

Less 'n Extra

This model came about following a challenge from my flying mate Ian, to produce a small electric powered aerobatic model using the same cheap power plant and hardware as I had used in my first electric model, i.e. TOM-BOY (RCMW plan MW2977 September '02). That model proved to be a delightful first electric model but now we wanted a little more excitement.

The basic profile and design was worked up in an hour or so of doodling one wet Friday night. Next morning I visited the photocopy shop, and they enlarged my sketch to my pre-calculated full size and then it was a simple job to put the copy on the drawing board and trace over it so it came out straight. It really was as simple as that. I had a mental idea of how it was going to be built, and construction was underway before lunchtime. Apart from one or two fiddly bits brought about by its relatively small size, it has proved to be a very simple and practical build, I was also delighted with the subsequent flight testing. The model has proved to be more aerobatic than I had hoped for, and apart from a very fast roll-rate it performs not unlike a tiny version of my favourite old patterns from times past.

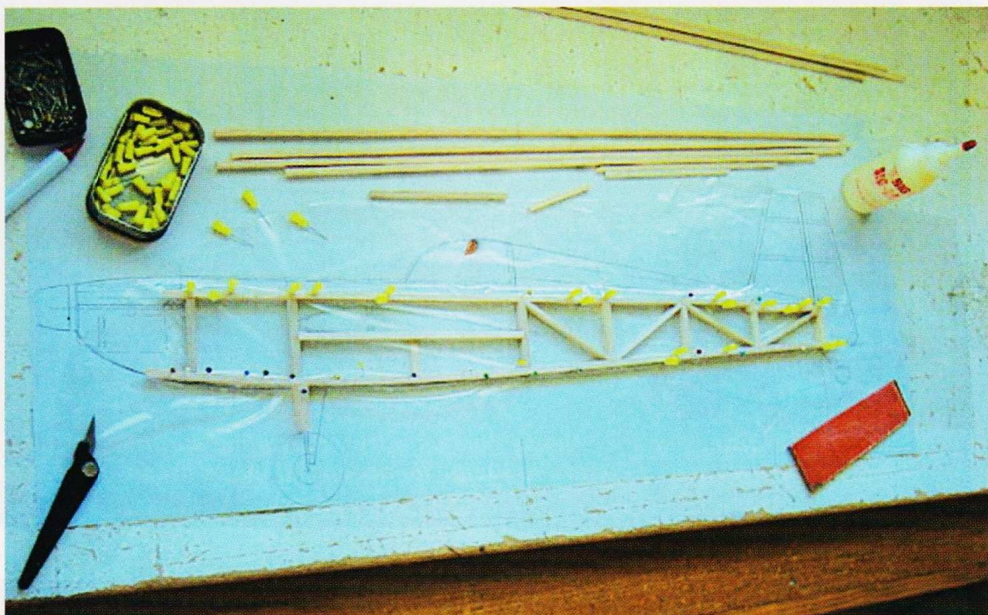
I stress this is not a beginners model, but should provide lots of cheap fun for anyone who can handle any of the current crop of .40 - .46 i/c powered sport aerobatic models. One important rule to apply here - build in lightness at every turn.

Construction Notes

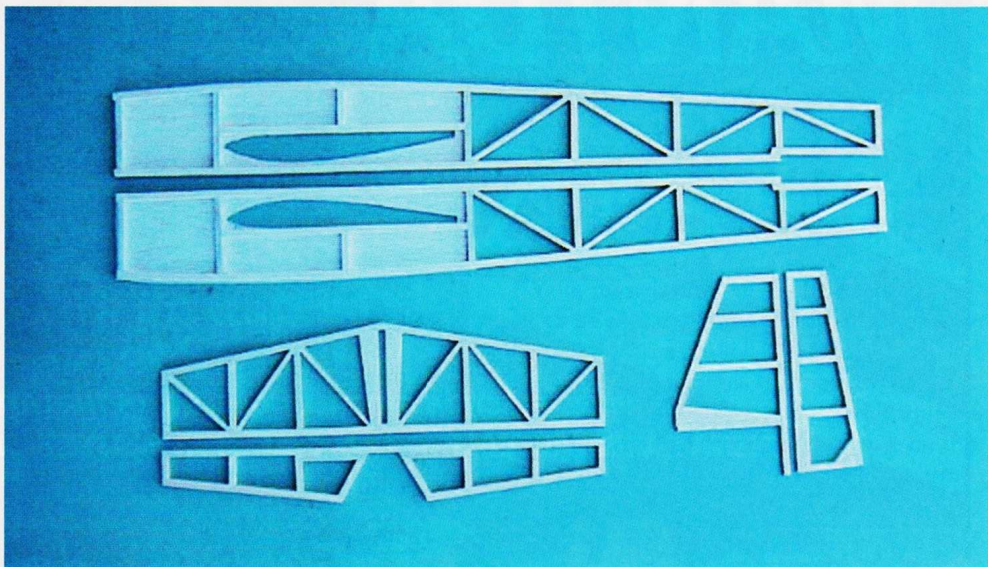
One of the main design criteria for this model was for a minimum practical finished weight in order for it to return maximum aerobatic performance. Consequently, there is very little wasted space which did make gear installation a little tricky for my big fingers however, it is a straightforward and simple build. It's a one-piece model but small enough to toss in the back of most small family cars. Construction is mostly balsa sticks with a little plywood in strategic places. The one-piece wing slides through the basic fuselage box and is glued permanently in place. The turtle deck is fabricated using balsa stringers over simple formers and the tailplane assembly is also fabricated from square balsa sticks. The prototype was covered with film.

FREE PLAN

A 36" wingspan electric powered sport aerobat for 400 size motors and 4-function R/C.



Use film over plan to prevent gluing wood to plan.



Completed fus sides, fin and stabiliser.

Access to the battery/motor plugs (no switches here) is via a relatively big top removable hatch. This is retained via a small spring-loaded catch made from a short piece of bent brazing rod inside a biro-pen spring running in a plastic tube. The Ni-Cads and two lower mounted servos are 'permanently' hidden behind two readily removable film patches

ironed over the two relevant bays on the fuselage underside. I did intend to fabricate small clip-in panels from 1/16" sheet balsa here, and the film patches were intended as a temporary fix only. In the event it has proved a practical fix, so I have left it that way. Most joints were glued using aliphatic glue and some 30 minute epoxy was used in high-stress

areas such as the u/c installation and gearbox mounting plate.

This model is still returning flights in excess of five minutes from the basic and affordable Rocket 400 motor fitted into the Mini-Olympus gear-reduction unit and powered with a pack of seven Sanyo KR-600AE cells. Early flights were carried out using a wooden Master Electric 9" x 4" prop, but I have since changed to an APC plastic 8" x 4" unit which seems to give a better performance. The prototype weighed in at 20% oz on digital kitchen scales.

Tailplane

Cut all stabiliser/elevator and fin/rudder components are medium 3/16" balsa sticks and soft sheet, and assembled over the plan. Sand all edges to half-round except the stabiliser TE which is left square.

Wing

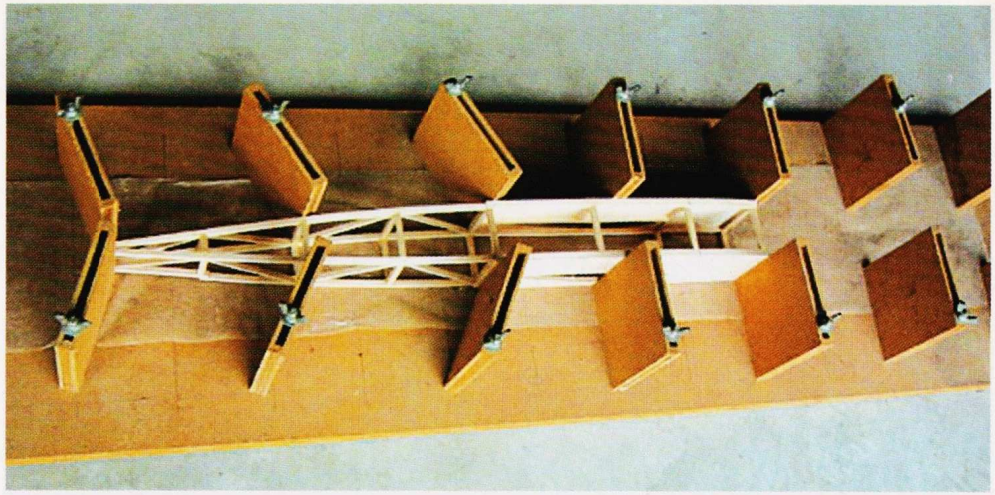
The wing is designed at 36" span to utilise most commonly available materials. I made a card template to basic R2 shape and marked out all ribs around this using a ball pen. Don't include spar cut-outs in the template - these are cut out with a razor saw later. Wrap ribs in masking tape to form a block and then drill them to accept two 1/8" bolts to hold the block together accurately. Remove tape and careful shaping with a razor plane and sandpaper will soon produce a stack of accurate similar-sized ribs. Cut the spar slots now before the block is dismantled. Plot the positions on the end ribs, square them across top and bottom and cut them with the razor saw.

TOP TIP

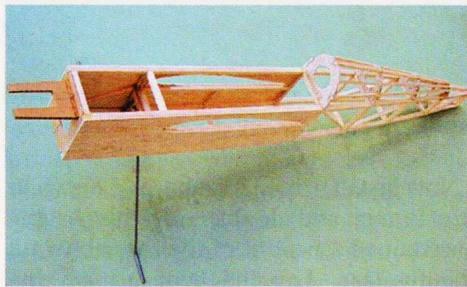
Number from 1 to 18 and retain that order for assembly.

The four ribs type R1 are further trimmed 1/16" all round to accommodate the later applied centre-section sheeting. I used both square and rectangular stock for the LE and TE and shaped with the razor plane after assembly. Use pre-shaped stock here if you can. Ensure your building board is FLAT!

Pin 3/8" x 1/4" TE to the plan having first cut the rib locating slots. Pin lower spar to plan using a rib as a guide for position. Align front edge of ribs. Use 1/16" balsa scrap to raise the four ribs R1 off the plan, and also raise the LE from plan using 1/4" scrap as spacer. Glue all ribs into place. Glue in top spar. Plane LE and TE to shape, apply both top and bottom sheeting and wing tips and sand



Fuselage jugged for assembly alignment.

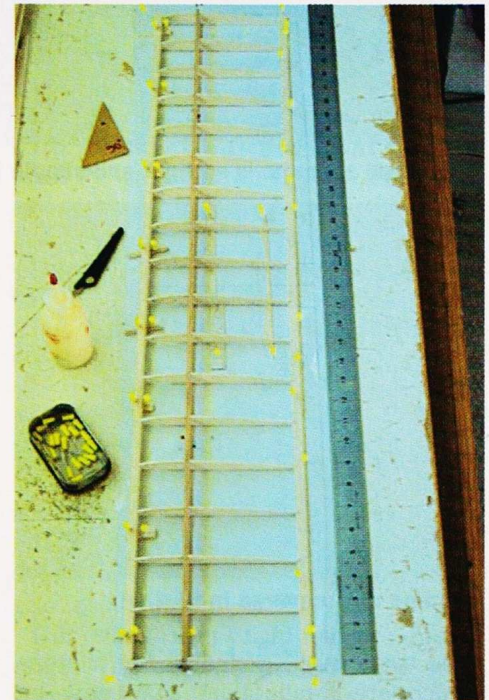


Fuselage is a very light basic construction. Note the motor mount.

it all to shape. I cut the ailerons from 3/16" medium balsa sheet. It is easier to plane and sand the wedge profile to shape before cutting them from the sheet. Bend the pair of torque rods from 16 swg steel wire. I slid a 3/4" plastic sleeve over each one before the last bend as a bearing to be glued to the TE after assembly. Mylar hinges were used on the prototype, so cut the slots now! DO NOT fix the ailerons to the wing yet - these are installed after the model is completed and covered.

Fuselage

Fabricate both fuselage sides from medium 3/16" sq. balsa sticks, one on top of the other over the plan. When dry, separate and glue the 1/16" balsa sheeting between the firewall and the wing TE to the outside of each fuselage side. Cut out the wing slots (mark out with a rib tem-



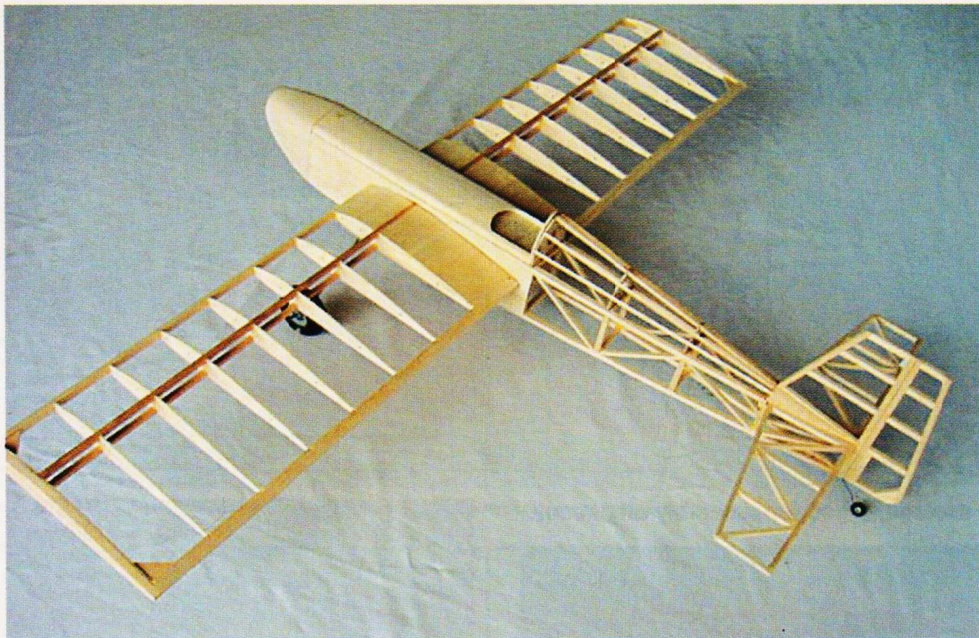
Can't get more basic than this for wing construction.

plate) to approximate size and shape in each side prior to joining the fuselage sides. The basic fuselage box is assembled inverted. The turtledeck can now be framed up using formers F3 - F6 and 1/8" sq balsa stringers.

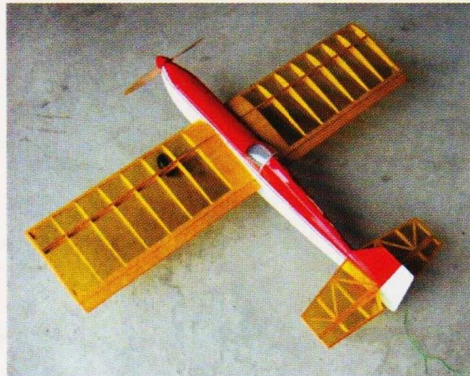
The soft 3/8" balsa top-block should now be glued in place and the whole nose area can now be planed and sanded to shape. It is easier to do this now before the wing is in place.

TOP TIP

The top stringer on the prototype broke twice (hangar-rash), so reinforce this one with a fin of 1/16" hard balsa on edge glued to the underside with one or two drops of cyano. The nose area may now be fabricated. Epoxy former F2 in place. Epoxy the motor-mount plate in position taking care that the plate is glued accurately at 90 degrees to the firewall. (The motor-mount plate shown is specifically for the Mini-Olympus gearbox.) Overall width and tapered sides of this plate are intended to accommodate the 3/8" soft balsa nose-cheeks which may now be epoxied to the firewall and edges of the motor-mount. When dry, the gearbox is temporarily installed with a prop-hub and spinner to enable the nose-ring F1 to be accurately placed and glued. Remove the gearbox and epoxy triangle balsa gussets around the top three edges of the motor-mount plate, side cheeks and firewall as reinforcing. DO NOT underestimate this requirement!



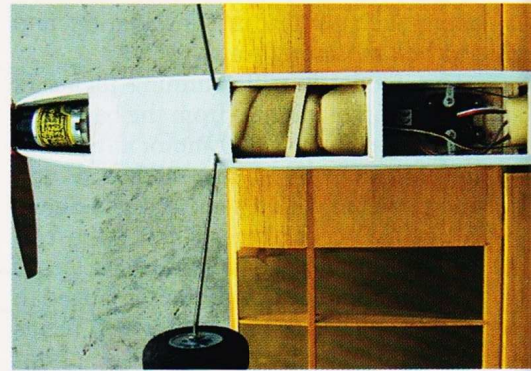
Completed airframe is so light and simple to build.



Airframe now covered in film.

The basic wing, excluding the ailerons (which are fitted later), may now be installed. This is a trial and error operation and the wing should sit level on the horizontal rails in the fuselage sides to maintain the zero-zero thrust line alignment. Take care to mount the wing true in all three planes and epoxy in place. Vertical grain 1/16" balsa sheet should now be glued inside the fuselage sides above the wing top surface as a reinforcing doubler. Maintain a neat hole, approximately 3/16" dia. immediately adjacent to the TE at both sides to accommodate the ailerons which are installed after the model is covered. Any gaps around the wing installation are filled with a mixture of micro-balloons and resin and sanded clean prior to covering. The fin is glued to the stabiliser before this assembly is glued to the fuselage. Check to ensure this is square. Before gluing the tail assembly to the fuselage the two fillets should be carved from soft 3/8" balsa. It is very easy to make a neat job of these if you make up a dummy fin/stabiliser inverted 'T' jig from scrap 3/16" balsa and temporarily tack this in place and carve the fillets to suit. Hollow out the underside for lightness. Glue the tailplane in place ensuring it aligns with the wing.

Now install u/c. Epoxy the 1/8" plywood u/c former and doubler together having ascertained a neat fit of the assembly into the fuselage. Lay the bent u/c on the assembly on the bench and draw around both sides of the inverted centre channel to mark the holes for sewing. Sew the u/c to the former assembly with thread. Keep the sewing reasonably tight so that the u/c wire holds firmly to the assembly. This assembly is now epoxied into the fuselage. When dry, adjust the sewn u/c so that the model sits level on its wheels and then seal the thread with epoxy to both sides of the former assembly. I bent up a simple lightweight tailwheel assembly from fine steel wire and fitted a 3/8" dia. wheel from a cheap 'Matchbox' type car. This assembly is epoxied into a slot cut in the fuselage bottom after covering. The top hatch is made up now. Lay a piece of film backing or grease-proof paper on the top of the fuselage so that the assembly will not stick to it, and build the hatch in situ. The hatch bottom is formed from cross-grain 1/16" balsa edge-joined prior to placement. Glue the 3/16" sq. balsa side rails in place. Glue the three hatch formers and cockpit former F3A into place. Chamfer the side rails to suit the profile. Consider how you



Underside access hatches and motor cooling.

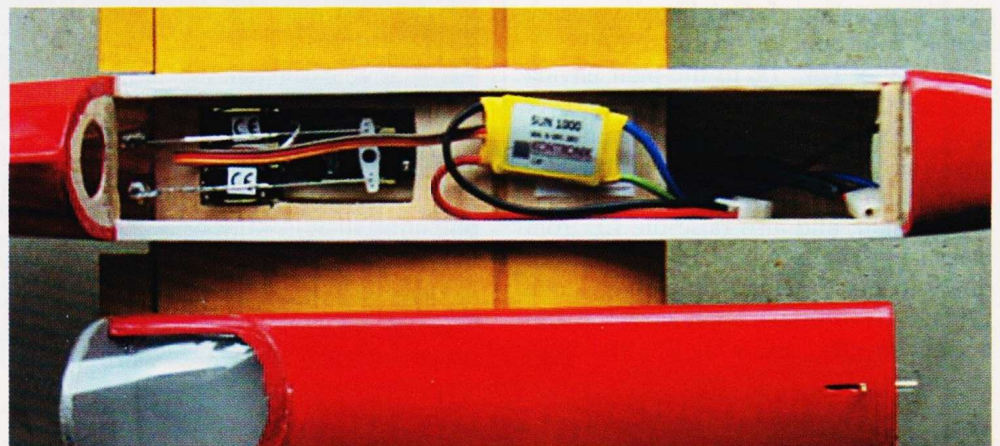
intend to hold this hatch down before gluing the top sheeting in place. I made up a neat spring-loaded catch using a biro spring, a short piece of soft 1/16" brazing rod and scrap plastic tube. It was fitted at the front of the hatch prior to sheeting and works well. The same job could be done using double-sided tape, Velcro, or Sellotape. I cut out the cockpit hole and painted the interior with grey acrylic paint prior to fitting the cockpit cover which was cut from a clear plastic soft drink bottle. Cut the hinge-slots for all control surfaces ready for assembly after covering. I cut the rudder horn from a sliver of Formica which is simply epoxied into a slot cut into rudder LE. If you choose similar, ensure the horn is fitted before rudder hinges are glued.

Do consider using lightweight covering material. I used translucent Solarfilm on the flying surfaces and opaque Easycoat on the fuselage. Both easy to apply and have proved quite durable. I just left two planned lower bays uncovered (for Ni-Cad pack, Rx, and lower servos), and then ironed film patches in place after installation was complete. I needed to go in there only once so far, and it's a simple matter to peel off the film patch, and re-apply when the job is done.

Assembly & Gear Installation

The ailerons are set up using conventional torque rods to a servo mounted in the top of the wing. The torque rods are

Topside radio installation. Note the full length hatch.



fed through the hole in the fuselage side at the wing TE, and the ailerons are then fitted to the wings. I glued the Mylar hinges into the ailerons before offering up to the wing. A little fiddly but it provides a neat finish. I couldn't find any small fittings to attach the servo rods to the torque rods so made my own from scrap aluminium extrusion. These were cut and filed to shape. As these were to be permanently epoxied to the top of each torque rod, I was careful that the holes were well over-size so that the epoxy could ooze well into the joint to provide a permanent fit. To arrive at the specified aileron throw of 3/16" each way, these fittings were fixed 3/4" up from the lower torque rod bend. This is not critical as there is a choice of holes at the servo output disc/arm. All pushrods are bent from 0.7 mm piano wire. At the ailerons, each pushrod is soldered together from two short wires. These have a 'Z' bend into each end and are taped together so the ailerons are level when the servo is at neutral. When aligned, the overlap is soldered. Rudder and elevator use a similar system. The servos are mounted into the underside of the wing and accessible from the fuselage bottom. I glued small pieces of scrap 1/16" plywood to the wing sheeting at the servo mounting screw positions for reinforcement. A small plastic snake tube is pre-installed and glued in place prior to covering. A 'Z' bend is formed in a long length of wire and fitted to the servo output arm. The wire is then fed down the tube to exit at the rear. The servo output arm is fitted at neutral position on the servo and a short piece of wire with a 'Z' bend into the rear horn is overlapped and soldered with the rudder/elevator also at neutral. I made the elevator horn from another scrap of aluminium 'T' extrusion and glued it to the elevator connector dowel. I drilled two fine holes through this assembly and pinned the horn to the dowel with two steel dressmaking pins and epoxied the assembly. Control throws are indicated on the drawing.

C of G is positioned on the mainspar. A little forward will not hurt; a little rearward may well prove terminal! To achieve the correct C of G, the Ni-Cads and Rx were positioned as shown on the plan. The Rx aerial wire runs along the bottom of the fuselage inside and exits through the tailpost and just trails in the wind. Masking tape is applied around the wire to prevent it from retreating back inside the fuselage.

Flying

My local strip is a full-size rural grass strip shared with some lightweight general aviation and ultralites, and is too rough



Flying made easy - but remember that the spin is fast!

for this little machine to consider ROG take-off, so the job fell to my wife to hand-launch it. There was a light breeze evident, but nothing to cause concern.

The model was launched more or less straight and level and zoomed away faster than expected (my electric flying until now was via my previous TOM-E-BOY). The first several flights were each cut short at under a minute when the motor stopped unexpectedly, but it was no problem to gently glide back to the strip.

Several days of soul-searching and questions followed before we discovered the problem was a faulty charger which had me flying on flat batteries. That problem solved it was all systems go. It still zoomed away on hand-launch but now kept going. The ailerons proved to be a little twitchy and returned a breathtaking roll-rate, but I am now attuned to that and it certainly can be handled. The model will stall quite



markedly when the throttle is closed and level flight held, and the spin rate is fast when stall-induced. Recovery is fast and crisp. Sustained inverted flight involves just a thought of down elevator, and bunts and loops from straight and level are no problem. I have flown this model from a well mowed grass strip since the original test flights, and it will leap into the air after a ground run of around three or four metres.

I'm no hot-shot aerobatic flier, but this little model brings back memories of my loved patternships from twenty years ago. Most flights have been carried out on almost continual full throttle, and I am gratified that most return a motor run in excess of five minutes with the current gear installation.

This small lightweight electric model project has certainly proved to be more successful than I had hoped for.

RCMW

Alan Wooster

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