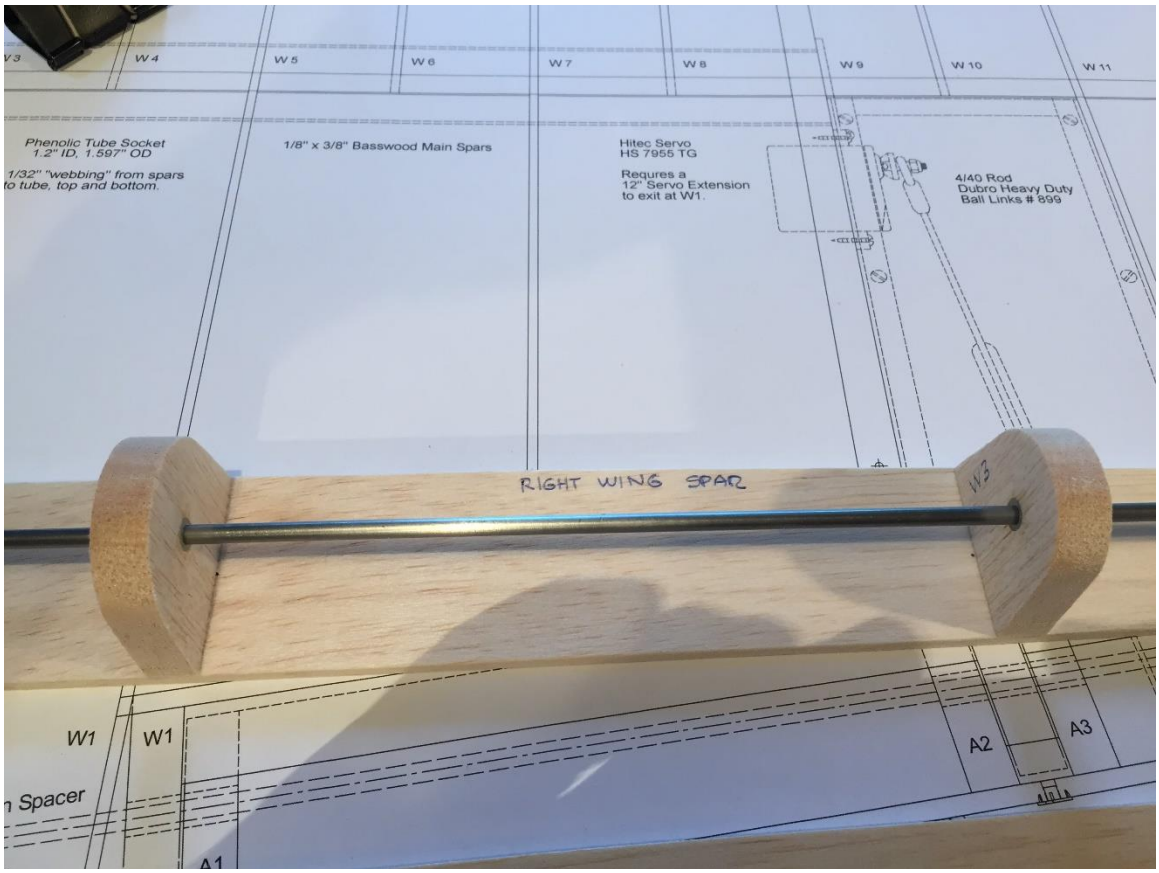
Prepare a piece of .191" steel drill rod to a length of 36.” (McMaster-Carr #8893K181) Smooth the ends for easier insertion. This rod helps to create perfect hinge alignment.

Lay the *wing* spar onto a flat surface. The label on the spar is on the hinge side and should face up. Note: Both wing and aileron spar bevels taper toward the trailing edge.

Insert W1, W2, W3 and W4 onto a .191" precision ground steel rod. This rod is used only for alignment and is more accurate than using the 3/16" Delrin rod that will become the hinge pin.

Accurately position the hinge blocks between the small locating 1/32” holes in the spar. It may help to use a sharp lead pencil to gently make a twist in the holes. This is not to make the holes bigger, but easier to see.

The complete hinge assembly for either the right or left wing panel is symmetrical. However, some ribs, while symmetrical in outline are specific to the right or left wing panel.



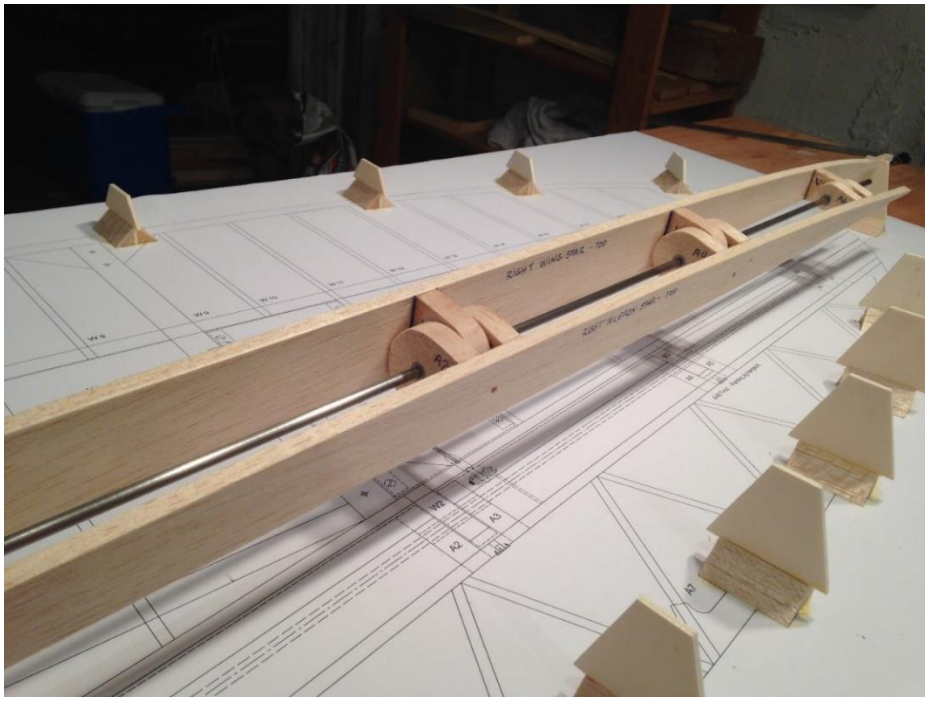
When all is in alignment, wick thin CA to glue W1 and W4 to the spar. Then glue W2 and W3. Note: Thin CA may leak through the locating holes and can cause the spars to stick to the building board. Use wax paper to prevent this.

In the same manner as above, lay the *aileron* spar onto a flat surface. Please note that the bevels angle toward the trailing edge; and unlike the wing spar, the hinge blocks face the leading edge.

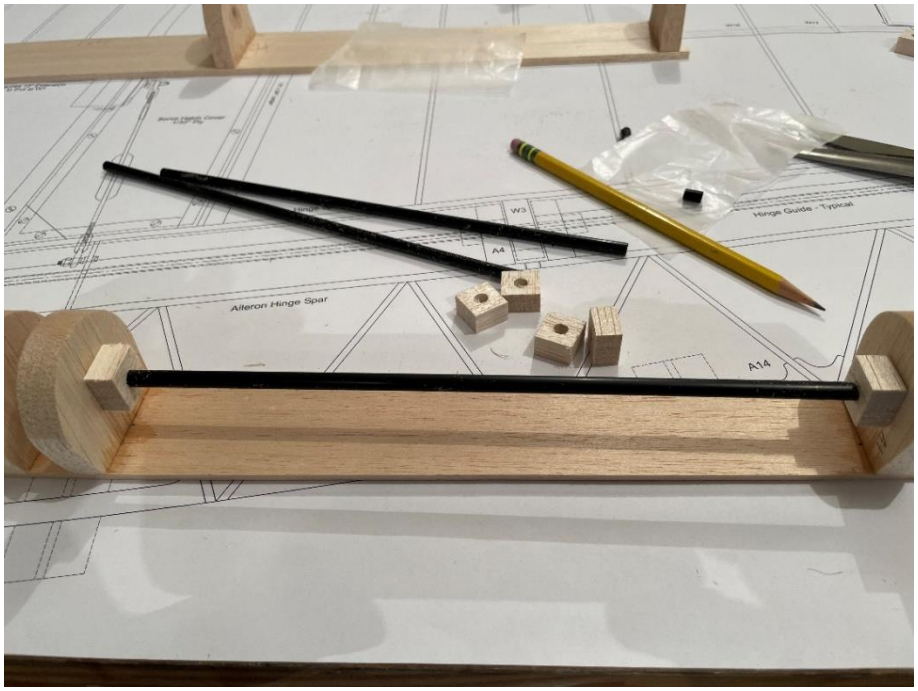
Insert A1 through A7 onto a .191" precision ground steel rod.

Like before, position the hinge blocks on-center between the small holes in the spar. When all is in alignment, wick thin CA to glue A1 and A7 to the spar.

Remove alignment rod. Assemble the hinge and check for fit. You may find that there is slight binding. The rod is very precise and has no give. The Delrin hinge should work fine.

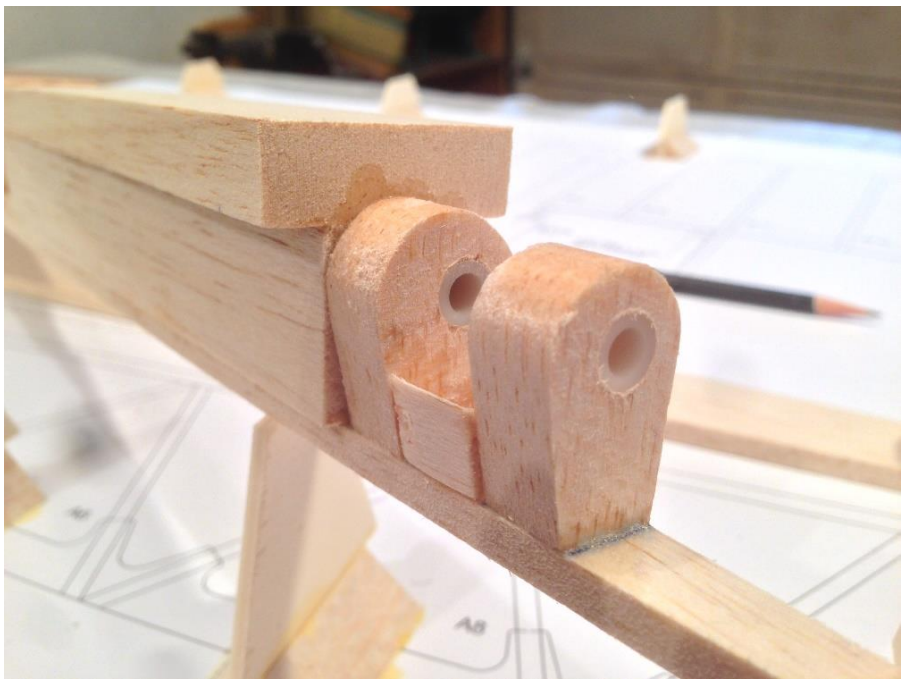


Because the Delrin hinge is so long, it can be difficult to insert. For that reason, hinge guides are strongly recommended. Any plastic straw that has an inside diameter larger than 3/16” and is at least 10” long will work. Its only purpose is to guide the tip of the hinge while inserting. Small balsa blocks with suitable holes position the straw at each end. Use the steel rod to align. CAUTION: Be Careful not to allow CA glue to creep into the nylon bearing and seize the rod. Just a drop of glue to tack, pull the rod, and then complete.



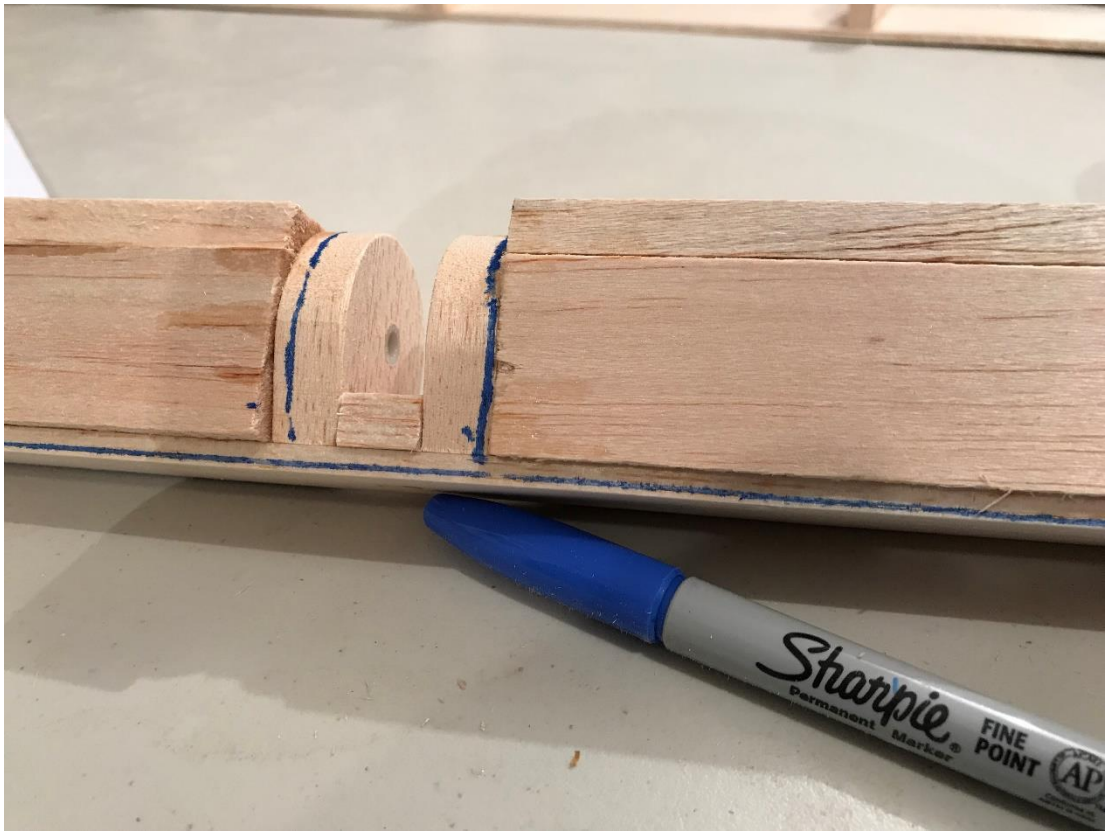
Aileron Hinge Spar – Fill Procedure

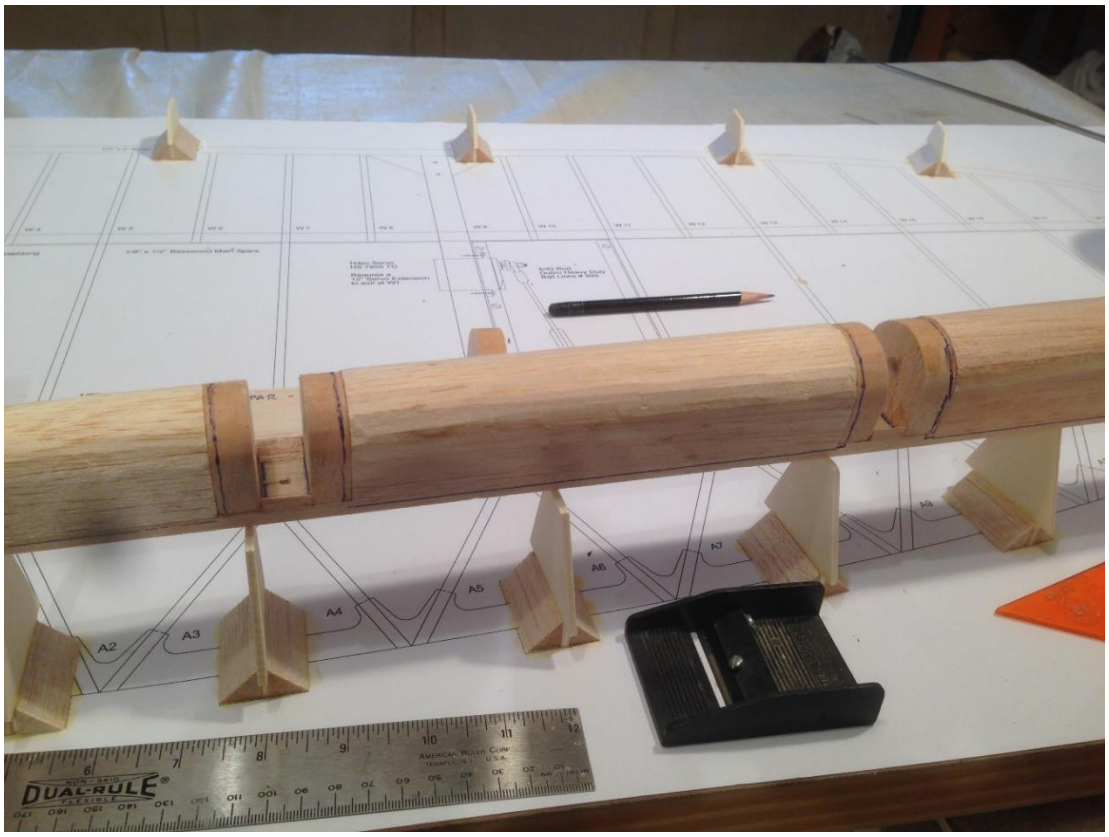
Fill aileron spar between the hinge mounts with 3/8” x 1-9/16” x 9-15/16” balsa on the sides and 3/8” x 2” x 9-15/16” balsa on top. Do *not* install aileron tip at this time.

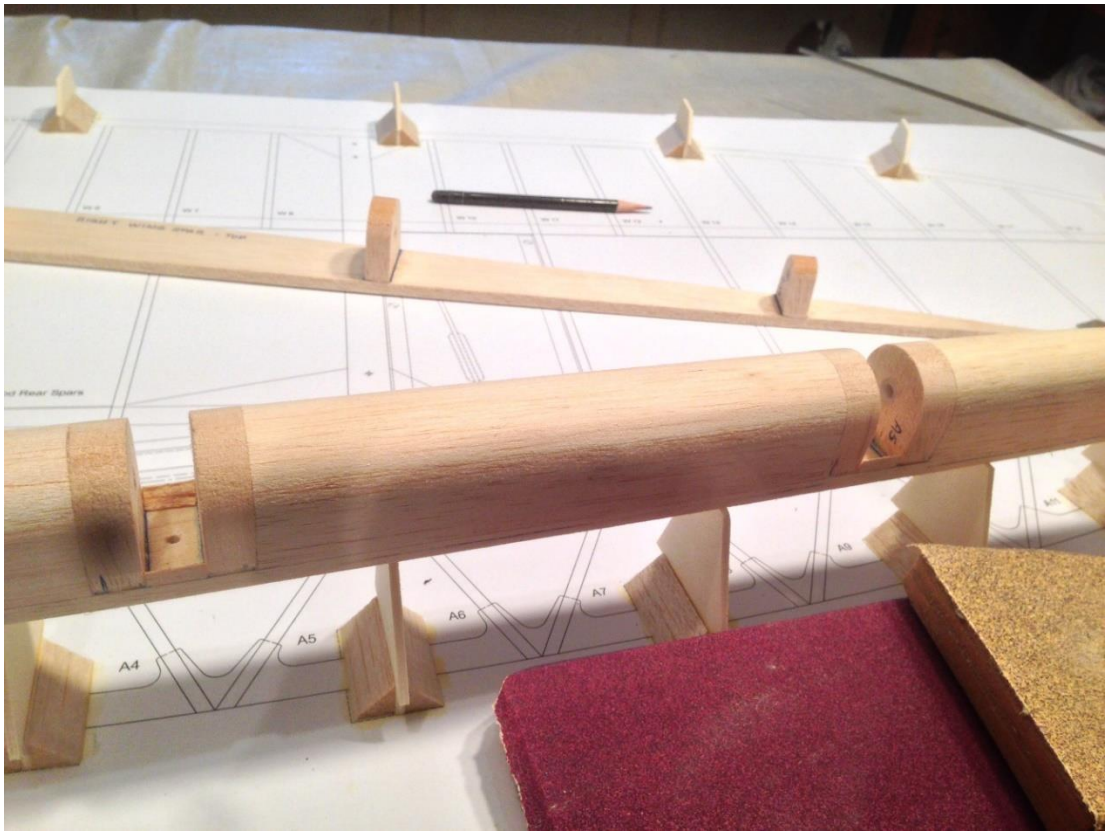


Fit and glue 3/8” triangle stock (top and bottom) at A1, between A2-A3, A4-A5, and between A6-A7. The sharp edge of the triangles should be even with the side of the hinge blocks. The excess will be sanded off later.

Use a razor plane to shape the aileron fill material. After planning use a 40 grit sanding block for initial shaping. Finish sand with 80 grit block. It can be helpful to draw witness lines so you can avoid planning or sanding too much. When the witness lines are almost gone, stop.


Sharpie
Permanent Marker
FINE POINT


A2
A3
A4
A5
DUAL-RULE



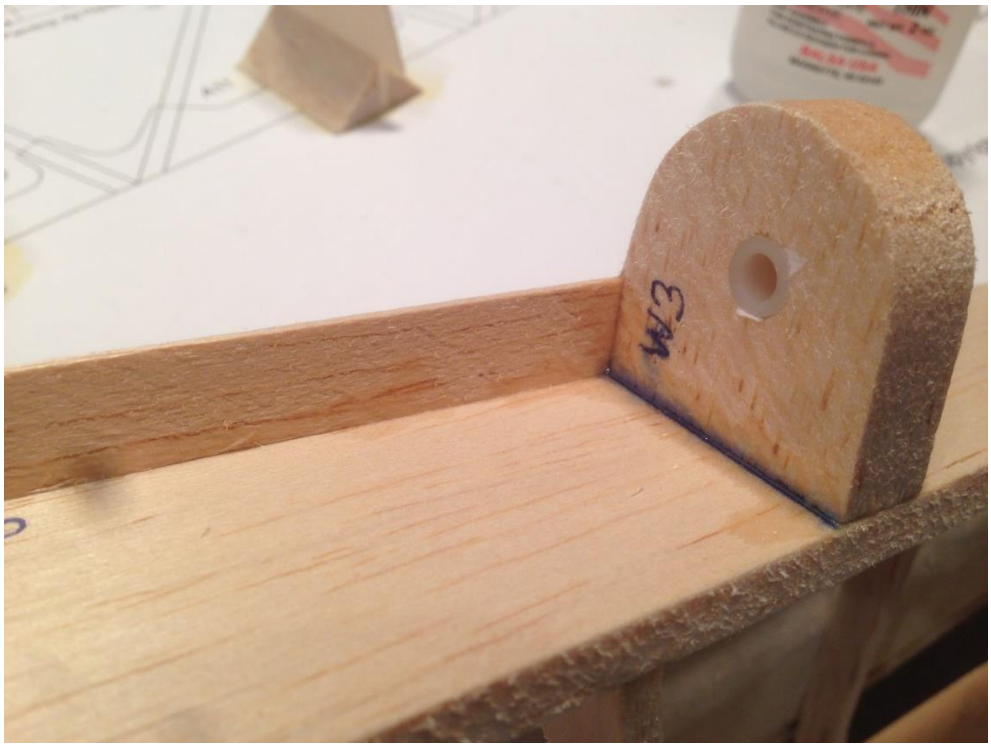
Wing spar – Fill Procedure

Fill the distance between W1 and W2, W2 and W3, W3 and W4 with 5/8" trailing edge stock. The *top* surface of the trailing edge of these pieces should align with the top edge of the hinge blocks. The idea is to set the trailing edge pieces so that the thin edge is nicely aligned with the aileron hinge. A fill coat of lite spackle over the trailing edge as it mates to the wing spar, then sanded will fair very nicely.

Make 5/8” trailing edge pieces by resawing the thick edge of standard 3/4" trailing edge stock.

See cross section drawing on Wing Plan.

Mark a line 6-3/4” from W4 toward the tip. Use 5/8” wide trailing edge stock. Make a series of partial cuts so the pieces will bend easily. The tip will be curved in a later step.


W3


Copyright 2023 / Gratner
6 3/4

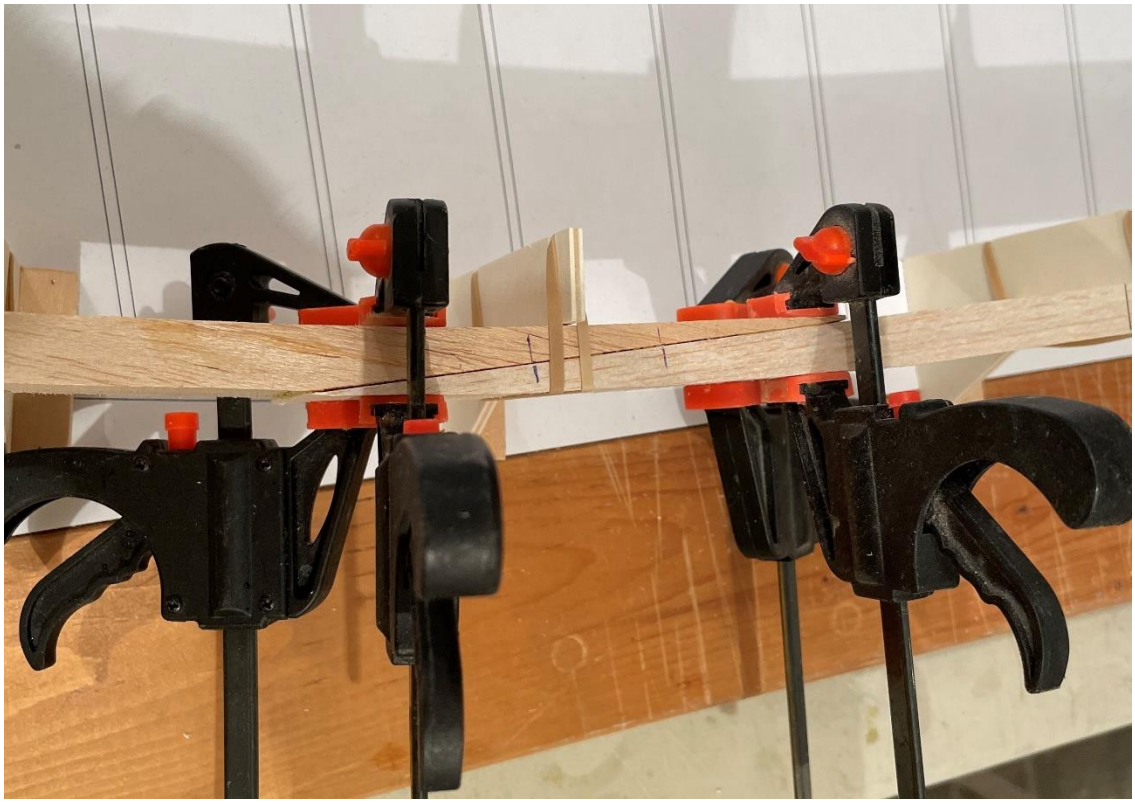

A12
A13
6 3/4

Framing the Wing

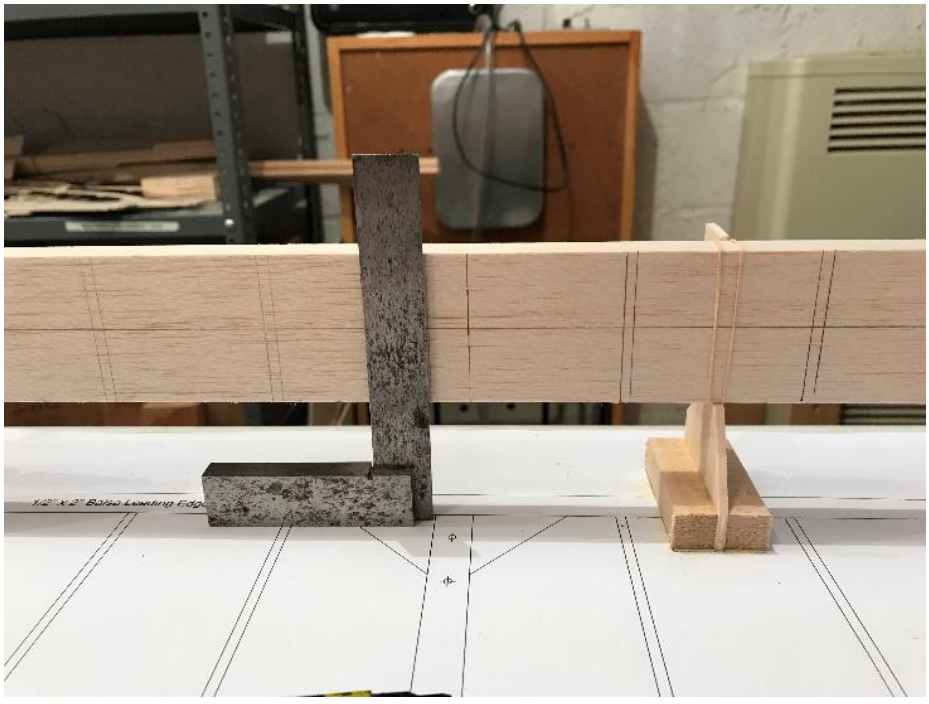
If you have not already done so, glue the 1/16” x 1/2"x 1” tenon into the root end of the leading edge.

Set straight leading edge on jigs and secure with rubber bands. Make certain that the end where the leading edge will butt against W1 (i.e., to the inside of W1 as shown on the plan), is square.

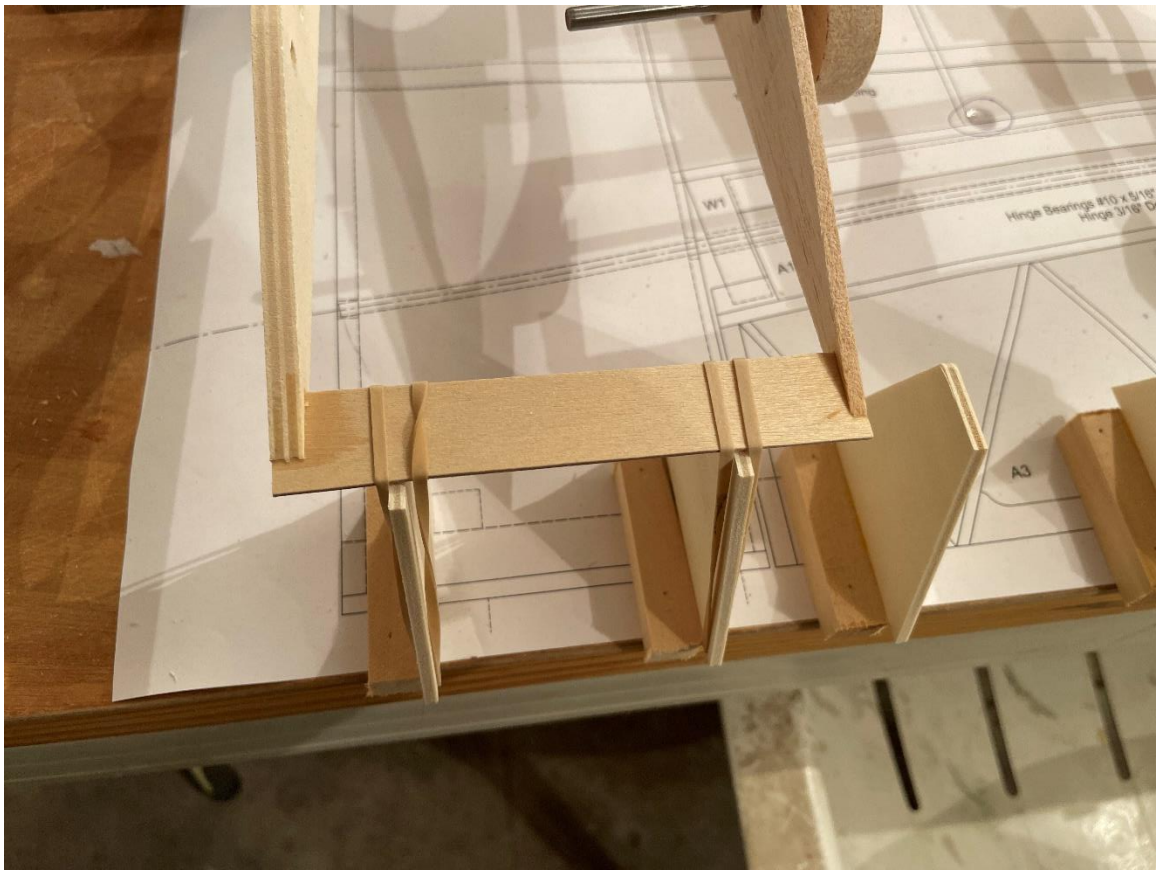
Set curved leading edge on jigs. Make sure the tip aligns with the plan. Make joint permanent with Titebond. Again, make sure that the leading edge terminates at the wing tip side of W1.



Using the Height Gage, draw a line on *both* sides of the leading edge exactly 3” inches above the building board. This is the datum/chord line. Or, if you prefer, draw lines on both sides of the leading edge on-center. Either method gets you to the same place. Use a small square to locate all ribs on leading edge.



Set the short trailing edge for W1-W2 onto the jigs and secure with rubber bands. Make certain that the leading edge and trailing edge are both *perfectly* aligned to the plan.



STOP AND THINK SO YOU WON'T MAKE A BIG MISTAKE!!!!!

IF you have finished the RIGHT wing panel are now building the LEFT wing panel, make sure that W1 (and all other ribs) are mounted upside down.

Set W1 in place. Make sure that the “top” is at the “top” for the right wing panel, (or on the “bottom” for the left wing panel). When all is checked and *square*, use thin CA and glue W1 to the leading and trailing edges. Perfect alignment between the leading edge, trailing edge and W1 is CRITICAL to building a straight wing. Check, check and re-check the alignment before you glue.

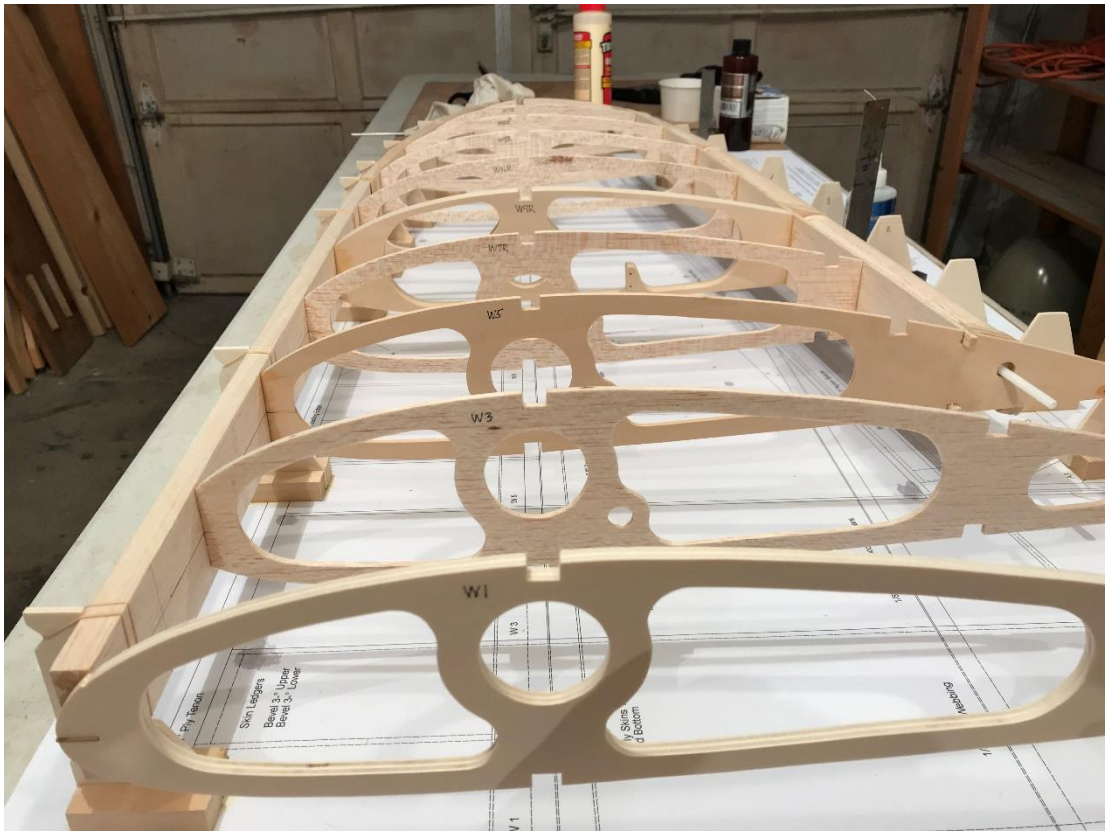
Install and glue W2 in place. Give special attention to the alignment of the rib kerf marks to the datum line on the leading edge.

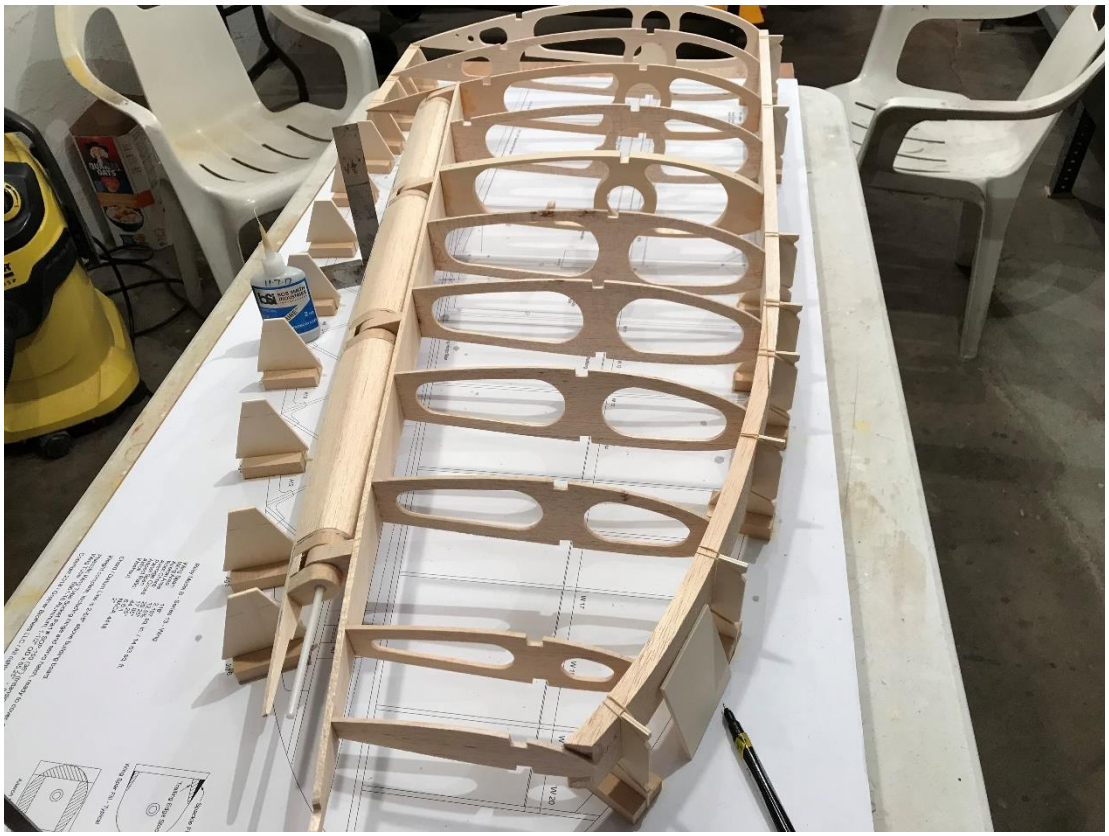
Install wing hinge spar. Glue spar at W2. Do not glue the tip to the jig, use a rubber band. Note: the tip is fragile. Use caution when setting into the jig.

Using a small square, mark the rib locations.

Glue W8 in place *first*. Then glue W4 and W6, followed by W-10 through W21. (Nose ribs will be installed later.) Make sure that the kerf line (locating line) on each rib aligns with the datum line on the leading edge.

See pictures on next page.


W3
W1
Skin Ledgers
Bevel 3 - Upper
Bevel 3 - Lower



Main and Rear Spars and Nose Ribs

It is critical that W1 be square to the building board. When the model is complete, W1 will mate to SW4 on the fuselage stub wing. If either of these ribs are not square, you will have a gap between the two that is almost impossible to correct. Use the main spars and the rear spars to help keep W1 exactly square. Glue spars to W8 first. Glue spars to W1 last. Save the excess basswood spar stock. These pieces will be used to form the servo hatch in a later step.

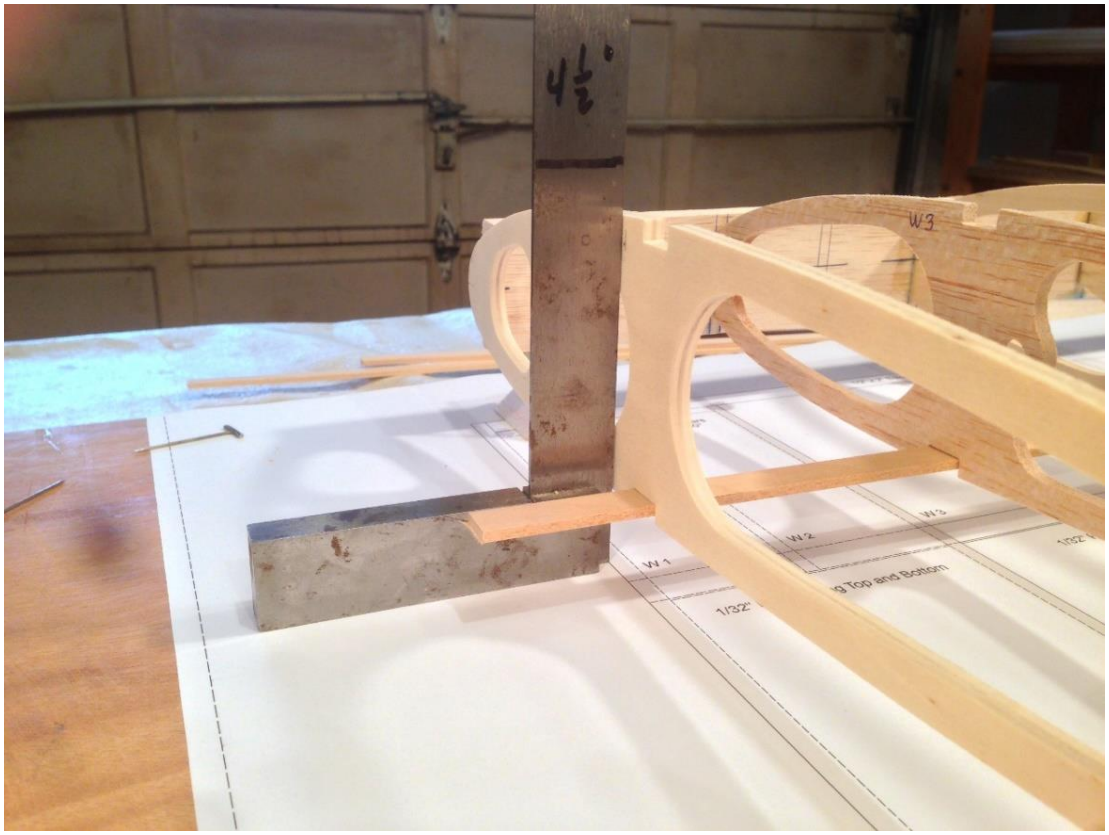
Swab 1/8” x 3/8" basswood main spars with accelerator where they will be glued to the ribs. Make sure the ribs are vertical and straight. Glue bottom spar (closest to the building board) first and then the glue the top spar.

Glue the bottom rear spar (spar closest to the plan). It should butt against W8. Install and glue the 3/8” thick balsa four-sided polygon spacer that fits between W6 and W8 and against the wing spar. Use Titebond. Glue the top rear spar and like above, glue the four-side polygon in place. The two pictures below should help.

Glue the acute triangle positioned to the right side of W8 and the wing hinge spar. Glue the two right triangles to the left and right sides of W8 on-center at the leading edge.

Install and glue all nose ribs in place. The nose ribs are somewhat fragile until glued in place.

Saw off spars almost flush with W1 and W21. They will be sanded smooth after the wing is removed from the jigs.

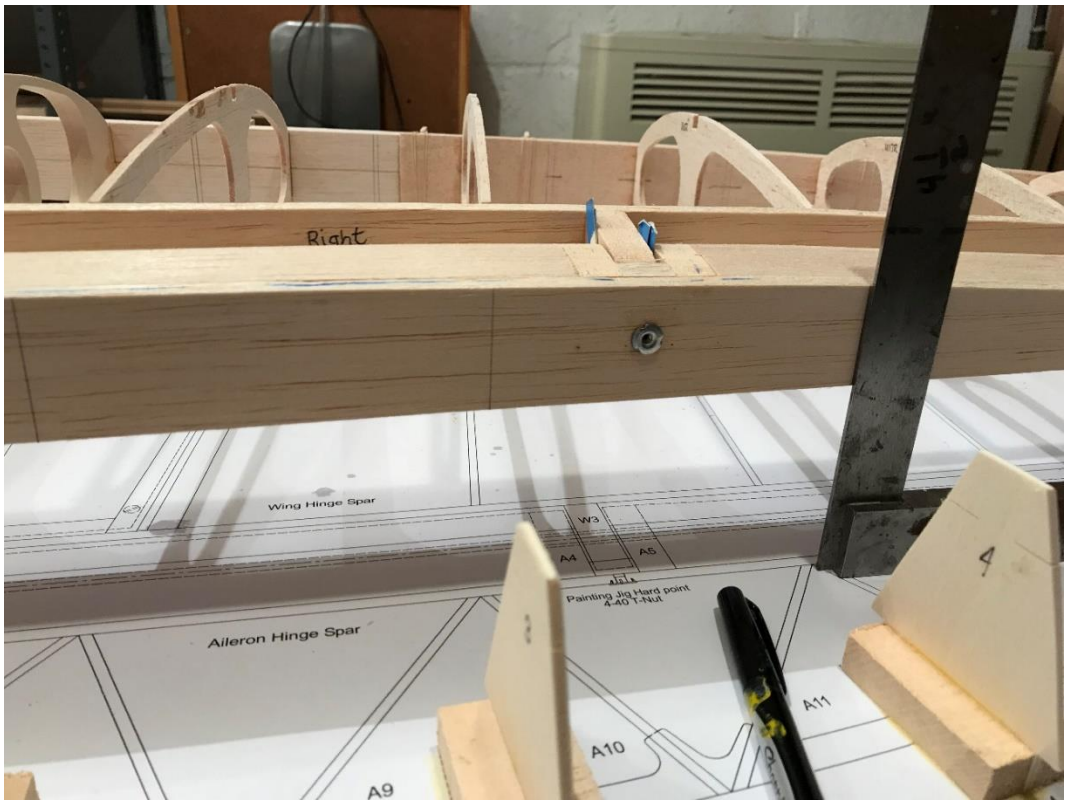


Framing the Aileron

Join the aileron spar to the wing spar with the Delrin hinge. Use a small square and mark location of all ribs on the wing and aileron spars. Insert two temporary wedges so that the hinge remain on-center and not float (move laterally) while gluing the aileron ribs, if needed.

Swab aileron trailing edge with accelerator then set aileron trailing edge on jigs with rubber bands. Glue trailing edge tip to aileron hinge spar.

Beginning with A1, and continuing *in order*, set in place and glue all aileron ribs.


Right
Wing Hinge Spar
W3
A4
A5
Painting Jig Hard point
4-40 T-Nut
Aileron Hinge Spar
A11
A10
A9
4


Right
A7R
A7R
A6
A6
A8
A9
W3
Jig 2
Hard point

Remove Wing from Plan

At this point all jigs have served their purpose and the wing may be removed. When removing be careful not to break the wing spar tip.

Remove Delrin hinge pin and set aileron aside.

Sand basswood spars flush at W1 and W21.

Glue balsa wing tip in place and trim off lug at tip.

Trim the wing spar lugs so they are flush with the top and bottom edges of W2

Go over wing and aileron to check for any joints that are loose and need more glue.

Wing Tube Socket

Wing tube sockets supplied by TNT Landing Gear usually come in 36” lengths. You will need (1) 1-1/2”ID x 36”socket, which will be cut into two 18” pieces. Cut carefully, as there is not much room for error. (You will also need (1) 48” x 1-1/2”ID socket for the fuselage.)

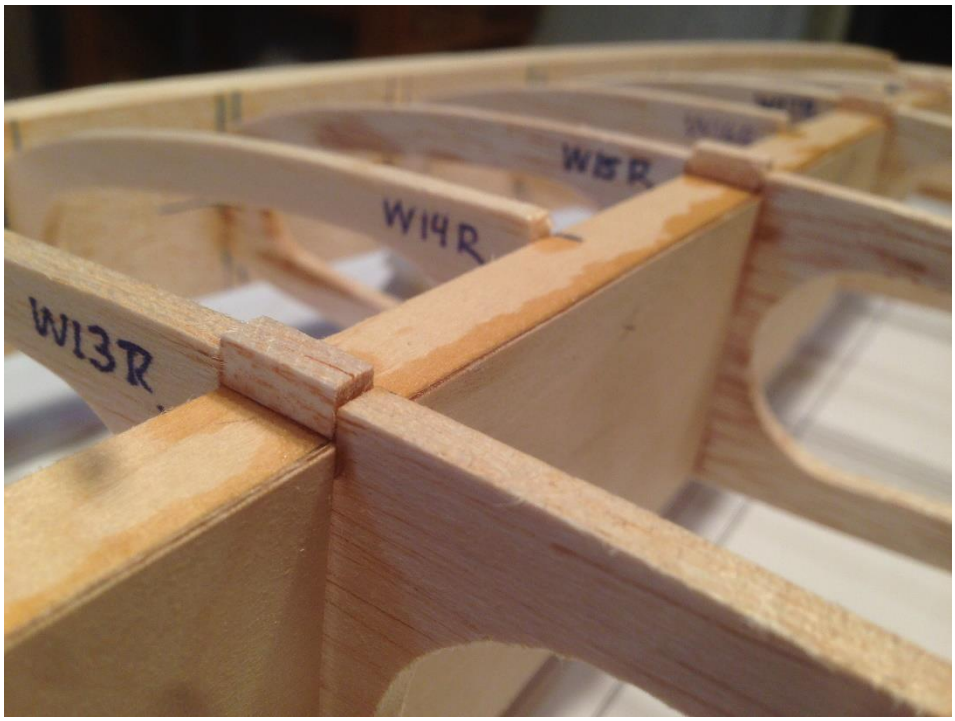
Glue the round wing tube socket “cap” to the wing tip side of W8. Make sure that the cap leaves plenty of clearance for the servo mount. (The picture is from an earlier design.)

Insert wing tube socket all the way in until it butts against the cap at W8. Glue in place at W1 and W8. The tube “floats” through W2 – W7.

When glue is set, trim and sand flush at W1.

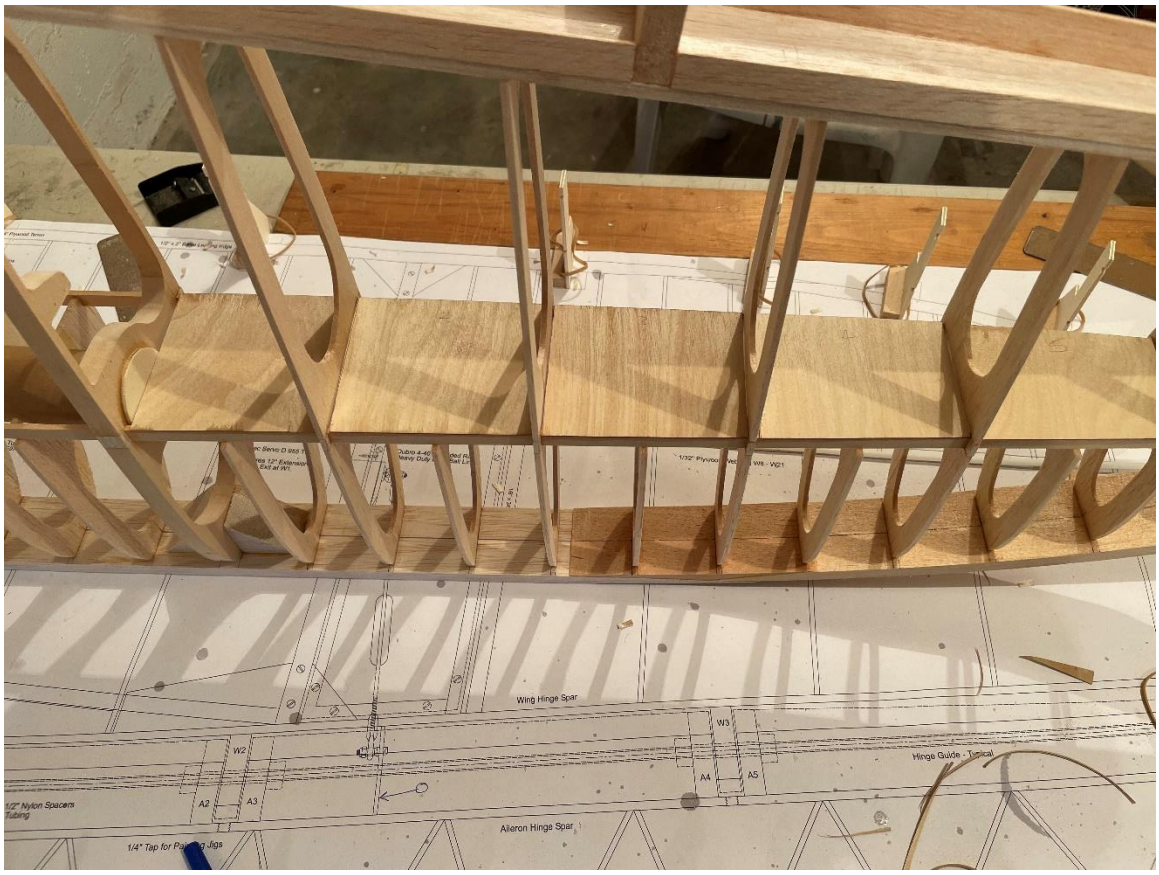
Filling Rib Notches in Main and Rear Spars

Fill all rib notches on top and bottom with 1/8” balsa scrap. Use razor plane to reduce height, and then sand smooth.



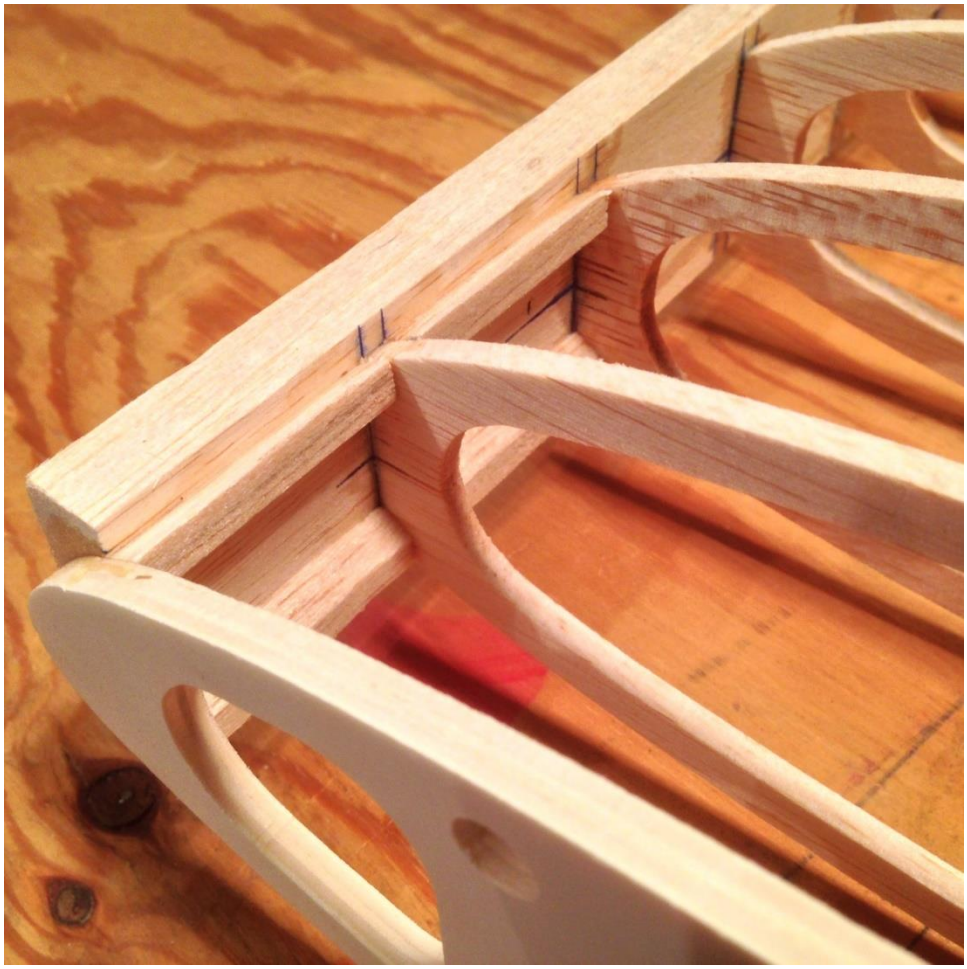
Spar Webbing

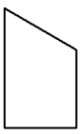
Install 1/32” plywood webbing from W8- W21 on the main spar and from W1-W6 on the rear spar.



Wing Skins

Install 3/8” balsa wing skin ledgers at leading edge between W1 and W2. Top and bottom. Make ledgers from scrap. Bevel 30.





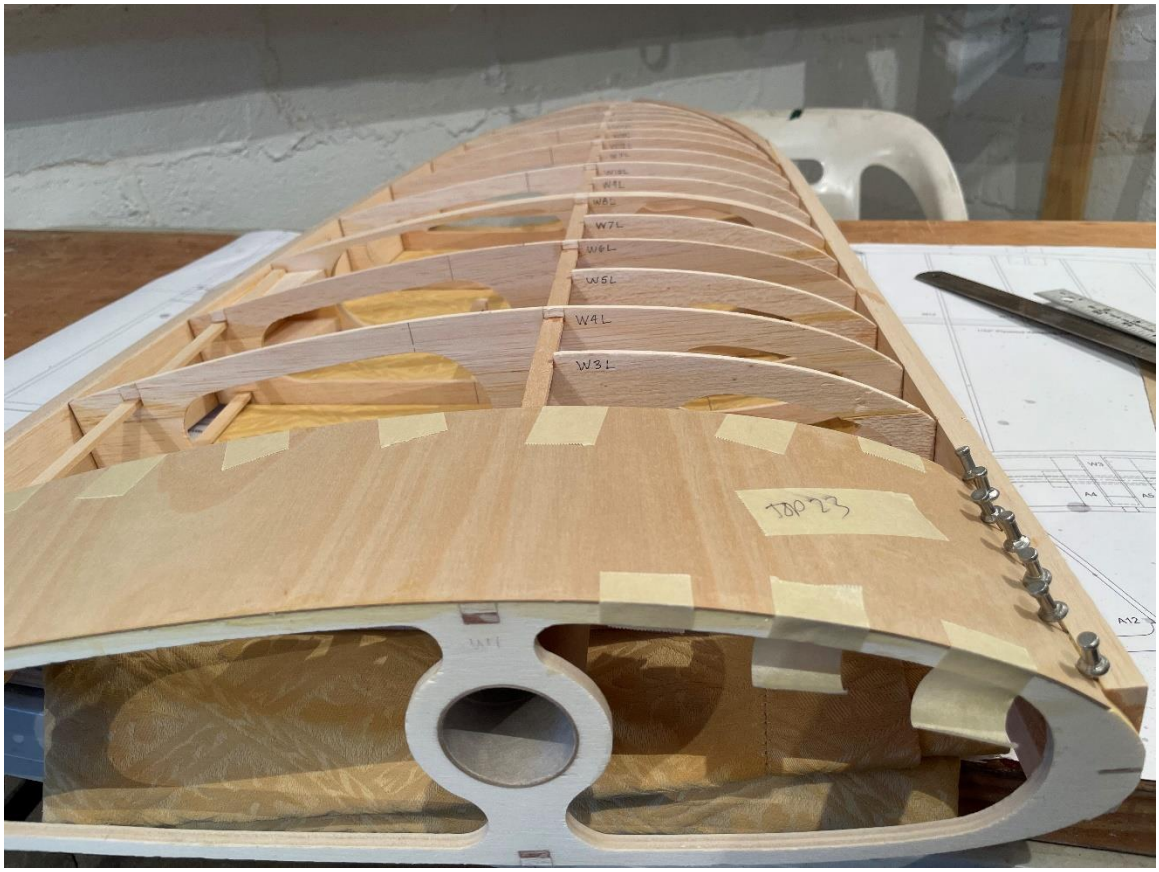
Ledger (Typical)

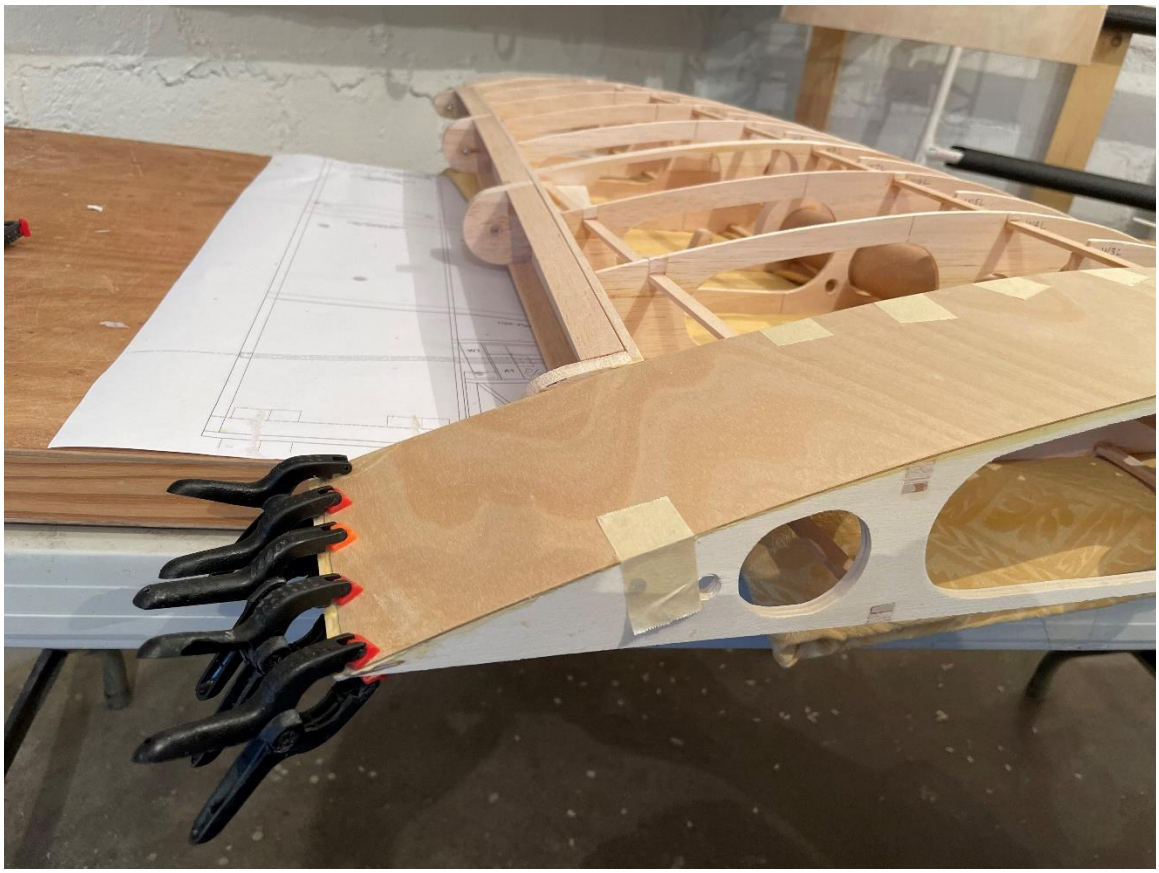
Prepare 1/32" plywood wing skins. 4-3/8” x 22-5/8.”

There will be a small gap at the trailing edge. These gaps will later be filled with lite spackle.

This step can get messy.

Install top skin first. Always dry fit before actual glue up. Use Titebond. Spread glue on ribs, ledgers, and trailing edge. Set skin in place. Work carefully to make sure there are no buckles or gaps. Secure joint at leading edge with heavy duty push pins and at the trailing edge with mini clamps. Another method of securing the skin leading edge is to apply thin CA along the edge. Even though Titebond has good "grab" and will stay in place after about 5 minutes, you still have plenty of time to position the skin, even if you need to pull it off and realign it. Titebond is very forgiving. Work all joints with your fingers until the glue has fully grabbed. Use high adhesive masking tape to secure. Leave clamps in place for at about 30 minutes. Allow yourself plenty of time to glue the skins in place.





Servo Hatch

Install 1/8” x 3/8” basswood ledgers to the inside of W8 and W10 for servo bay cover. The ledgers should be relieved about 1/16" (thickness of hatch plus an allowance for the covering material).” Glue additional ledgers front and rear to finish off the box.

Fill space between W8 and W10 along the main spar with a piece of 1/4” x 3/8” x 3-7/8” scrap balsa. Sand to conform to the ribs W8 and W10.

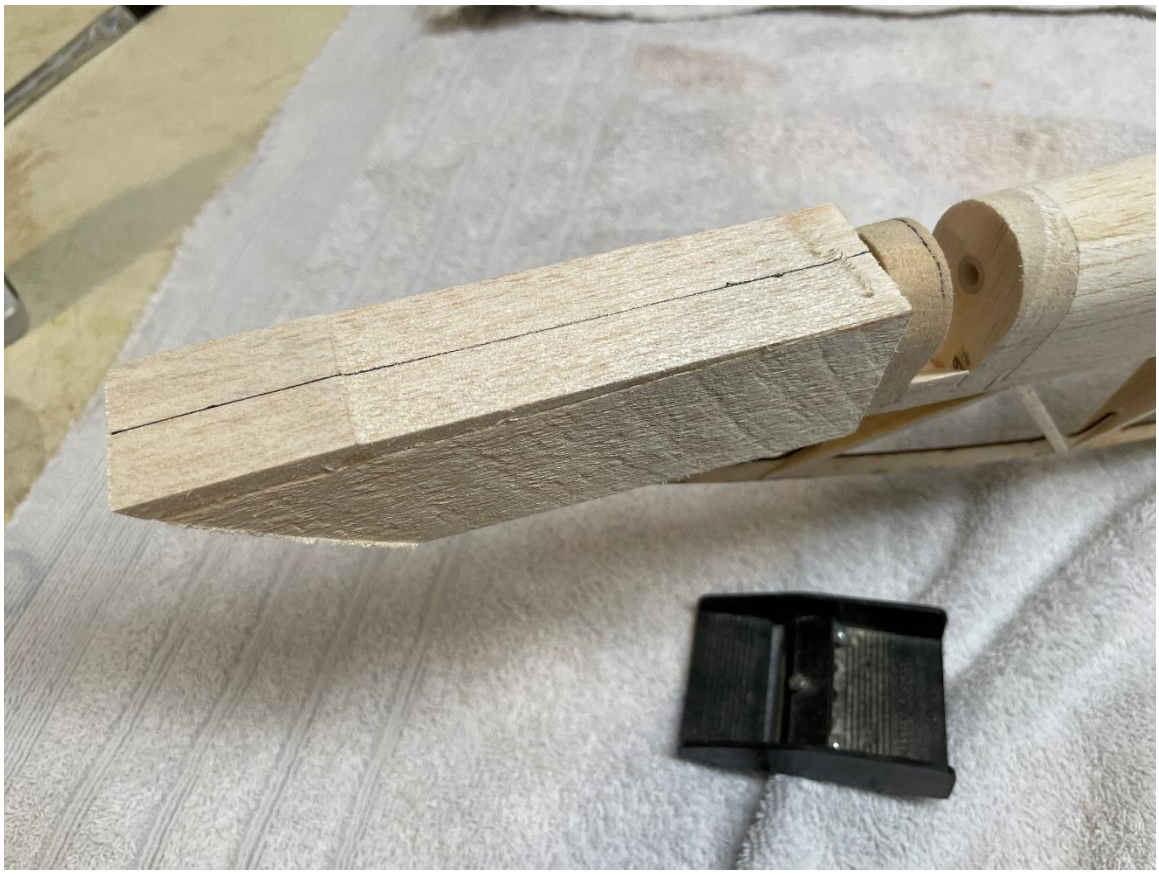
Drill 1/16” holes in basswood ledger using servo hatch as a guide. Hatch will later be secured with #2 wood screws. Use an awl to put a dimple in the rails so that the drill won't wobble off the mark.

Although not shown in this picture, add a ledger to the tip side of W10. This will prevent the covering material from pulling and distorting W10 when it is tightened.

Shape and Finish Aileron Tip

Apply a couple of drops of thin CA to harden the end grain in the area where the Delrin hinge will butt against the tip. Install and glue aileron spar tip in place.

Shaping the aileron spar tip requires a good eye, a lot of trial and fit, and a lot of patience. If you make a mistake, just create a "flat" and glue additional balsa scrap to the tip and try again.




Left

Sand aileron ribs so they taper to the trailing edge, if needed.

IMPORTANT NOTE: The nose of W1 is exactly the correct finished shape. Since the wing will join the stub wing at SW4, it is critical that the airfoil shapes of the two leading edges be identical. This is primarily an appearance issue, but still important. For this reason, be very careful to not be overly aggressive when sanding the wing leading edge near W1. As a practical matter, it is best to leave the shape of the wing leading edge slightly proud of the nose of W1. When the fuselage stub wing is completed, the wing can be checked for good continuity at the joint between the two leading edges. If any mismatch is evident, a lite sanding will bring them into perfect alignment.

This YouTube video may help. Press Ctrl key and click on the link.

https://www.youtube.com/watch?v=cBM2YyOhB3o

Shaping the Leading Edge

At wing tip, scribe a continuous *straight* line from leading edge to the trailing edge (not curved).

Shape the leading edge and wing tip. Use razor plane and 40 grit sanding block. Allow about 90 minutes to shape. About 30 minutes to sand.

These three YouTube videos show how it's done. Press Ctrl key and click on the link.

https://www.youtube.com/watch?v=EVpIc8-flHs

https://www.youtube.com/watch?v=Q-f0JnXpIrM

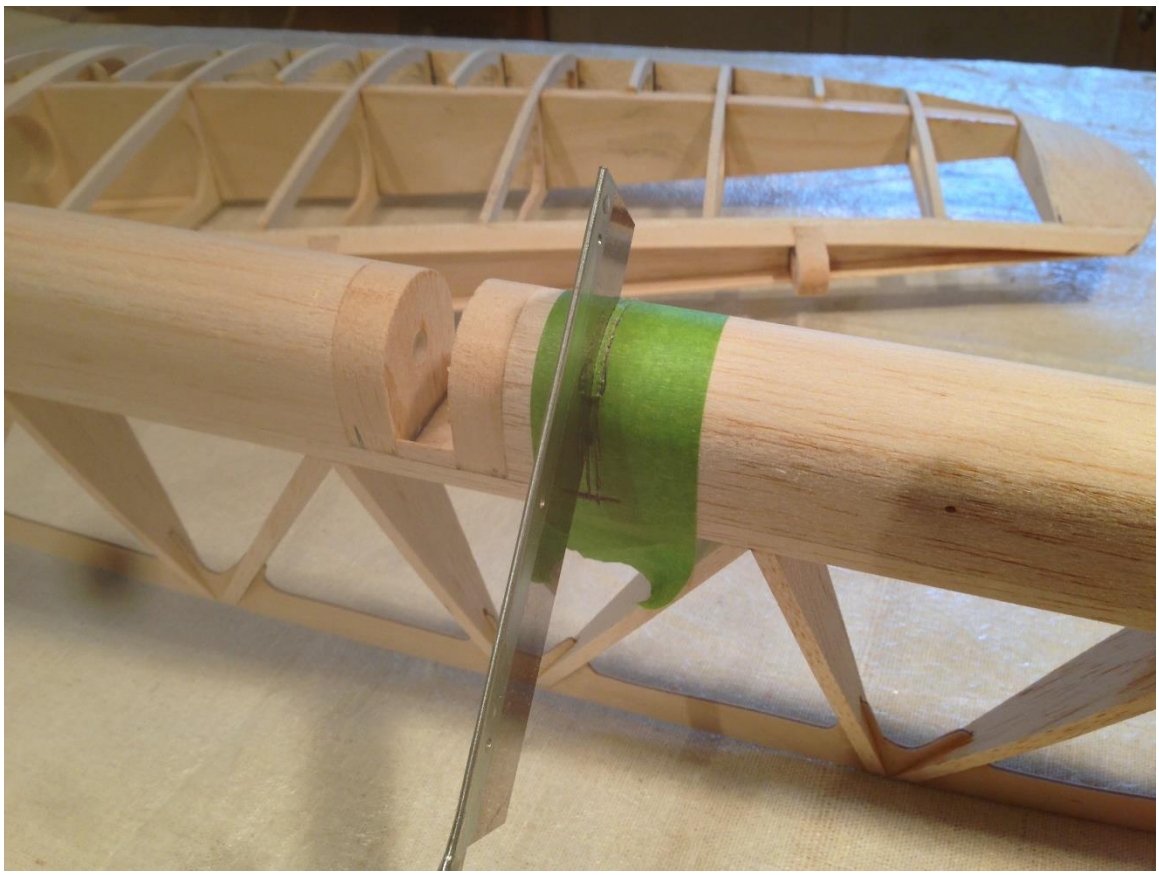
https://www.youtube.com/watch?v=S-sR2MFsmuo

The best place to steady the wing while shaping and sanding is at W8. Take plenty of time. Work slowly. Allow 2 hours to do it right.

Install Control Horn

Study plan carefully to locate the Garolite control horn. Cut slot with a razor saw. You want to widen the slot to 1/16". An ignition file works well. ***DON'T CUT INTO THE PLASTIC STRAW HINGE GUIDE OR THE SPAR***!

CAUTION! Double-check the location on the horn because it is easy to mount in on top instead of on the bottom where it belongs. When *certain* that the control horn will mount correctly, install and glue with thin CA. Although the horn has the same contour as A3, because of the way the balsa fill is sanded, the horn *may* need a little trimming for a nice fit. If so, do this before you glue. The masking tape was used only to make the cut line easier to mark.



Install aileron. Note the location where a slot needs to be cut so the control horn has clearance to allow full down aileron. ***DON'T CUT INTO THE SPAR!***

Completing Wing Construction

Trim 3/16" Delrin hinge to fit. Make sure the tubing seats all the way through A7. When fully seated, the hinge should end just inside of W1. If insertion is difficult, round the end slightly.

If not already done, drill holes for hard points in W8. Use 5/64"" drill. Holes are 7/8" apart and on-center. Locate first the hole 1/2" from leading edge and trailing edge.

Fill gap between W2 and the hinge block with toilet paper. Harden paper with a few drops of thin ca. Make sure you don't block the hole! Fill this gap with lite spackle. Do the same with the top and bottom wing skins where they meet the trailing edge. And fill all other gaps or cracks with lite spackle. Allow drying overnight before final sanding.

Final sand with 180 grit sanding block.

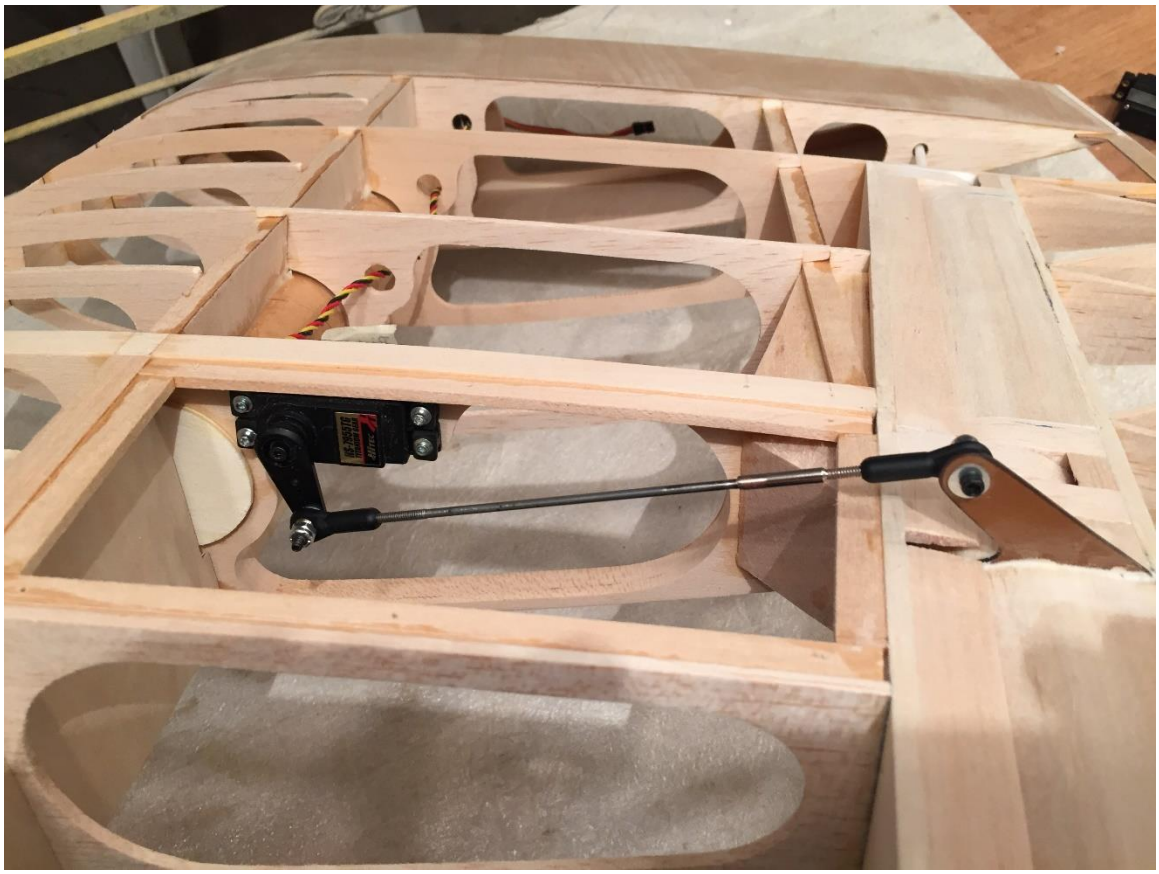
Weight – Complete – Ready to Cover

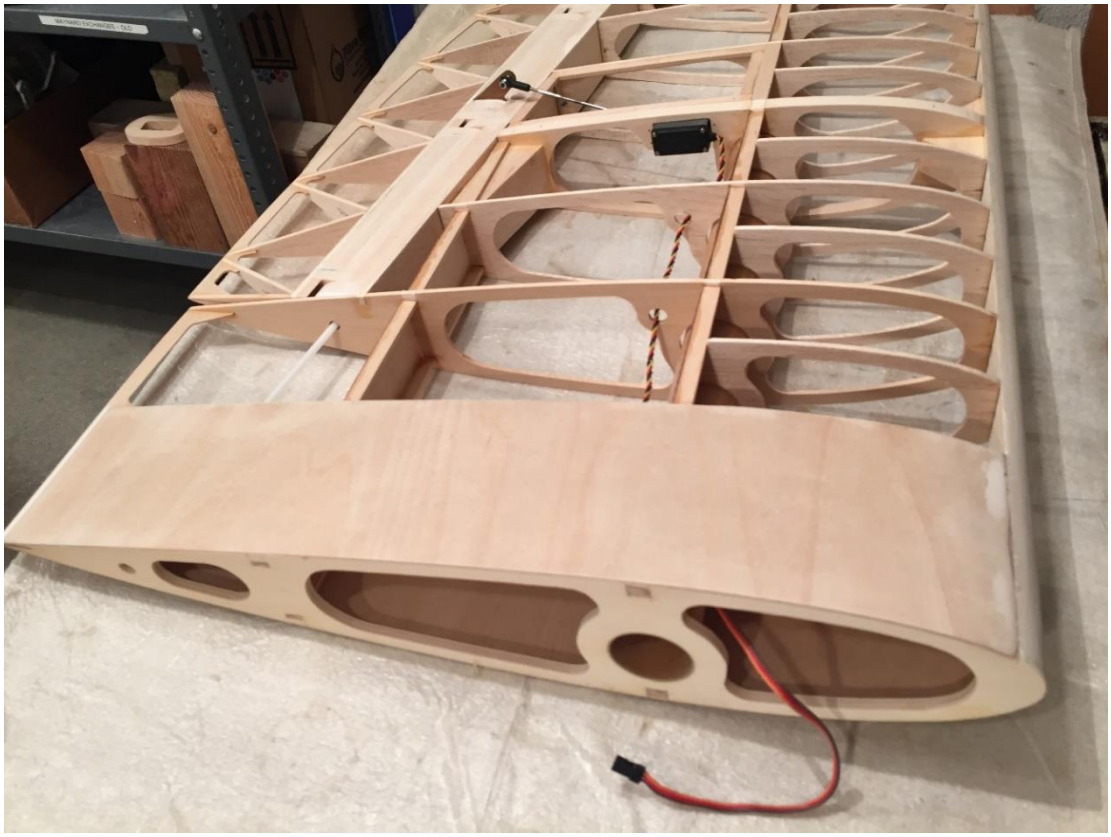
Each wing panel complete and ready to cover should weigh approximately 30ounces.

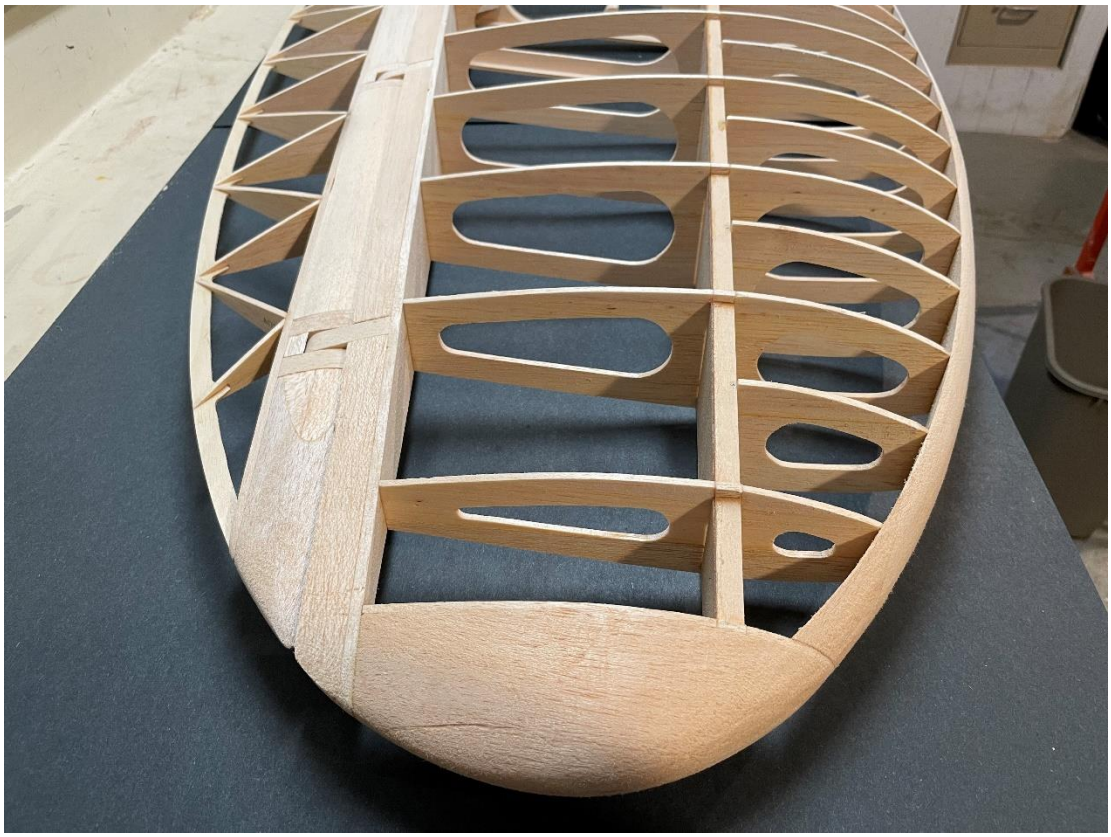
Wing Servo

The servo arm, at neutral, should be 90° to the servo case. This offset will create a small aileron differential, more up than down, which is desirable.

The connecting rod length is 6-3/4” (threaded end to threaded end).





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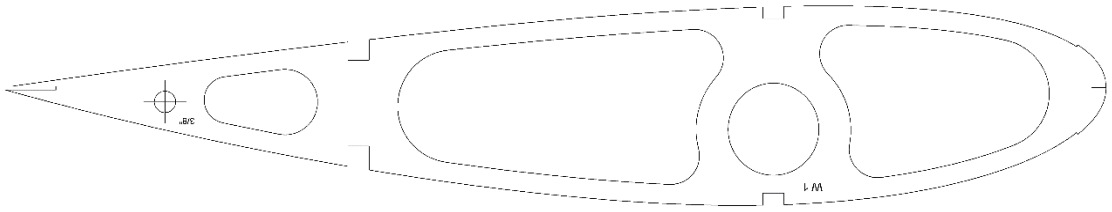
Building the Left Wing Panel

The left wing panel is built on the same plan, with the same jigs, using the same set of instructions and in exactly the same *order* as the right wing panel. But! The left wing is built *upside down*. All parts *labels* should orient *down* toward the plan on the building board. Like this.



The leading edge, the trailing edge and the hinge assembly are the only `parts that need no special orientation. All other parts orient upside down for the left wing panel.

Left wing panel under construction

Make Jigs for Painting Ailerons

It is virtually impossible to paint the ailerons (and elevator and rudder) without some device to hold them while you paint. That is why there are 1/4-20 tapped holes in the aileron spars. To make these jigs cut pieces of 3/8" dowel to a length of about 9" inches. Disk sand the ends so they are flat and square. Sand the heads of 1/4-20 x 3/8" nylon socket head screws by scraping across 100 grit paper on a flat surface such as your sanding block. Apply CA accelerator to the wood dowel only. Hole the nylon screw to the end of the dowel and wick in thin CA around the perimeter. When the glue sets, the jigs will have plenty of strength. When the jigs are in place for painting insert the plane ends into any suitable block of wood drilled with 3/8" holes.