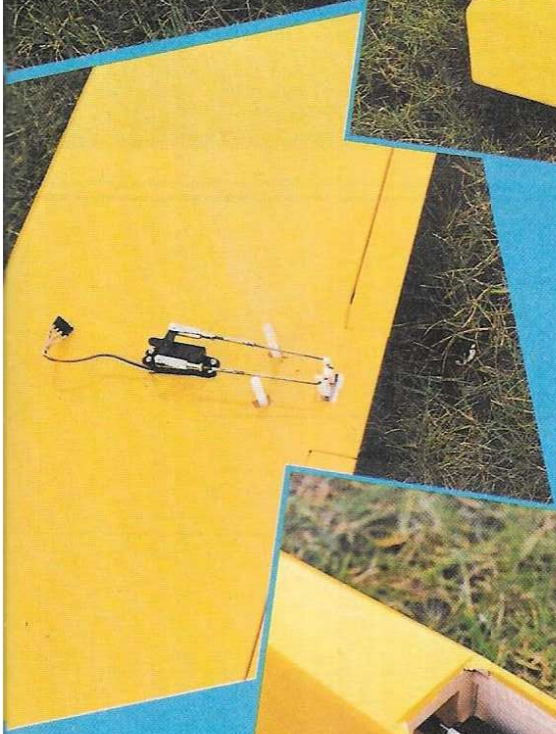
This lightweight electric sports model requires only budget buggy motor and cells to give a sprightly aerobatic performance. Right; Less vulnerable than a 'standard' tail, the V-tail requires a split pushrod for elevator control. Below right; Full span strip ailerons driven by a single micro servo.

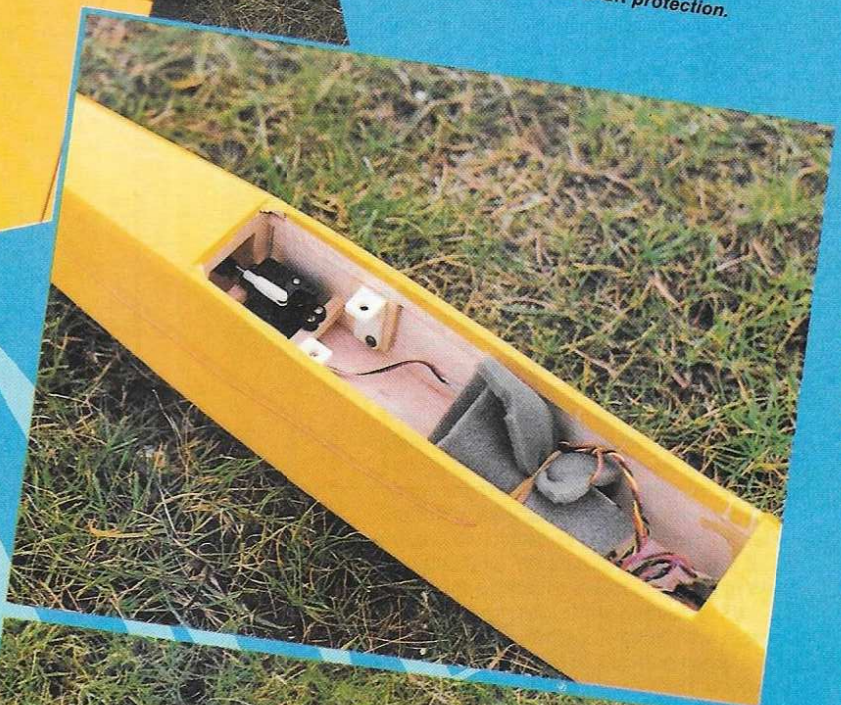
PROOF

Electric aerobatics on a shoestring with Dave Wilshere's Proof

THE INSPIRATION to design 'Proof' came when a member of my local club built a semi-aerobatic electric model from a kit. Although it flew reasonably well, nearly every landing caused something to bend or crack. It seemed to me that this was down to two things; it weighed too much and the flat-bottomed fuselage made the motor vulnerable to ground damage. With these points in mind, I drew the plans for Proof, hoping for an all-up-weight of around 2 1/2lb. The fuselage bottom was drawn curved with the lowest point falling below the Ni-Cad position to keep the motor shaft clear of the ground. To keep weight to a minimum a fully built-up structure was used,



Below; Simple radio installation with single fuselage mounted servo. Standard servos will fit but 'micros' used to save weight. Bottom; Ni-Cad access could not be more convenient with this large hatch. Battery compartment kept low for best weight distribution and motor shaft protection.



with very little use of ply. The model really does not need 'beefing-up' as the prototype has had over 150 flights without any damage. Lazy builders – do not be put off by the built-up wing, it is an evening's work.

The name 'Proof' came about because I wanted to prove to my local club's members that you could have a great performing electrical model without the need for an expensive motor/battery combination.

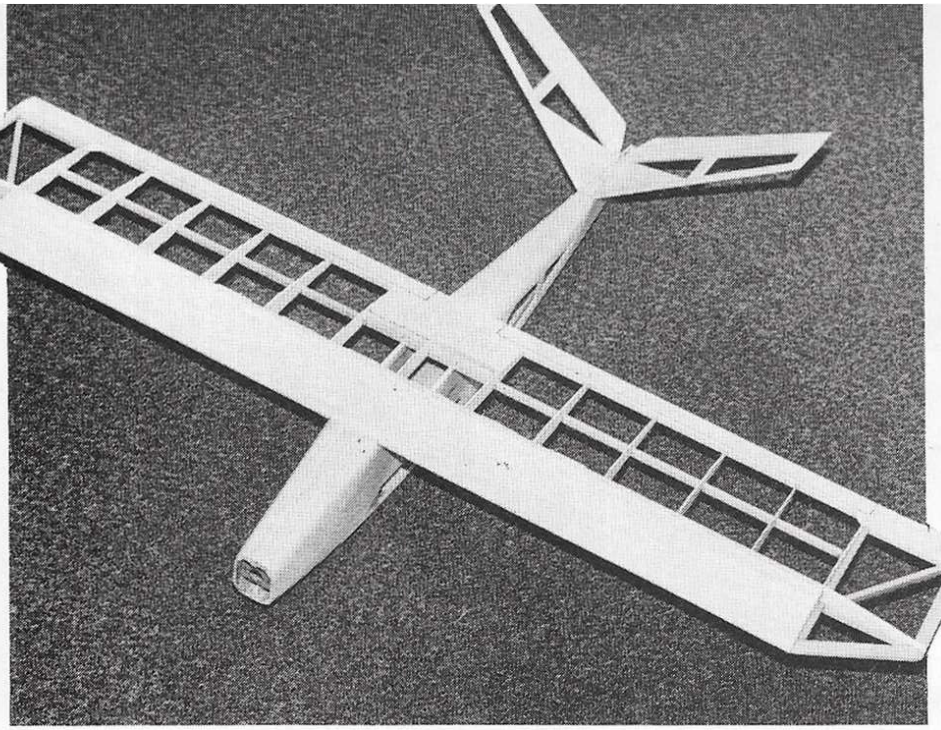
Wing

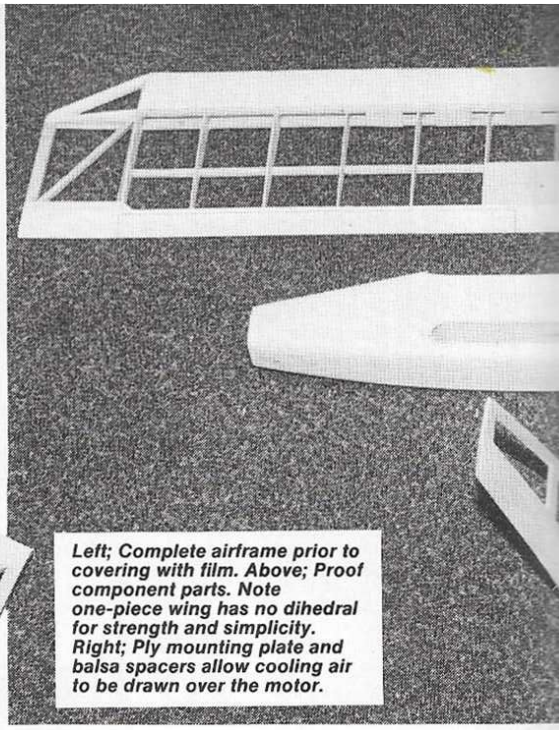
Start the model by building the wing first as it is useful to have a finished wing when completing the fuselage construction. The wing if built using 36in. lengths of wood; one piece and no waste. I always cut a rib template from cardboard or plywood and use it to draw out all the balsa ribs. It is worth the effort as the ribs come out exactly the same size . . . at least they should.

Lay the plan on a flat board and give it a good waxing to prevent any glue from sticking to it. Pin the trailing edge stock in position, followed by the 1/4in. square rear spar. Starting at the centre section, glue all ribs to the spar and trailing edge. I use medium cyano throughout the construction. Once all ribs are in position glue in the upper spar, checking that it sits down correctly in the rib slots. Pack up and attach the square leading edge and carve to the rib section using a sharp blade in a razor plane. Do not round-off the leading edge at this stage, as the leading edge sheet must be glued in place first. Pin the wing flat to the building board and cut the leading edge sheeting oversize and glue in place. When set, turn the wing over and pin back down to the board. Pack the trailing edge as necessary to keep the wing square and flat. Add the lower leading edge sheet and allow to dry. Remove from the board and rough carve the leading edge to shape. The wing tips are constructed from 1/4in. square and 3/8 × 1/4in. strip, using scrap trailing edge section to complete. Glue each tip to the wing and add gussets to strengthen. The wing can now be sanded and the vertical webs added to stiffen the structure, ensuring that no warps are built-in.

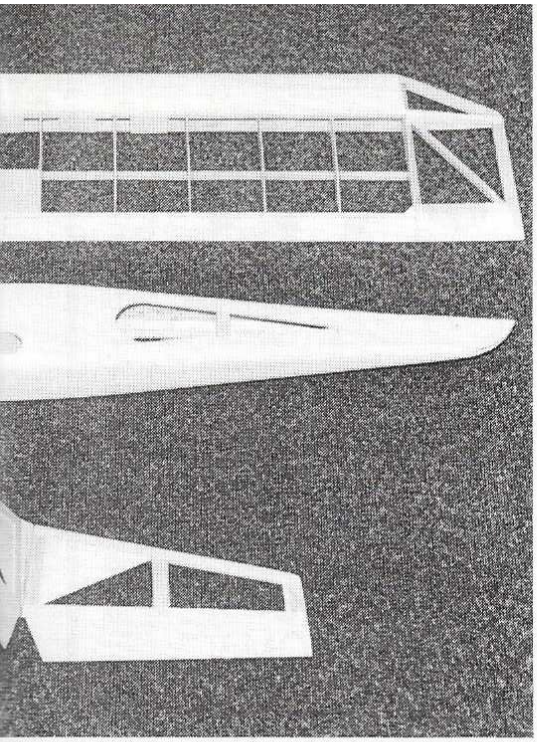
Fuselage

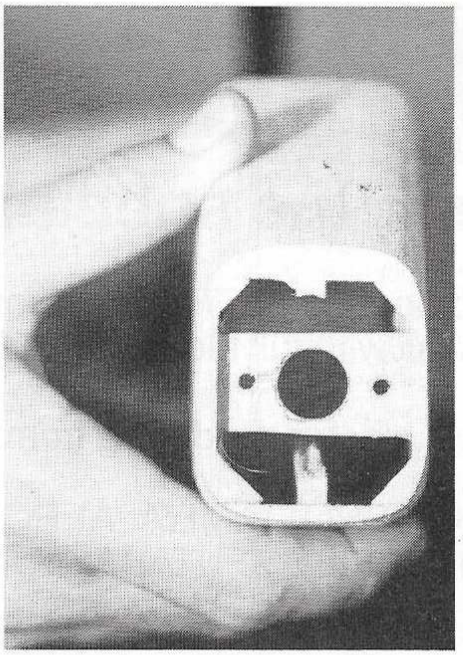
Cut the fuselage sides from medium 1/8in. sheet, making sure they are identical in size and weight. Do not cut out the battery slot or the lightening slots at this stage. Cut the two formers from 1/8in. sheet, marking the position of the battery floor on each. Cut out and attach the wing seating doublers to each side, making sure you make a left and right hand side! Add the triangular reinforcement using soft, flexible wood. A few saw cuts in the wood should help it bend to the curvature of the fuselage sides. Glue the two formers to one fuselage side at the front and rear of the wing seat, checking they are perpendicular and square to it. Add the radio compartment floor then the other fuselage side making sure it is correctly aligned. Allow to dry. The 1/16in. plywood motor mounting plate should be





Left; Complete airframe prior to covering with film. Above; Proof component parts. Note one-piece wing has no dihedral for strength and simplicity. Right; Ply mounting plate and balsa spacers allow cooling air to be drawn over the motor.





drilled to clear the boss of the motor and two mounting holes drilled to suit. The motor used in both prototypes was a Kyosho Le Mans 600E, which is one of the cheapest around with plenty of 'go' but a similar motor of your choice could, of course, be used. Glue the tailplane seat to one side of the fuselage and pull in the tail. Check that all is square and glue together. Sand the top and bottom of the fuselage using sandpaper taped to the building board before adding the upper and lower rear sheeting. Using a dummy front former cut from balsa, pull in the nose and attach the dummy former. Add the motor mounting gussets to the sides. The bottom central gusset should support the motor from underneath, the top one can be added later. This arrangement allows cooling air to be drawn over the motor. Glue a piece of 1/16in. ply to the front former. This will be drilled later to accept the wing dowel. Add the upper and lower nose sheeting then carve and sand until the triangular wood begins to show through. The position for the battery cut out and lightening holes can now be marked and cut out. Glue a piece of scrap sheet in the rear cut-outs as shown. The battery bay is lined with two pieces of 1/4in. balsa sheet. This allows the batteries to flex slightly. Cut out and glue the top motor gusset in place and check the motor is a nice snug fit. Remove the temporary balsa front former and slide the motor, bolted to the ply motor former, into position. When happy that there is sufficient propeller clearance glue in place. If using a spinner, allow at least 1/8in. clearance for cooling. Remove the motor.

The wing is held in position using a single front dowel and two Micro Mold wing bolts and right-angle brackets. Screw the bolt brackets to pieces of 1/8in. ply and glue these to the fuselage sides, leaning them backwards so that the wing bolts seat flat to the wing top surface. Drill the wing leading edge to accept the retaining dowel and mark its postion on the former using dab of paint on the front of the dowel. Drill the former and glue the dowel into the wing using thick cyano or epoxy.

The battery pack is retained using rubber bands stretched between a self tapping screw on each side of the battery slot. A simple Ni-Cad hatch could be used, but would require the addition of cooling slots.

Tailplane

The tailplane is a butterfly, or 'V' tail. The reason for this configuration is that with no undercarriage, a 'normal' tail is prone to damage when landing. The V tail also looks nice! Build the tail over the plan. Cut out the centre of the sandwich from lightweight, soft 1/16in. sheet. Do not cut the lightening holes yet. Glue the 1/2 × 1/16in. medium strip in place; this stiffens the tail. Sand the leading edge and hinge line angle and cut out between caps as shown. A solid sheet tail could be used, but would be heavier and not as strong. The elevators are simply cut from soft 3/16in. and sanded to section. Lightening holes can be added if desired. The tail centre section is cut from light but firm sheet and pinned to the building board. Prop the tail halves to the angle shown on the plan and glue to the centre section using thick cyano or epoxy. When set, remove from the board and lightly sand the joints.

Covering

Both prototypes were covered with Solarfilm but any lightweight covering can be used. Do not use Solartex or nylon coverings and don't forget this model does not require fuel-proofing! Hinge all surfaces using thin strips of Mylar, keeping all gaps to a minimum.

As the Proof is not a high speed heavy model, the loads on control surfaces are reduced and servos may be mounted on 1/4in. hard balsa bearers. Mini servos are better for keeping down the overall weight but 'full-size' servos will fit with no problems if they are mounted on their sides. My model uses a standard size World Electronics receiver with two mini servos and a new World Electronics speed controller and 110mAh battary pack. This gave an all-up-weight of 2 1/4lb. ready-to-fly, so if you use a standard size servos with a 500mAh pack, build light!

The elevator uses a split fork pushrod with soft wire that can be bent out through slots in the rear fuselage sides. The aileron movement should be set to a maximum of 1/4in. each way, elevator 1/2in. each way. These should be increased or reduced to suit personal flying styles.

Flying

The first flights of the prototype Proof were made on a warm summer evening, after our club's power flying time had elapsed; another good reason to fly electric! The first flight of any new design without an undercarriage calls for the help of an assistant to launch it, flying buddy Trevor Skedge provided the gentle shove into wind after a thorough check of the controls and the addition of a fully charged Ni-Cad. The speed at which the model climbed away surprised us both and I soon had enough height to switch off the motor, revealing a flat glide angle and very little loss of height. With power on the model is capable of loops and roll with ease. Loops can be very tight or large, ending with a fast beat-up along the strip with a wing-over at the end to bring it back. Landings are no problem, just remember that the glide is flat so you need to set-up the approach from a fair distance and float it in. Proof is capable of all manoeuvres that an aileron/elevator model can do. I hope you enjoy Proof as much as I do. I have built two as Trevor liked the model so much he insisted that I needed a new one to replace the prototype he wanted!