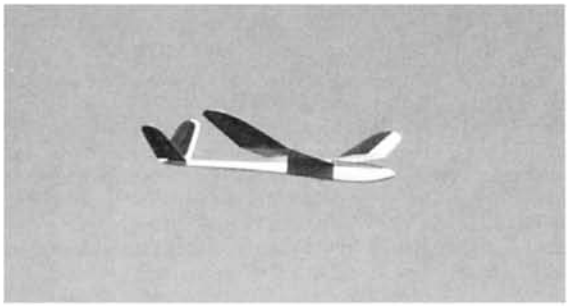


Built with conventional materials this gem can thermal out on a hand launch. Needs 3–4 channel R/C.

A 2-meter just for fun

Sapphire 2M

By George Voss

Sometimes our quest for technical excellence causes us to lose sight of our initial goal. And so it seems in the world of R/C soaring. *Anthems, Eagles* and *Hawks* grace the magazine advertisements announcing their 21st century materials and manufacturing methods, assuring the purchaser of performance superiority, higher scores and better this and that. Have we lost sight of the fact that most of us entered the world of soaring for the enjoyment and shear fun of cheating gravity with a sailplane? To a point, I had and I doubt I'm the only one!

I have an affinity for elliptical planforms and V-tails, so it was only natural for me to develop a sailplane that had the visual appeal of those features. The design criteria was simple: design a 2M "just for fun" sailplane that was easy to build, uses common materials, has the ability to use standard size radio gear, was transportable, would handle both winch and hi-start launches and most importantly, handles and thermals well and looks great!

The ever popular Eppler 205 airfoil was chosen because of its excellent flying characteristics and its ability to be built flat on the building board. A 2-piece wing and removable V-tail were chosen for transportability and storage reasons. If you can comfortably handle a one piece wing, it can certainly be built that way. V-tail operation can be handled by a simple 4-channel radio by using a DuBro V-tail mixer, or by using a mixing radio. A computer radio is *not* needed for the *Sapphire.* If the pictures and the intro have whet your appetite for a new sailplane, let's get started.

Construction

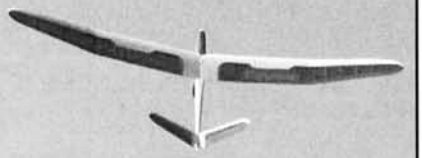
I strongly recommend the use of a balsa stripper to prepare the 3/16-inch pieces in the tail. I always start on the tail surfaces. This gets me in the building mood and if I goof something up, I can easily start again. It's not so easy to rebuild a wing. The prototype was assembled using Zap and Zap-a-Gap exclusively.

Tail. Pin down the 3/16 × 1/4-inch and 3/16-inch square leading and trailing edges. Glue the 3/16-inch sheet tip, 3/16-inch square tip gusset and center ribs in place. Glue the 3/32 × 3/16-inch diagonal ribs and the 3/16-inch sheet center in place. Be sure to leave room for the 1/8-inch dihedral brace. Remove the surfaces from the board and sand the dihedral angle on each half. Zap the dihedral brace to one half of the V-tail.Align the other half of the V-tail and Zap it in place. Cut the ruddervators from 3/16-inch sheet. If you are going to use a lightweight radio system, you can use built up ruddervators or drill lightening holes in the sheeted ones. Sand the tail pieces to shape and set aside.

Fuselage. Cut the fuselage sides from medium 3/32-inch balsa and mark the former locations. Install the 1/16-inch ply tail doublers, 1/4-inch triangles, and 1/8 × 1/4-inch spruce stiffeners to each fuselage side. Cut the kerfs in the 1/4-inch triangles as needed. Cut out the formers and drill all the appropriate holes. Draw a centerline on each former and position them over a straight line drawn on your building board or over the plans. Place the fuselage sides upside down on the board and Zap the formers in place. Remove the fuselage from the board and temporarily install the tail assembly. Pull the fuselage sides tight against the tail dihedral braces and glue a piece of scrap balsa to the bottom of the fuse-

PHOTOGRAPHY: GEORGE VOSS

As curved as the wing and tail surfaces are on the *Sapphire*, its looks are sharp. Wing can be built as one piece or with plug-in removable outboard panels. George's son, Jimmy, proudly poses.



Contest considerations

Don't let my just-for-fun statement turn you away if you're looking for a first contest mount. The E205 airfoil has won more contests than anyone cares to count. For the contest minded flyer, I recommend the following changes/additions to the *Sapphire:*

1. Use 3/16-inch shear webs the entire length of the main panels.
2. Use 1/16-inch shear webs the entire length of the tip panels.
3. Add 3 inches to each spoiler, 1½ inches on each end.
4. Add .014 carbon fiber to the lower spar and wrap the spar in the joiner tube area with Dacron™ or Kevlar™ thread.
5. The airfoil shown has been modified for assembly purposes only. Use 3/16 × ¾-inch balsa sheet with ⅛ × ¼-inch spruce for the trailing edge of the wing. Sand the spruce to 1/64 inch for optimum performance.
6. Add an additional wing bolt and clip near the aft portion of the airfoil.

lage to maintain this distance. Now glue the ⅛-inch square balsa in the nose and install the nose block. Pin the fuselage upside down on the straight reference line again and install the ⅛-inch lite ply and 1/16-inch bottom sheeting. The ⅛-inch lite ply tail screw plate can be installed now or after preliminary sanding. Remove the fuselage from the board and install the pushrod housings. I use inner Ny-rod with 1/16-inch braided cable. Install the ⅛-inch upper sheeting.

I laminated the canopy and nose block from ¼-inch balsa sheet. Use an acetone based glue like Ambroid or Sigment since it sands easier then Zap. Tack glue the canopy to the fuselage sides and securely attach it to the nose block. Carve and sand the nose block, canopy and fuselage to shape. Cut the bevel in the canopy and remove it from the fuselage .

Wing. Make a copy of the rib templates. For a reusable set, glue the paper templates to a piece of Formica™ and sand them to shape. Cut the ribs from ⅛-inch balsa. Cover the plans with wax paper and pin the trailing edge in place. Lay the lower ⅛ × ¼-inch spruce spar in place over the plans. Install all of the W2 ribs except at the dihedral joint. Install ribs W4-W8 and Zap in place. Glue the 3/16-inch sheet tip pieces in place. Cut the ¼-inch square × 36-inch leading edge (L.E.) in half and make the kerf cuts as shown on the plans. The kerfs should go about half way through the wood. Glue the tip L.E. to the 3/16-inch tip sheet and W8. Now bend the L.E. to contact the remaining ribs and glue in place starting with W4 and finishing with W7. Use a straight edge to trim the L.E., trailing edge (T.E.) and spar to length. Unpin the tip and bevel the L.E., T.E. and spar to the proper angle to obtain the 3-inch dihedral and block up the tip. Zap the tip to the root and install the ⅛-inch lite ply dihedral brace. Install W2 and W3 at the joint.

Now install the upper ¼-inch square and ⅛ × ¼-inch spruce spars. Install the aft lower center section sheeting and W1. Install the 3/16-inch and 1/16-inch shear webs. Taper the upper spar as shown and install the root rib but don't glue it in place yet. Install the aft ⅛-inch lite ply shear web. Install the ¼-inch I.D. brass joiner tube and fill above and below with ⅛ × ¼-inch spruce fillers.

Prepare both wing panels to this point. Block up one panel 3 inches while the other is flat on the board. When you're satisfied with the fit, Zap-a-Gap the brass tubes, fillers and root ribs in place. When that cures, install the 1/16-inch shear web spacer and forward shear webs.

I recommend installing the spoiler cord in the tube prior to installing the tube. Install the spoiler tube and ⅛ × ¼-inch spruce spoiler framework. Install the forward lower center section sheeting. Sand the L.E. to accept the upper sheeting. Install the upper sheeting, center section sheeting and spoiler 1/16-inch sheeting. Install and temporarily hook up the spoilers and check for proper actuation. Rough sand the wing in preparation for finishing.

Setup

I've recently started completely setting up my airplanes prior to covering. This allows me to make adjustments to pushrod exits, radio installation and balance without having to hack up a good paint job later. Trim the sheeting away where the wing holddown clip will go. Use lite ply shims on the root ribs to obtain a slop-free fit of the joiner clip. The clip I used came from a hardware store and was originally used to attach casters to ½-inch wood. Clips are also available from Culpepper Models (424 Locust, Dubuque, IA 52001: phone (319-582-0029).

Align the wing panels to each other and to the fuselage. Drill through the root ribs into the holddown plate. You'll have to tap the holes for a 10–32 screw but don't need to buy a 10–32 tap. Cut two "V" grooves in a 10–32 steel screw and thread it into the plate. The screw will cut threads in the plywood. Remove the screw, Zap the threads (be sure it's the water thin stuff) and retap the hole.

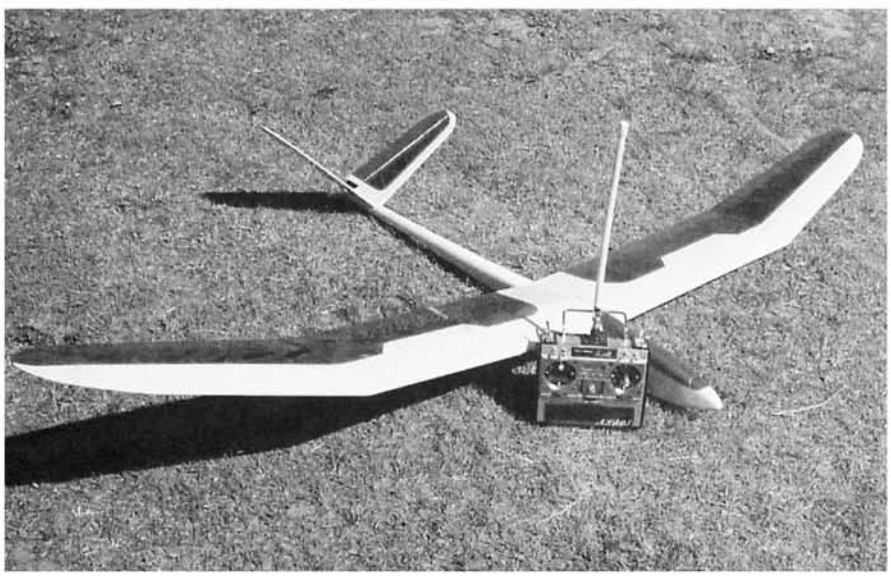
Install the ¼-inch triangle between the V-tails on the top surface. Drill through the V-tail and ply holddown plate. Install a 4–40 blind nut inset into the triangle and Zap in place. Install the tail and Zap some small scrap triangles between the V-tails and the fuselage. This will give a finished look to the fuselage and cut down on drag.

If you've never set up a V-tail before it can be a bit intimidating. The mode of actuation is actually quite easy to understand. Visualize your airplane in flight as viewed from another airplane directly behind it. Obviously if both of the ruddervators move up, "up" command is what you get and the same goes for down. To make a right turn, we want to move the tail to the left. To do this, the right ruddervator will move down and the left one will move up. The opposite is true to make a left turn.

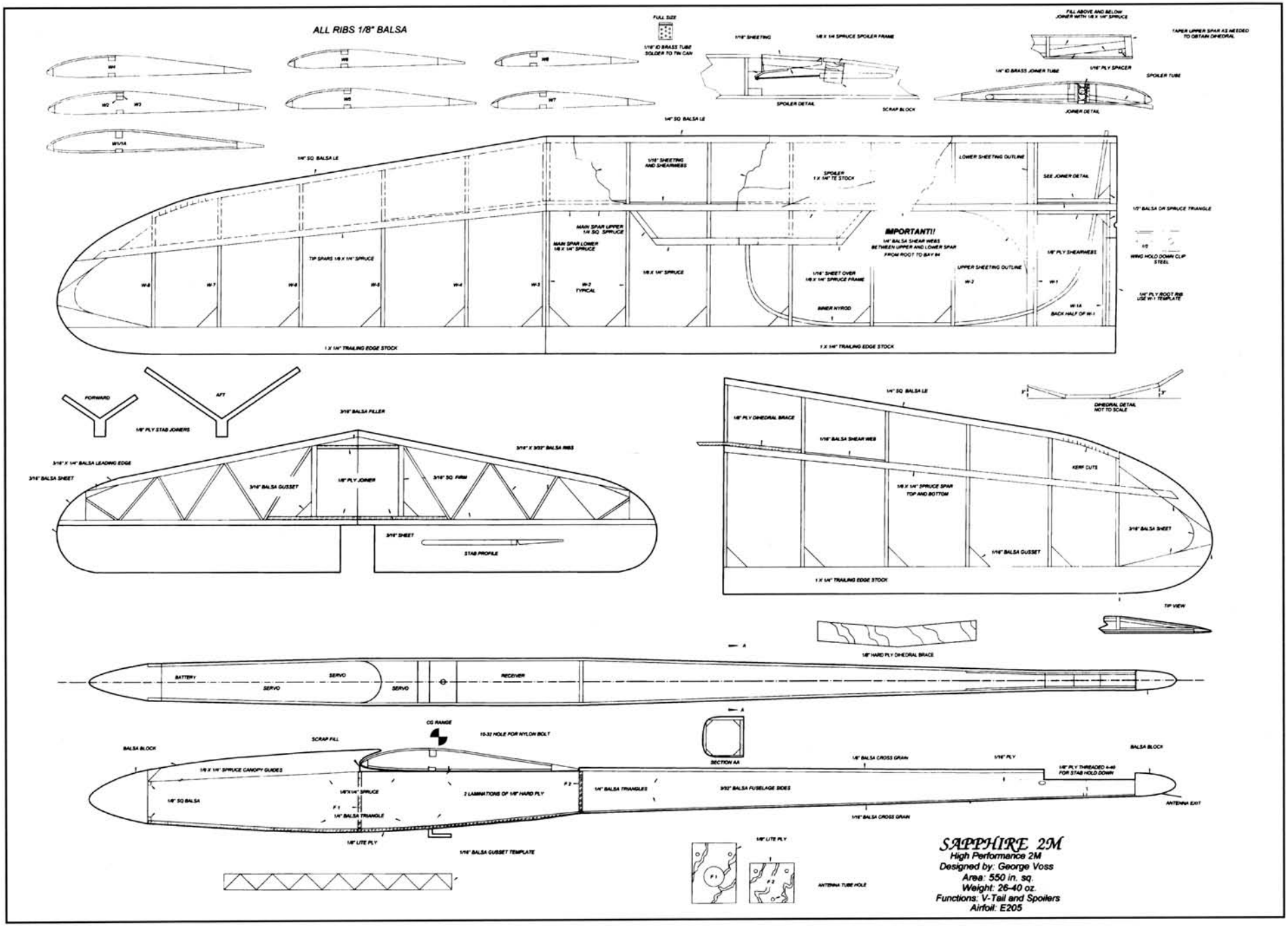
Another way to visualize this is to hold the fuselage in front of you while maintaining the same view. Now, rotate the fuselage so one of the V's is straight up (vertical). If you give right rudder command, the ruddervators will move to the right. This will be true no matter which ruddervator is up. See how easy that was?!

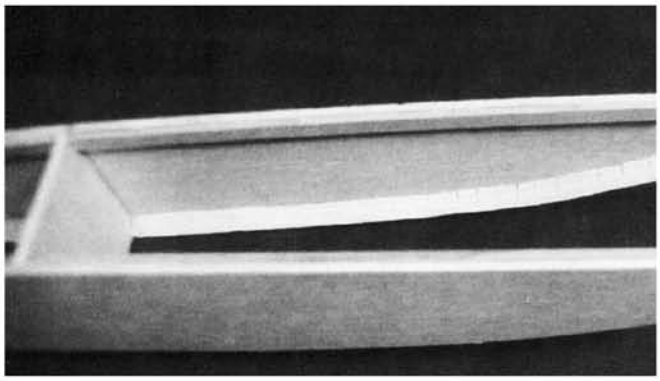
Finish

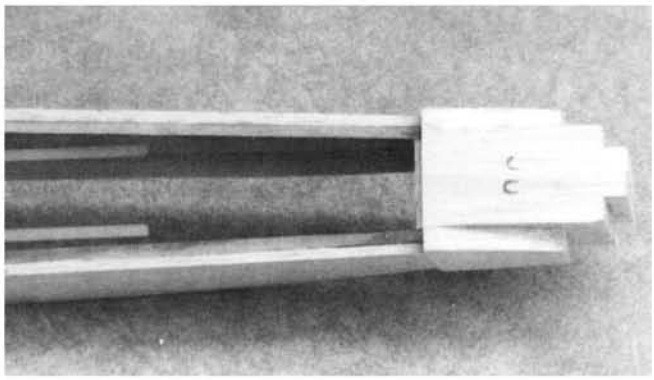
Final sand all of the components using progressively finer grades of sandpaper, finishing up with no less than 400 grit. Cover the wings and tail with your favorite covering. I used transparent MonoKote on the open bays of the wing and the tail and covered the sheeted portion of the wing with opaque yellow.



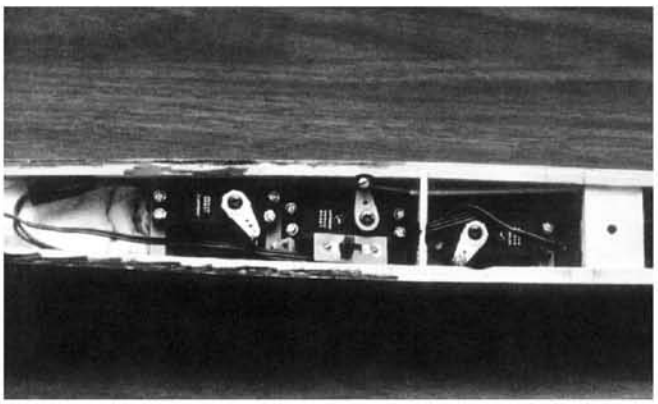
The V-tail empennage keeps the over-all airframe lighter than with a conventional tail. The *Sapphire* uses three mini servos mounted in the nose and under the wing. A computer radio or V-tail mixer is necessary for control.

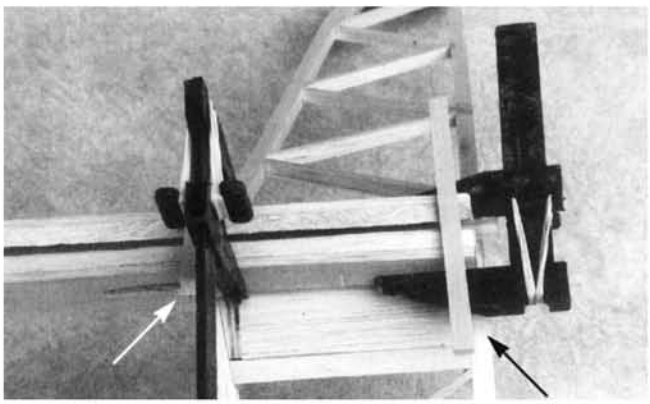


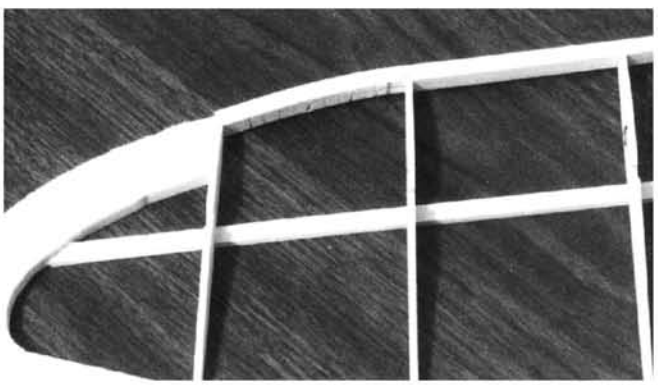


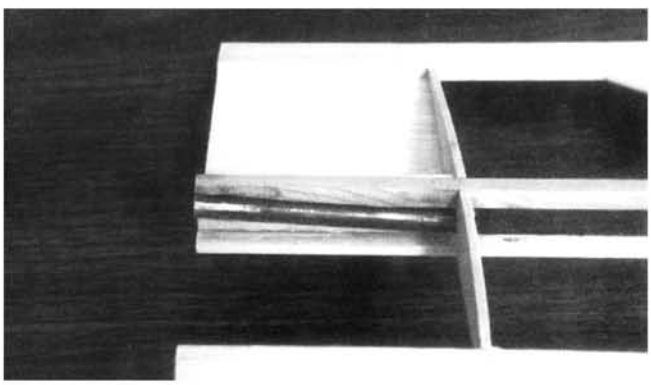


Fuselage forward section ready to install the nose braces **(above left)**. You can see the kerf cuts in the lower ¼-inch triangle stock. Make the nose block one piece **(above right)** if you have a large enough block on hand. Three Airtronics 94831 mini servos provide the guidance **(below left)**. You should not require any nose weight to balance the sailplane. Note the temporary sticks CyA'd to keep the fuselage pulled tight against the V-tail dihedral braces **(below right)**.

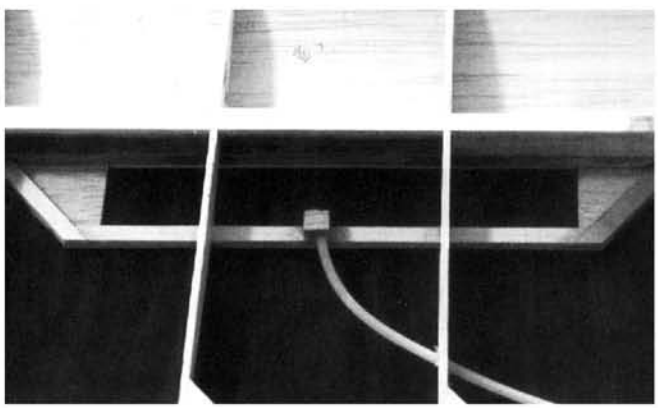


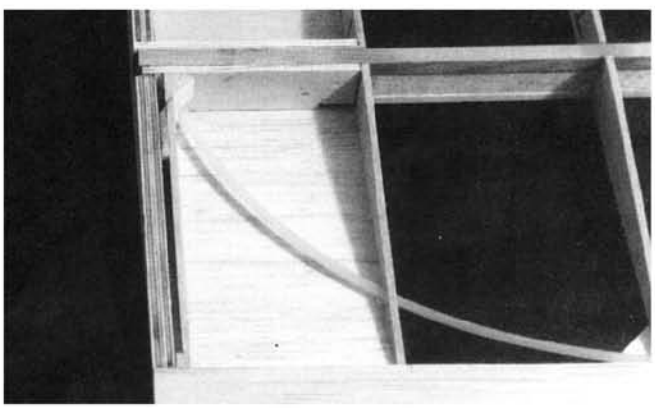


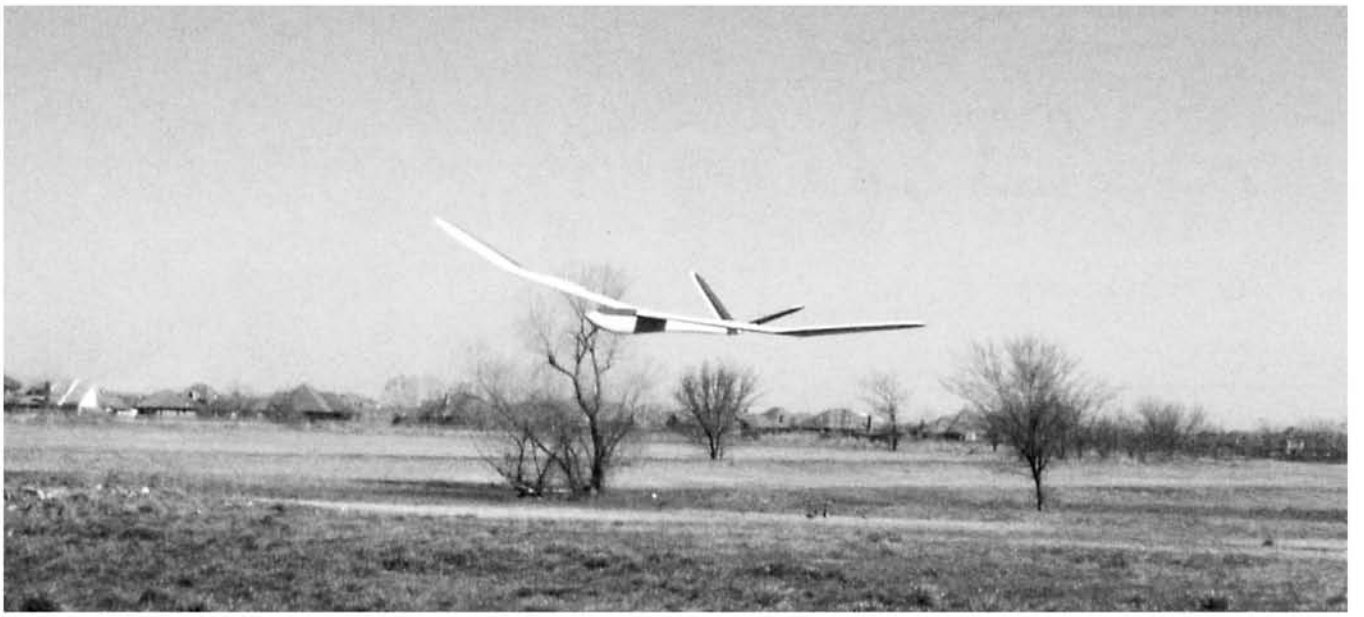




Note the kerfs in the leading edge outboard of the second rib **(above left)**. Lower spar is ⅛ × ¼-inch. Close up of the wing joiner tube **(above right)**. Note that the top spar has been relieved to allow the proper amount of dihedral. The 1/16-inch gussets can be seen at the trailing edge **(below left)**. The spoiler frame is made from ⅛ × ¼ spruce, and 1/16-inch balsa. Close up of the wing center section **(below right)** shows the extra rib and triangle for the wing hold down clip.







The *Sapphire* will reward you with out-of-sight flying times. The model flies with a light touch and a little finesse will allow for optimum performance.

Since the fuselage takes most of the abuse, I covered mine with ¾-ounce glass cloth. A brief narrative goes like this: lightly spray the fuselage with 3M Spray 77™ adhesive, and attach the cloth. Cover your finger with plastic (*wax paper works well—Ed.*) and apply thin Zap. Spread the Zap with your covered finger. Apply a coat of Zap-a-Gap. This should fill 90% of the weave. Wet sand the fuselage using 240 wet or dry. Apply 2–3 *heavy* coats of primer. This should get 99% of the weave. Wet sand the primer and remove as much as possible. All that should remain is what's filling the weave. Spray your favorite paint and you're ready to go.

Flying

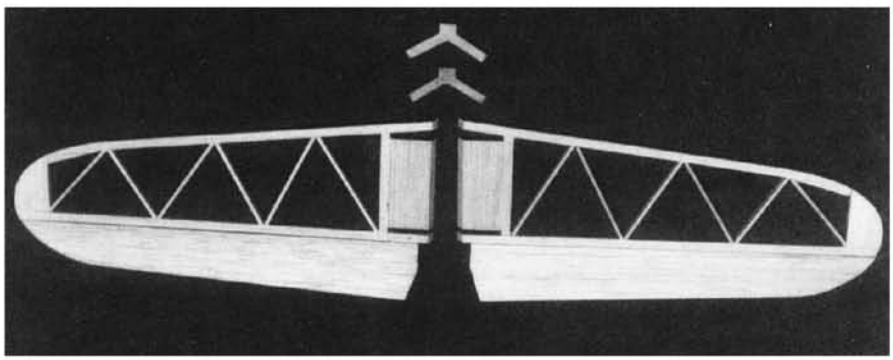
Set up your throws as follows: turn commands ⅝ inch and elevator commands ½ inch. Make sure the c.g. is within the recommended range. The aft limit shown is at 38% MAC. The E205 airfoil performs at its peak at this setting, but I recommend starting a bit farther forward for initial flights. The towhook location shown on the plans is in a very safe location. Move it aft ¼-inch at a time until you're satisfied with the launch. One thing to remember: as you change the c.g., the effective location of the towhook is moved along with it! As you move the c.g. forward, the towhook is effectively moved aft. With that in mind move the towhook the same amount and direction as you move the c.g. Make sure the wing panels are flat. A few degrees of wash-out (trailing edge higher than the leading edge) in the tips is okay, wash-in is *not*!

I always do some hand tosses before winch or hi-start launch. If you find you need a lot of trim in the tail during the hand launch phase, shim the stab platform 1/64 inch at a time. Initial high start launches were nearly hands off. Only minor corrections for the slight crosswind were needed. The *Sapphire* doesn't like to be slammed around! A light touch, finesse if you will, will give you optimum performance. Be gentle with the controls and you'll be rewarded with longer flying times and it *will* make you a better pilot.

The *Sapphire* was designed as a "clean" sailplane and can really cover some sky when it needs too. Don't be afraid to add some ballast in windy conditions. This is one area where the airfoil seems to work more efficiently, allowing you to cover more sky in search of those elusive thermals.

The *Sapphire* is fair at aerobatics. Loops are no problem but stall turns and rolls while possible, are humorous at best. The *Sapphire* will core tightly in turns, and thermals nicely. This is what she was designed for and aptly delivers. The spoilers are not very large in size but do give you good control during landings and will get you out of a hat sucker thermal! If you plan to use your *Sapphire* for competition, *don't skip* the advice listed in the Contest Considerations section, page 28.

I hope you enjoy your *Sapphire*. It's a great looking, great flying 2M that you can be proud of. While I didn't try it, with a wider set of formers and a one piece wing, the *Sapphire* should make an excellent electric platform. If you try this conversion, let me and FLYING MODELS know and send pictures! Thermals.



The tail feathers are ready to be joined. Tabs on joiner braces allow the tail to be built as a removable assembly. The plans show a new, longer rear joiner brace that is stronger than the one shown in this photo.

Sapphire 2M at a glance

Wing span	77 inches
Fuselage length	40 inches
Airfoil	E205
Wing area	550 square. inches
Weight	26–40 ounces
Wing loading	6.8–10.5 oz./sq.ft.
Radio requirements (ruddervators, spoiler)	3–4 channel 3 standard servos