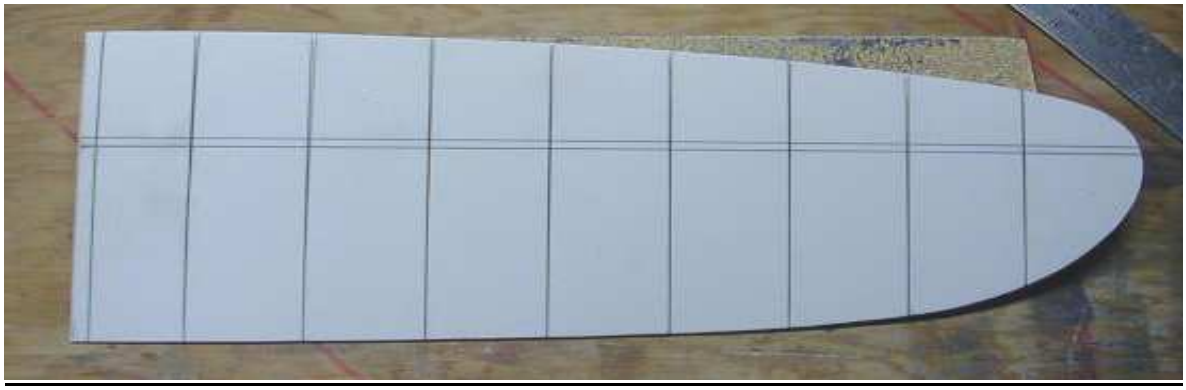
CONSTRUCTION FILE #2 (Oct. 24, '09)

BUILDING STAB HALVES, RUDDER, RUDDER HINGING, MOUNTING THE PIVOT ROD

These inexpensive, built-up structures work especially well. Plans sent out after 7/9/07 show a stab half 13-1/2" in span with 7 ribs spaced on 1-1/2" centers. Use it with the 130" and 145" wings. Reduce length one bay at the root end for the Easy LT/S with its 48" one-piece SS's. If using the LT/S composite fuse, or making the longer, glassed-over LT/S fuse with the 2-piece slab sides, shown on August, '09 downloadable plans, use the smaller stab on the plans.

Spars are 1/8" very hard balsa. ¼" LE, 1/8" TE & the 3/16" rounded tip piece are medium. It's fine to 3M77 1/8" sheet pieces together & sand them or ¼" balsa down to 3/16". The 3 layer root lamination & ribs are 1/8" light stock. Using these densities, the properly sanded, Monokoted pair combined weight should be 1 to 1.2 oz. assembled with CA glue.

Nothing, including tail pieces, is built on the plans & working over them would be awkward. For the stabs, place a 5-1/2" x 14" piece of Sintra under the plans. Use a common push pin to outline the stab perimeter. Cut it & sand edges smooth. Squared to the root end, pencil in parallel lines at the spar location. ¼" from the root draw a chordwise line. Draw another 1-1/4"out from it & a series 1-1/2" apart at rib locations. The full 13-1/2" span pattern then looks like this:



LE'S, TE'S & TIPS: A bandsaw, scroll saw or jigsaw makes quick work of preparing a stabs kit. Directly on balsa sheet, mark around the pattern to outline the outer perimeters of the curved ¼" LE & curved 1/8" TE pieces. Shift it to mark the rear line of the LE with slight taper. Shift to mark front edge of the TE. Cut 1/8" or so beyond the marks. Cut balsa blanks to place under the marked ones. Pin & stack saw matched pairs. Use a 1/8" sq. file, etc. to make notches at rib rear ends.

Place a 3 x 5 card under the pattern to mark the tip outer perimeter. Cut that line with scissors. Place it & a balsa LE & TE in position over the full pattern. Eyeball, mark & cut the remainder of the card for the 3/16" tip piece pattern. Duplicate the rounded tip piece on Sintra. Cut two tip pieces & notch them where spars go.

ROOT LAMINATIONS: Grain is to run chordwise. The 1/8" aluminum tubes are to be vertically centered in 3 layers of 1/8" balsa. From balsa sheet, rip a strip 1-1/4" wide. To cut it into pieces with ends squared up, stand it on edge on the leveled bandsaw, etc. table to do the following:

Cut six (6) pieces 1-1/2" long for the front laminations. Cut four (4) 2-3/4" long for top/bottom rears. Cut two (2) 1-3/4" long for center pieces behind the rear tube.

Middle layers behind the spar will be custom-fitted after the rear tubes are attached to the bottom layers.

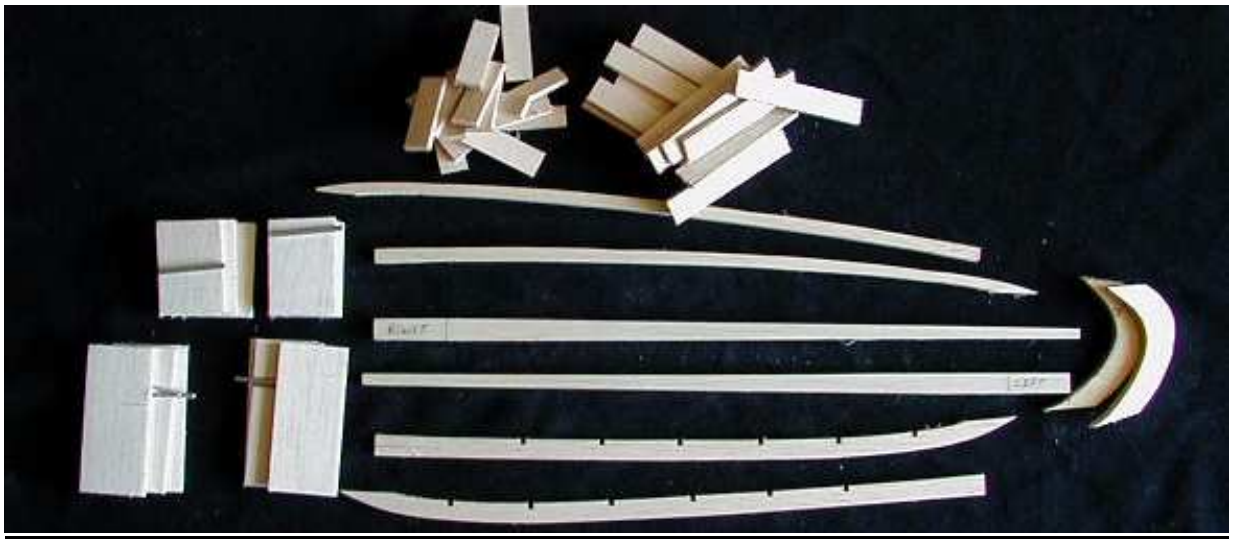
RIB STOCK: From light 1/8" sheet, rip strips 7/16" wide. Cut 14 pieces 1-1/2" long to use ahead of the spars. Cut 14 pieces 2-3/4" long for the straight ribs behind the spars. Diagonals come later.

HARD SPARS: (REALLY HARD!)You want the inboard 1-1/4" to exactly match the actual thickness of the 3 layers of the root laminations. Beyond 1-1/4", on what is to be the bottom edge, mark the spar stock to taper to 3/16". Pin together, stack saw & sand to get a matching pair that will sit perfectly upright on that inboard 1-1/4".

ALUMINUM TUBES: These are based on using 3/32" music wire for stab support. If going metric, 2.5mm is fine, with similarly related tube choices as given below in inch fractions.

From 1/8" OD, cut four pieces exactly 1-1/4" long. In two, use instant CA glue to bond 3/32" OD aluminum in ½" deep. Trim to leave ¼" exposed. Smooth & open the tube ends.

After doing the above, except for strips to size the diagonals, you'll have a stabs kit ready to assemble that looks like this:



.025 FLAT SURGICAL RUBBER AS FRICTION GRIP RETAINERS: Wash the talc coated rubber so it will bond. Scissor off ¼" x 1" pieces. With those 1-1/4" spar ends down & toward each other, mark spar tops as "L" & "R". Mark rubber strip inboard end location on the spar fronts. Make micro-dispensers by heating & stretching fine Teflon tube or by slipping the needle cut from a small syringe into it. Practice attaching rubber pieces to scrap. Apply a drop of instant CA at one end & let it wick toward the other. Finish from the other end.

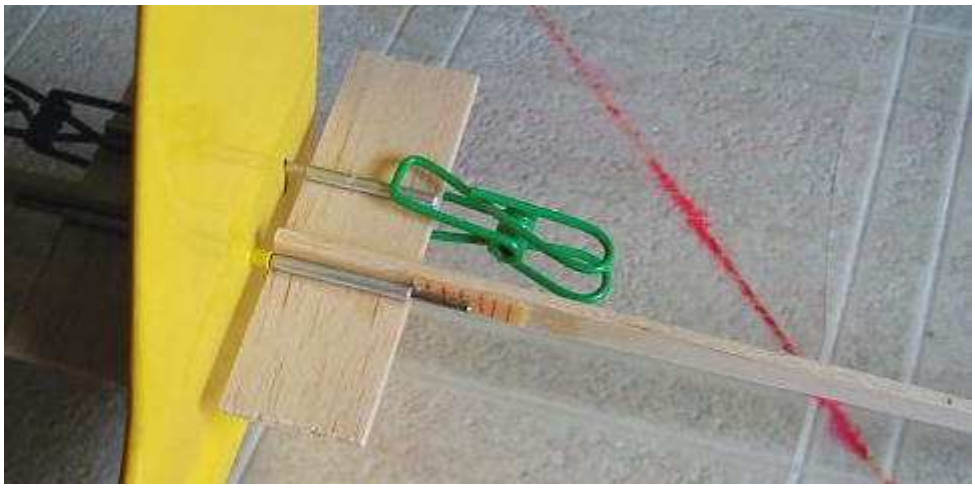
When you can do it without the rubber curling or flooding with CA, attach pieces to the real spars. Start at the inboard end. Dampen a rag with acetone to wipe off any CA residue on the exposed rubber surfaces.

Over Saran wrap, etc., position the "R" spar perfectly upright against a block. With the 1-1/4" end pressed down flush, press the rear bottom lamination down flush in position and apply a drop of instant CA glue. Inspect the work. Then attach the front bottom piece with all down flush. Inspect the work! Make a matching, but opposing "L" assembly. Bottom to bottom, the root layers must fit perfectly flush to each other.

Prepare the 3/32" main stab support wire with the aluminum tube centered on it, bonded with CA glue. Round the ends of the wire to slide over the rubber.

Tube walls are thinner than the .025" rubber. Press a plain tube into the corner where the front bottom lamination meets the spar. A friction grip should be noted when the support wire slides over the rubber. If not, gently file down one side of the tube to get more grip.

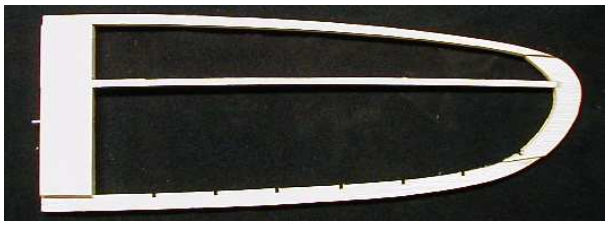
Press front tubes in place & tack down with instant CA glue. Run the support wire & 1/16" drive wire thru the fin. As shown below, slip on both stab sub-assemblies. Red lines mark the rubber.



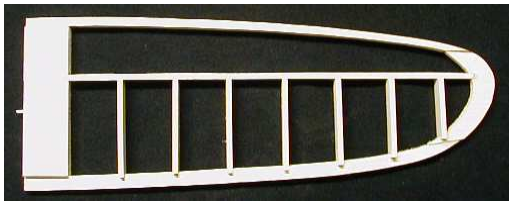
Slip rear tubes on the drive wire, so the inner 3/32" tubes protrude beyond the bottom laminations. Lightly clamp both tubes as shown above & view from the tail end to see if the two assemblies are in true plane with each other. If not, put a suitable shim under the tube on the high side. A 1/8" wide strip of CA hinge, business card, etc. works well. With everything squared up, apply a tiny drop of CA to lightly secure the rear tubes & any shim.

Glue on the other 1/8" pieces to firmly bond and surround the tubes in place with CA glue. Trim off excess lamination ends, front & rear on one stab. Use it, bottom to bottom, as a pattern to equally trim the other one. Attach the 3/16" tips with all inverted flat to the workbench, so the tip pieces are in plane with the root assemblies.

In the hands, position a TE on the root & tip so it's level & vertically centered. A dab of instant CA glue quickly joins well-fitted parts at the two points.

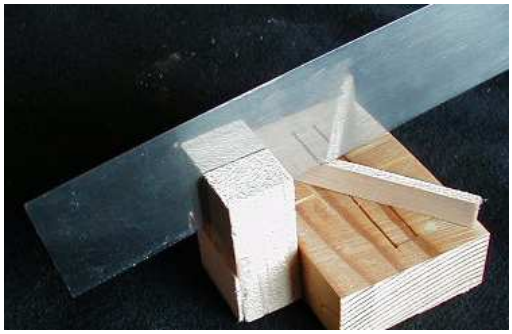


Similarly, vertically center the LE's creating frames with no ribs. This <u>visual</u> vertical centering helps prevent building any twist into the structures & helps get identical LE & TE alignment on both stabs.



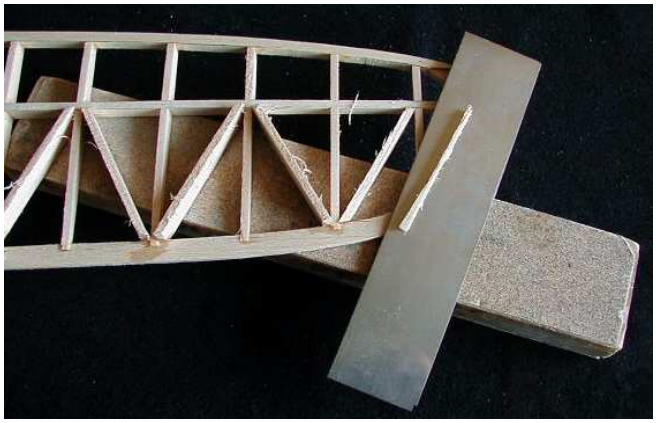
Cut the rear straight ribs as rectangles. Size them to make the spar straight. Glue them <u>only</u> to the spar at this stage.

Eyeball stab from its end. As needed, adjust the notched TE's vertically on the rib ends so the TE looks straight & centered relative to the spar. With instant CA, lightly tack rib <u>rear</u> ends only in the <u>rear</u> end of notches. Glue in front ribs as rectangles.



DIAGONALS: Ignore the reflection. Make a support to hold a razor saw blade upright. Position a rib strip under the stab to mark the angled diagonal ends. Hold the piece upright to cut the angled ends. Cut the pieces about 1/32" longer than marked & sand ends to get a fine fit. Glue in at both ends.

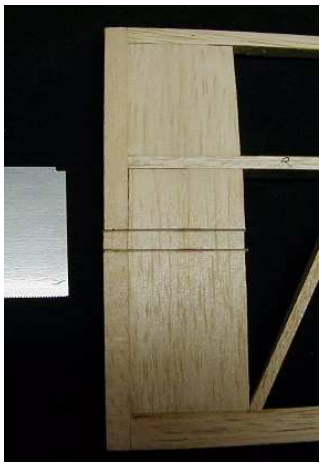
An unbacked razor saw blade can be bowed to impart curvature as seen on the trimmed off piece in the picture below. If you have a 2nd blade, support the cutting blade on it to leave a little to sand down.



This blade is the 1-1/2" x 6-1/2", 32 tpi Zona. The larger Exacto blade should be okay, too. Progressively, rough trim all ribs. To sand, lay the work on one 12" sanding block and sand with another one. Or, hold a trimmed rib between thumb & finger of one hand & sand it with a small block in the other hand. First sand ribs down to the spar & to the unshaped LE & TE, top and bottom. The airfoil is generic & symmetrical. Ribs may be sanded flat or rounded. No flying difference is noted but rounded looks nicer.

As viewed head-on, the tapered LE can be sanded progressively thinner toward the tip. This will thin the airfoil in that area. Do one stab half first & use it as a pattern to make the other one. By counting strokes, equal amounts can be sanded off the top & bottom of the LE & later the TE. Gently round the LE. Bevel the TE down to a thickness of 1/32" at its rear edge. Taper the 3/16" tip down to TE thickness. Weight is reduced as excess balsa is sanded away.

See next pic. Using ¼" light balsa for endcaps, initially drill a 3/32" hole to slip over the protruding rear 3/32" tube. Carefully mark the center of the front tube locations & make 3/16" openings. Wick-join endcaps in place. To get the root assemblies the same shape, rough sand each down some, then butt both together on 3/32" & 1/16" wires to simultaneously fine sand.



STAB MISALIGNMENT?: Before adding the 1/64" ply finishing endcap, slip the stabs on to make a last check that they're in plane with each other. If not, slit both sides of a rear tube as shown here to raise or lower it as needed. Shim the slits & glue parts back together. Fill & sand as needed.

There's a little play between the brass tube in the fin & the aluminum tube on the support wire to help with stab alignment to the saddle & fin. The wire doesn't pivot. Stabs pivot on it as the rubber grippers "give".

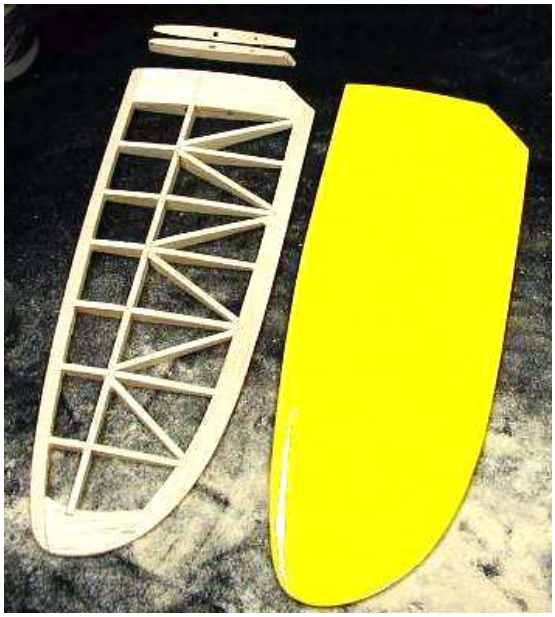
Slip on stabs to check fit to fin in bird's eye view. If the support wire can be positioned to square stabs to the fin, stab ends can be left as is. If not, trim as needed. Finally, make 3/32" & 3/16" holes in 1/64" ply on 1" centers to cap over the balsa endcaps. Wick these in place & scissor/sand off the excess.

From the nose end of the fuse, see that the stabs can be squared to the fin & the saddle. Determine how the support wire should be positioned inside the brass tube for best alignment. If more play is needed to square things up, file on the aluminum.

To protect the fin paint, wax around the brass tube. While holding the support wire to best align things, with fin horizontal wick instant CA between it & the brass tube.

<u>ALTERNATIVE REMOVABLE SUPPORT WIRE</u>: Get best possible alignments of the main wire to the brass tube. Smear the aluminum tube on the wire with bee's wax, etc. Run it into the short brass tube. Good fitting rubber grippers on the spars of the stabs will secure the whole assembly but allow the support wire to pivot. Just be sure it stays centered or secure it to one stab half with a light coat of 3M77, etc.

In this picture, the stab roots were fitted before the fuse & fin were glassed-over & painted, which is okay, too. The fin should be left flat where stabs butt it.



Working the simple assemblies to airfoil profile can also be done with sanding blocks alone. Witness the uncovered one & the actual sawdust created in the shaping process. A generic symmetrical airfoil has proven to be totally suited to the job. Crisp response to stick input occurs at very low airspeeds due to the stabs being under the wing wash, as partly accounted for by the droop snoot, bowed boom fuselage profile.

These stabs will produce a quick, steep dive before the zoom, very tight loops & hold the ship inverted after intentionally tucking under. Tight 360 degree turns after rolling the wing on a tip can be done with them. Their light weight helps minimize the potential for damage to the fuse near the fin in a hard dork.

<u>CF CAPPED SPARS</u>

While winch towing I've never broken a stab built as detailed above, but spar strength can be increased as follows: (thanks to Chris Boultinghouse of Austin, Tx for this suggestion)
Before adding the ¼" balsa endcap, with triangular file make a "V" groove along the spar top & bottom. From your CF cloth, pull a strand of CF. Tack it around the root & twirl it in the fingers to make a "rope" out of it. Lay this snugly down into the groove. Secure it with CA glue.

This is a MonoKoted stab set for the 130" & 145" wings.

Unlike many other films, MonoKote imparts rigidity to an open structure to resist warping & when rapped with fingernail, makes a nice tight sound compared to the dull thud heard with other films.

I don't consider TopFlite MonoKote "heavy". This pair's weight on a digital postal scale is 1.1 oz. The specified balsa densities were used.

COVERING: Sag between ribs is minimized if MonoKote pieces are cut lengthwise from the roll. For the tops, cut rectangular pieces 1" longer than the stab & 1" wider than its maximum chord.

Over the structure top, center the film & so it extends ¼" beyond the rounded tip. With iron set so the film tends to slightly shrink but not melt when a scrap is placed topside up on it, tack the film along the root horizontal edge. Pull at the tip end to remove slack & tack centered at the tip vertical edge & just a little around the top.

Along the TE and LE center, tack at the LE, pull at the TE to remove slack and tack. Similarly tack each way at 1" intervals. If all looks good, scissor around the perimeter to leave enough film to wrap fully around the LE, about ¼"around the TE and about 3/16" around the tip. Slit film around the tip to make little flaps about 3/16"-¼" in diameter.

Over a sanding block for a support, progressively seal the film down & around the entire perimeter, keeping the iron flat. Seal at the vertical root end & come over the bottom about 1/8". For the bottoms, proceed similarly to tack and then seal to the horizontal surfaces. Scissor away the excess beyond the perimeter.

SHRINKING: Preferably shrink from root to tip, alternately doing opposing top and bottom sides a bay or two at a time to minimize chance for making warps. It's safe to use a heat gun on top, but it can unseal overlapped edges at the bottom, so an iron is better to use there over the open areas.

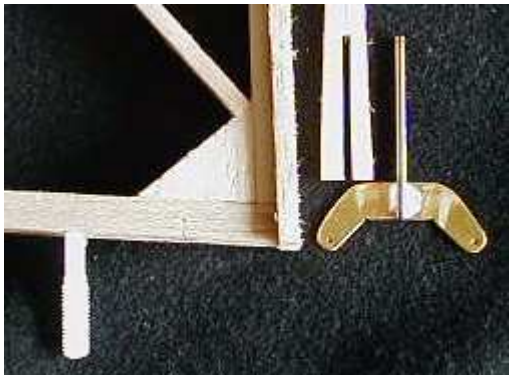
Punch a hole at the root for the 1/16" wire. Slit the larger one. Heat the end of a drill bit to seal the edges inside the hole.

RUDDER: After sanding the fin to airfoil shape, pin a strip of light 1/8" balsa to its rear to mark around as a pattern for the rudder LE. Cut 3 such strips Think of them as "inner", "middle" and "outer" rudder LE layers. Jump to page 8 about the Snap Tight hinges, the rudder "T" & the slotted ply piece the wire part of the T slips into. Note that the bottom balsa piece of the rudder frame is not to be shaped until the slotted ply piece has been wick joined to it. Similarly as done with a stab, join the notched TE, balsa top, balsa bottom & the inner LE layer to make a frame.

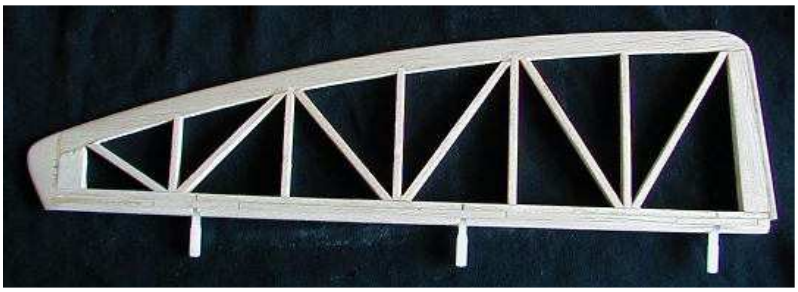
Attach the rounded hard top if you wish. Install the straight ribs as rectangles to get a straight inner LE layer. Add the diagonals. Plan on one hinge being located 1-1/4" from the bottom of the rudder, another about 2" from the top and others spaced evenly between.

Through the middle LE layer, carefully open centered 3/16" holes. Either side of the holes, make centered grooves in which to exactly recess 1-1/2" long pieces of 1/32" music wire. Bond the wires in the grooves with instant CA glue. Glue the middle layer to the inner one, wires forward. Attach the Snap Tight hinges (page 8) to the wires.

<u>FORWARD RAKED RUDDER T</u>: See plans for configuration. A #16 wire nail (not music wire) & .015 brass strip are used. Put masking tape on the brass to mark the shape & hole locations. Drill holes for cables with 1/32" bit. Use Dremel with cutting disc, scissors & metal file to shape the brass. Place "T" parts on a ceramic tile to solder with a small butane torch. The soft nail can bend to spare the solder joint & the slot & be manually straightened. If solder joint breaks, take output arm off the servo for slack. Pop off the rudder. Pull out the nail. Resolder.



This illustrates relationships between rudder bottom, the "T" & the slotted & shaped ply piece. Cable holes in the brass part are to be at right angles to the music wire pieces. After the ply piece is wicked to the balsa bottom, the bottom is shaped to it & the ply piece capped.

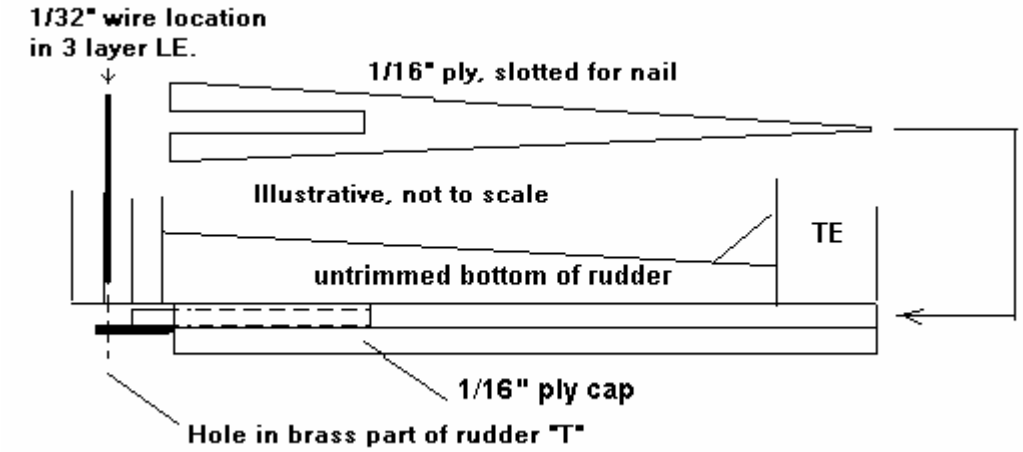


Snap the hinges on the exposed wires. Section the outer LE strip to fit either side of the hinges as shown here. Glue the sections in place. Pull off the hinges. Round the LE & concave the fin.

<u>CONCAVING THE FIN</u>: First, make a centered groove with a triangular file. Use it as a track for larger round tools to groove to the fin edges. Don't try to groove where the piece of thin ply is set in the pointy tip. The rudder needs to recess just enough to prevent a gap. About 1/8" depth will do.

Shape the rudder LE to nicely work manually in the fin. The upper part of the rudder will need to be trimmed back to not jam the fin during deflection. Trim it before covering.

The drawing below illustrates how a slotted ply piece receives the nail part of the "T". Blunt the pointy end of the nail. Position & attach ply piece so the cable holes in the brass part are at right angles to the wires the hinges snap over. Shape the balsa bottom piece.



After the balsa bottom is shaped, cut a ply cap wide enough to wick to the slotted piece. Use the Dremel with sanding drum to shape the cap. If the hole for the nail end is too tight, open it with a #51 bit. After covering, insert the T & secure it with a drop of thin CA glue.

The rudder is operated by pull-pull cables. Between the 2-way output arm & the "T" fitting, a parallelogram is to be formed. Operating radii at the output arm & the T must match for precise & smooth operation. If holes up front are further apart than at the rear, cables will repeatedly be put under high tension & develop slack, Keep cables taut or the rudder will buzz at higher speeds.

KNUCKLE HINGING WITH FOURMOST PRODUCT'S "SNAP TIGHT" HINGES

Do a web search for "Fourmost Products". Click on "HINGES" in the ONLINE catalog. Get the #144. With sharp razor blade, slit hinges back through their inside hole. The cylindrical part anchors in the fin. If necessary to prevent it jamming the BK, shorten it.

Before covering the rudder, mark hole locations in the fin to align fin & rudder at the top. Centered, progressively open holes in the fin to 11/64". With hinges snapped on the wires, insert them without adhesive. Manually check operation. If all looks good, the rudder can be covered.

COVERING: A rounded balsa cap can be placed under the 1/16" ply cap. MonoKote will stick better to it than to the ply. Cut a 7/8" wide strip of Monokote to go from the bottom of the LE to around the top. It can be a contrasting color to the fin or rudder, such as black.

Centered, tack it along the LE. With pin, center punch it at hinge locations. Seal the strip to the rounded LE. At the top, slit at each side to tack along the edge hard top. Trim to 1/8" on either side & seal it down.

At each pinhole make a top & bottom slit for the hinge to fit between, then slit vertically at the center to tuck ends on either side of the music wire pieces. Cut separate pieces for the overall rudder sides & attach similarly as done for a stab.

Coat the concaved area & the rudder LE with paste wax to prevent inadvertent bonding. Attach hinges to the rudder. Put a little Elmer's wood glue in the holes in the fin. Avoid excess that would ooze out between fin & rudder.

CABLES: After the rudder is installed, clamp it in neutral. Cut two cable pieces. Tie a simple knot at cable rear ends. Insert one through bottom of the T. Nose down, dangle end forward to butt F2. Avoid getting it in the pushrod tube. Fish out with long tweezers. Tape cable to the saddle. Do other cable.

Cut 1/8" pieces of 3/32" aluminum tubing for crimps. See plans how cables are attached up front.

Cables are to pass under the main bolt holddown. Attach rigging couplers to clevises using just a few threads. Run crimp tube on cable. Slip 2-way output arm on servo. Fasten clevis. Take up slack. Crimp tube. Repeat on other cable. Keep cables taut or the rudder will buzz at higher speeds.