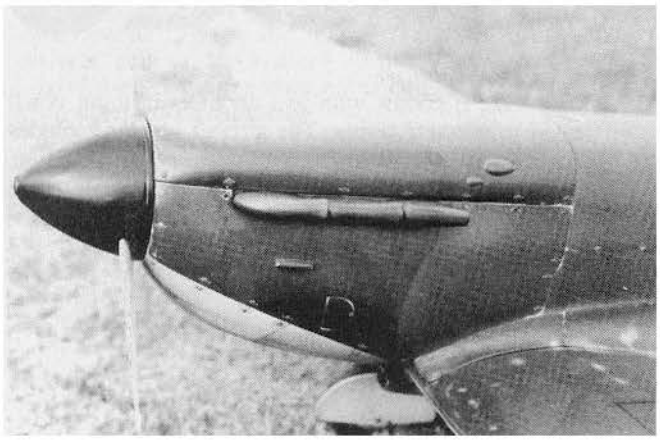
SUPERMARINE

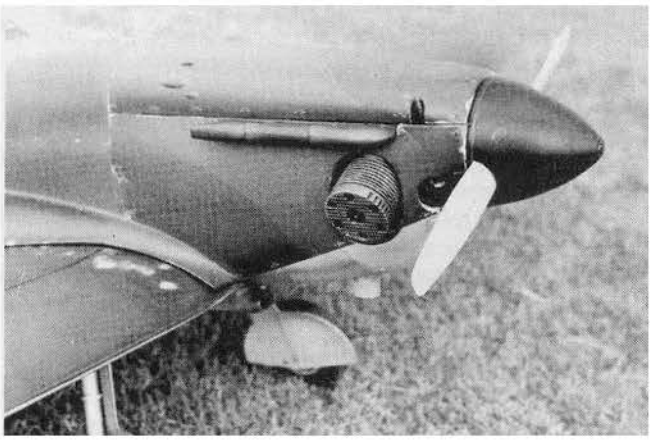
Editor's Note: Our thanks and appreciation to Clive Smalley of Leicestershire, England, for sending us this beautiful airplane. Also, our thanks to Jim Rolph of Rossville, Tennessee, who built the Spitfire and provided us with many of the construction photos. Jim's model was powered with an O.S. FS-90 4-stroke and is an excellent flying model.

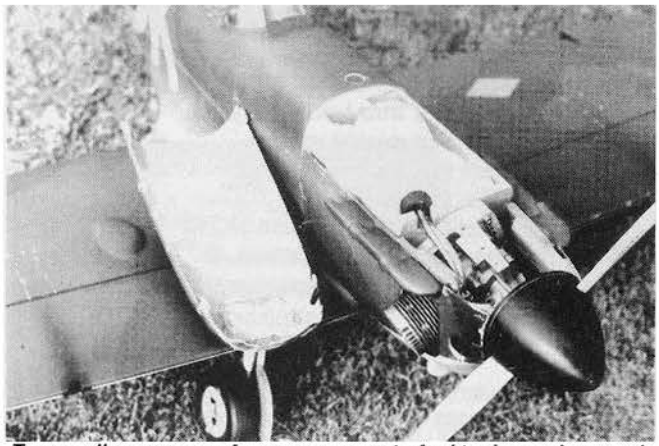
For WW II buffs, this Spitfire will add the ultimate class to your stable of aircraft. It's a real beauty

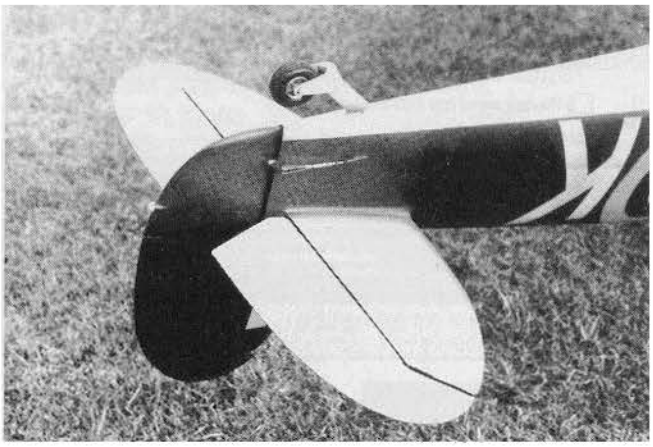
By Clive Smalley
Designed and Built
By Rob Millinship

Author's Note: The credit for the conception, design, and construction of this Spitfire model, belongs entirely to Rob Millinship. Due to pressure of work, Rob asked the author to trace the original working drawing into a formal plan, and to write a few constructional notes for this article. That is the author's only contribution to the project.









Top cowling removes for easy access to fuel tank, receiver, and battery pack.

SPITFIRE MK I

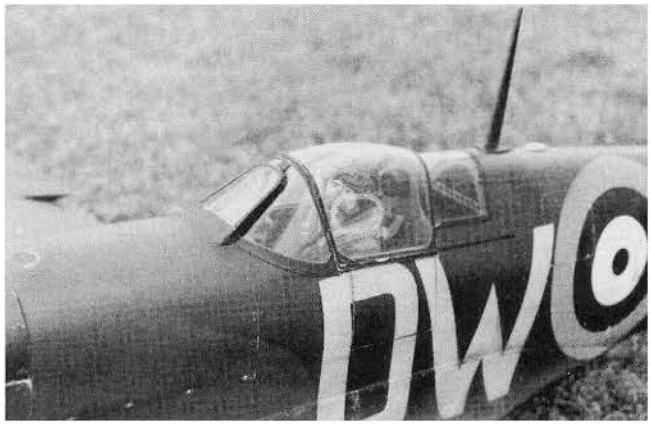
Introduction:

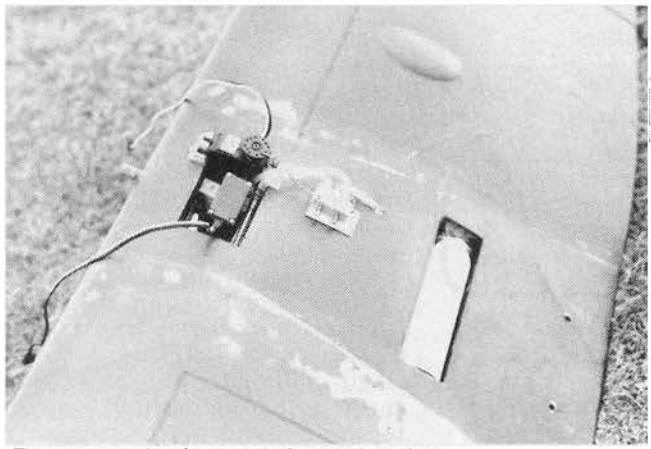
The requirements behind the design of this model were to provide a means for the average modeler to be able to build a good scale Spitfire with a relatively simple structure, and possessing excellent handling characteristics. It also had to be capable of standing up to the rough and tumble of everyday flying as well as the average sport or aerobatic design. Add to this a requirement for a retracting U/C (undercarriage) arrangement, which could be fitted into the wing by practical methods, and would utilize any commercial unit. Several pretty tough requirements to combine in one airframe.

Before getting into detailed construction notes, let's analyze the problems generated by these requirements and the general shape of the Spitfire, and look at how these have been eliminated.

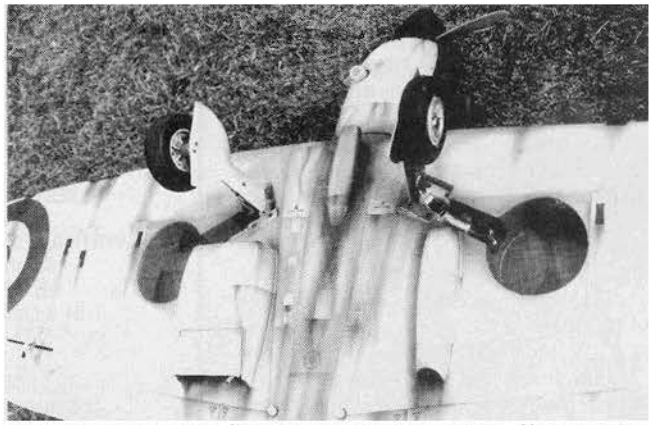
Design Concept:

Taking the fuselage first, the obvious complexities lie with the engine cowling, spinner, and canopy. By using a ready-made cowl, molded canopy and spinner, the remaining structure becomes only slightly more

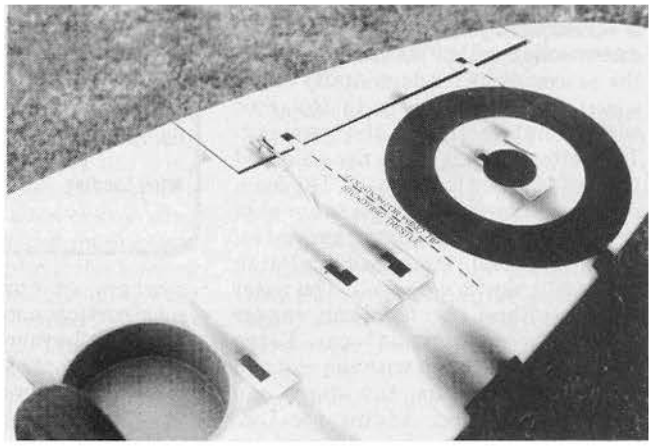




Easy access to air operated retract system.



Add as much, or as little detailing as you want. Note retract system filler valve located in radiator air outlet.



complicated than an average sport model. Few people enjoy planking, so that has been eliminated by adopting a thick sheet square box with triangular corners approach, to the lower fuselage. The upper fuselage consists of a thick sheet top deck with the upper side panels cut and bent from thinner sheet. There is little difficult double curvatures with this model as will be realized by the fact that the full size machine can be plated from flat sheet for about 90% of the skinning.

The cowling is split above the line of the exhaust stubs. The lower section is permanently glued in position, while the upper section allows access to the engine and fuel tank bay.

Simple carved and sanded thick sheet has been adopted for the fin and tailplane. The rudder and elevators use the standard core and half-rib form of construction.

It is with the wing that really all the design and handling problems lie. To make the wing fly well at slower speeds with the highly tapered elliptical planform, a fair amount of washout is mandatory. The problem is to design a simply constructed wing with easy to build washout and incorporating any type of retract system. There are two fundamental approaches to the construction, built-up or foam. There are advantages and disadvantages to each method. The built-up method does require the U/C to be "designed-in" to obtain the correct angles and this type of structure is also more easily damaged in transportation and storage. The most practical method is to use a foam wing, but how can this be utilized and still keep to the beautiful elliptical shape? This then is the crux of the model design.

Several methods were considered including cutting foam "ribs" about 1½"-2" wide and butt joining together. This was rejected due to the amount of work involved in making the many templates required. The method finally adopted is possibly the simplest, requiring the minimum in templates and preparation. The actual construction will be detailed later, but the procedure is fundamentally to cut a parallel chord wing to the root section but including the washout. The bottom skin is cut to the elliptical shape and glued to the foam. The foam is then trimmed back to the lower skin and the upper surface taper sanded in. This may sound rather fraught, but in practice it works very well. The outer panels minus the tips and center section are only some 24" span. Using a large sanding block with the root and tip ribs as a guide, the shape can quickly be formed. Adding the L.E. and upper skin then locks the washout at the correct angle. The big plus with using the foam wing is that the U/C bearing plates can be located by marking their position with the gear in place on the wing and trimming the foam away until the correct angles are found, without the need to calculate any angles.

Having generally explained the system of construction, more construction notes follow, explaining in detail the more complex or unusual procedures. Anyone having made a foam wing aerobatic model should have little difficulty in building this Spitfire.

SUPERMARINE SPITFIRE MK1

Designed By:
Rob Millinship
Plans and Text By:
Clive Smalley
TYPE AIRCRAFT
Sport Scale WWII
WINGSPAN
63 Inches
WING CHORD
11 Inches (Avg.)
TOTAL WING AREA
723 Sq. In. (Approx.)
WING LOCATION
Low Wing
AIRFOIL
Semi-Symmetrical
WING PLANFORM
Elliptical
DIHEDRAL EACH TIP
2¾ Inches
OVERALL FUSELAGE LENGTH
52½ Inches
RADIO COMPARTMENT SIZE
(L) 11" x (W) 4" x (H) 4"
STABILIZER SPAN
18 Inches
STABILIZER CHORD (incl. elev.)
6¼ Inches (Avg.)
STABILIZER AREA
112½ Sq. In. (Approx.)
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Top Of Fuselage
VERTICAL FIN HEIGHT
6½ Inches
VERTICAL FIN WIDTH (incl. rud.)
6½ Inches (Avg.)
REC. ENGINE SIZE
.61 2-stroke; .90 4-stroke
FUEL TANK SIZE
12 Oz.
LANDING GEAR
Conventional (retracts)
REC. NO. OF CHANNELS
5
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail., Ret.
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa, Ply & Fiberglass
Wing	Balsa & Foam
Empennage	Balsa
Wt. Ready To Fly	142 Oz. (8 Lb., 14 Oz.)
Wing Loading	28.3 Oz./Sq. Ft. (approx.)

CONSTRUCTION

Fuselage:

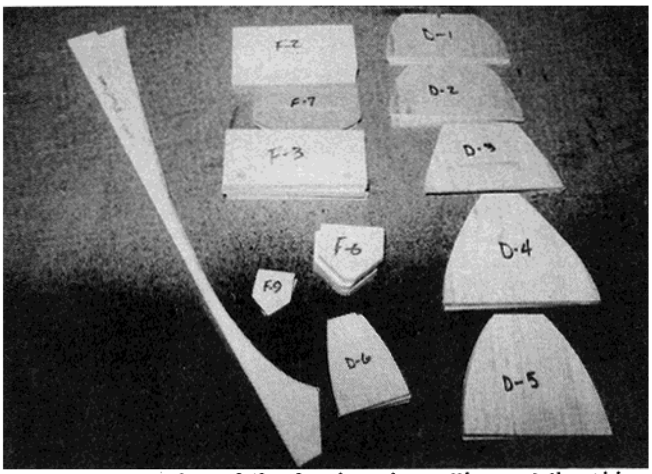
The fuselage construction is really quite simple and needs little explanation. Study the plans and construction photos carefully and you shouldn't have any major problems. The fiberglass cowl is separated along the panel line above the exhaust stacks. The lower cowl can be sprung around the fuselage until the correct position is obtained by reference to the spinner. Do this with the engine bolted in place to enable the spinner to find its correct position. Trim away the fuselage sides underneath the lower cowl until the cowl sides are almost flush with the main structure. If a side mounted engine is used, this lower cowl can now be permanently glued in position, and any reinforcement or packing pieces added. If an inverted engine mounting is selected, you will have to determine the best cowl attachment method based on your particular engine installation.

The wing fillets are the only other problem area. The 1/32" plywood fillet base cannot be added until the wing is complete. When the fillet base has been positioned and glue applied to the fuselage, bolt on the wing and ensure the fillet base is in good contact with the wing upper surface until the glue has cured. Note: Be sure to place plastic wrap or waxed paper between the top surface of the wing and the fillet base to prevent any glue from contacting the wing. The top line of the fillet can be drawn onto the fuselage using the top edge of the sides as a datum line. After the fillet formers have been added, thin card templates of the three central sections of the fillet can be made. The final shapes are then cut from 1/64" ply. The front and rear of the fillets are from soft balsa blocks or sheet.

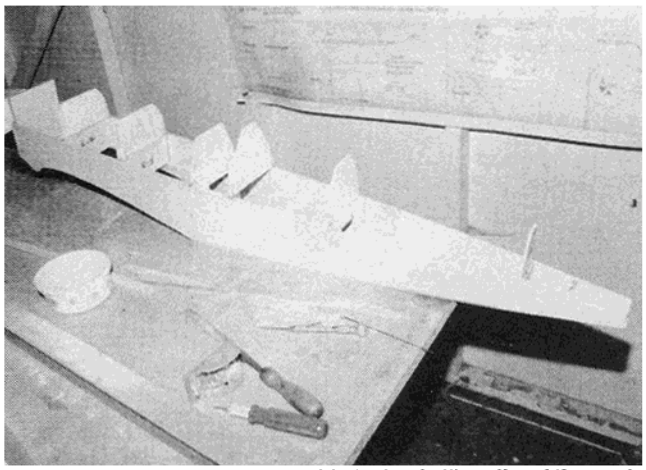
One other interesting feature on the original model is the scale Aerial Mast. This was made from a U/C nose gear wire with the "spring loop" concealed within the fuselage. The wire is faired with balsa to form the mast, and a slot in the top decking is cut to allow fore and aft movement. This prevents the mast from being knocked off during handling. Alternatively, the mast could be of the "plug-in" type, provided it remains a sufficiently tight fit to stay firmly in place during flying.

Wing:

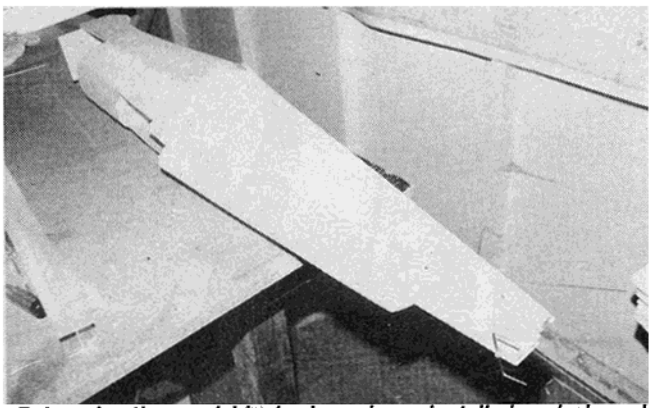
As previously outlined, the wing construction differs from the normal veneered foam method. The foam block must first be cut to the exact length of the outer wing panel minus the wing tip. This is important because if the block is not of the correct length, the degree of washout at the tip rib will vary and be incorrect.



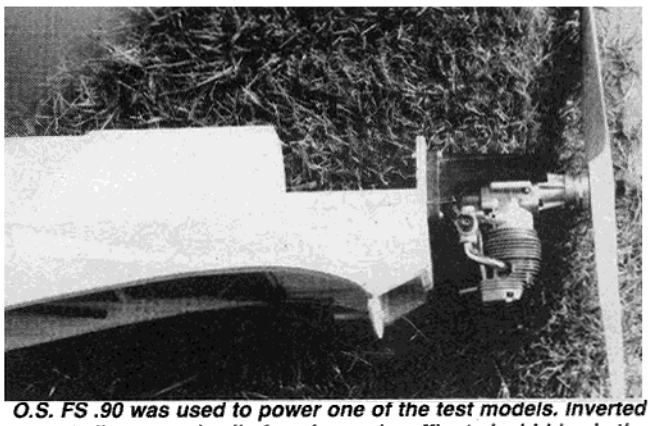
Begin construction of the fuselage by cutting out the sides, formers, and doublers.



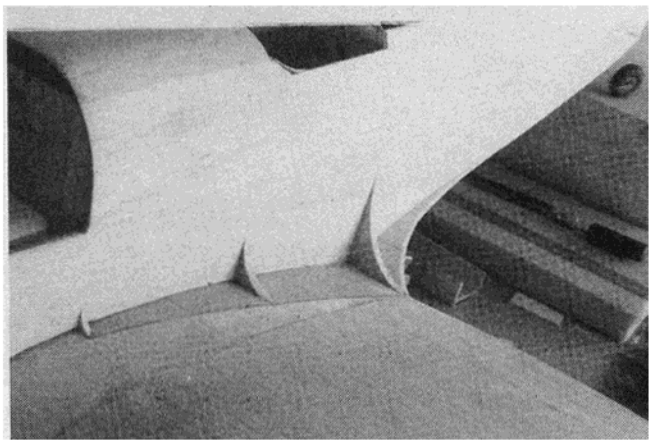
The fuselage structure starts with the basic "box," and then gets the sheeting and blocks to take shape.



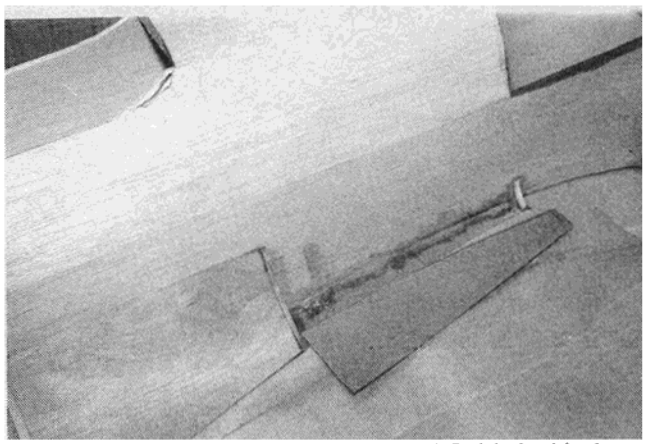
Balsa sheeting and blocks have been installed and shaped. Internal elevator and tail wheel linkage has already been installed. Fuselage is now ready for wing fillets.



O.S. FS .90 was used to power one of the test models. Inverted mount allows nearly all of engine and muffler to be hidden in the cowling. Plenty of power, and sounds great!



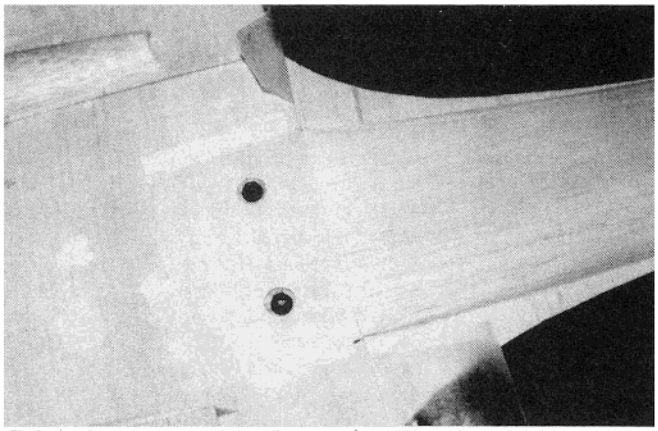
1/32" plywood wing fillet base, and 1/4" balsa formers glued into position on fuselage. Note: Be sure to place plastic wrap or wax paper between top wing surface and fillet plate during this phase.



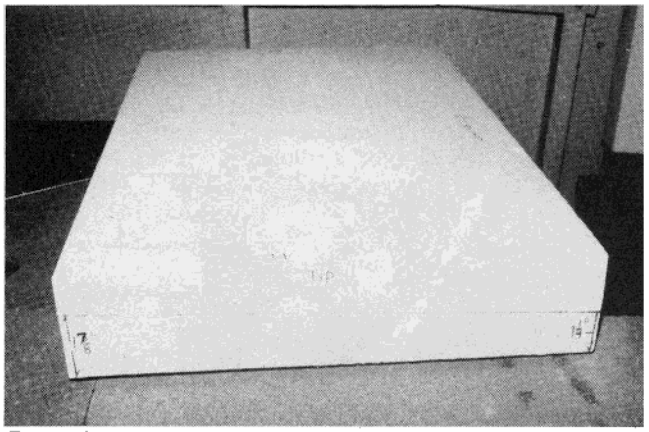
1/64" plywood skin is used for fillet material. Soft balsa blocks, or resin and microballoons, can be used for front portion of fillets.

Make two cutting templates to the root section shown. These are set up on the foam block ends as shown on the plan. **Note:** Although initially the wing is of parallel chord planform, the outer sections should be made as left and right hand panels due to the washout. Mark the cores left and right as it will be difficult to know the difference if a mix-up occurs. Next, prepare the bottom skin by butt jointing several widths of balsa sheet. Carefully cut this skin to the exact outline shape as denoted on the plan. This skin can now be glued to the foam core underside lining up at the root end. After drying out, cut the foam block to the wing planform using the bottom skin as a guide. Now add the correct size wing tip rib to the end of the foam block. Either mark a line along the leading edge or glue on the inner leading edge strip, joining the top "corner" points of the tip and root ribs. This will give guidance to the final shaping of the core. Use a long sanding block and shape the foam core to the airfoil section and front view along the panel. A cardboard template may be of help if you don't feel your Mk 1 eyeball is sufficiently accurate.

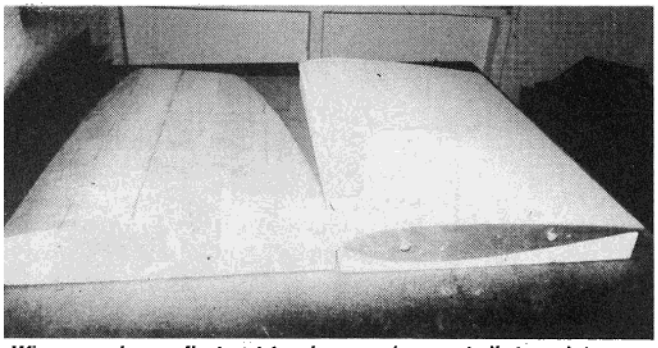
Make up the balsa top skin sheet, but this time cut the leading edge oversize chordwise to allow for the airfoil curvature. Place the wing back into the core box and glue on the upper skin. Leave to cure thoroughly. The center section is a simple parallel chord, constant thickness panel that can be made using the two original root templates. Cut the airfoil section in the normal way and add the



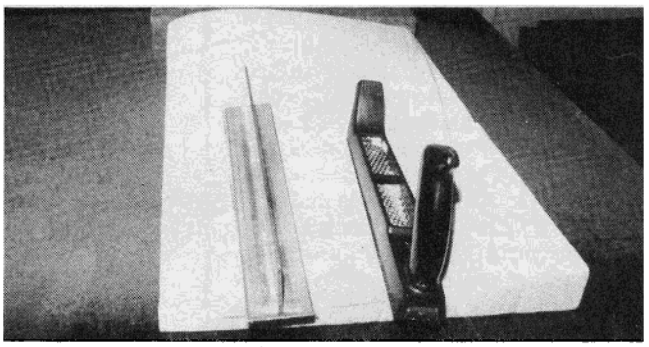
Balsa sheeting used for lower rear fillet material blend into fuselage. 1/8" balsa filler plate sanded to form smooth contour from wing center section to fuselage.



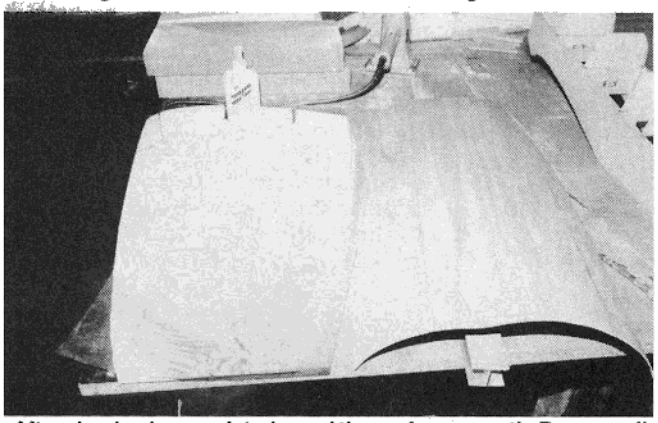
Foam wing cores are first cut to exact length, then marked for the proper washout at the tips. Be sure to identify the cores for left and right wing halves.



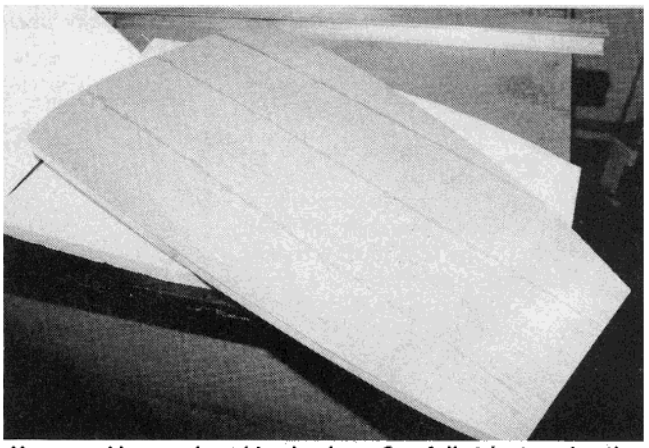
Wing panels are first cut to shape using root rib templates on both the root and tip. The bottom sheeting is then cut to exact size and glued to the bottom of the foam wing core.



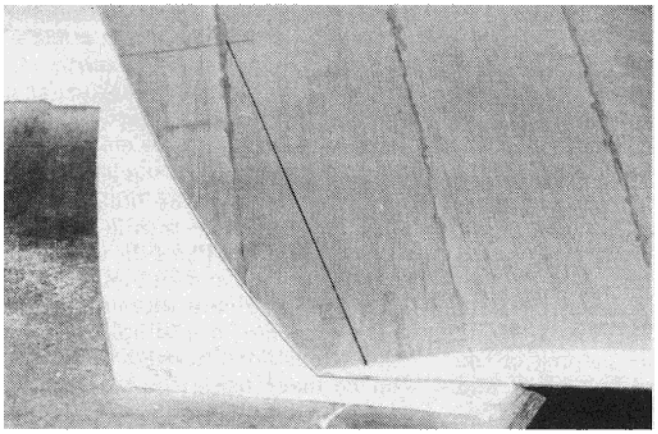
With the bottom wing skin glued in place, the tip template is placed in position, and the top shape of the wing is formed using coarse sandpaper, or other tools like the Stanley Surform.



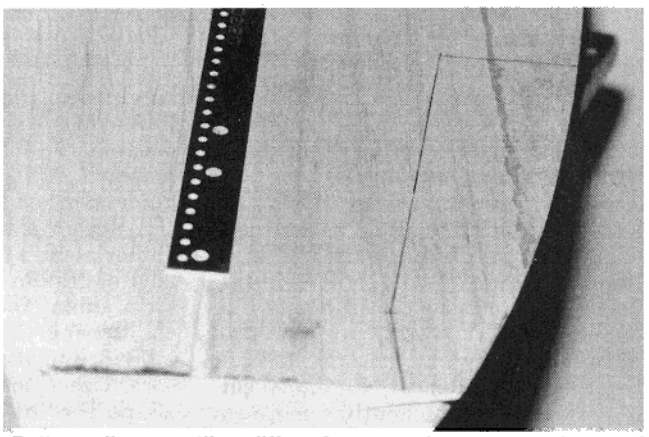
After shaping is completed, sand the surface smooth. Remove all dust and glue the top wing skin in place. Be sure to make the top wing skin oversize to allow for the curvature of the upper wing surface.



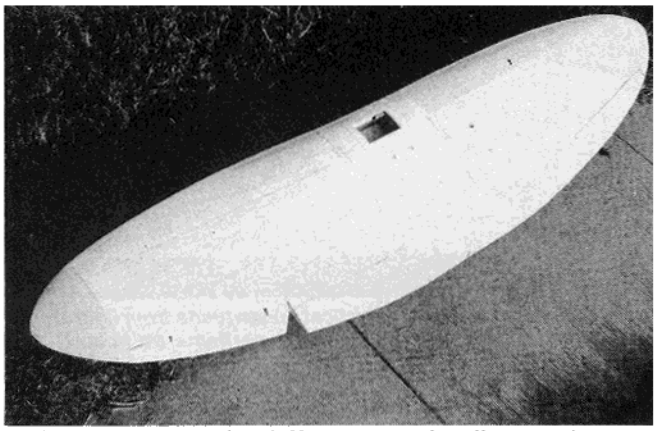
Upper and lower wing skins in place. Carefully trim top sheeting to match bottom.



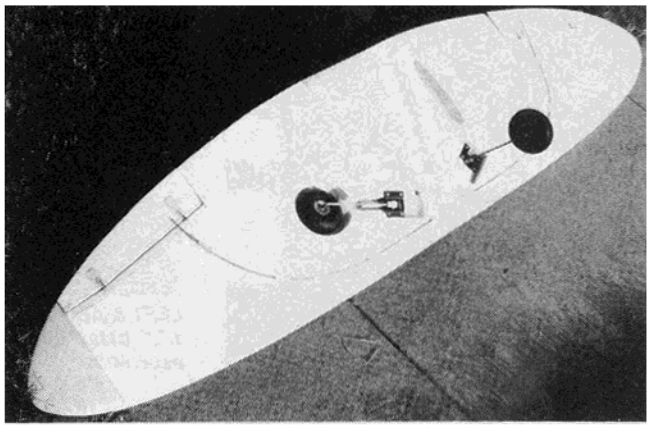
Before installing wing tip, carefully locate ailerons and cut out. Refer to notes on plans for aileron mounting instructions.



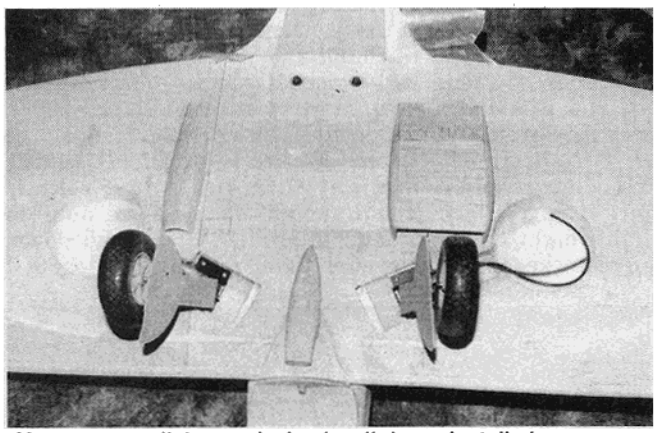
Bottom aileron outline differs from top due to type of control surface and hinge point location.



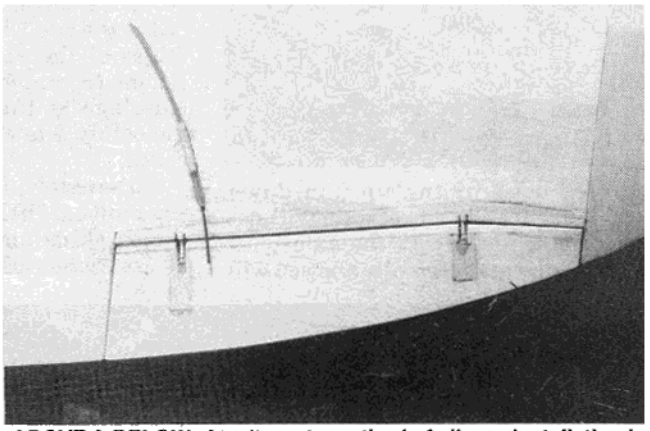
Wing structure completed. Note cutouts for aileron and retract servo, and air tank for retracts.



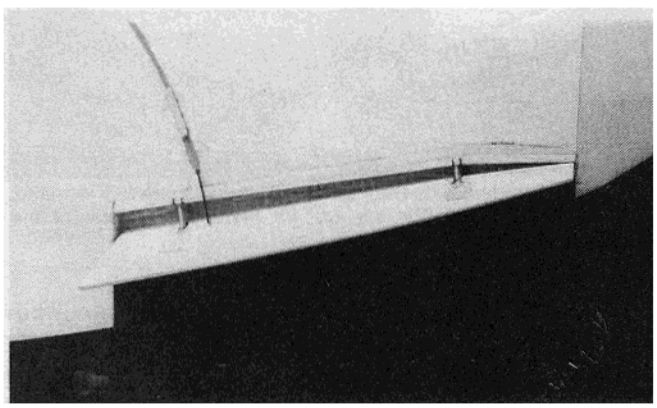
Retracts and aileron control cables installed in wing.

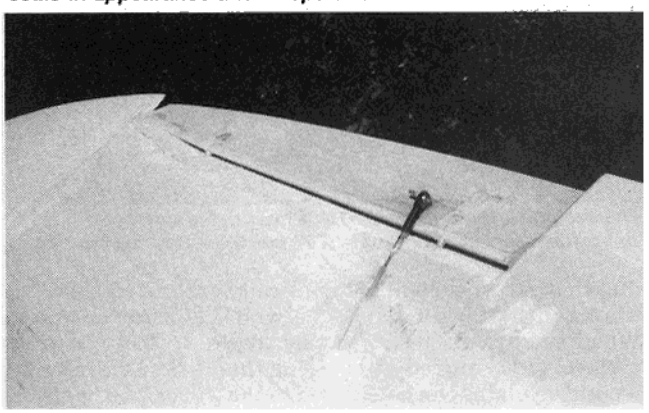


Air scoops, radiator, and wheel well doors installed.



ABOVE & BELOW: An alternate method of aileron installation is shown here. This requires a little more work, but is much more scale in appearance and in operation.



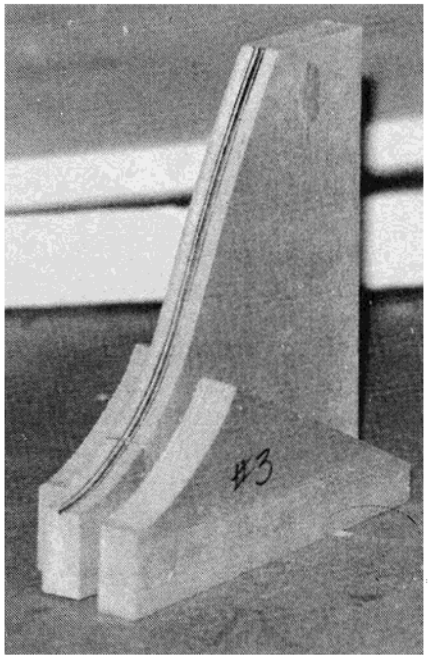


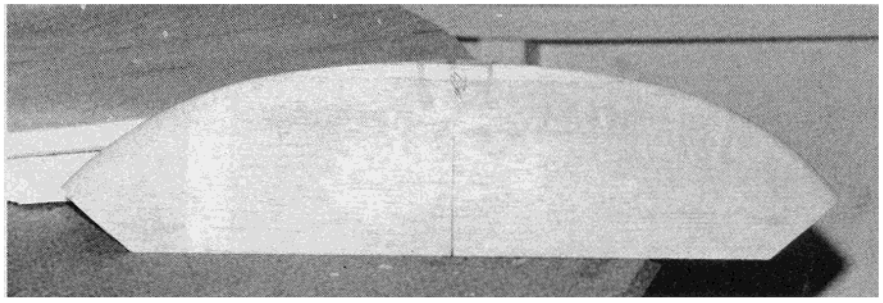
plywood wing dowel braces, top and bottom skins, and the leading edge.

Before joining the panels, it is probably more convenient to mark out and separate the ailerons. Note the section through the ailerons, and that the upper surface wing skin overhangs to form the "Frize" system. The aileron hinges are of the round "Robart" type fitted into 1/4" sheet extensions recessed into the main wing panel. These hinge brackets also reinforce the upper skin overhang. The aileron control cable tube is recessed into the lower wing surface and the slot filled with scrap balsa and sanded flush.

The three wing panels can now be joined. Cut slots right through the skins and core for the 1/4" sheet balsa dihedral braces. These have been used on the prototype in place of the more usual fiberglass "bandage" to preserve the smooth surface. They have proved more than sufficiently strong to cope with all normal aerobatics.

The next job is to install the U/C units and this may vary from type to type. A little forethought and studying of the plan will be necessary for the detail differences, but the overall method of fitting will remain the same for most commercial units. The first job is to mount the units to a piece of 1/4" ply about 3" x 2". Mark out on the wing skin, the position of the wheelwell and the center of the U/C leg pivot. Lay the retracted unit onto the wing, centering the wheel and pivot and draw around the ply mounting plate. Cut out and recess the wing under the plate just sufficiently to locate the unit. The wheelwell can now be cut out to the full depth of the section and lined with thin sheet. (Note: Be careful not to cut through the upper surface skin.) Next, operate the retract unit to lower the wheel. Now start to carefully and gradually cut away the foam under the mounting plate until the U/C legs take up the correct forwards and sideways rake. Use ply or cardboard templates to achieve this accurately. At this stage, the U/C **leg** will then be at the correct





LEFT & ABOVE: Both the horizontal stabilizer and vertical fin are made from lightweight 1/2" balsa sheet. If the builder prefers, he can make these items as hollow core assemblies to help reduce weight.

angles both in the up and down positions but the wheel **axle** will not track properly. Twist the axle until the wheel tracks correctly and you will find that the wheel will automatically fit much better in the wheelwell. When you are absolutely happy that all is correctly angled and located, the mounting plates can be epoxied to the wing. Fill in over the plate with a scrap balsa block and sand flush with the wing lower surface. Install all the remaining pushrods or air lines depending on your particular system. The original model was fitted with "Powermax" air retracts which have proved adequate for operating from smooth grass strips.

Finally, add the leading edge, tips, radiators, and all the other minor details. Sand smooth and you should have a beautiful elliptical wing.

Vertical Fin and Horizontal Stabilizer:

Both the vertical fin and horizontal stabilizer are made up from soft 1/2" balsa sheet. This wood should be kept as light as possible to help keep the weight down in the aft section of the plane.

Using the plans as a guide, shape the fin and stab to the outlines shown. Glue the two 1/2" fairing blocks to the sides of the vertical fin, and shape them to match the contour of the fuselage at the front, and to blend smoothly into the fin as they proceed back.

Alternately, the fin and stab could be built-up "hollow core" using 1/16" balsa skins and a lightweight 3/8" balsa framework. In any case, keep the its mating component and the outline on the plans. These parts are now ready for covering.

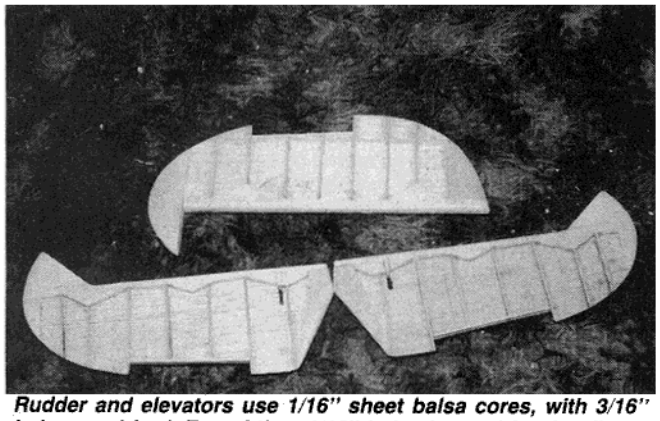
Finishing and Flying:

Use your own favorite methods for finishing and painting. The original had a dope/tissue covering and was painted with car cellulose paints.

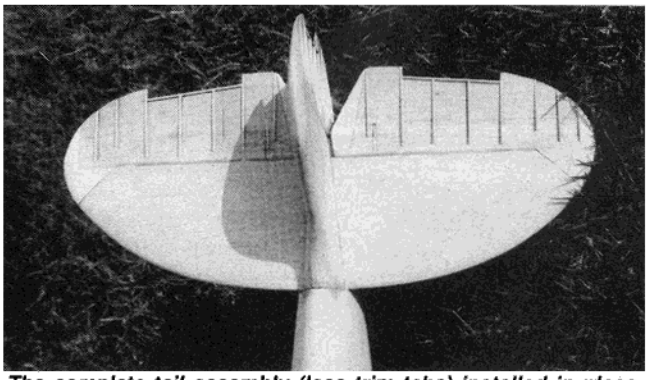
The final all-up weight should be around 8½ lbs. using 5 function R/C, and any 0.61 cu. in. 2-stroke is adequate power. Control surface travel: ailerons 3/8" up and down, elevator 1/2" up and down, rudder 3/4" left and right.

The model is fully aerobatic and has no vices, provided the C.G. is correctly located. It is **vital** that this is correct for trouble-free flying. Ballast should be added to the nose in whatever amount is necessary to achieve the correct balance point.

Good luck with your own model and don't forget to send in some photos and let us see your finished model. □



Rudder and elevators use 1/16" sheet balsa cores, with 3/16" balsa used for L.E. and tips. 1/16" balsa is used for the ribs.



The complete tail assembly (less trim tabs) installed in place. Note how smoothly the vertical fin matches the rear of the fuselage.

Rudder and Elevator:

The construction of both the rudder and elevator begins by cutting a piece of 1/16" balsa sheeting to the outlines shown on the plans. Next, cut the leading edge, tip, and any filler blocks from 3/16" balsa sheet and glue them in place on both sides of the 1/16" sheet. Add the 1/16" balsa ribs and shape each of the assemblies to match

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