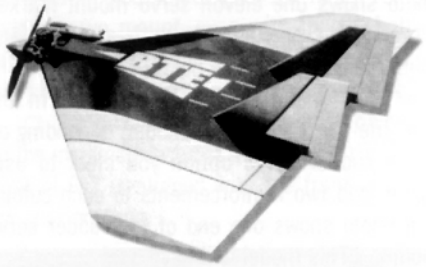
# DELTA VORTEX

## INSTRUCTION BOOK



# INTRODUCTION

*by Bruce Tharpe*

**ABOUT THE DESIGN** - Deltas have been very popular for R/C, but most of the designs in the past were geared toward the ultimate pursuit of speed. I wanted a different delta; one that was geared towards aerobatics and could be flown like a normal sport model. Well, it worked! This design could possibly change forever how deltas are perceived in the R/C community.

**BALANCING THE DELTA VORTEX** - I know how much modelers hate to add dead weight to their airplanes to acheive proper balance. Well, you need to understand and accept the fact that no matter what you do, you will simply have to add some **tailweight** to this model. The engine is so far forward that there's simply no getting around this unpleasant fact. But how bad is this, really? Consider an extreme case where the model weighs 7 lbs, but needs a pound of lead to balance. (Actually, you will need much less than a pound, but this is an extreme case, remember?) At 7 lbs, the wing loading would have been 11.7 oz./sq. ft. (wow!). At 8 lbs, the wing loading increases to only 13.4 oz./sq. ft., which is still far less than many trainers!

Okay, enough math. Now that you are aware of the need to add tailweight, it becomes obvious that there's no sense trying to save weight in the tail. Don't bother cutting lightening holes in the fins or elevons - you'll just end up having to add more tailweight. There is not much in the nose structure that can be lightened, either; you need some "beef" in the nose to absorb the engine vibration. My best advice is to not let the idea of adding extra weight bother you. It will certainly be forgotten after the first flight.

**FLYING THE DELTA VORTEX** - Intermediate pilots who are experienced with low-wing, four-channel sport models should have no problems flying the Delta Vortex. Have an experienced pilot test fly and trim your model if you are unsure of your own ability to do so. If your Delta Vortex is warp-free, balanced properly, has a good radio and a reliable engine, then a successful maiden flight is virtually assured.

The single word that best summarizes this airplane's flight is "neutral". With its symmetrical airfoil and the engine centered on the wing, it simply wants to go exactly where you point it. Although not designed for speed, it still skoots right along at full throttle. Like most deltas, however, its most amazing flight attributes are displayed at low speed. You'll enjoy its honest control response and soft, nose-high landings.

**ENGINES, PROPS, AND SPINNERS** - The range of recommended engines is:

**.60 - .91 2-Stroke -or- .80 - .91 4-Stroke**

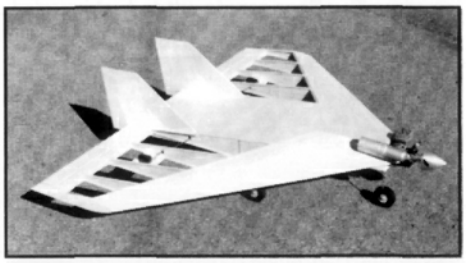
Choose an engine with a high power-to-weight ratio. Larger 4-strokes aren't recommended because of their weight and possible propeller clearance problems. Always use a propeller in the range recommended by the engine manufacturer. The largest diameter that can be used safely on this design is 14". Please use an effective muffler on all of your models. Many flying sites get shut down each year because a neighbor became annoyed at the noise. Don't let this happen to your club! Any spinner from 2-1/2" to 3" diameter will look okay on this model. My particular favorite is the 2-7/8" dia. Ultimate spinner from Tru-Turn. A "pointy" model deserves a pointy spinner.

**RADIO REQUIREMENTS** - At the very least, you will need a four-channel radio with elevon mixing and five or six servos, depending on whether you use the single or dual rudder servo option. Standard servos are fine for all but the elevons; I prefer to use ball-bearing servos with at least 50 oz.-in. of torque on the elevons. If your radio doesn't have elevon mixing, you can use a simple aftermarket electronic mixer.

**GLUES** - The Delta Vortex can be assembled almost entirely using cyanoacrylate adhesives (abbreviated throughout the book as "CA"). There are several places in the book where the use of epoxy or yellow glue (aliphatic resin) is specified. Whatever glue you use, don't be stingy with it! The strength of any model airplane depends on properly bonded joints. The Delta Vortex, in particular, is what I consider to be a "minimal" airframe. Every part in its lightweight structure depends on every other part and good glue joints for its ultimate strength.

**CONSTRUCTION OVERVIEW** - Chances are good that you've never built a model quite like this one. Take the time to read and understand this instruction booklet and the plans before you begin construction. It's actually a very easy model to build, but there are a few steps and techniques that may be new to you.

For instance, you will probably need a larger building board than you've used in the past. This is a big wing and it requires a building surface that's at least 56" x 24". You can use a couple of ceiling tiles on top of a straight, flat table. I've just been using the top of my building table which is made from particle board. It's hard to pin, but not impossible. It's also ***extremely*** handy to have your table in the middle of the room so you can move all the way around it while building. Spend some time now to insure that your building surface is not bowed or twisted, and you will be rewarded with a straight, warp-free wing. One nice thing about the Delta Vortex is that once the wing is built, you're practically done!



Even though the plans show the wing as viewed from the bottom, construction begins with the wing right-side up. For the purposes of these instructions, "bottom" and "top" refer strictly to the finished model's top and bottom surfaces, no matter which side happens to be pinned to the board at any particular time. After the top sheeting and capstrips are installed, the wing will be flipped over and its bottom surface will be finished. After some sanding, the engine box will be assembled directly on the wing structure. Cover it, glue the fins on, hinge the control surfaces, mount your engine, install the radio, and fly! For those of you who want more detailed instructions, just turn the page . . .

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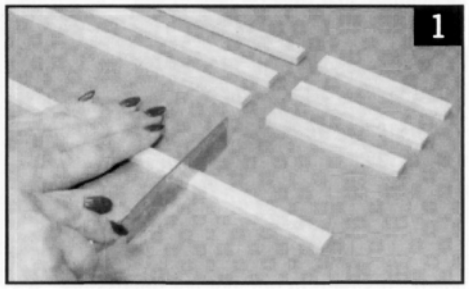
# SUBASSEMBLIES

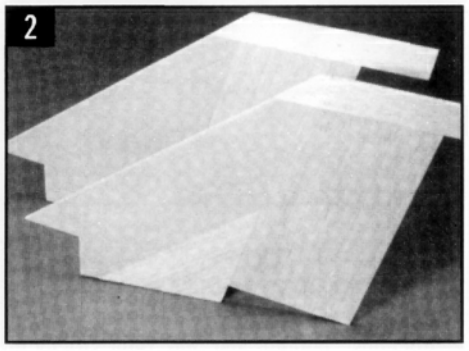
*These subassemblies may seem to take a lot of time, but having them ready will help the flow of construction when you're building the wing.*

1. ❒ Locate the four 1/4" x 1/2" x 36" balsa sticks, then cut four inches off the end of each one. Set aside the 32" long wing spars, and keep the 4" scraps handy for later use.




2. ❒ a. Build two separate fins; each using the four 1/4" balsa fin pieces, FIN-1 through FIN-4. The parts should be glued together in number order, pinning them to your building board as you go. Yellow glue is recommended so that the joints will be easy to sand.

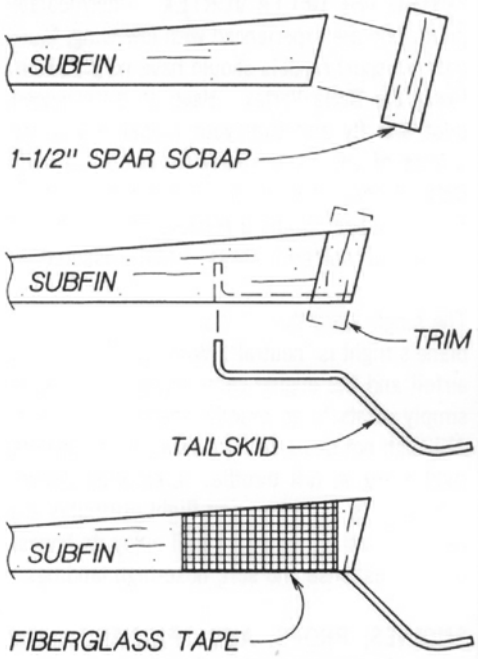
❒ b. When dry, remove the pins and sand each side of the fins until smooth. Sand the leading edges round, but leave all of the other edges square.




3. ❒ a. Cut two 1-1/2"-long pieces from one of the 4" spar scraps, then glue them to the rear edges of the two subfins, again using yellow glue. When dry, trim the pieces to match the subfin top and bottom edges.

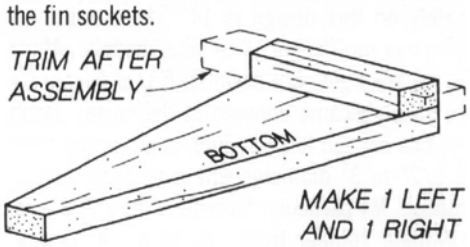
❒ b. Drill and groove the subfins to accept the pre-bent 3/32" tailskid wires. Clean the wires with sandpaper and alcohol, then epoxy them in place on the subfins.

❒ c. Cut the 6"-long piece of fiberglass tape into two 3"-long pieces, then glue them to the subfins using epoxy or thin CA. Wrap the tape around the bottom of the subfins, trapping the tailskids in place. When dry, trim the excess tape flush with the subfin top edges.



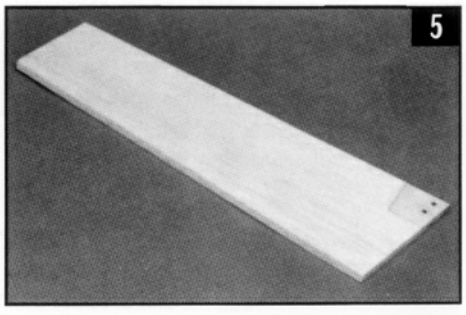

4. ❒ a. Mark the bottom edge of the two 1/4" balsa fin sockets using the "Small Parts Identification Diagram" (on plans) as a guide.

❒ b. Cut one of the spar scraps in half, then glue them to the sides of the fin sockets, even with their front edges. Be sure to make one left and one right. Trim the 1/4" x 1/2" pieces even with the top and bottom edges of the fin sockets.



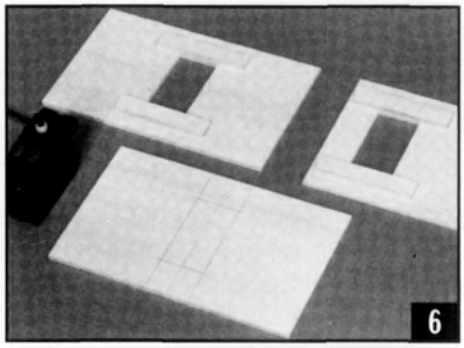

5. ❒ a. Inlay a 1/16" plywood control horn pad into one side of each 1/4" balsa rudder. The right-hand rudder needs a pad on its left side, and the left-hand rudder needs a pad on its right side. Use a modeling knife to carefully cut 1/16"-deep recesses, then glue the pads in place. Trim the bottom edge of each pad to match the bottom edges of the rudders.

❒ b. Drill two 3/32" holes for each nylon control horn using the plans as a guide. Harden the balsa inside and around the holes using thin CA.

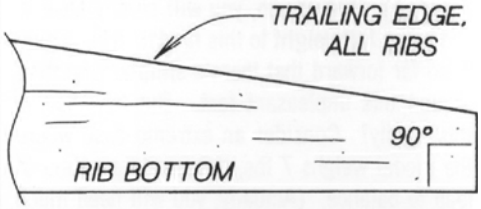



6. ❒ a. Rectangular holes must be cut in the 1/8" lite-ply elevon servo mounts. The cutout in each mount should be centered left-to-right and fore-and-aft. Make the cutout to fit your servos, allowing a 1/16" clearance around the entire servo body. Add two 1/8" lite-ply reinforcements to each mount. The photo shows one elevon servo mount marked for a cutout and another with a cutout and reinforcements glued in place.

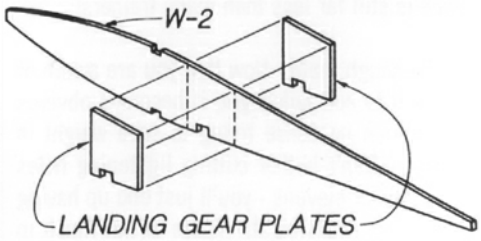
❒ b. Make one or two cutouts in the 1/8" lite-ply rudder servo mount, depending on which rudder servo option you elect to use. Again, add two reinforcements to each cutout. The photo shows one end of the rudder servo mount. (This model will have dual servos.)




7. ❒ The Delta Vortex airfoil is symmetrical, but the wing ribs have a definite top and bottom. The bottom edges of W-1 and W-2 are easy to identify; they have a cutout for the landing gear block. You can identify the bottom edges of W-3 through W-6 using the diagram below. Clearly mark the bottom edges of all ribs so that there's no confusion later.



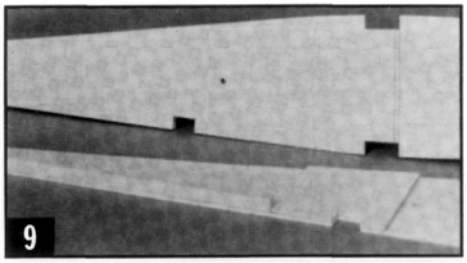

8. ❒ Glue two 1/8" lite-ply landing gear plates to each W-2 rib (one plate on each side), being sure that the notches for the landing gear block are lined up.



9. ❒ a. Glue a landing gear plate to the outboard side of each W-1 rib (make one left and one right!).

❒ b. Cut an 8-1/4" long piece from both of the 1/4" x 3/8" x 12" basswood sticks provided in the kit (save the scraps for later use). Glue these to the sides of the W-1 ribs between the landing gear plate and the notch for the rudder servo mount, even with the rib bottom edge. **NOTE:** it's the 1/4" side (not the 3/8" side) of the sticks that gets glued to the ribs.

❒ c. Accurately mark the position of F-2 on the inside surfaces of the two W-1 ribs. The front of F-2 is aligned with the front edges of the spar notches.




10. ❒ a. From the fourteen 3/32" x 4" x 36" balsa sheets provided in the kit, select the six softest, most flexible pieces to be used for leading edge sheeting. You may need to trim the edges slightly for a perfect fit, but try to remove as little as possible (1/16" max, each edge). Glue the sheets together in two sets of three, as shown in the "Leading Edge Sheeting Diagram" on the plans. Remember, a bumpy seam will be very obvious on the finished model, so care must be taken to make a high-quality glue joint. On a very smooth surface (glass is best), lay down some wax paper and mist it with CA accelerator from a spray bottle. Position the balsa pieces on the wax paper, then apply three or four strips of tape across the joint to hold the edges together tightly. Hold the parts down flat with one hand and apply a bead of thin CA to the joint with your other hand. The CA will wick into the joint, but the accelerator on the wax paper should instantly cure any glue that seeps through. Work slowly, gluing two or three inches at a time and remove the tape strips as you go. Done correctly, the seams will be virtually invisible when you lift the sheeting and look at the opposite side.

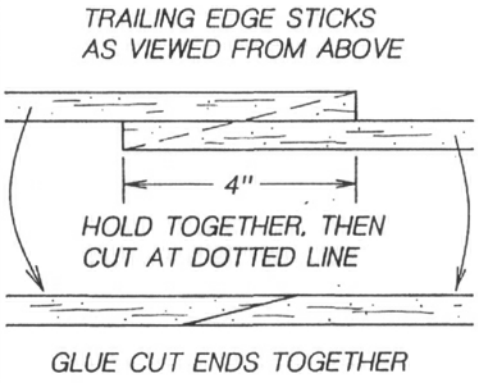
❒ b. Sand the "good" side (the side that was against the glass) with 150-grit followed by 280-grit sandpaper, until smooth. Consider this to be the final sanding for the sheeting, because it will be difficult to sand once it's installed on the model.

❒ c. Now make the final cuts (steps 3 and 4 on the plan), and set the leading edge sheets aside for later use.

11. ❒ a. Select the two hardest pieces from the remaining 3/32" x 4" x 36" balsa sheets to be used as trailing edge sheeting. Refer to the "Trailing Edge Sheeting Diagram" on the plans for the proper procedure.

❒ b. Use the last six 3/32" x 4" x 36" balsa sheets to make two large center sheets. Refer to the "Wing Center Sheeting Diagram" on the plans. Use the gluing technique described in step 10, then give the assembled sheets a good final sanding.

12. ❒ Splice the two 1/2" x 1/2" x 36" balsa trailing edge sticks as shown below. Use a straightedge to keep them aligned while gluing.

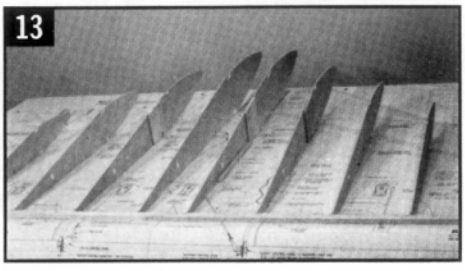



# WING ASSEMBLY

*Lay the wing plan on your building board and protect it with a layer of wax paper. Note that an early version of the kit plans are shown in the photos. You may see differences in your plans, but the structure in the photos is exactly the same as your kit.*

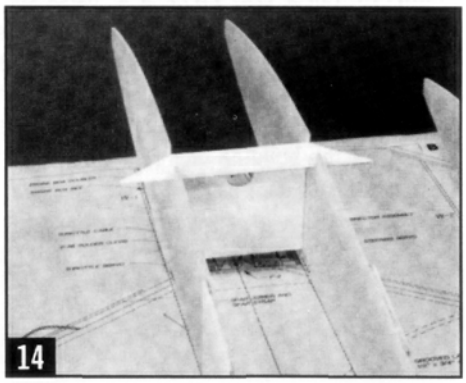
13. ❒ a. Pin the trailing edge on the plan, noting the position of the splice. The excess trailing edge material at each end can be trimmed and discarded.

❒ b. Glue all of the wing ribs to the trailing edge, making sure that all of their bottom edges are down against the plans. Also, be sure the W-1 ribs are positioned properly; the landing gear plates and hatch rails should be on the outboard side of each W-1 rib. Carefully pin each rib to the building board.




14. ❒ a. Spot glue the 1/8" lite-ply F-2 former to the two W-1 ribs, using the marks made in step 9 for proper positioning. The hole in F-2 should be at the top, and the top and bottom edges of F-2 should be even with the spar notches. Use a triangle to check that the W-1 ribs are square to the building board.

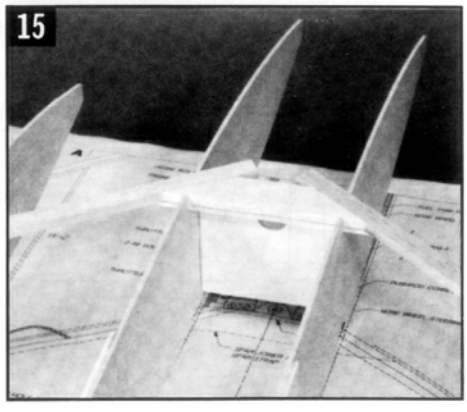
❒ b. Glue a 1/8" lite-ply spar strap to the W-1 ribs and the top of F-2. Be certain the beveled ends of the spar strap are facing up.




15. ❒ a. The spar notches in ribs W-2 through W-6 are purposely made undersize so that they could be sanded for a perfect spar fit. Sand the front and rear edges of the upper notches at an angle as shown in the "How to Bevel the Spar Notches in Ribs W-2 to W-6" diagram on the plans (do not sand the W-1 notches). Use a sanding stick like the one shown in photo 24. The end of the stick without sandpaper will help guide it at the proper angle. The ribs will seem weak and fragile at this point, so take your time and hold each one firmly as you sand. Don't worry - as more parts are added, your wing will become a very stiff and rugged structure (and still be amazingly light!)

❒ b. Trial fit the two 1/4" x 1/2" x 32" balsa wing spars, adjusting the spar notches if necessary. The spars should be snug in each notch, but not so tight that they distort the rib. Notice that the inboard ends of the spars must extend completely over the lite-ply spar straps. When satisfied with the fit, glue them in place.

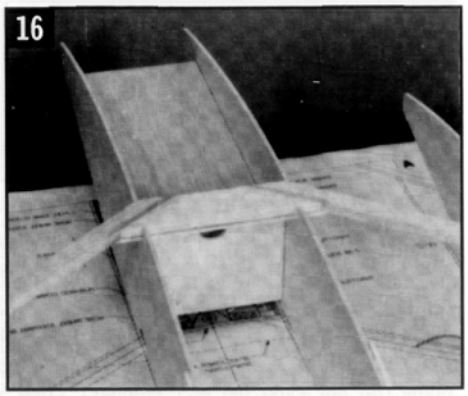
❒ c. Epoxy a 1/4" balsa spar joiner firmly to the spars, ribs, and spar strap.



16. ❒ a. Trim the inboard ends of the spars flush with F-2, then sand them flush with the top of the balsa spar joiner. The outboard tips of the spar joiner may need a light sanding to bring them flush with the tops of the spars.

❒ b. Locate the 1/4" balsa hatch (in the "Engine Box" bag), then spot glue it between the W-1 wing ribs to serve as a temporary spacer. **Important!** Check the W-1 ribs against the plan to avoid building in side thrust.

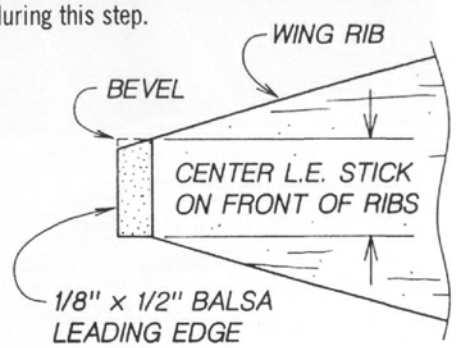
❒ c. Cut a 1/4" x 1/2" x 4" balsa spar scrap to a length of exactly 3-1/2" to serve as the front edge of the radio compartment. Glue this piece between the W-1 ribs in the position shown on the plans. The balsa stick should be resting on the building board, even with the bottom edges of the ribs.




17. ❒ a. The front ends of all the wing ribs must be beveled for the leading edge to seat properly. Carefully sand each rib, one at a time, using the next rib in line as a guide for the proper angle to hold your sanding stick.

❒ b. Glue the two 1/8" x 1/2" x 36" balsa leading edges to the front of the ribs. Start with the W-1 rib followed by the W-6 rib on each side. Glue the remaining ribs to the leading edge, being careful not to create "bulges" in the stick fore or aft. If you spot glue each joint, you can check your progress with a straightedge and slightly reposition the ribs if necessary. (I know the wing still seems like a flimsy noodle at this point - have faith!)

❒ c. Bevel the top edge of both leading edges to match the angle of the ribs. This should only require a few swipes of the sanding block. Be careful not to sand or break the ribs during this step.




18. ❒ a. Glue the fin socket assemblies in place as shown on the plans, making sure the bottom of each socket is down against the plan. You can use the fins as temporary spacers to insure a perfect fit.

❒ b. Temporarily unpin the trailing edge, then trial fit a trailing edge sheet with the splice positioned as shown on the plans. You can trim the excess from each end of the sheet to make it easier to handle if you wish. Glue the sheeting in place and repin the trailing edge firmly to the building board to keep it straight.

❒ c. Using scrap 3/32" balsa from the center sheeting, cut three 1-1/2" x 4" sheeting supports. The grain should be parallel to the 1-1/2" dimension. Glue these supports under the trailing edge sheeting as shown on the plans (the center one will need to be trimmed to fit). These supports will provide a "ledge" for the center sheeting and also help reinforce the splice in the sheeting. Look ahead to photo 18-22 for a clear view of the sheeting supports.

19. ❒ a. The next step is to add the two top leading edge sheets. You'll need some weights like magazines or zip-lock bags filled with sand to hold the sheets in place while they dry. Gather your weights now so they're ready for the final part of this step. Make certain the trailing edge is firmly pinned to the building board so the weights don't cause it to "pop" up.

❒ b. Trial fit the leading edge sheets to the wing. The rear edge of the sheeting should be centered on the spar, the front edge should extend past the leading edge, and the inboard end of the sheeting should extend inboard of W-1 about 1/2" (it will be trimmed later).

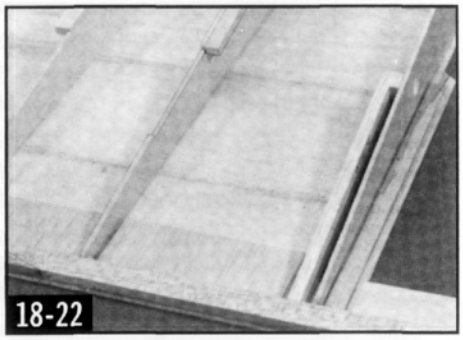
❒ c. It's time to start gluing! This can be done many ways, but one good procedure is as follows: Working on one side of the wing at a time, start by applying yellow glue to the top edges of the wing ribs, forward of the spars. Run a bead of thick CA along the top edge of the leading edge and the forward half of the spar, where the sheeting makes contact. Lay the sheet in its final position on the spar and run thin CA along the joint. With the sheeting now firmly glued to the spar, rub the sheeting down onto the ribs and leading edge. Finally, working a few inches at a time, hold the sheeting tight to the leading edge and spray the joint from underneath with accelerator. Add the weights, pin if necessary, and allow to dry.

20. ❒ Remove all pins from the area under the center sheeting. Trim one of the center sheeting assemblies for a precise fit, first at the front, then the rear. Glue the center sheet in place with yellow glue; add weights to hold it firmly against the wing ribs while drying.

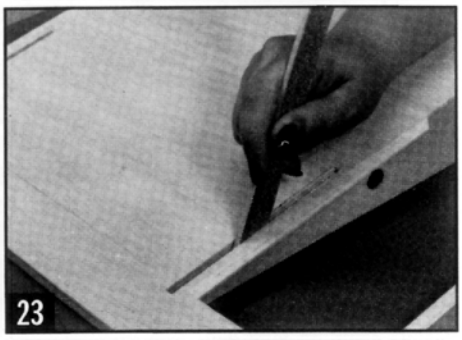
21. ❒ a. Add 3/32" x 3/8" balsa capstrips to the tops of ribs W-3 through W-6.

❒ b. The edges of the center sheeting need to be reinforced in the area near the fin slots (to be cut later). The reinforcements will also provide a greater area to attach the covering material. Start by gluing 8"-long pieces of 3/32" x 3/8" balsa under the outboard edges of the center sheeting on each side. These sticks should also go under the trailing edge sheeting, all the way back to the trailing edge. Now you have "ledges" for the final reinforcement sticks, which should be cut from 3/32" x 3/8" balsa to the shape shown on the plans. Glue these sticks in place against the edges of the center sheeting and trailing edge sheeting.

22. ❒ Lift the wing from your board and spend a few moments marveling at its size and lightness... Okay, back to work! This is a good time to go back over all your glue joints with medium CA, especially if you've been using thin CA to "tack" things together. When finished, you should be able to see a small build-up of glue on both sides of every joint. Remember that the strength of any wing is determined by the integrity of its glue joints.



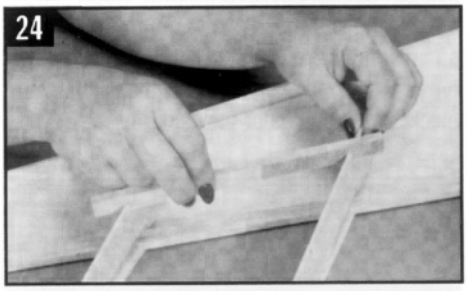

23. ❒ The slots for the two fins DO NOT run the full length of the sockets. Poke holes through the center sheeting (not the trailing edge sheeting) from the bottom in the fin slot area. Now you can use the holes as guides to carefully cut the slots. Use a thin sanding stick to finish off the slot edges. Extend the fin slots 1/4" back into the trailing edge sheeting. Trial fit the fins and continue trimming and sanding until satisfied with the fit.



24. ❒ a. Trim the leading edge sheeting along its front edge, leaving about a 1/16" overhang (which will be sanded later). This rough trimming step is necessary to keep the excess material from interfering with the installation of the bottom leading edge sheeting.

❒ b. Remove the plan from the building board; it's no longer needed for construction but will be handy for reference. Pin the wing, upside down, to the board. Glue the 1/8" lite-ply spar strap, beveled ends up, to F-2 and the W-1 ribs. Use plenty of glue now, keeping in mind that you won't be able to go back and re-glue these parts after the bottom center sheeting is applied.

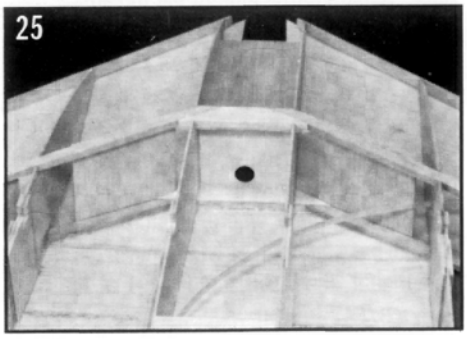
❒ c. Bevel the spar notches in W-2 through W-6 as you did before, then trial fit the two bottom 1/4" x 1/2" x 32" balsa wing spars. When satisfied, glue the spars in place.




25. ❒ a. Add the 1/4" balsa spar joiner, then trim the inboard ends of the spars flush with F-2. Sand the spars and joiner as you did for the top.

❒ b. Now is a good time to add the plastic antenna tube. Some of the holes in the wing ribs may need to be elongated slightly (use a hand-held 3/16" drill bit or a rat-tail file) for the tubing to fit well. Scuff the tubing lightly with sandpaper, wipe it with alcohol, slide it into place, then glue it at each rib with medium or thick CA.

❒ c. Cut six shear webs from scrap pieces of 3/32" x 4" balsa with the grain running vertically, from top to bottom spar. Use the wing structure itself as a guide for marking and cutting the webs to their proper lengths, then glue them in place to the front edges of the spars.




26. ❒ Glue the bottom trailing edge sheeting in place, this time with the splice located on the opposite side of the model as the splice in the top sheeting. Pin the trailing edge firmly, again in preparation for the leading edge sheeting. Add three sheeting supports, cut from scrap 3/32" balsa, as you did in step 18c.

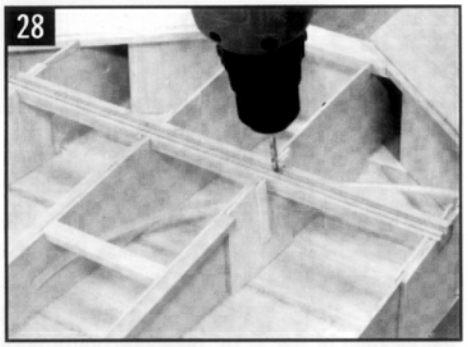
27. ❒ Carefully bevel the edge of the leading edge stick, then glue the two remaining leading edge sheets in place, as you did in step 19.

28. ❒ a. Epoxy the 1/2" x 3/4" x 14" grooved basswood landing gear block into the notches in the W-1 and W-2 wing ribs.

❒ b. Epoxy the two 1/2" x 3/4" x 1-1/2" basswood landing gear vertical blocks in place underneath the landing gear block.

❒ c. Glue a 1/8" lite-ply reinforcement to the landing gear plate on each side of the vertical blocks for an extra measure of support.

❒ d. Mark the center groove of the landing gear block 4-7/8" from each end. Visually confirm that holes drilled at these spots will go through the appoximate centers of the vertical blocks (adjust the marks slightly, if needed). Drill all the way through the landing gear block and vertical blocks at the marks, being careful to hold the drill perpendicular to the surface of the wing. Vacuum the wood chips from the wing.

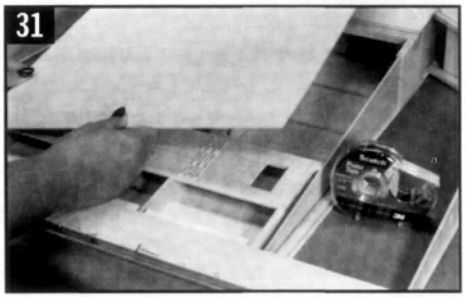



29. ❒ a. The purpose of the 1/8" lite-ply radio bulkhead is to prevent radio components from shifting forward (you know, after one of those very rare hard landings). Glue one end to the inside surface of the center sheeting, and the other end to the 1/4" x 1/2" balsa stick, as shown on the plans.

❒ b. Add a lite-ply reinforcement to the sheeting, just in front of the radio bulkhead.

30. ❒ The center sheeting on the bottom surface of the wing is applied in two pieces, fore and aft of the landing gear block. Trim the front piece to fit from the rear edges of the leading edge sheeting to the front groove of the landing gear block, then glue it in place. Use weights and pins to hold it down as it dries.

31. ❒ Trim the rear piece of center sheeting to fit from the rear groove of the landing gear block to the front edge of the trailing edge sheeting, but don't glue it in place yet. First, you must make cutouts for the rudder servo(s) and radio hatch. To do this, place the rudder servo mount (prepared in step 6b) in place on the model, but don't glue it in yet. Apply several pieces of double-sided tape to the servo mount, then carefully lay the sheeting over it. Press down where the tape was applied, lift the sheeting and servo mount (which are now stuck together), and use the servo mount as a guide for cutting the servo cutout(s) in the sheeting. Untape the servo mount, then lengthen each cutout in the balsa 5/16", both fore and aft. When the servos are installed later, their bolt flanges should rest on the lite-ply mount, not balsa. Now repeat this process for the 3/32" plywood radio hatch, using tiny pieces of tape to temporarily hold it in place on the model.

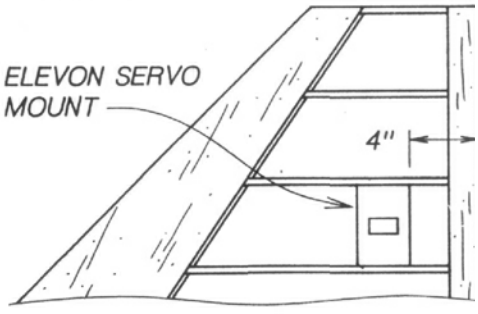



32. ❒ a. Firmly glue the rudder servo mount to the model.

❒ b. Glue the final piece of center sheeting in place. Be sure to wipe away any excess glue that oozes out in the radio hatch area, then put some weights on the sheeting and allow it to dry.

❒ c. Add 3/32" x 3/8" balsa capstrips to wing ribs W-3 through W-6.

33. ❒ Glue the two elevon servo mounts (prepared in step 6a) in place so that the rear edge of each mount is 4" forward of the trailing edge. Notice that the mounts should be in contact with the ribs on each side, just under the "lip" created by the capstrips. Be sure that the reinforcements are facing down towards the building board.



# FINISHING THE WING

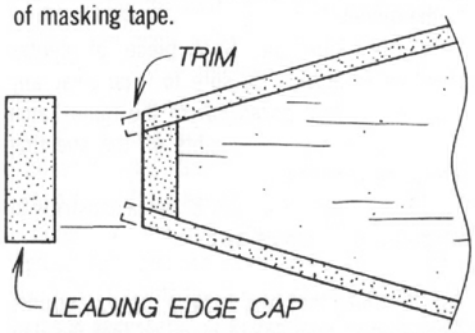
34. ❒ When dry, remove the wing from the building board. Okay, you can play with it again for a minute... Go over the most recent glue joints with another coat of medium CA.

35. ❒ A piece of 3/32" x 3" x 9-1/2" balsa is provided for sheeting over the elevon servo mounts. Cut the two sheets to fit between the capstrips, then hold them in place and mark the positions of the servo cutouts. Make the cutouts in the balsa, again with an extra 5/16" fore and aft. Glue the sheeting to the mounts.

36. ❒ Use a sharp knife to roughly trim the inboard edges of the leading edge sheeting flush with the W-1 ribs and F-2. Remove the balsa hatch (temporary spacer), then sand the area with a large sanding block. Use the balsa hatch as a "tester" to be sure you've sanded this area properly. The hatch should be a snug fit at all points between the ribs.

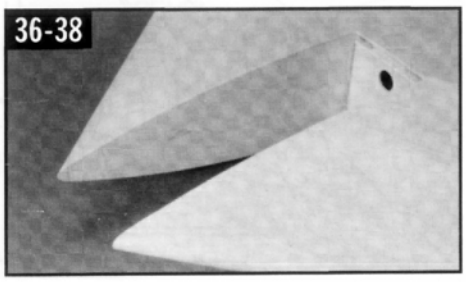
37. ❒ **a.** Carefully trim and sand the leading edge sheeting flush with the leading edge.

❒ **b.** Glue the two 1/4" x 3/4" x 36" balsa leading edge caps in place. Use yellow glue and hold the sticks in place with several strips of masking tape.

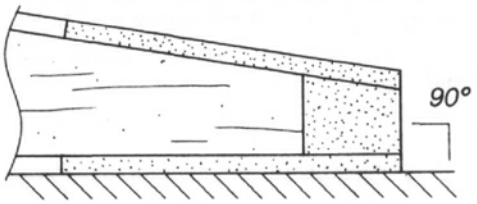



38. ❒ **a.** Carve and sand the leading edge cap round, using a long sanding block. Take your time with this step and strive for a constant radius along the entire leading edge, from root to tip.

❒ **b.** Sand the inboard ends of the leading edge caps flush with the W-1 ribs.

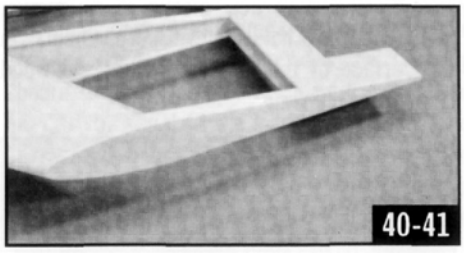



39. ❒ Again using a long sanding block, sand the entire length of the trailing edge so it's square with your building board as shown here.



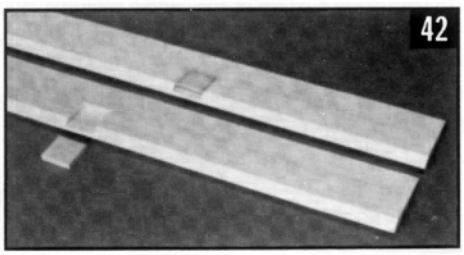

40. ❒ Pin the wing to your building board, this time on the plans, right-side up. Glue the two 1/2" pre-tapered balsa fixed wingtip elevon pieces and the fixed center elevon piece to the wing trailing edge, positioned as shown on the plan. These fixed elevon pieces have a smooth side and a rougher side - the rougher side should be facing "up".

41. ❒ Trim and sand the sheeting, spars, leading edge, and trailing edge at each wingtip. Glue the two 1/8" lite-ply wingtips in place, then sand the edges of the wingtips to match the contours of the wing. A good way to do this is to mask off most of your sanding block, leaving only a small portion exposed to sand the edge of the plywood wingtip.



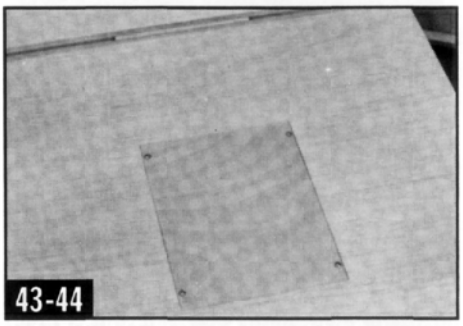

42. ❒ **a.** Cut two elevons from the tapered and beveled 1/2" x 2-1/2" x 36" balsa elevon material provided in the kit. Use your model to determine the proper length for each, leaving a 1/16" gap at each end of the elevons.

❒ **b.** Using the plans as a guide, mark the location of the 3/16" plywood control horn pads on each elevon. Carefully notch the elevons as necessary to imbed the pads. You can use scrap balsa to fill the small beveled areas forward of the pads.




43. ❒ Fill the groove between the holes in the landing gear block with scrap balsa. Also add small scraps of balsa, 3/8" long, to each end of the groove in the landing gear block.

44. ❒ Using the plans as a guide, mark the location of the four mounting screws on the 3/32" plywood radio hatch. Firmly tape the hatch in place on the model, then drill through the hatch and hatch rails at each mark with a 1/16" drill bit. Remove the hatch, then redrill the holes in the hatch with a 3/32" drill bit.




45. ❒ Now is a good time to give the wing a final sanding, starting with 150-grit, followed by 220- or 280-grit on a sanding block. Avoid the sheeting as much as possible. Concentrate on smoothing the major sheeting junctures, the tops of the fixed elevon pieces, the landing gear block, and the ends of the capstrips.

# ENGINE BOX

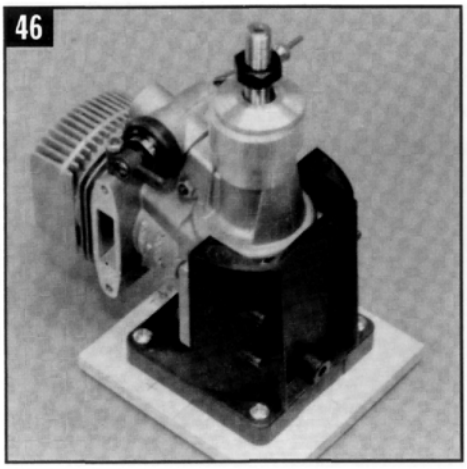
*This design doesn't have a true fuselage, but it does have an engine box for mounting the engine and enclosing the tank, steering servo, and throttle servo.*

46. ❒ **a.** Using the "Cross-Section at F-1" drawing on the plan, draw the center line and thrust line on the front of the 1/4" plywood firewall, F-1. Place your engine mount (not included in the kit) on F-1, and align it with the lines you just drew. While holding the engine mount in place, mark the location of the four mounting holes. Remove the mount, then drill at each mark with a 3/16" drill bit.

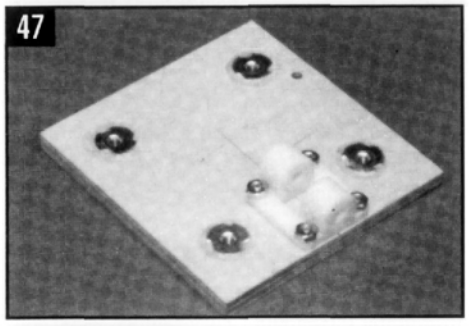
❒ **b.** Hammer four 6-32 blind nuts into the back of F-1 at the mounting holes. Bolt the engine mount onto F-1 using four 6-32 x 3/4" machine screws. Tighten all four screws, then apply medium CA around the edges of the blind nuts. Avoid getting glue in the threads!

❒ **c.** Place your engine on the mount and mark the location of the engine mounting holes. Drill (and tap, if necessary) for your engine mounting bolts (these are also not in the kit, but they usually come with the mount).

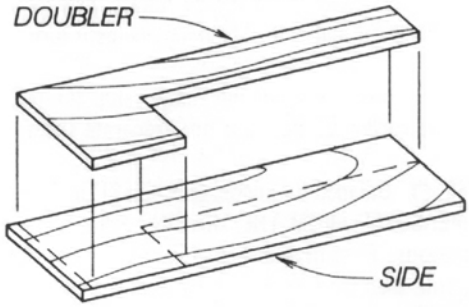
❒ **d.** Temporarily bolt the engine to its mount, then mark where the throttle pushrod should pass through F-1. Remove the engine and mount, then drill through F-1 at the mark with a 9/64" drill bit.



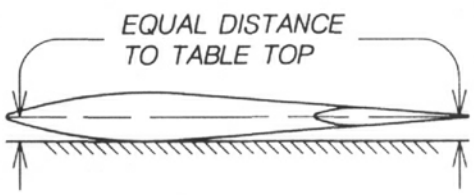

47. ❒ Position the nylon nose wheel bearing on F-1 as shown on the plans, and mark the location of the four mounting bolts. Drill at each mark with a 1/8" drill bit, then countersink each hole on the front face of F-1. You can use the tip of a 1/4" drill bit to countersink the holes just enough to allow the 4-40 x 1/2" flat-head machine screws to be flush with the surface of F-1. Flat-head screws are necessary to avoid interfering with the engine mount. Go ahead and bolt the nylon bearing in place using the flat-head screws and 4-40 hex nuts.




48. ❒ Glue the two 1/8" lite-ply engine box doublers to the 1/8" lite-ply engine box sides as shown in the diagram below. Be sure to make one left and one right side!



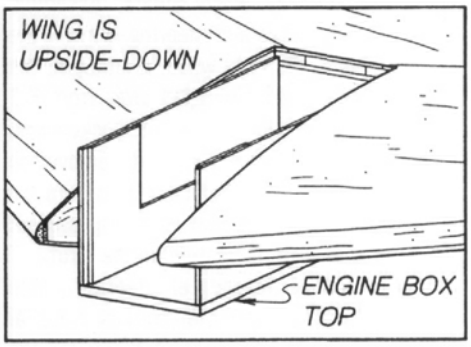

49. ❒ Pin the completed wing to your building board, UPSIDE-DOWN, with a piece of wax paper under the engine box area. Block up the wing so that the center of the trailing edge is at the exact same height above the board as the center of the leading edge (it should be about two inches). In other words, the chord line of the wing should be parallel to the table top.




50. ❒ a. Trial fit the 1/4" balsa engine box top, the side/doubler assemblies, and F-1 in place on the model to be sure everything fits.

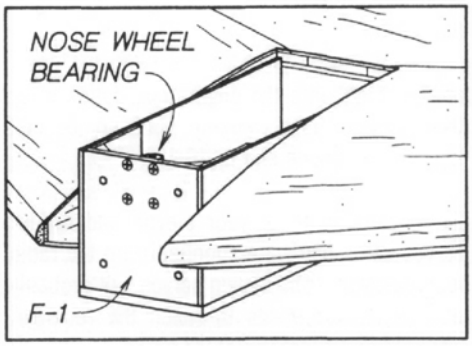
❒ b. The engine box top is the first part to be glued in place. It should be flat against the building board, between the W-1 wing ribs.

❒ c. The engine box sides can now be glued to the W-1 ribs and the engine box top. Remember, the model is upside-down, so make sure the doublers are positioned with their cutout areas facing "up", towards the hatch. Make sure the rear edges of the sides are positioned firmly against the front of F-2.




51. ❒ a. Trial fit F-1 with the nose wheel bearing "up", away from the building board. Use a triangle to confirm that F-1 is perpendicular to both sides (for zero sidethrust) and the engine box top (for zero downthrust). When satisfied, epoxy F-1 in place.

❒ b. Cut two braces from 1/2" balsa triangle stock to reinforce the joints between the engine box doublers and F-1. You will probably need to notch the braces to clear the blind nuts. Epoxy the braces in position.




52. ❒ Glue the 1/4" x 1" x 3-1/2" balsa engine box cross brace, flush with the front surface of F-1. Use a sharpened piece of brass tubing to cut a clean hole in the cross brace for the nose wheel strut.

53. ❒ a. Trim the 1/4" balsa fuel tank hatch as necessary to fit behind the cross brace. Glue the 1/8" lite-ply hatch tongue to the inner front surface of the hatch, leaving about 1/8" protruding past the front edge of the hatch.

❒ b. Epoxy the 1/4" basswood hatch block to the front of F-2, 1/4" down from the wing surface. Trial fit the hatch to check its position before the epoxy sets.

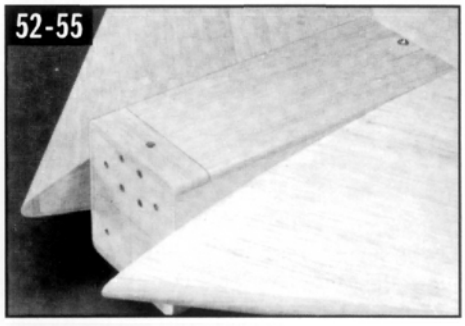
❒ c. Notch the outer surface of the hatch at the rear to imbed a 1/16" plywood pad, then glue the pad into the notch.

❒ d. Using the plans as a guide, mark the position of the hatch retaining bolt on the plywood pad. Put the hatch on the model and visually confirm that a hole drilled at the mark will pass through the appoximate center of the hatch block. With the hatch in place on the model, drill completely through the hatch and hatch block at the mark with a 1/8" drill bit.

❒ e. Remove the hatch, then harden the balsa in and around the hole with thin CA.

54. ❒ Remove the wing from the building board. Redrill the hole in the hatch block with a 5/32" drill bit, then install a 4-40 blind nut. from underneath. You can tighten a 4-40 screw and flat washer in the blind nut to "pull" it into the wood. Remove the screw and apply a bit of medium CA to the edges of the blind nut to hold it in place.

55. ❒ Carefully sand the engine box at the front and sides. The corners of the engine box top and the hatch can be rounded off slightly at the front, but should gradually fade into square corners where they blend into the wing.




56. ❒ a. Position your fuel tank with foam rubber padding as close to the engine box top as possible. Put the 1/8" lite-ply fuel tank floor in position. While holding it depressed slightly against the padding, glue reinforcements to the engine box sides at each end of the fuel tank floor. The idea is to leave the floor unglued so it can slide back for easy removal of the fuel tank.

❒ b. Mark F-1 where the fuel lines will come through. Remove the tank, then drill holes at the marks for the fuel lines.

# FINAL ASSEMBLY

57. ❒ This is a big step - it's time to cover! Most modelers like to cover all of the pieces separately, which is the procedure we recommend. If you prefer to glue the fins in place before covering, do step 58 first. General notes on covering are supplied on a separate sheet.

58. ❒ a. The fins and wing must have a firm wood-to-wood joint, which means the covering material must be removed from the bottom portion of the fins where they slide into the slots. You must also cut away the covering on the wing where the bottom edges of the fins make contact, both fore and aft of the slots.

❒ b. Use slow-drying epoxy to glue the fins to the wing. Wipe away most of the excess glue with alcohol, but leave a small fillet of epoxy at the fin bases to completely seal down the edges of the covering. To hold the fins in position while drying, run a strip of tape all the way from one wingtip, over the top of the fins, back down to the other wingtip. Before the glue sets, be sure the fins are 90° to the wing.

❒ c. Repeat the process described above for the two subfins. Be sure to align the rear edges of the subfins with the fins.

59. ❒ Easy Hinges are supplied in the kit for all of the control surfaces. Let's start with a fin and rudder. Use a #11 X-Acto blade to cut slots right through the covering, 1/2" deep, in the positions shown on the plans. Slide three Easy Hinges halfway into the fin (the bottom hinge will need to be trimmed). Now carefully slide the rudder onto the exposed portion of the hinges. (Some modelers like to clip off the corners of each hinge to help ease assembly.) Push the rudder all the way on, then deflect it both ways to be sure there's no binding. Apply four or five big drops of THIN CA to the center of each hinge on both sides and allow five minutes to dry. You must use THIN CA, the fresher the better, for maximum penetration of the hinges and wood. Do not overglue or apply a second layer of glue. When done properly, the hinges should actually appear dry. Repeat the process for the remaining rudder and elevons.

60. ❒ Grind or file any burrs on the ends of the two main landing gear wires. Fasten each wire to the l.g. block with two nylon straps and four #2 x 3/8" sheet metal screws. Attach the 3" main wheels to the wires using 5/32" wheel collars, one on each side of each wheel.

61. ❒ a. Use #2 x 3/8" sheet metal screws to attach a nylon control horn to each elevon.

❒ b. Use 2-56 x 1/2" machine screws to attach a nylon control horn to each rudder. If you are using Rudder Control Option #2, you will need to modify the horns as shown in the diagram on the plans.

62. ❒ a. Cut two 3-1/4" servo rails from the remaining 1/4" x 3/8" basswood sticks. Glue the rear servo rail against the front of F-2 so that it's resting on the flat edge of the doubler. Add the forward rail, leaving a space that's about 1/16" wider than your servos Cut a lite-ply reinforcement in half, then use the pieces to brace the ends of the forward servo rail.

❒ b. Mount your steering and throttle servos to the rails.

63. ❒ a. Attach a 3" wheel to the nose wheel strut using two 5/32" wheel collars. Assemble the nose wheel strut and steering arm on the bearing. When the nose wheel is straight, the steering arm should be angled away from F-1 about 15°. Tighten the 6-32 x 3/8" socket-head bolt in the steering arm, loosen it, remove the strut, then file a flat spot at the mark where the bolt made contact. The flat is to help prevent the steering arm from twisting on the strut.

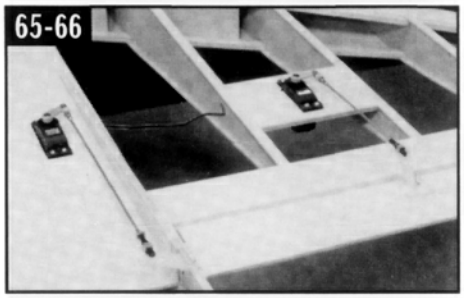
❒ b. Cut a nosewheel steering cable from the steel cable and nylon housing material provided in the kit (save the leftover for the throttle cable). Route the steering cable so that it flows smoothly from the steering arm to the servo arm using the hardware shown on the plans. To prevent unwanted flexing, glue the nylon housing to the engine box (use some scrap balsa spacers, if needed).

64. ❒ a. Bolt your engine and engine mount in place on F-1. Smoothly route the throttle cable from the carburetor's control arm to the throttle servo arm, again using the hardware as shown on the plans. Glue the nylon housing to the engine box.

❒ b. Slide the fuel tank (with fuel lines and padding) into the engine box, followed by the fuel tank floor. Finally, hook up the fuel lines to the engine and muffler.

65. ❒ Mount all of your elevon and rudder servos using hardware supplied from the radio manufacturer. The elevon servos will probably need extension wires to reach the receiver; either 6" or 12" depending on brand. To thread the wires through the rib holes, start by fishing a weighted string (an old hex nut tied to some kite string works well) from the radio area to the elevon servo opening. Tie the string to the servo lead, then pull it gently through the wing.

66. ❒ Carefully assemble all of the rudder and elevon pushrods as shown on the plans. Fuel line "keepers", as shown in the photo, are recommended on every clevis in the model.




66. ❒ The battery position shown on the plans is not mandatory. If you have a flat pack, you may want to stuff it (with foam padding, of course) aft of the radio hatch to help with balancing. The receiver should be in the radio area so that you can make all the connections easily. To help the antenna slide through its tube, straighten it as best you can and give it a light coating of oil or Armor-All. The switch and charging jack on our prototypes were mounted on the plywood radio hatch to keep them protected from the engine exhaust.

67. ❒ The recommended control throws for the first few test flights are:

**ELEVATOR: 5/8" UP, 5/8" DOWN**
**AILERON: 5/8" UP, 5/8" DOWN**
**RUDDER** (on inboard side of turn): **1-3/4"**
**RUDDER** (on outboard side of turn): **1-1/4"**

The geometry of the rudder linkages shown on the plans should automatically result in the differential movement. For example, when you move the transmitter rudder stick to the left, the left-hand rudder (on the inside of the turn) should deflect 1-3/4" while the right-hand rudder should deflect only about 1-1/4". The extra deflection on the inside rudder increases the drag on that side, which also helps it turn.

More information on the radio setup for the Delta Vortex can be found on a separate sheet.

68. ❒ Balance the model between 21" and 22" MEASURED FROM THE TRAILING EDGE of the elevons. First flights should be made at the 22" point, then the C.G. can be moved aft slowly as you gain experience with the model. The BTE prototypes used a lead shot/epoxy mixture poured into the back of the wing through the rudder servo openings. Keep in mind that the further aft you place the weight, the less you'll have to use. Be sure your tailweight is secure!

*Fly safely, and enjoy your BTE Delta Vortex.*