

TERRIER ES

Build this fun-to-fly electric sport model. | by Al Clark

Extended editorial from
the January 2017 issue of
Model Aviation.

Construction

Making a “kit” of parts first, makes the construction go easier, so study the plans and make a rib template, cut the ribs and the other parts, and let’s get started building!

Landing Gear

I like to make the landing gear and tailwheel assembly first. The landing gear is made from $\frac{1}{8}$ -inch diameter music wire. You can bend this with vise grips and large pliers, but it is much easier using a wire bender such as the one supplied by Harry Higley. Pay close attention to the plans for the correct lengths and angles, and be sure to make a left and right gear.

The gear is designed to have 1° of camber and no toe-in or toe-out. It might take you a few tries to get it right, but music wire is inexpensive. Cut two pieces of $\frac{5}{32}$ -inch outer-diameter (OD) brass tube to fit into the Du-Bro 2.75-inch low-bounce wheels. These are used as bushings to allow the wheels to fit on the $\frac{1}{8}$ -inch diameter music wire landing gear.

When bending the $\frac{1}{16}$ -inch diameter music wire for the 1-inch diameter tail wheel and tail wheel bracket, don’t forget to put the wheel collar on before putting the wire through the tail wheel bracket and making the final bend. I used a small washer soldered to the wire on the inside of the tail wheel, and a wheel collar on the outside, to hold the tail wheel on.

Stabilizer and Elevator

The simple tail is made of medium $\frac{3}{16}$ -inch sheet balsa. If you are using 3-inch wide wood you will need to edge glue two pieces together to get enough width for the stabilizer. Cut the stabilizer and elevator pieces to size and glue on the cross-grained tips using medium CA glue or 5-minute epoxy.

Bend the $\frac{1}{8}$ -inch diameter elevator joiner wire.

Drill a hole into each elevator for the wire joiner, holding the elevator against a square block and using a drill press to make the two holes. After the holes are drilled, cut a slot in the front edge of each elevator to allow the wire joiner to sit flush with the front of the elevator.

Trial-fit the elevators and wire joiner, adjust the slots and/or wire if required, roughen the wire joiner using sandpaper, and glue the wire joiner with 5-minute epoxy. If you don’t have a drill press, you can just cut slots all the way through the elevators, glue in the wire joiner, and sand the glue flush after it cures.

After the wire joiner is glued into the elevators, draw a centerline along the front edges, cut the hinge slots with a #11 hobby knife, and bevel the front edges according to the plans. Draw a centerline along the aft edge of the stabilizer and cut the hinge slots. Note that there is no bevel on the aft edge of the stabilizer.

Sand the front of the tips to the shape shown in the top view. Dry fit the CA hinges into the stabilizer and elevator and adjust the length of the ends with a sanding block if required. Round off the outer edges and finish sanding with 220- and 400-grit sandpaper.

Fin and Rudder

Cut the fin and rudder to the shapes shown on the plans. Add the cross-grained pieces to the rudder using CA or 5-minute epoxy. Draw a centerline on the aft edge of the fin and leading edge of the rudder, and cut the hinge slots. Bevel the leading edge of the rudder according to the plans.

Cut out the notch in the rudder to clear the elevator joiner wire. Glue the short piece of inner Nyrod (or similar inner pushrod) to the bottom of the rudder using CA. Add a small piece of

fiberglass (2 ounces per yard or similar weight) around the inner Nyrod piece and glue with CA. Dry-fit the CA hinges into the fin and rudder and round off the outer edges. Sand with 220- and 400-grit sandpaper.

Wing

Use medium balsa for the wing, except for the spar webs, which should be fairly hard balsa. The first things to build are the four landing gear blocks. Make up one long piece and then cut it into the four pieces shown on the plans. Cut the pieces from $\frac{1}{8}$ -inch plywood and glue together with CA using some $\frac{1}{8}$ -inch music wire as a spacer to achieve the proper gap.

Glue the $\frac{1}{16}$ -inch plywood rib doublers to ribs W3 and W4 using 5-minute epoxy or CA glue. Note that one doubler goes on the inside of W3 and one goes on the outside of W4.

Cut the lower $\frac{1}{16}$ -inch balsa trailing edge (TE) sheeting to size and pin it down over the plans, using waxed paper to cover the plans. Cut the $\frac{3}{16}$ -inch balsa wing TE strip so it is slightly taller than shown on the plans (see section A-A) and sand the bottom edge at a slight angle to match the plans then glue it to the $\frac{1}{16}$ -inch TE sheeting.

Position the lower $\frac{1}{4}$ -inch square spruce spar cap over the plans and add $\frac{3}{16}$ -inch shims underneath near each rib position. Make sure the root end of the spar cap is correctly positioned and glue ribs W2 through W11 to the lower spar cap and TE sheeting using CA.

Glue rib W1 in place using the W1 rib angle gauge. Cut to size and glue in all of the spar webs from W1 to W11 with CA glue. Note there are three different thicknesses of spar webs. Make sure you get the correct thickness webs in the proper rib bays. Dry-fit the top spruce spar cap and make sure no webs are too tall; adjust as required.

When you are happy with the fit, glue the top spar cap into place using 15- or 30-minute epoxy. The epoxy will fill any small gaps that might exist between the spar webs and upper spar cap. Cut the upper $\frac{1}{16}$ -inch balsa TE sheeting to size and sand the aft edge to the slight angle required to allow it to fit tightly against the $\frac{3}{16}$ balsa TE strip, then glue it into place.

Sand off the top of the $\frac{3}{16}$ -inch balsa TE strip to make it flush with the upper $\frac{1}{16}$ -inch TE sheeting. Fit the $\frac{1}{4}$ -inch square balsa LE strip (this should be medium to hard balsa), adjust rib notches if required, and glue into place using CA glue.

Unpin the wing panel from the building board. Study the positioning of the long and short landing gear mounting blocks. Install the blocks using 5-minute epoxy, making sure to glue the long block to the lower spar cap as well as ribs W3 and W4. Add the three $\frac{1}{4}$ -inch triangular balsa reinforcement pieces. Sand the upper and lower edges of the $\frac{1}{4}$ -inch square balsa LE strip flush with the top and bottom edges of the ribs. Refer to section A-A on the plans. Be careful not to sand the ribs (add a temporary strip of masking tape across the ribs near the LE strip to prevent sanding into the ribs).

Sheeting the D-tube is next. Use medium-weight balsa for the D-tube sheeting. Cut the lower $\frac{1}{16}$ -inch balsa sheeting slightly oversize (remember to allow for the extra distance because of the rib curvature). Glue the sheeting to the spar cap, ribs, and LE strip. Remember the sheeting only goes halfway back on the spar cap.

Locate the slot for the landing gear block by running a $\frac{1}{8}$ -inch diameter drill through the vertical landing gear mounting block and through the lower sheeting, then trimming away the balsa sheeting to reveal the landing gear wire slot in the landing gear block.

Make sure the sheeting is glued to the landing gear block. Determine the position of the landing gear straps and cut away the $\frac{1}{16}$ -inch balsa sheeting to allow the straps to sit directly on the plywood landing gear mount. Mark the holes for the landing gear straps and drill with a $\frac{1}{16}$ -diameter drill bit.

Pin the wing panel back onto the building board with $\frac{1}{8}$ -inch thick shims under the spar near each rib location. Make sure the wing panel is pinned down well so no twist gets built in when you add the top D-tube sheeting, and make sure there are no pins placed that would end up inside the D-tube sheeting.

Cut the $\frac{1}{16}$ -inch balsa top D-tube sheeting slightly oversize. Make a pencil mark $\frac{1}{8}$ inch from the edge at each end of the upper spar cap. These will be used to align the aft edge of the D-tube sheeting. Glue the top D-tube sheeting into place as follows:

1. Apply Titebond glue on the edges of ribs W2 through W10.
2. Glue the back edge of the D-tube sheeting to the spar cap with CA (use the alignment marks you made).
3. Pull the sheeting snugly down over rib W6 and CA to the LE strip at the front of the rib.
4. Continue to pull the sheet down over each rib and CA to the LE strip at the front of each rib, alternately working your way out to the ends of the wing panel (W5, W7, then W4, W8, etc.).
5. CA the sheeting along the edges of ribs W1 and W11, then remove the wing panel from the building board.
6. Finish gluing the sheeting all along the LE strip. This completes the D-tube sheeting and no pins were required!

Cut, fit, and glue the $\frac{1}{16}$ -inch balsa top and bottom center section sheeting from ribs W1 to W4, and add all the $\frac{1}{16}$ x $\frac{1}{4}$ -inch balsa rib capstrips.

The TE stock and ailerons are made from medium $\frac{1}{2}$ -inch sheet balsa. The front edge is slightly thicker than $\frac{1}{2}$ inch so add a $\frac{1}{16}$ x $\frac{1}{4}$ -inch balsa strip to the top front of a $\frac{1}{2}$ x 1.5 x 29.25 inch piece of balsa. Shape the piece as shown on the plans (the view that has the $\frac{1}{16}$ x $\frac{1}{4}$ strip) using a razor plane and sanding block. This produces the basic TE stock.

Cut the piece into three sections (fixed-tip section, aileron section, and fixed inboard section) and lightly sand the ends of all three pieces. Make sure the ends are perpendicular and that they fit well with each other. Set the outboard and inboard pieces aside for

now.

Draw a line along the front edge of the long middle piece that is .32 inch from the bottom edge, then draw a line along the top .09 inch back from the edge, and a line along the bottom .12 inch back from the edge (refer to the view shown on the plans). Bevel the front edge with a sanding block using these three lines as a guide. The result is an aileron. Locate and cut the three hinge slots.

Bend up the aileron torque rod assemblies (left and right are mirror images) from $\frac{3}{32}$ -inch diameter music wire and don't forget to slide on the $\frac{1}{8}$ -inch OD brass tube before completing the bending! I used a Harry Higley wire bender for this but vise grips and linesman pliers will also work. Pay attention to the angles of the ends relative to each other. They should roughly 95°. The part that sticks out of the wing should be straight up when the aileron is at neutral; this gives some aileron differential after the pushrods are connected.

Make a $\frac{1}{8}$ -inch wide slot in the front of the inboard TE stock piece to fit the brass tube bearing of the aileron torque rod assembly. This slot should be centered .32 inch from the bottom. Cut some clearance for the horn to rotate aft. Using CA or 5-minute epoxy, carefully glue the aileron control horn assembly into the TE piece. Avoid getting any glue into the brass tube bearing.

The front edge of the brass tube should be flush with the front edge of the TE stock. After the glue has cured, fit-check this assembly against the wing's TE to make sure the proper airfoil shape is maintained, and then glue it onto the back of the wing's TE. Cut some clearance into the wing's TE to allow the control horn to rotate forward.

Draw a line along the back of the wing's TE, .32 inch up from the bottom edge. Locate the position of the hinge slots and cut them using the line as a guide. Drill the hole into the root end of the aileron and cut a slot for the $\frac{3}{32}$ -inch diameter music wire to fit into. Use a drill press and a square block, with a shim between the block and aileron, to keep the aileron perpendicular while drilling the hole.

Fit the aileron to the aileron torque rod assembly to make sure the aileron will fit well against the wing's TE. Dry-fit the aileron with its CA hinges, tape the root end at neutral, and use the outer end as a guide to glue the outboard TE stock piece to the wing's TE.

You should have gaps between $\frac{1}{32}$ and $\frac{1}{16}$ inch between the ends of the aileron and the fixed TE stock pieces. Add the $\frac{1}{2}$ -inch balsa wingtip and sand to the cross-section shape shown on the plans. Sand the entire wing panel and aileron with 220- and 400-grit sandpaper.

Repeat all these steps for the second wing panel. Dry-fit the ailerons to both wings and hold the two wing panels together to check if the aileron torque rods align with each other when the ailerons are both at neutral. Adjust the twist in one or both torque rods if required.

Check the fit of both panels at the center joint to make sure you have a total of 2 inches of dihedral (1 inch under each wingtip) and that the joint fits tightly. Touch it up with a sanding block if required, set a 2-inch block on the building board, and glue the two panels together with 15-minute epoxy, being careful not to introduce any twist between panels.

After the epoxy cures, sand the center joint area as required to get a flush joint and install 3-inch wide, 2 ounces per yard fiberglass around the entire joint using 30-minute epoxy. After the epoxy has cured, cut out the sheeting in the center of the wing behind the spar, to fit the aileron servo. Use a Dremel tool to cut out a portion of the two W1 center ribs to clear the aileron servo. Make a small notch on one side of the aileron cutout to clear the servo lead.

Glue the two $\frac{1}{4}$ -inch square spruce servo rails to the underside of the wing sheeting using 5-minute epoxy. Place the servo into position and mark the screw holes. Remove the servo, and drill the holes with a $\frac{1}{16}$ -inch diameter drill bit. The wing hold-down dowel will be installed later after match drilling with the fuselage former F2A.

Fuselage

Cut the fuselage sides from medium balsa. Cut the pushrod exit slot into

each side (note that these are in different places on the left and right side). Glue the vertical-grain $\frac{1}{16}$ -inch balsa doublers to each side (starting at the front edge of F5) using CA or a thin coating of 5-minute epoxy. Be sure to leave an accurately located gap for F1.

Add the $\frac{1}{8}$ -inch balsa stabilizer doublers and the small $\frac{1}{2}$ -inch wide balsa filler pieces at the aft ends. Sand a bevel onto the stabilizer doublers and filler pieces according to the plans' top view, and carefully make a shallow CA hinge notch in the filler pieces with an emery board. This notch only needs to be half the thickness of a CA hinge.

Glue the $\frac{1}{4}$ -inch balsa triangle along the bottom edges in front of F2A, up to the back of F1. Cut the two $\frac{1}{4}$ -inch square spruce longerons to length that go from F1 to just behind T4, and cut the $\frac{1}{2}$ -inch long notch into the aft end of each piece to clear F4. Glue these to the top edge of the fuselage sides using CA.

Position the upper $\frac{1}{16}$ -inch plywood servo rail rests as shown on the plans, and glue them in place. Position the $\frac{1}{4}$ -inch square battery shelf rails also as on the plans, leaving a gap at the front for the $\frac{1}{4}$ -inch triangular piece of balsa behind F1, and glue in place using CA. You are now ready to join the fuselage sides.

If you haven't already, glue the $\frac{1}{8}$ - and $\frac{1}{16}$ -inch balsa pieces together to make former F5 ($\frac{1}{8}$ -inch balsa goes on front), paying attention to the crossed-grain directions shown on the plans. Cut out the pushrod hole. Install the 4-40 blind nuts into F1 and add some CA glue to help hold them. Glue F1 to the right fuselage side using CA, making sure it is perpendicular. (A tiny amount of right thrust is allowable, but no left thrust!).

Glue F5 to the right side using CA, and make sure it is perpendicular. Turn the right fuselage side upside down on the building board with F1 hanging off the end so the fuselage side sits level on the board. Glue the left fuselage side, also upside down, to F1 and F5 using CA.

Make a pencil mark at the top center on the back side of F1 and F5. Draw a long, straight line on your building board. Position the fuselage upside down

with the center marks on F1 and F5 over the long line, and pin balsa scraps or strips along the outside of the fuselage near F1 and F5 to hold it centered over the long line.

Pull the aft ends of the fuselage sides together centered over the long line, check for perpendicularity using a square, and glue the aft ends together. Remove the fuselage from the building board and glue F4 in between the sides and up against F5, making sure to also glue the front corners into the notches in the $\frac{1}{4}$ -inch square spruce longerons at the top of the fuselage.

Add the $\frac{1}{4}$ -inch square balsa cross-piece at the front of F4, and the $\frac{1}{4}$ -inch square balsa cross-piece positioned under where T1 will go. If you haven't already done so, cut F2 and F2A from $\frac{1}{8}$ -inch plywood. The easy way to get a clean $\frac{1}{4}$ -inch diameter hole in F2A is to first drill the hole into some plywood then mark and cut the piece out.

Glue F2 and F2A in place using 5-minute epoxy. Add the $\frac{1}{4}$ -inch triangular balsa pieces to F2A. Fit F3 to the fuselage and glue into place between the fuselage sides and against F5 using CA or 5-minute epoxy. Add the $\frac{1}{4}$ -inch triangular balsa pieces.

Position the wing on the fuselage and check the fit to the wing saddle area of the fuselage. Small gaps in a few spots are no problem because they will be taken care of later. Improve the fit if required with a bit of sanding on the fuselage sides. Center the front of the wing exactly on the fuselage and tape it down with painter's or masking tape.

Use a 3-foot ruler to measure from the wingtips to the center of the fuselage at the aft end, adjusting the wing position until the two distances are equal, then tape the wing's TE to the fuselage. Sharpen the inside end of a 12-inch long piece of $\frac{1}{4}$ -inch diameter brass tube and use it to drill about $\frac{1}{8}$ inch deep into the wing's LE, through the $\frac{1}{4}$ -inch hole in F2A. Replace the brass tube with a long $\frac{1}{4}$ -inch drill bit and finish drilling into the wing to a depth of 1.75 inches.

Cut a piece of $\frac{1}{4}$ -inch diameter birch dowel to a length of 2 inches, round off the front end, and slide it into the hole you just drilled into the wing, but do not glue it yet. Place the wing, with the

dowel in place, back onto the fuselage and check the fit. If all looks good, remove the wing and glue the $\frac{1}{4}$ -inch dowel into place using 5-minute epoxy.

Add the $\frac{1}{4}$ -inch triangular balsa to the back of F1, leaving a gap for the battery shelf. Glue the $\frac{3}{16}$ -inch cross-grained balsa bottom to the front of the fuselage. Sand the aft portion of the $\frac{3}{16}$ -inch balsa bottom flush with F2, and sand the edges flush with the fuselage sides. Glue the $\frac{3}{32}$ -inch plywood tailwheel mounting plate to the aft fuselage bottom.

Glue the $\frac{3}{32}$ -inch cross-grained balsa to the fuselage bottom from the front of F5 back to the tailwheel mounting plate. Sand the edges flush with the fuselage sides. Position the tail wheel bracket according to the plans, mark the two holes, and drill with a $\frac{1}{16}$ -inch diameter bit. Cut the two air-cooling exit holes into the $\frac{3}{32}$ -inch fuselage bottom.

Place the wing back onto the fuselage, check the wingtip-to-tail distances again, and tape down the wing's TE. Mark the spots where the holes will be drilled for the two wing bolts. Drill through the wing and F3 at one of the wing bolt locations using a #21 drill bit, then run a 10-32 tap all the way through F3. Remove the tap, install a 10-32 nylon screw, and recheck the wingtip-to-tail distances.

Drill and tap the second wing bolt hole. Remove the wing, add CA into the tapped holes in F3, replace the wing, and run the 10-32 tap through the holes in F3 again. Now upsize the holes in the wing with a #9 drill bit, being careful not to drill into F3. Remove the wing, add CA into the holes in the wing, and run the #9 drill through the holes again to clean them up.

Depending upon the length of your 10-32 nylon bolts, you might want to shorten them to the length shown on the plans so they take less time to install and remove. This completes the wing mounting.

Cut the battery shelf from $\frac{1}{8}$ -inch light plywood, with the grain running across the fuselage and make the holes for the four screws, ESC wire, and Velcro strap. Add a $\frac{3}{4}$ -inch wide length of Velcro One-Wrap, sized to fit the 4S 4,500 mAh LiPo battery. I glue the One-

Wrap to the underside of the battery shelf so that it will remain in place.

On top of the battery shelf, coat the area near the aft end with a thin film of 5-minute epoxy, let it cure, and add two pieces of Velcro. These will interface with Velcro pieces on the LiPo battery and prevent it from moving fore and aft. Place the battery shelf into the fuselage tight against F1. Place the two 1.25-inch long pieces of $\frac{1}{4}$ -inch square spruce in position on top of the battery shelf and against F1, and glue them in place. Be careful not to glue them to the battery shelf!

Use a $\frac{1}{16}$ drill bit to drill through the four screw holes into the battery rails. I used a pin vise to hold the drill bit because there is not room for an electric drill. Four #2 sheet metal screws will be installed later to hold the battery shelf in place.

Study the plans for the hatch assembly and make the T4 angle gauge. Cut the hatch bottom from $\frac{1}{8}$ -inch medium balsa and make it slightly wide (use the outer lines on the base top view as a guide). Draw a centerline on the base plate. Locate and drill the two $\frac{3}{16}$ -inch diameter magnet holes (I used a sharpened brass tube for this). Glue a magnet into each hole, flush with the bottom surface, using CA glue. It helps to slightly roughen the edges of the magnets with sandpaper before gluing.

Sand the angle into the bottom of former T4 as shown on the plans. Mark the center on T2, T3, and T4, and glue them to the baseplate aligned on the centerline. Be sure to use the T4 angle gauge on T4. The edges of the baseplate must now be sanded so they are tangent to formers T2, T3, and T4. Because the heights of these three formers are all different, the angle on the edges of the base plate will also change from front to back, from more angle near the front to less near the back.

Sand a little at a time and check often by sighting along the edges from the front. After the baseplate edges have been sanded, you are ready to add the $\frac{1}{8}$ -inch balsa sheeting to the top of the hatch assembly.

Before sheeting the hatch, the baseplate must be temporarily attached to a piece of wood so it cannot twist or

bend during the sheeting process. You can use nearly any type of wood—just cut it so it is slightly narrower than the baseplate (I used leftover scrap $\frac{1}{2}$ -inch hard balsa). Tack the baseplate to the wood at the four corners using $\frac{3}{16}$ -inch diameter dots of CA glue.

Using a sanding block, carefully sand the top edges of T2, T3, and T4 so the edges will match with the underside of the sheeting. This is mainly necessary to remove the angled edge on former T4. Mark the top center on the edges of T2 and T4. The hatch sheeting will be done in two pieces using $\frac{1}{8}$ -inch A-grain balsa. Start with one side, cutting the balsa large so it will overhang the ends and lower edge by $\frac{1}{8}$ inch or so. Wet the outer surface of the balsa with water and let it sit for a couple minutes before gluing.

Align the top edge to the center marks on T2 and T4 and glue at T2, T3, and T4. Pull the sheeting down over T3 and glue it to the baseplate at T3, and to T3. Repeat for T2 and T4, and then glue the sheeting all along the baseplate edge. Repeat this process for the second piece of sheeting, except before starting, add some CA glue to the edge of T3, and then glue the two pieces of sheeting together on top along the centerline.

After the gluing is completed, let the wet sheeting dry and then remove the hatch assembly by cutting the tack glue spots loose with a razor blade. Sand the front, rear, and bottom edges flush.

Place the hatch into position on the fuselage and glue T1 to the $\frac{1}{4}$ -inch square balsa fuselage cross-piece using the front of the hatch as a guide to ensure a good match between T1 and T2 (don't glue the hatch!). Check again to make sure the hatch is in its proper position and use a long $\frac{1}{8}$ -inch diameter drill bit to drill a hole into T2, using the hole in T1 as a drill guide.

Glue a short piece of $\frac{1}{8}$ -inch diameter dowel into the hole in T2. This will be the front hatch hold-down. Refer to the fuselage top view on the plans and cut out the two $\frac{1}{8}$ -inch light plywood magnet holders, but do not make the holes yet.

Glue these two pieces into place using CA glue. Measure the positions of the two magnets on the hatch assembly and

make corresponding center marks on the two light plywood magnet holder pieces, then drill the $\frac{3}{16}$ -inch diameter holes. Roughen the outer edges of two magnets and glue them into place using CA glue. Make sure both magnets are in the correct orientation before gluing!

Place the hatch back onto the fuselage, push it up against T1, and center the aft end on the fuselage. Glue the two $\frac{3}{16}$ -inch balsa pieces to the underside of the hatch that serve as locators for the aft end of the hatch.

Cut a piece of $\frac{3}{4}$ -inch triangular balsa to fit between the sides at the lower front of the fuselage. Bevel the faces of the triangular stock so it fits well to the fuselage bottom and front edges and then glue it in place. The upper $\frac{3}{8}$ -inch triangular balsa is a curved piece, so regular $\frac{3}{8}$ -inch triangular stock cannot be used. Make a paper template for the curved upper piece from the plans front view and adhere it to some $\frac{3}{8}$ -inch balsa using rubber cement.

Cut the balsa following the lines of the template, except on top cut $\frac{3}{32}$ inch above the template line. Sand the backside of this piece so that it has a triangular shape (as shown in the fuselage side view). Glue this piece to the fuselage sides, paying attention to the proper location as shown in the fuselage front view. Apply some masking tape to the top edges of F1 and T1. Using a long sanding block and F1 and T1 as a guide, carefully sand the top edge of the $\frac{3}{8}$ -inch triangular piece down to the template line. Remove the paper template.

Fit and glue the two $\frac{1}{4}$ -inch triangular balsa pieces to the fuselage sides and bottom in front of F1 (these must fit well against the front lower $\frac{3}{4}$ -inch triangular balsa piece). Fit and glue the two $\frac{3}{8}$ -inch triangular balsa pieces to the fuselage sides at the front ends of the fuselage. These two triangular pieces must fit well to the lower $\frac{3}{4}$ -inch triangular balsa and the curved upper $\frac{3}{8}$ -inch triangular balsa pieces.

The $\frac{1}{8}$ -inch A-grain balsa top nose sheeting is done in two pieces as was the hatch sheeting. Make center marks on the top edges of T1, F1, and the upper nose triangular balsa. This time the lower edges of the sheeting pieces

will need to fit against the top edge of the fuselage before gluing. Start with one side and cut a piece of balsa that is oversized all around. Bevel the lower edge to match the upper fuselage edge. Here again, the angle on the bevel will become sharper as you go from T1 to the nose, so be sure to sand accordingly.

After you are happy with the fit at the upper fuselage edge, wet the outer surface of the balsa and let it sit for a couple minutes. Dry-fit the piece to the fuselage and mark the top where the centerline is, then trim the width to the centerline. Glue the lower edge to the upper edge of the fuselage, and then glue to T1, F1, and the upper nose triangular piece. Repeat for the second side, except use CA+ on F1 before installing. Glue the center seam along the top and let the balsa dry, then sand the ends and sides flush.

Cut a piece of hard $\frac{1}{8}$ -inch balsa to fit the front of the fuselage. Make the air intake hole as shown on the plans. This hole should be centered on the motor shaft. Sand the front edges of the fuselage if required to ensure that all of the wood pieces are flush, and glue the $\frac{1}{8}$ -inch hard balsa nose piece into place, making sure the air intake hole is properly positioned.

Carve and sand the side and top corners of the nose, and the lower fuselage in front of the wing, to the shapes shown on the plans and in the photos. The nose should end up looking like a typical homebuilt aircraft engine cowling. Cut the motor access hole into the $\frac{3}{16}$ -inch balsa fuselage bottom. Round off the lower edges of the fuselage behind the wing (refer to fuselage cross-section at T7 on the plans).

If you haven't already done so, use CA to make up turtledeck former T5 from $\frac{1}{8}$ -inch and $\frac{1}{16}$ -inch balsa ($\frac{1}{8}$ -inch balsa in front), paying attention to the cross-grain directions shown on the plans. Install the $\frac{1}{4}$ -inch square balsa crosspieces at the T6 and T7 locations using CA glue. Fit and install the three $\frac{1}{4}$ -inch square balsa diagonal braces using CA glue. Add T5, T6, and T7 making sure they are perpendicular. Use the stabilizer to exactly locate T8 (half of T8 should be over the stabilizer)

and glue into place (don't glue the stabilizer).

Make some templates of the stringer positions for T5 and T8 from the plans, and make marks on T5 and T8 where the stringers are located. The stringers are $\frac{3}{32} \times \frac{3}{16}$ -inch spruce. If you can't find $\frac{3}{32}$ -inch spruce, sand down some $\frac{1}{8}$ -inch spruce.

Install the top center stringer first using a straightedge or sighting from one end to make sure it is straight. Glue the stringer to T5 and T8 first, and then to T6 and T7. Do the same for the other six stringers. Add some fillets of CA glue to all of the stringer glue joints and apply CA accelerator. The balsa fairing blocks behind T8 will be made after the stabilizer is installed.

Wrap the wing where it rests against the fuselage on each side, with a 1-inch wide strip of covering material backing, such as the clear backing that comes from MonoKote. Pull the backing strip tight, make sure it is smooth, and tape the ends to the bottom of the wing. Mix some epoxy finishing resin and micro balloons together and apply a thin layer to the fuselage edges that contact the wing.

Place the wing onto the fuselage and install the wing bolts. The resin and micro balloons will squeeze out slightly from the joint between the wing and fuselage. Turn the model upright and leave it to cure overnight. The next day, remove the wing and remove the covering backing strips from the wing. Sand off the excess resin and micro balloons from the fuselage, and you will have a perfect fit of the wing to fuselage joint.

Place the wing back onto the fuselage and tighten the two nylon bolts. Place the model on a level surface and block up each wingtip equally. Place the stabilizer onto the fuselage and verify that it is level with the wing. If necessary, sand the top of the fuselage where the stabilizer mounts align the stabilizer with the wing. Remove the stabilizer and wing, and sand the entire fuselage with 220- and 400-grit sandpaper. Mask off the top of the fuselage (the F4 area) from the front of the T4 former position back to the front of T5, and spray with flat black paint.

Final Assembly

Vacuum the model well and cover it with your choice of film covering material. I used UltraCote. Cover the tail before installing it onto the fuselage. Remember to leave the gluing area uncovered under the stabilizer and on top of the stabilizer where it will be glued to the fuselage, fin, and fairing blocks. Leave the bottom of the fin that goes between the fairing blocks uncovered as well.

When covering the fuselage in the cockpit (F4) area, let the fuselage side covering lap over onto the top surface $\frac{3}{16}$ inch on the left and right side. This simulates the open cockpit fuselage side thickness in the cockpit area.

After the fuselage and tail are covered, glue the fin to the top of the stabilizer, making sure it is centered, square, and perpendicular. Glue the stabilizer to the fuselage with 15-minute epoxy, making sure it is centered and square with the fuselage centerline. Measure from the stabilizer tips to a point toward the front center of the fuselage to verify.

After the glue cures, cut and sand the two fairing blocks to shape that mount behind T8. Cover the fairing blocks and glue them into place using CA (but not so much that it squeezes out). Install the elevator and CA hinges, and glue the hinges. Install the tail wheel assembly onto the fuselage using two #2 sheet metal screws. Install the rudder and CA hinges, and glue the hinges.

Find a plastic soda straw that is roughly $\frac{1}{4}$ inch in diameter and cut it to 6 inches long. This will be the antenna tube for the Spektrum AR400 receiver. Make a $\frac{1}{4}$ -inch diameter hole in former F5 on the left side, slightly above the wing mount plate and against the fuselage side. Glue the soda straw into place approximately 2 inches in front of F5.

Make the rudder and elevator servo rails by gluing together two pieces of $\frac{1}{4}$ -inch square spruce with CA, trimming the width to $\frac{3}{8}$ inch wide, and then cutting each servo rail to fit inside the fuselage.

Position the servo rails inside the fuselage, resting against the $\frac{1}{16}$ -inch plywood pieces that were glued in earlier. Place the two $\frac{1}{16}$ -inch plywood

locking plates over the rails and then glue the rails and locking plates to the fuselage using CA glue. Position the rudder and elevator servos according to the plans, mark the holes, remove the servos, and drill the holes using a $\frac{1}{16}$ -diameter drill bit. Install the servos with screws and you are ready to make the pushrods.

Cut the elevator and rudder pushrods from $\frac{1}{4}$ -inch square spruce to the length shown on the plans. Make up the four $\frac{1}{16}$ -diameter music wire pushrod ends to the lengths shown on the plans. These each have a $\frac{1}{4}$ inch L bend on one end.

Drill $\frac{1}{16}$ -inch diameter holes into the spruce pushrods where the music wire L bends will be inserted. Insert each music wire L bend into the spruce pushrod, tack glue with CA, wrap with fishing line or strong thread, and apply some 5-minute epoxy along the wire and a thin coating over the thread wrapping.

Refer to the wing cross-section at W1 on the plans for a list of the hardware used on both ends of the rudder and elevator pushrods. Solder on the threaded couplers and solder links, and slide the pushrods into the fuselage and through their respective slots in the fuselage sides. Plug the servo leads into the receiver, turn on the radio, and set the servo arms to their neutral positions.

Attach the solder links to the servo arms and add the Kwik Links to the aft ends. Attach a control horn to the rudder pushrod, position it accurately on the rudder so the pushrod is centered in the fuselage slot, and glue the control horn to the rudder covering with a small drop of CA. Drill through the rudder horn and rudder using a $\frac{3}{32}$ -diameter drill bit, and install the control horn screws and backing plate. Repeat this for the elevator control horn. Adjust the rudder and elevator throws and exponential settings according to the plans.

Mount the receiver where shown on the left fuselage side using Velcro. Slide the long antenna down the soda straw antenna tube and push in a long skinny piece of soft foam rubber to prevent the antenna from vibrating and moving around inside the straw. Refer to the plans to see where the ESC is mounted, and apply a thin coat of 5-minute epoxy

to the fuselage bottom in this spot. When the epoxy is cured, apply a couple Velcro strips at this spot.

Get some $\frac{3}{8}$ -inch long standoffs to mount the motor, or make your own as I did. Simply glue three $\frac{1}{2}$ -inch wide pieces of $\frac{1}{8}$ -inch plywood together and then mark off four $\frac{1}{2}$ -inch lengths. Before cutting them off, mark the centers and drill $\frac{1}{8}$ -inch diameter holes through them. Cut off four pieces, sand the edges, and you have your four standoffs.

Attach the X mount to the back of the motor using blue Loctite on the screws. Put the motor through the hole in the bottom of the fuselage, slide the standoffs under the X mount (one position at a time), and install the 4-40 screws into the blind nuts using blue Loctite. Make sure the 4-40 screws don't stick out of the back of F1. Trim them off with a Dremel cutoff wheel before installing if necessary.

In the event of a hard landing or a crash, any screws sticking out could puncture the LiPo battery causing a fire! Feed the motor wires through the lower cooling slot on F1, hook up the ESC, and plug the ESC into the receiver to check the direction of motor rotation. When the rotation is set correctly, add some Velcro to the ESC and attach it to the bottom of the fuselage behind F1.

Slide the battery floor into position, bringing the ESC battery lead up through the hole in the battery floor, and install the four #2 screws. Tape the ESC receiver lead to the side of the fuselage, and coil up the excess servo leads so they are out of the way. Add a 3-inch extension lead to the receiver aileron slot so you will be able to connect the aileron servo lead coming from the wing.

Devise an instrument panel in whatever fashion you like and install it. I used Photoshop and PowerPoint to shape a panel that I printed onto photo paper with an inkjet printer. I oversprayed the panel with two light coats of Rust-Oleum Clear Enamel then cut it out and glued it in place with 5-minute epoxy.

Install some kind of pilot figure because an open cockpit model looks odd flying without a pilot! I installed an Airborne Models 75mm pilot figure by

removing the flat black paint under the pilot and gluing the figure to F4 using UHU POR glue. (Foam-Tac glue and probably even CA+ glue will also work.)

Cut the windshield from .020 Lexan to the shape shown on the plans, and bevel the lower inside edge as shown using a Dremel tool sanding drum and/or sanding block. Find two straight pins (dressmaker's type with small flat heads) and cut them off approximately 1/2 inch long. Select a small drill bit (PC board drill bit, for example) that is the same diameter as the straight pin, and drill a hole into the bottom lower corner on the left and right side of the windshield. Hold each corner of the windshield in its proper position on the hatch assembly and use the windshield hole as a guide to drill into T4 on the hatch assembly.

Install the windshield and the two straight pins, using a tiny bit of epoxy on the straight pins. Get some 1/4-inch wide striping tape that matches your covering and run it around the bottom edge of the windshield to attach it to

the hatch covering material. Use some 3/16-inch wide striping tape around the back edge of the windshield to simulate a windshield bow.

Install the aileron servo into the wing and make up the aileron pushrods according to the plans. Attach the pushrods and center the ailerons. Plug the servo into the receiver and check the aileron throws, adjusting them if required.

Install the 2.75-inch diameter wheels with brass tube bushings on the landing gear using wheel collars, and blue Loctite on the collar screws. Plug the landing gear assemblies into the wings and install the landing gear straps and screws. Use some bar soap on each screw to help it go into the hard wood more easily. Apply a strip of covering material over the landing gear slot and mounting straps.

Mark a 5-inch long line, using a fine Sharpie, across the bottom center of the wing at exactly 3.17-inches back from the wing's LE. This is the balance line.

Plug in the aileron servo lead and bolt the wing to the fuselage. Attach the 11 x 5.5 APC propeller and propeller adapter to the motor. Place the 4S 4,500 mAh LiPo battery on the battery shelf so it is roughly 1 inch ahead of the aft end of the battery shelf.

Put the hatch on and check the balance point of the model. Shift the LiPo battery to balance the model on the line with the fuselage level. Mine balanced with the aft end of the 4S 4,500 mAh 35C Turnigy Nano-Tech LiPo exactly 1 inch ahead of the aft end of the battery shelf. 🐕

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Sources:

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www.harryhigley.com

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