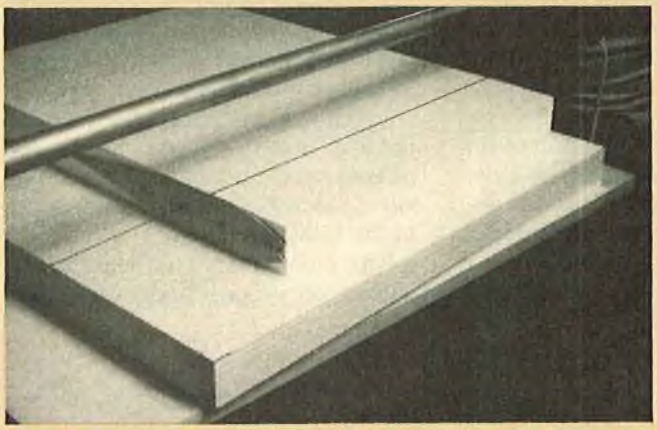
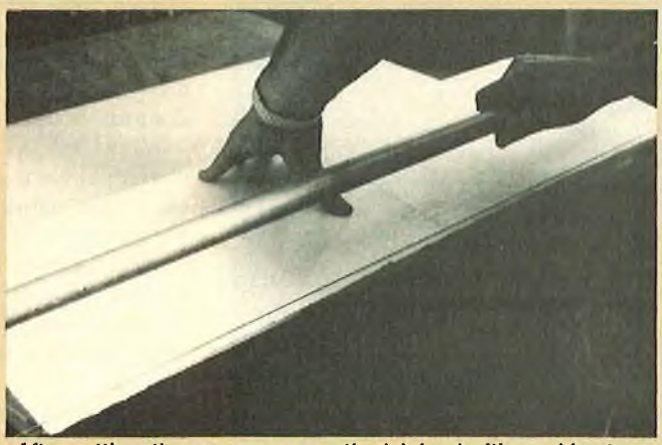
Two versions of the Winger have been built: In the foreground is shown the use of elevons for both pitch and roll control. In the rear is a version using conventional aileron and elevator to control these functions.

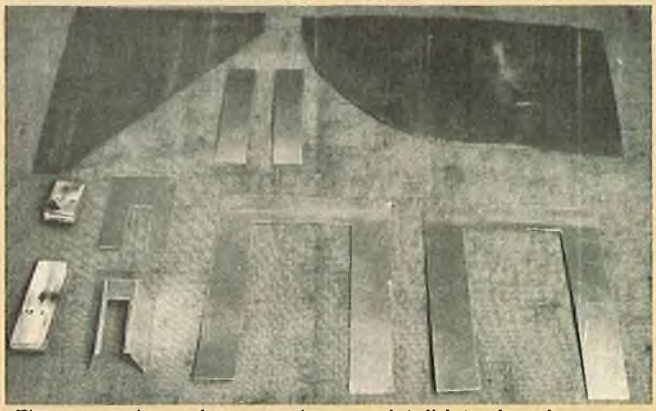
From a club discussion, suggesting a "Battle to the Death" with old airplanes, came this flying wing. Designed for R/C combat, this "Winger" makes a perfect model with minimum building time required.



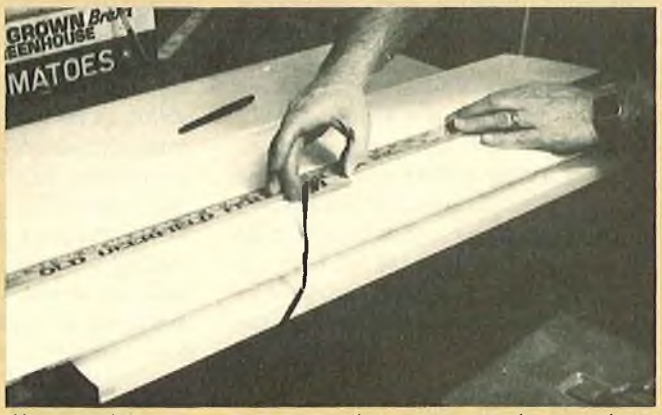
The wing core is cut in two halves from insulation foam. The end templates are lite ply held to the foam with 2" nails.



After cutting, the cores are smoothed, joined with masking tape and the trailing edge is cut straight.



Fixtures and templates used to cut detail into the wing cores. Note the two hot wire slot cutters at the extreme left. Adjacent to these cutters are the templates used to cut the motor mount reinforcement slots. The use of the remaining parts is illustrated in subsequent photos.



Use a straightedge and a hot wire slot cutter to cut the spar slots while the cores are still taped together.

WINGER
Designed By:
James E. McKeown
TYPE AIRCRAFT
Flying Wing (Combat)
WINGSPAN
39 Inches
WING CHORD
13 Inches
TOTAL WING AREA
490 Sq. In.
WING LOCATION
N/A
AIRFOIL
Symmetrical
WING PLANFORM
Tapered T/E
DIHEDRAL EACH TIP
None
O.A. FUSELAGE LENGTH
19½ Inches
RADIO COMPARTMENT SIZE
(L) 2" x (W) 8½" x (H) 1½"
STABILIZER SPAN
NA
STABILIZER CHORD (Incl. elev.)
NA
STABILIZER AREA
NA
STAB. AIRFOIL SECTION
NA
STABILIZER LOCATION
NA
VERTICAL FIN HEIGHT
4¾ Inches
VERTICAL FIN WIDTH
4 Inches
REC. ENGINE SIZE
.15-.25
FUEL TANK SIZE
4 Ounces
LANDING GEAR
None
REC. NO. OF CHANNELS
2-3
CONTROL FUNCTIONS
Ail., Elev., Throt. (opt.)
BASIC MATERIALS USED IN CONSTRUCTION
Birch Ply Engine Pod
Foam Wing
Fome Cor® Control Surfaces
Wt. Ready To Fly ..... 40 Oz.
Wing Loading ..... 12 Oz./Sq. Ft.

and easy to cover with the added advantage of providing an exit for the antenna.

Several more wings were built over the next year, all of which flew well; however, it took about two years to identify a couple more problems. The second "First Annual Battle Royale" came with two more wings to this design giving a total of four. A problem which had exhibited itself to a greater or lesser degree now became more apparent. On hard landings, the power pod tended to loosen and, after several such landings, it was necessary to re-epoxy the assembly in place. After this was done several times, the epoxy seemed to provide enough reinforcement to prevent further problems. I, therefore, decided to provide an internal wood reinforcement to eliminate this problem. The 1/2" plywood element shown does this job admirably. Nose first landings do not phase this construction! A further minor problem was a bit tough to identify, however, it was easy to solve. One member of our club built a large horizontal "box" protruding from the top of the wing by about one inch to house the radio. This one had no elevator control! We thought at first that it was a radio problem but finally found that the elevator was masked by this box.

The construction materials on the early versions were balsa, plywood, spruce and insulation foam. To provide simpler hinges and to help to reduce the materials cost, the control surfaces, fins and wing tips have subsequently been changed to "Fome Cor®" which is a cardboard coated foam about 3/16" thick. This material can be obtained from most art supply shops. The construction portion of this article demonstrates techniques for working and using this material.

The third "First Annual Battle Royale" has just passed and there were nine flying wings and only two conventional models present which has developed a "One Aircraft Contest."

With the advent of electronic mixing, several of these wings have been built using elevons. These are simpler to build and, with increased control surface area, perform in a manner similar to the conventional control systems. The plans show the configuration used for electronic mixing.

Construction of this model is covered in detail in the photos and drawing, but to eliminate errors it will be further covered step by step.

The foam cores are cut from 2" insulation foam which is obtainable from any building supply firm. A standard 16% symmetrical airfoil was chosen to accommodate the 2" foam. Templates were made from lite ply and marked as shown on the plan. These numbers are essential during cutting to ensure a uniform cut rate between you and your assistant. The templates were affixed to the ends of a piece of foam 18" x 12" which was then cut with a hot wire. Due to the thickness of the wing being close to that of the foam, the wire will "break" out of the foam in the area of maximum thickness and may leave a rough spot. This can easily be smoothed after cutting with 60 grit aluminum oxide sandpaper affixed with contact adhesive to a piece of fairly thick plywood. The slot for the leading edge is best cut by entering the wire to the vertex of the slot and drawing it out along the template. This is repeated twice for each slot.

When both cores have been cut, smooth them with coarse sandpaper and, using the 3/8" square leading edge taped to join the cores together, cut the trailing edge to provide a chord of 11½". Using a hot wire slot cutter and a straightedge, mark and cut the 1/4"(W) x 1/8"(D) spar slots in the joined wing cores. These slots are positioned so that the rear of the slot is 8⅝" from the trailing edge. Separate the halves and cut the radio compartment in each half using templates made from an old fuel can taped to the core. Position the template so that the front edge falls in the middle of the spar slot. Using two fuel can straightedges taped to the core, hot wire cut 1/4" of foam from the inside front face of each wing core to provide clearance for the motor mount. Referring to the photographs of the various templates, make the two templates to cut the motor mount reinforcement slot, tape in place and, in turn, cut the slot in both cores.

Using suitable templates, hot wire cut 3/16" radius slots for the fins and aileron cable in both cores. Finally, cut the antenna tube slot in the bottom of the right core only.

The motor mount is made to the outline shown on the plan from two

BILL OF MATERIALS

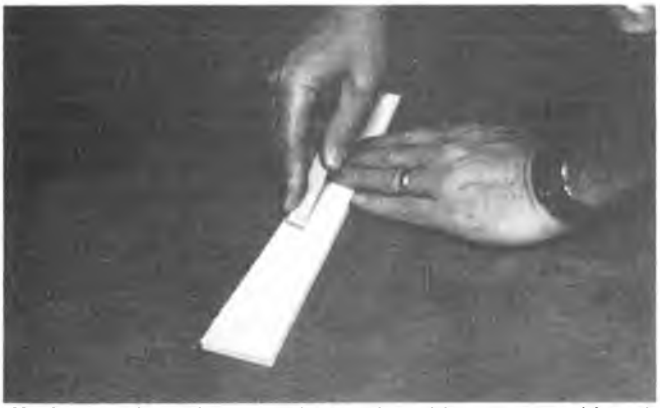
2 — 18" x 12" x 2" Insulation Foam.
1 — 8¾" x 1¾" x 1/8" Poplar (lite) Ply.
1 — 8¾" x 1⅛" x 1/8" Poplar (lite) Ply.
2 — 1⅛" x 2⅛" x 1/8" Poplar (lite) Ply.
2 — 3" x 3/4" x 1/4" Birch Ply (Servo Bearers).
2 — 3" x 6" x 1/4" Birch Ply (Motor Mount).
1 — 12¾" x 12⅝" x 3/16" Fome Cor®.
1 — 3/8" x 3/8" x 36" Balsa L.E.
2 — 1/8" x 1/4" x 36" Balsa Spars.
1 — 8¾" x 2½" x 1/32" Birch Ply (Hatch).
1 — 2⅜" x 3" x 1/2" Fir Ply (M.M. Reinf.).
2 — 3" x 3/16" Dia. Birch Dowel.
1 — 36" x 1/8" O.D. Antenna Tube.
1 — Sig SH-560 Flexible Control Cable.
2 — Du-Bro #111 Threaded Couplers.
3 — Medium Control Horns.
2 — Threaded Pushrods and Clevises.
2 — Small Clevises (Use With Aileron Horns).
1 — Sullivan RST-4 4 0z. Fuel Tank.
4 — #4-40 x 1" Engine Bolts and Blind Nuts.
24 — #2 x 1/2" Sheet Metal Screws.

The core cutter is used in conjunction with templates to cut the radio compartment hole.

A slot cutter with suitable templates is used to cut the fin slots and aileron linkage slots.

The wing cores are completed by cutting the motor mount reinforcement slots.

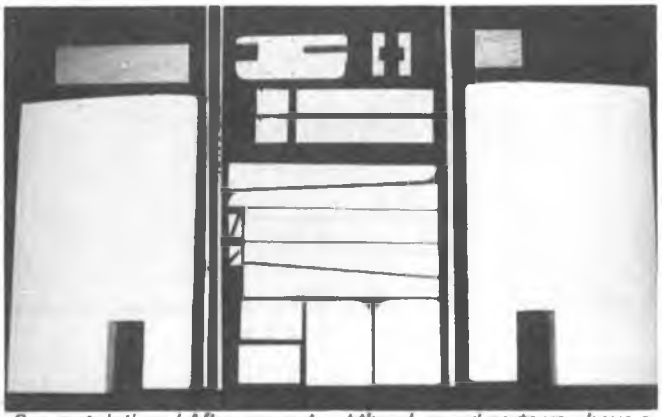
After cutting the "Fome Cor®" parts, to form the hinges, cut through one skin of the control surface with a sharp knife as shown.



Having cut through one surface to form hinge, crease this cut into surface with a square corner of wood.

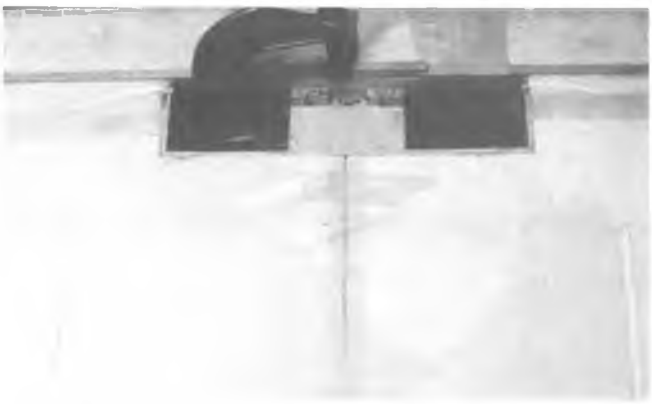
After cutting and creasing the hinge, fold the hinge back on the uncut surface and, with a razor saw, remove the foam on the side to be attached.

With a round object, roll all exposed "Fome Cor®" edges to form a finished radius.



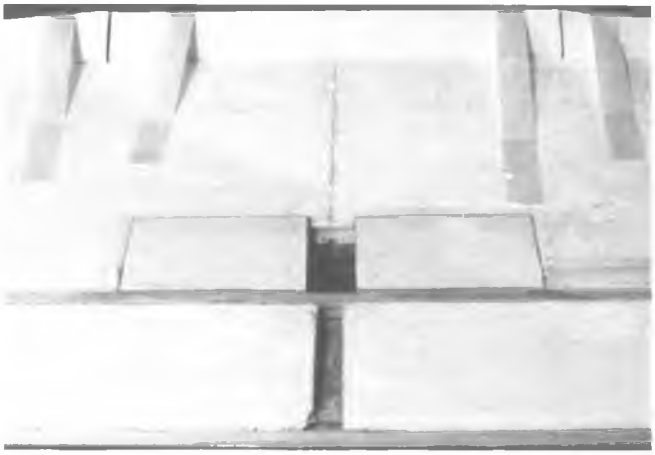
Congratulations! After you cut out the plywood parts you have a "Winger" kit. The "Fome Cor®" parts are at the top center and can be identified from the plan. Immediately below this group are the lite ply radio compartment liners. At the bottom from left to right are: The motor mount reinforcement, the servo bearers, the motor mount and the radio compartment cover.

Temporarily tape the wing cores together and check the fit of the various parts. Where necessary, ease the component fit to provide good glue joints.

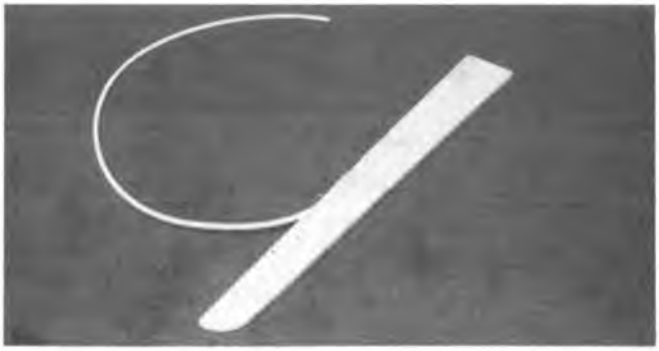


After checking the fit of the components, epoxy the wing cores, spars, leading edge, radio compartment liners, and servo bearers in place.

Tape the control surfaces in place as shown, fold back, apply epoxy and tape the surface in the down position until cured.

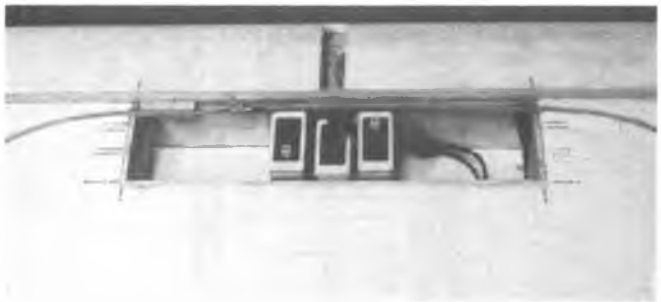


While the control surfaces are curing, epoxy the radio compartment bottoms in place.

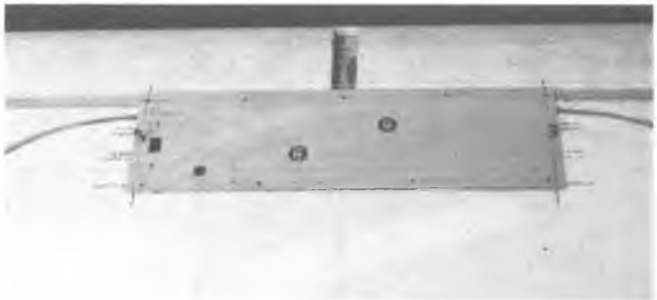


Slot the bottom and inner edge of the right hand wing tip to accommodate the antenna tubing. Epoxy tube in place and use tape to hold till cured.

Epoxy and tape both wing tips to core as shown. Note the slot in the wing for the antenna tube and the "Fome Cor®" gussets.

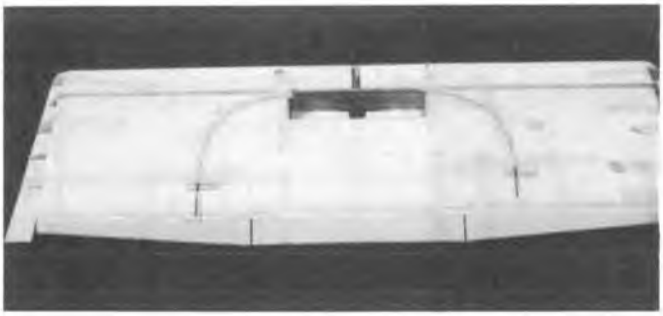


Install the aileron linkage and servos. Note the music wire link soldered to the cable at the left of the servos.

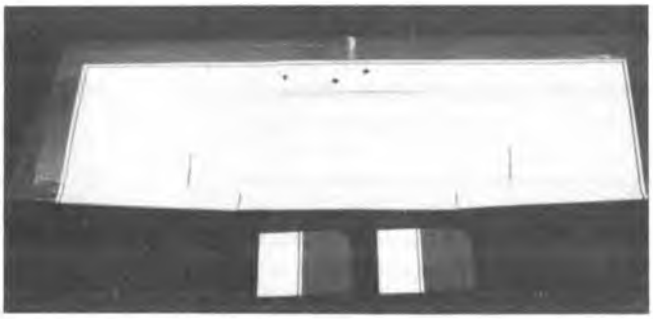


Mark and drill the holes in the radio compartment cover. The #2 sheet metal screws used to retain the cover go into the compartment liner.

pieces of aircraft grade birch plywood. It is important that a hard plywood be used in this application since the softer construction grade plywood will "crush" in the region of the engine bolts. Epoxy the two pieces together prior to cutting to shape. When cured, cut to the outline shown, making sure that the engine of your choice will fit in the space provided. Fit the rear part of this mount to the space between the spars so that you will have a sound



The completed assembly. Do not install the motor mount until covering is completed. Allow to dry overnight, sand smooth with 100, 150, 220 and 400 grit sandpaper prior to covering.



The completed assembly prior to installing the motor mount.

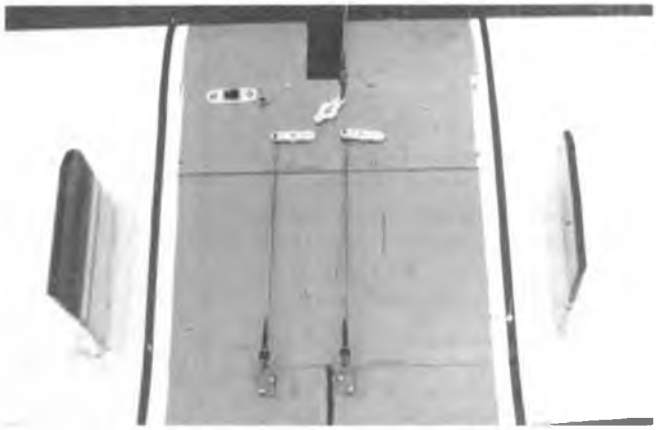
glue joint when finally installed in the assembled wing. Cut the radio compartment liners from 1/8" lite ply. The end liners are slotted to accommodate the aileron cable if used. The motor mount reinforcement member is cut from either balsa or fir plywood 1/2" thick. I prefer the fir material since it is stronger and does not add significantly to the overall weight.

The servo bearers for the aileron version of this model are "stepped" so the aileron servo arm can be mounted at the same level as the aileron cable. To provide clearance for the servo wires during installation, the bearers are made from two pieces of 1/4" birch ply 3/4"(W) x 3"(L). These are then clamped together in a vise and three 1/4" holes are drilled vertically through the interface between the two parts. This can easily be accomplished by first drilling a 3/32" diameter pilot hole to guide the larger drill. These bearers may then be epoxied to the front and rear radio compartment liners prior to assembly.

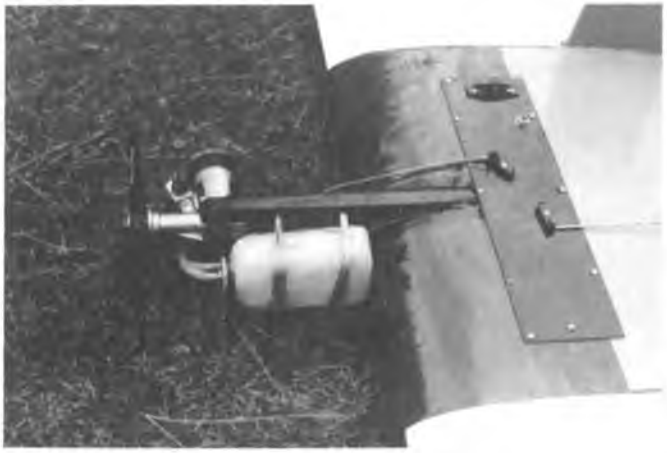
The leading edge and spars can be of balsa, spruce or bass wood. I feel that balsa is easier to shape and lighter, however, I have used all of these woods with good results. Temporarily join all of the pieces together using masking tape where necessary and check the fit of all the piece parts. Where needed, relieve the fit of any parts which fit too tightly. To check the fit of the motor mount, it will be necessary to round the leading edge in the center to permit it to engage fully into the space between the spars. When satisfied with all fits, disassemble, epoxy and reassemble using clamps and tape to hold the various parts in place during curing.

While this assembly is curing, cut out all of the "Fome Cor™" components

The fabricated wing tip is easily covered with low temperature films.



A close-up shot of a typical elevon system.



The engine and radio installation in a model using conventional aileron and elevator control.

Had to give my age away with this engine shot.

as shown on the plan. Referring to the plan and pictures, form the hinges from one skin of the control surface. In cutting the aileron or elevon hinges, note that there is one left and one right control surface. Cut a slot in the right wing tip as shown to accommodate the antenna tube and epoxy this tube in place prior to securing to the wing. Epoxy the control surfaces to the trailing edge using masking tape as shown. Be sure that the gap between the control surface and the trailing edge is sufficient to permit full down movement of the control surface. After applying the epoxy, tape the control surfaces in their full downward position till cured.

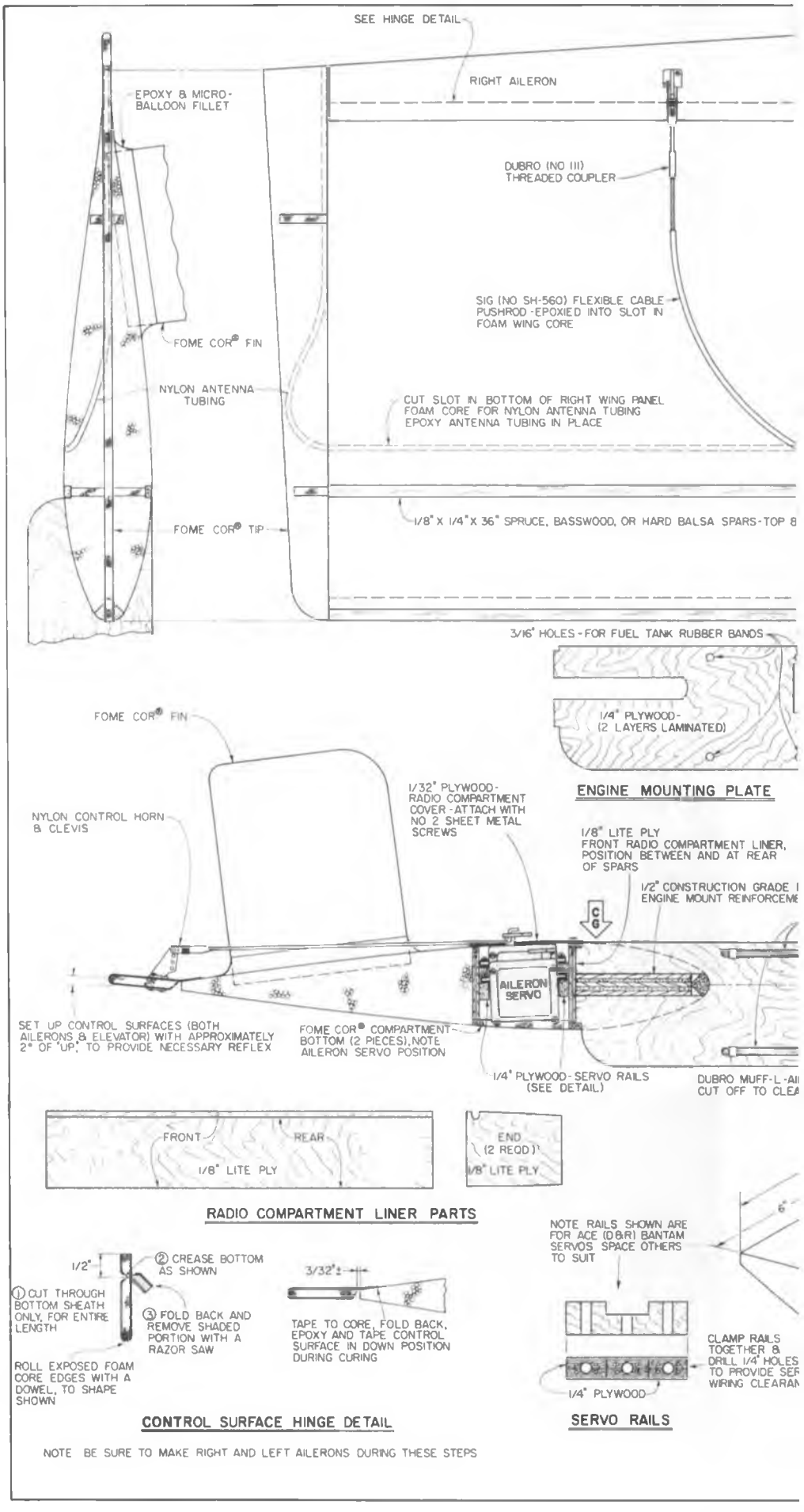
Turn the assembly upside down and epoxy the "Fome Cor®" radio compartment bottoms in place. For some servos, the full depth of the wing is required, thus a "slot" is provided in the center to accommodate such servos. This slot presents no problems during landings since it is protected by the motor mount.

Using the gussets provided, epoxy the wing tips in place. Now epoxy the control cables and antenna tube in place. When cured, sand the entire assembly smooth using 100, 150, 220, 320, and 400 grit wet or dry sandpaper dry. Do not try to sand the "Fome Cor®" components with anything but 400 grit as it will rip the surface. The exposed edges of this material can easily be rounded off with a round object such as an X-Acto knife handle. By gently rubbing these edges, a nice smooth edge can be formed which requires no sanding.

Temporarily install the servos and radio. Connect the linkages to the servos and install the control horns. Check the operation of all controls. When satisfied, remove the servo arms and cut the holes in the hatch to clear these arms. Install the switch and charging jack in the cover and carefully drill the holes for the retaining screws. In drilling these holes, be very careful to locate them so the #2 screws will thread into the radio compartment liners. When this portion of work has been completed, remove the radio equipment and proceed with covering the model.

In covering the model, use only enough heat to provide covering adherence and shrink. Excessive heat or the use of high temperature materials will produce a "scalloped" or "pocketed" appearance on the finished model. Cut slots in the covering and install the fins and engine mount

continued on page 115



using epoxy. When cured, mix some micro-balloons into some epoxy and, using a flat paddle about 1/4" wide, neatly fillet the joints at the motor mount and fins. When fully cured, paint the motor mount and fillets with a fuel resistant paint such as Testor's Pla or Formula U.

Install the engine, radio and fuel tank. In the radio installation **do not** try to use a control configuration which would permit the control horns to be on the bottom of the wing. This tends to destroy servo gears during landings! Check all controls for freedom of movement and direction of travel. Be sure the controls, in the neutral position, are around 1 to 2 degrees above center. This ensures that there will be adequate flying reflex. Check the balance of the model. In the event that the balance point falls to the rear of that shown on the plan, add enough nose weight to balance it. In all of the models built to date, nose weight has not been required.

Before flying, fully charge the batteries and pick a reasonable day. For the first flight, to be on the ever ready position, it is advisable to have an experienced friend launch the model. Start the engine, adjust the mixture to provide a slightly rich run, check the idle and, when satisfied, prepare to launch. Open the throttle fully and check the controls for both direction and movement. All being well, give your assistant the nod for a fast slightly nose-up launch. Let the model climb to a couple hundred feet making corrections only as necessary to keep the direction and climb reasonable. Turn the model downwind and try a straight downwind pass adjusting the trims for straight, level flight. Try several more turns adjusting the trims until they are satisfactory. As you become more familiar and comfortable with the model, you will soon be trying any maneuver you can think of. After the first flight, correct any errors in reflex as illustrated by significant off neutral settings of the elevator trim. To accomplish this, adjust both the aileron and elevator neutral until a central trim position is obtained.

I hope that this project will give you as many hours of fun as it has me. Happy flying!

I would like to extend my thanks to Paul Niles for his contribution in the development of this model and to Stacey Barnard for building one of the very first prototypes. □