YAHOO 40

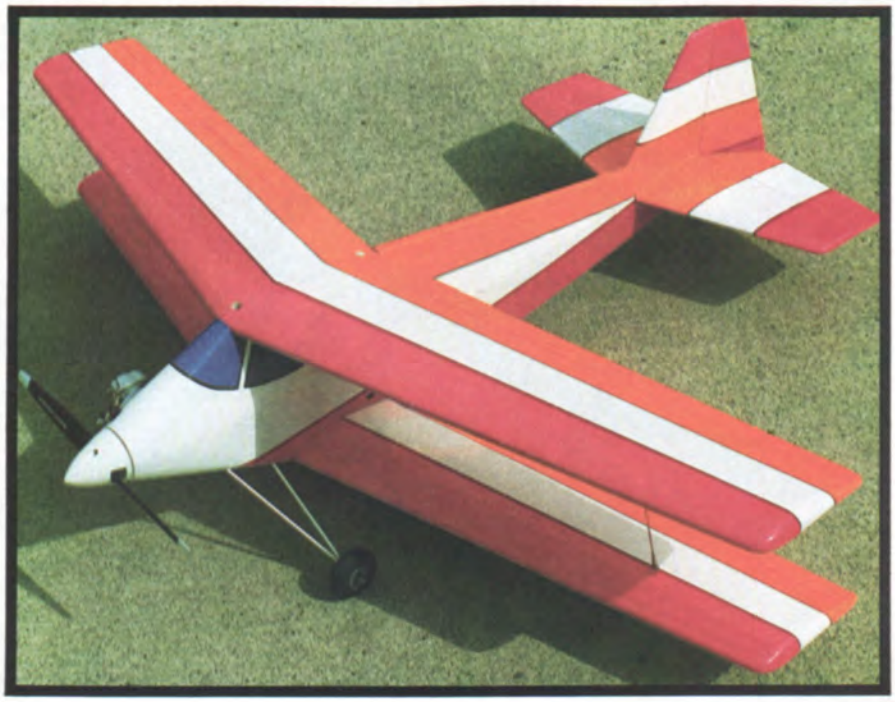
By Dave Harris

If doing wild aerobatics and extended knife-edge flight is what turns you on, then this is the one for you.

Why go to the trouble of designing your own airplane, when there are so many excellent kits and plans around? For me, it's fun, a challenge, and very satisfying; I can also get **exactly** what I want. In this case, I wanted an airplane that could do "everything in the book" and a bit more besides. In particular, I wanted an airplane that would do knife-edge maneuvers **really** well. I figured that this capability would allow even a dumb-thumb pilot like me to not only do respectable looking knife-edges, but would also improve other maneuvers such as four-point rolls.

The result is the subject of this article, which I've called the Yahoo for no particular reason. I've been flying it for the last four seasons, and have never enjoyed an airplane so much. It's a real hot-dogger's airplane, as many 40-sized bipes are, but is very well-mannered and can be slowed down and landed almost like a trainer. It does even better in knife-edge (and related maneuvers) than I had hoped, and will knife-edge loop easily. It will also do some things you've probably never seen before, which I'll describe later in this article.

The Yahoo has added a whole new dimension to my flying, and I'm sure it would do the same to yours.



YAHOO 40

Designed By:
Dave Harris
TYPE AIRCRAFT
Aerobatic Sport Biplane
WINGSPAN
45 Inches
WING CHORD
7 Inches (Avg.)
TOTAL WING AREA
630 Sq. In.
WING LOCATION
Biplane
AIRFOIL
Symmetrical
WING PLANFORM
Tapered, Swept Back
DIHEDRAL, EACH TIP
None
OVERALL FUSELAGE LENGTH
42 Inches
RADIO COMPARTMENT SIZE
(L) 6" x (W) 5" x (H) 3" (approx.)
STABILIZER SPAN
19.5 Inches
STABILIZER CHORD (incl. elev.)
7 Inches (Avg.)
STABILIZER AREA
130 Sq. In.
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Mid-Fuselage
VERTICAL FIN HEIGHT
7 Inches
VERTICAL FIN WIDTH (incl. rud.)
10 Inches
REC. ENGINE SIZE
.40-.46 2-stroke
FUEL TANK SIZE
8 Oz.
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Balsa & Foam
Empennage	Balsa & Foam
Wt. Ready To Fly	88 Ozs. (5 Lbs. 8 Ozs.)
Wing Loading	20 Oz./Sq. Ft.

Design Philosophy

Much of the Yahoo design is based on that soundest of engineering principles. TLAR (That Looks About Right). But I did have some design goals in mind. First, as I already said, I wanted an airplane that would knife-edge well. Biplanes are recognized as being superior in knife-edge, so a bipe it was. I didn't want to mess with cabane struts and the like, so the fuselage extends the full depth between the wings. I figured this might also "trap" the airflow and prevent it spilling over the top of the fuselage during a knife-edge. To avoid the fuselage looking too "heavy," I tapered it in at the top. (Incidentally, at least half the people who see the Yahoo say, "Ah. A Hots bipe." Well, this really bugs me, because the **only** thing the Yahoo has in common with the Hots is the triangular shape of the upper fuselage — so, please don't call this airplane a Hots bipe. Such a thing does exist, but this isn't it.) To continue, a bipe, with its higher drag, would tend to have a more constant speet, especially in vertical maneuvers — another feature I wanted. To get similar performance upright and inverted, I made the wings the same size and shape, with no dihedral, and put them the same distance from the centerline of the fuselage, with the thrust line and the horizontal stab on the centerline. I kept as much of the vertical stab area as was practical near to or below the centerline, to minimize roll coupling with yaw. The stagger in the wings is more for appearance than anything else; also, I've heard bad things about bipes with no stagger or a negative stagger (lower wing in front).

"Much of the Yahoo design is based on that soundest of engineering principles. TLAR (That Looks About Right)."

I made the airfoil symmetrical for good inverted performance, and fairly thick for good stability and a fair amount of drag. There are several aerodynamic advantages to both sweeping the wings back and to tapering them, hence the wing planform. The amounts of taper and sweep were strictly "TLAR." A tapered wing also has the advantage that the center area can be made to stall before the tips simply by using a constant leading edge radius. The tips then

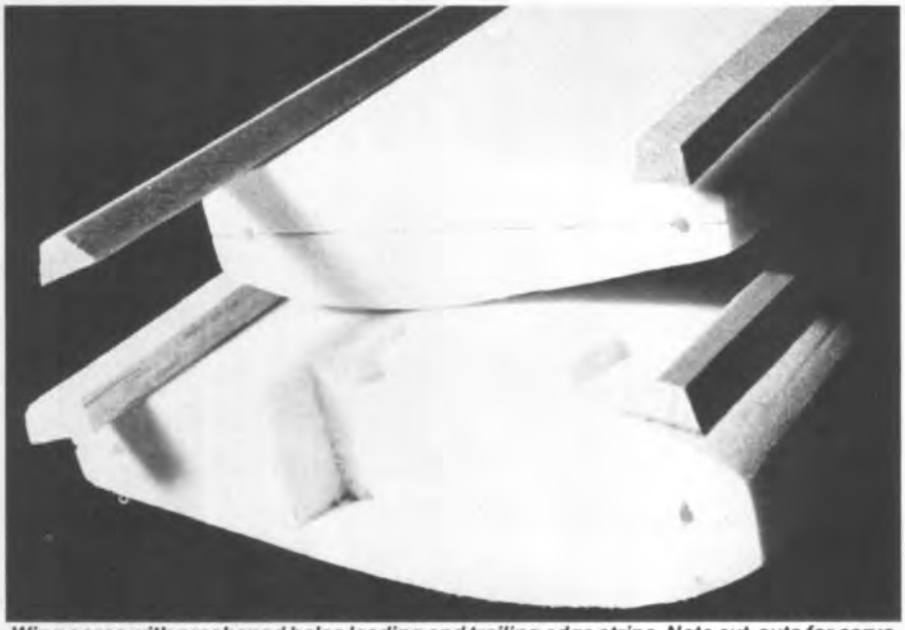
have a larger leading edge radius relative to the chord, and as is well known, a "blunt" leading edge improves the stall characteristics. This really does work, and has the advantage (over other methods such as washout) that the effect is the same both upright and inverted. I put ailerons on both wings, because to me it makes no sense to have one wing trying to fly level and the other trying to roll. Besides, it's easier to build two almost identical wings, and the aileron linkage is very simple.

I also used airfoil sections on the tail feathers. I'm not sure how much advantage this has over flat plate sections, but there must be some and the extra effort needed is not great.

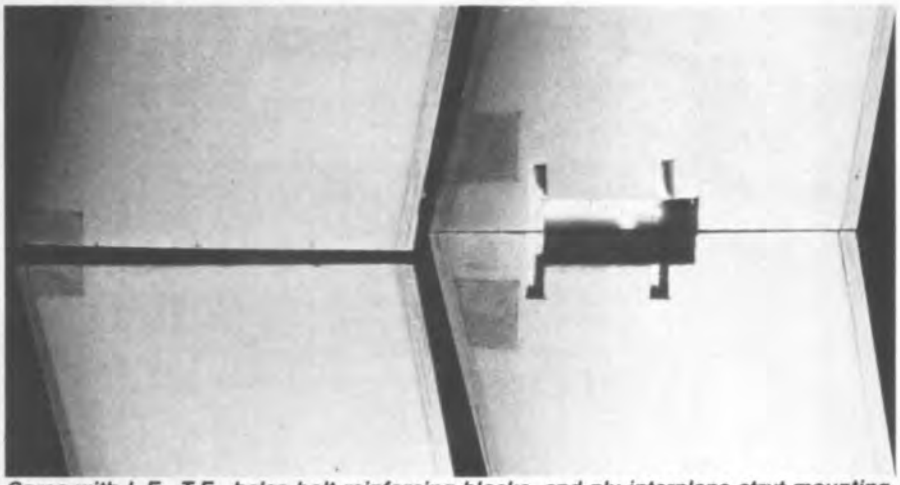
Again in the interest of similar performance upright and inverted, everything (both wings, horizontal stab, and engine thrust) is rigged at zero relative to the fuselage datum line. I've read that some positive stab incidence is needed on bipes, but I haven't noticed that; all the Yahoos I have built have needed no trim changes at all, except for perhaps a very small amount of up elevator trim.

From looking at the fuselage side view on the drawings, you may think that the C.G. is too far back. Not so — it's correct; the sweep and stagger of the wings give that impression. I calculated the C.G. position on the prototype by finding the point where 30% of the area of the wings, treated as a single unit in plan view, was in front of the C.G. and the rest was behind. This worked out just right; I've tried moving the C.G. position forward and backward then flight testing, but keep coming back to the position originally calculated and the one shown on the plans.

The landing gear is located at about the only place it could go, without being mounted in the wings. It may appear to be a bit far forward, but I've never had a problem with the ground handling and, of course, nose-overs are just about impossible. I make no apologies for the extra-solid landing gear mounting system (3/8" ply, tied to the ply fuselage sides with hardwood triangle stock). I've lost count of the number of airplanes I've seen that tear the gear out of the fuselage on anything but a perfect landing.



Wing cores with preshaped balsa leading and trailing edge strips. Note cut-outs for servo and servo mounting rails.



Cores with L.E., T.E., balsa bolt reinforcing blocks, and ply interplane strut mounting blocks installed.

CONSTRUCTION

I've kept the construction details quite brief, because the Yahoo isn't really a beginner's airplane and you should have a bit of experience with scratch-building before attempting it. Construction isn't difficult, but I suggest that you read through the instructions even if you intend to "do your own thing."

Included on the plans are two template sheets, showing various small parts. Photocopy these for use in producing the parts (be sure that the copier produces true 1:1 copies) or cut the template sheets themselves from the plans.

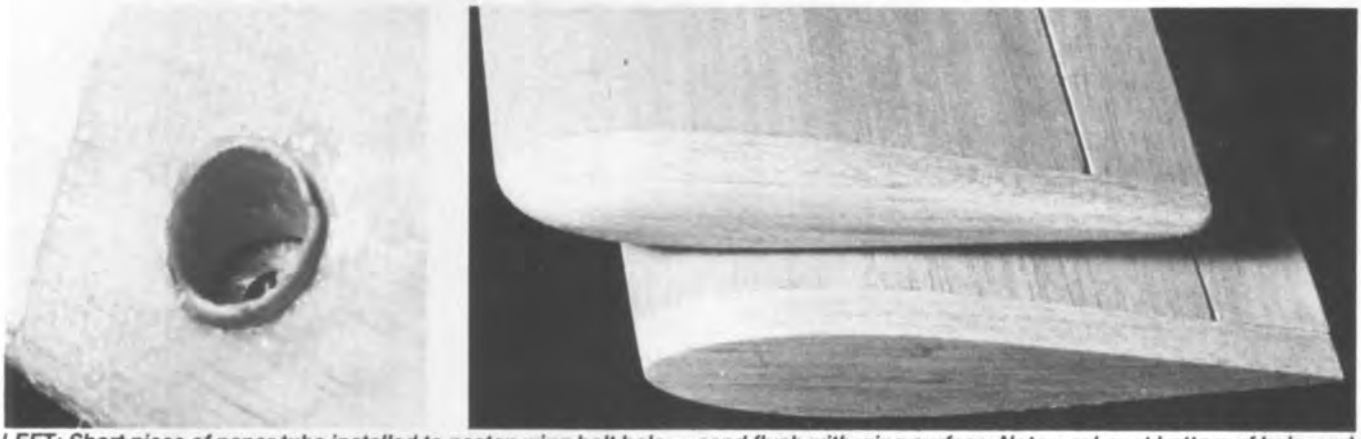
Avoid the use of epoxy unless absolutely necessary. Use cyanoacrylate (CA) glues whenever possible. For large surfaces such as plywood doublers and wing sheeting, use 3M 77 spray contact adhesive.

Wings:

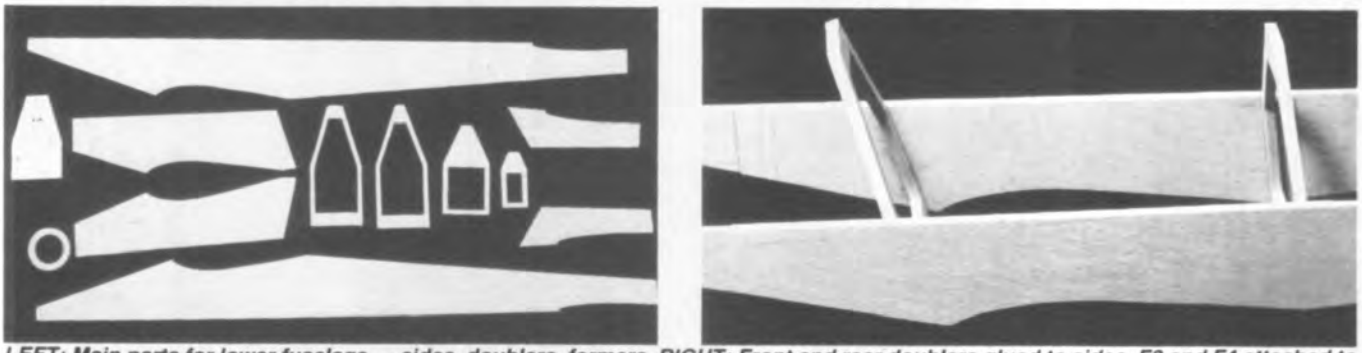
Decide which type of foam you want to use. Using blue foam (Styrofoam SM), the four cores for the Yahoo wings will weigh about 8 ozs. in total; you could save about 3 ozs. by using white foam. Your choice. Cut the cores, then mark each one — upper left, lower right, etc.

Make the cutouts for the balsa wing

LEFT: Lower wing sheeted, with center trailing edge piece and aileron torque rods. Note grooves for torque rod and arms. RIGHT: Center section of lower wing, with aileron.



LEFT: Short piece of paper tube installed to neaten wing bolt hole — sand flush with wing surface. Note washer at bottom of hole, and fiberglass center reinforcement. RIGHT: Wingtips made from 1/2" balsa sheet, sanded to airfoil contour and rounded.



LEFT: Main parts for lower fuselage — sides, doublers, formers. RIGHT: Front and rear doublers glued to sides, F3 and F4 attached to right side, then left side attached.

hold-down bolt blocks. Cut the blocks to shape and glue them in place. Make the interplane strut mounting blocks from 1/8" ply and install them flush with the wing surfaces. Locate these blocks accurately, or you'll have a hard time finding them once the sheeting is on the wings.

Make cutouts in the center of the lower wing cores for the aileron servo and the hardwood servo rails. Cut the wing leading and trailing edges from hard 1/4" balsa and glue them to the cores.

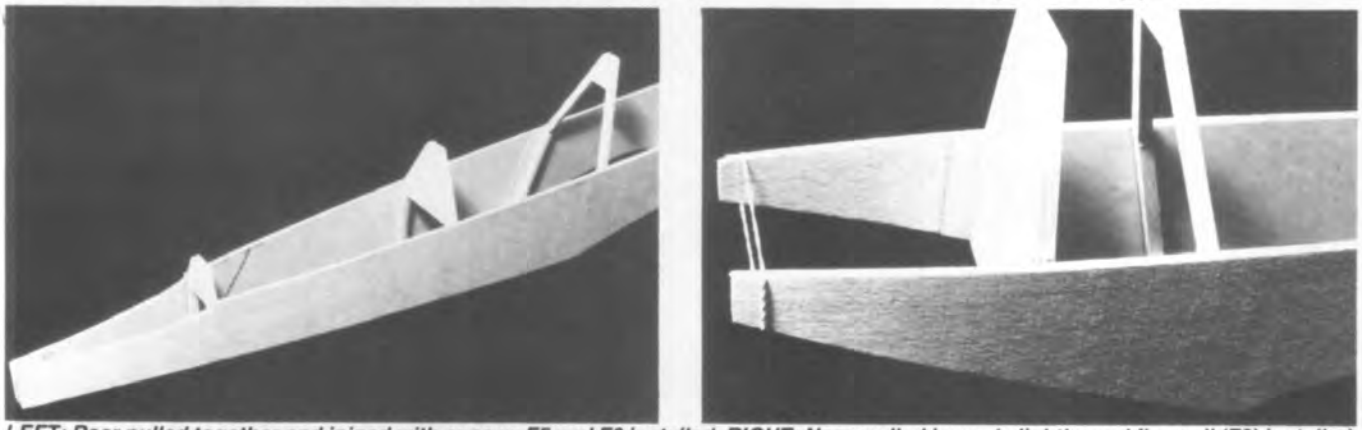
Prepare the eight sheets of 1/16" balsa needed for the wing skins, sand smooth, and apply to the cores using 3M 77 adhesive. Sand the sheeting at the centers flush with the cores, and check that the angle is right (no dihedral or anhedral). Also sand the trailing edge sheeting flush with the balsa edging, and sand the leading edges to shape. Be especially careful with the leading edge sanding; the radius on each of the four wing halves must be the same, and the radius must also be constant from root to tip. Glue the wing halves together.

Cut the two 1/16" ply center trailing edge pieces, and the 1/4" balsa pieces that go on the top and bottom of these, then glue together. Note that the ply piece for the lower wing is undercut and inset about 5/64" at the front to allow for the aileron torque rod groove. Cut the corresponding aileron torque rod groove in the trailing edge of the lower wing, and notches in the top of the wing to allow forward and backward movement of the vertical torque rod arms.

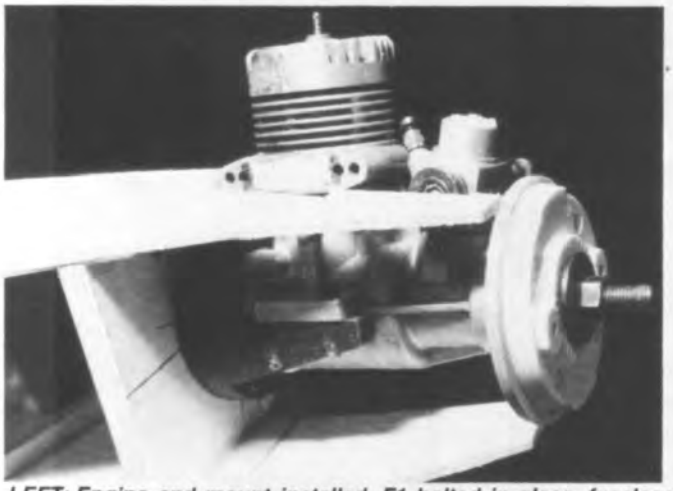
Make aileron torque rods from 1/8" piano wire and 1/8" i.d. brass tube. Don't use thinner or softer wire, or you may get aileron flutter. Check the fit, then glue the center trailing edge assemblies and torque rods to the wing. Add the balsa tip blocks, and sand to shape.

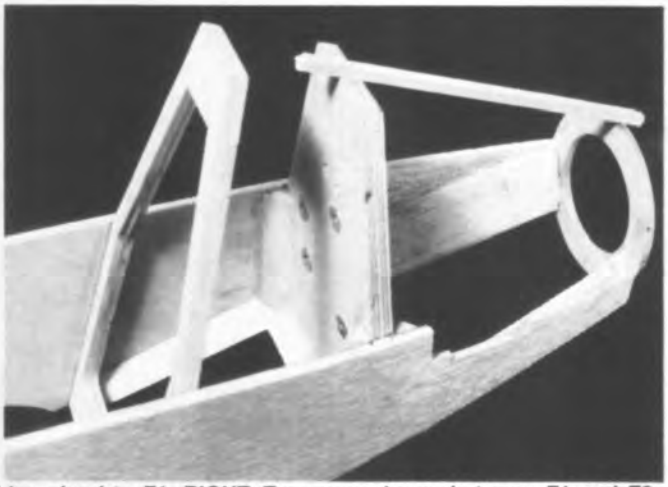
Mark the positions of the holes for the wing mounting bolts (two on the upper wing and four on the lower wing) and drill holes at these locations as far as the centerline of each wing at the front and the 1/16" plywood plate at the rear (drill from the top of the upper wing and the bottom of the lower wing).

Now lay the wings aside, and build the fuselage (as described later) to the point where it's ready for installation of the wings. Having done this, mount the wings onto the fuselage (as described in the section on building the fuselage) and drill through the wings and the mounting blocks in the fuselage using a 9/64" drill. Remove the wings and enlarge the wing bolt holes to clear a No. 10 bolt (3/16"). Using CA, glue 1/16" plywood washers (with a 3/16" center hole) into the bottom of each front wing bolt hole (the bottoms of the rear holes already consist of plywood).

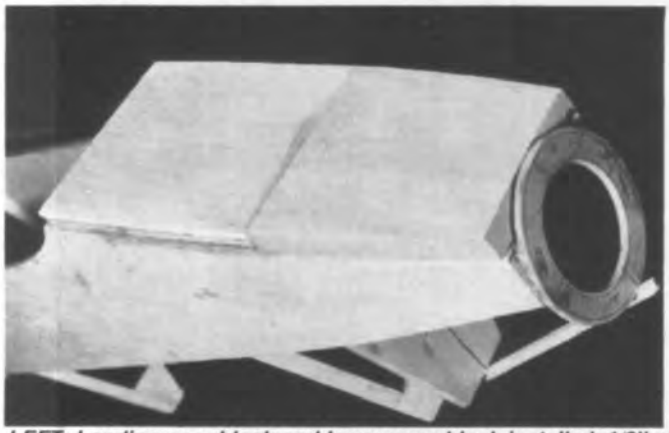


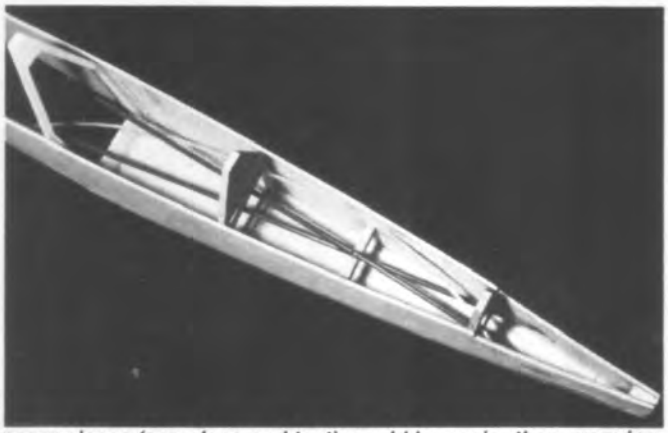
LEFT: Rear pulled together and joined with spacer; F5 and F6 installed. RIGHT: Nose pulled inward slightly, and fire wall (F2) installed.





LEFT: Engine and mount installed, F1 bolted in place, fuselage sides glued to F1. RIGHT: Temporary brace between F1 and F2; hardwood and balsa triangle stock installed.





LEFT: Landing gear block and lower nose block installed. 1/8" ply spacer pieces (see plans and text) would be easier than grooving block later as was done here. LEFT: Pushrod guide tubes and antenna tube installed; fuselage bottom attached.

Now make some paper tubes to neaten up the wing bolt holes. Take a piece of notepaper about 3" square, and roll it around a 1/2" diameter rod or dowel which has been covered with a layer or two of plastic wrap. Saturate the paper with thin CA and allow to harden. Cut the tube into short lengths and glue a piece into each wing bolt hole, being sure to center them. Fill any gaps between the tubes and the balsa sheeting, then trim and sand flush with the wing surface. Install the fiberglass center reinforcing, using CA or fiberglass resin. When cured, sand the fiberglassed area, apply some filler, and sand smooth.

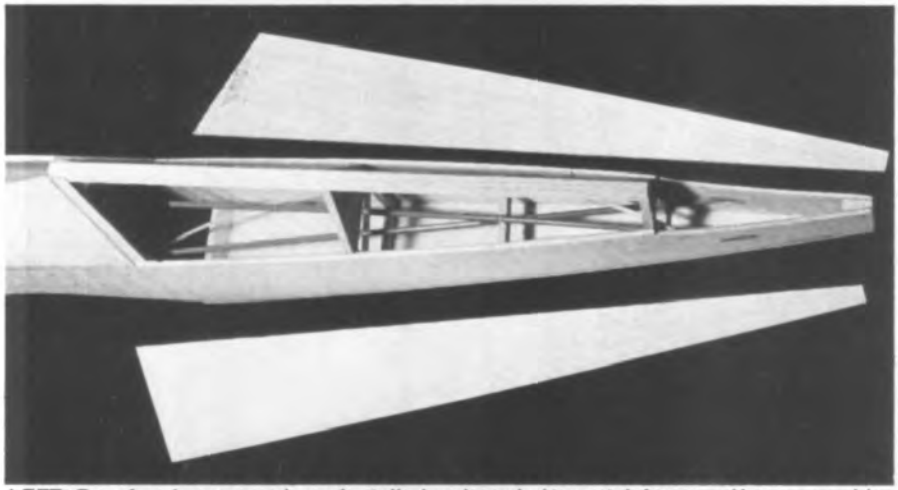
Make the ailerons from medium 1/2" balsa sheet. Make the interplane aileron and interplane strut connector horns from fiberglass-impregnated phenolic printed circuit board. Cut slots in the ailerons, and glue the horns in. Cut slots for the hinges in the ailerons and the wing trailing edges, then drill and groove the lower wing ailerons for the torque rods. Mark the positions of the interplane strut connector horns, and cut the slots using a 1/16" drill bit and a small file. The horns are installed after covering the wings.

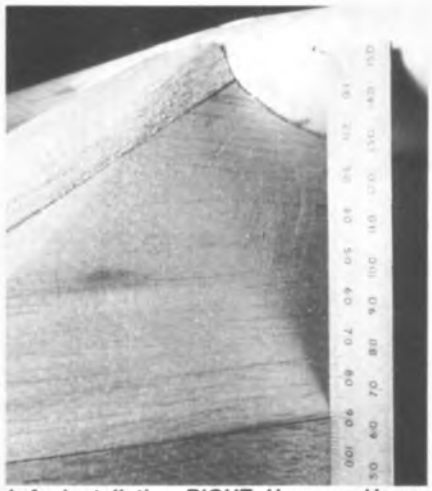
Horizontal Stab and Elevator:

Cut the horizontal stab foam cores. I find it easier to carve and sand the thin, highly tapered cores to shape rather than using a hot-wire cutter. Join the two halves. Glue the balsa trailing edge to the core. Tack glue an extra piece of hard 1/4" balsa to the trailing edge of the stab, and sand all the pieces of balsa to conform to the contours of the foam; the piece tack glued to the stab trailing edge will be the leading edge of the elevator. Remove this piece, and glue it to 1/16" balsa pieces cut to the shape of the elevator. Glue in some 1/4" balsa filler pieces, as shown on the plans. Now take some pieces of foam about 1/4" thick, and glue them to the elevator assemblies. Sand the foam and balsa filler pieces to conform to the shaped leading edge, and tapering to meet the 1/16" balsa at the trailing edge. Glue sheets of 1/16" balsa, cut to the shapes of the elevator, to these assemblies. Remove the elevator from the plans, cut the two halves apart, and sand to shape (including the leading edge bevels). Drill the holes for the 1/8" wire joiner, and cut

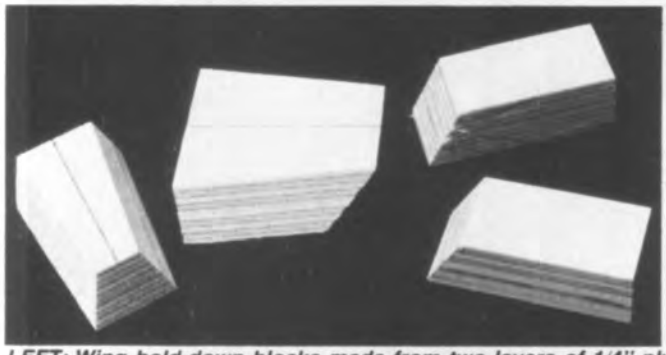
Front upper fuselage sides (with ply doublers) attached.

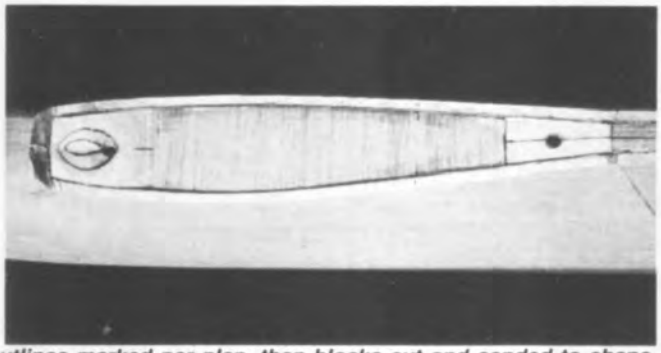
Top nose block installed.



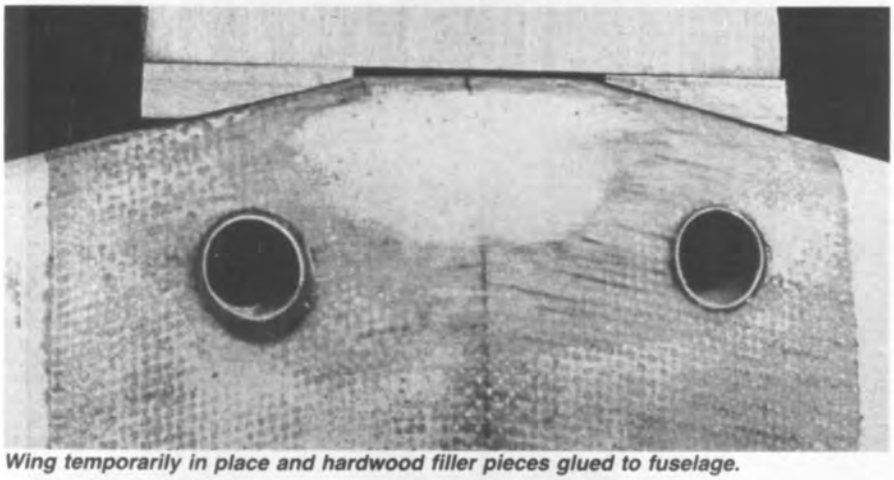


LEFT: Rear fuselage top stringer installed and sanded to match formers. Upper rear sides ready for installation. RIGHT: Upper and lower wing saddles sanded to give zero incidence. Measure from airfoil centerline to fuselage datum line, leading and trailing edges. Take your time and get this right.





LEFT: Wing hold-down blocks made from two layers of 1/4" ply; outlines marked per plan, then blocks cut and sanded to shape. RIGHT: Upper wing hold-down blocks and cross-grain balsa filler piece installed. Front block hollowed slightly to receive "point" of wing, then blocks drilled and tapped.



Wing temporarily in place and hardwood filler pieces glued to fuselage.

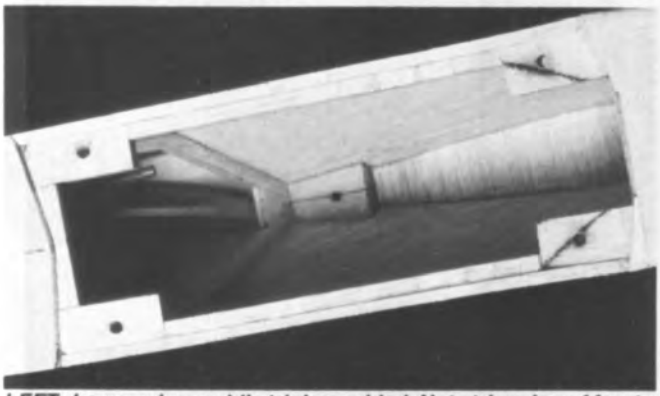
grooves so that the front of the joiner is on the stab/elevator hinge line. Bend the joiner from 1/8" piano wire (don't use a thinner or softer wire) and glue to the elevator halves. Complete the stab by adding the balsa leading edges and sheeting.

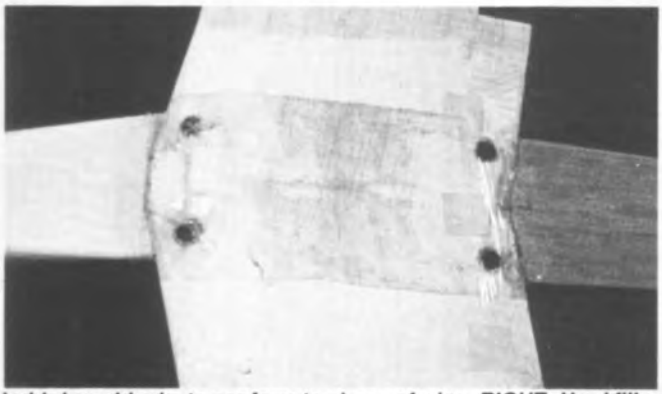
Harden the control horn mounting area with CA. Using a straight pin, prick holes all the way through the elevator over an area about 1/4" larger all around than the horn mounting plate. Saturate this area with thin CA, allow to cure, and sand smooth.

Make the hinge slots and sand the stab and elevator to final shape.

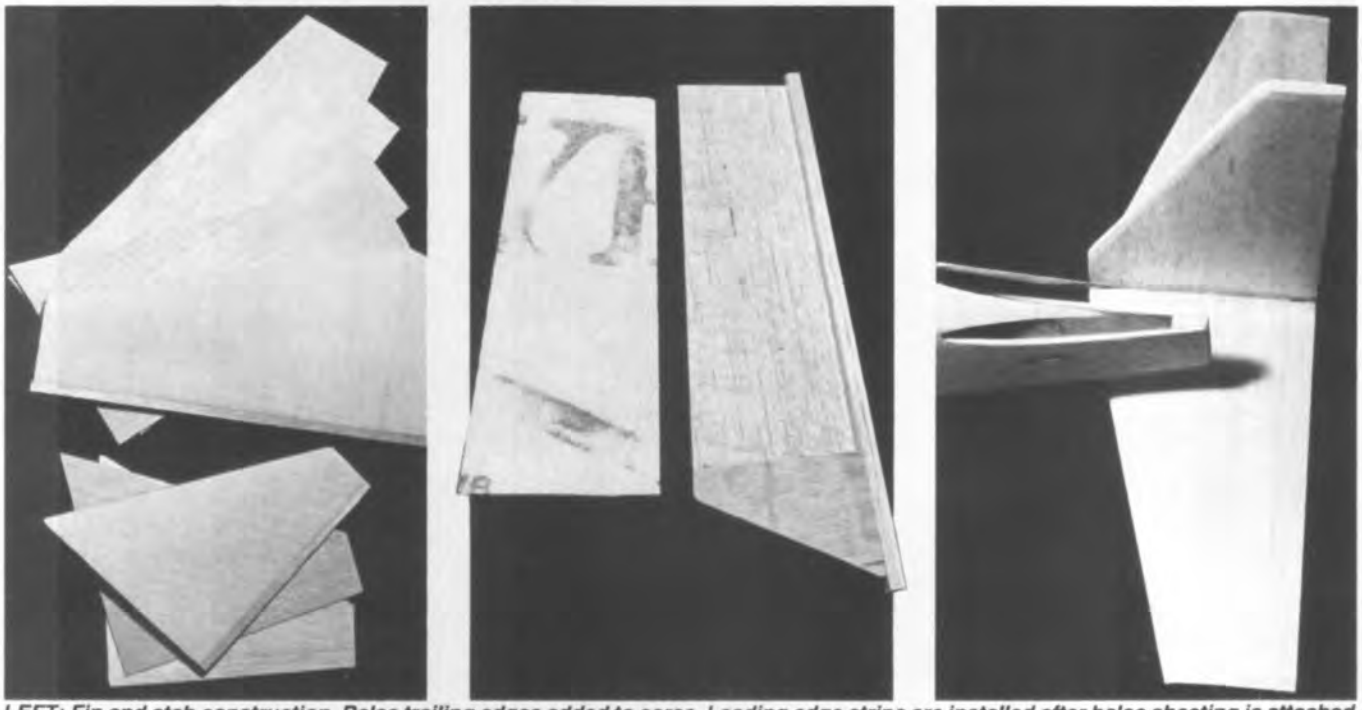
Fin and Rudder:

Make the fin and rudder in the same way as the stab and elevator. Sand to shape and





LEFT: Lower wing saddle triplers added. Note trimming of front wing hold-down blocks to conform to shape of wing. RIGHT: Hard filler (such as microballoons and epoxy) applied to lower wing saddle area, then plastic wrap taped to center of wing and wing bolted in place. Excess filler will be sanded off when dry and wing has been removed.



LEFT: Fin and stab construction. Balsa trailing edges added to cores. Leading edge strips are installed after balsa sheeting is attached and trimmed. CENTER: Typical elevator and rudder construction — preshaped L.E., bottom balsa sheet, balsa insert, foam core. Foam is glued in place and sanded to shape, then top balsa sheet is installed. RIGHT: Completed fin and horizontal stabilizer, glued together.

cut the slot in the bottom edge for the tail wheel arm. Also cut out a semicircular shape to clear the elevator joiner wire. Harden the control horn mounting area with CA. Make the hinge slots and sand the fin and rudder to final shape.

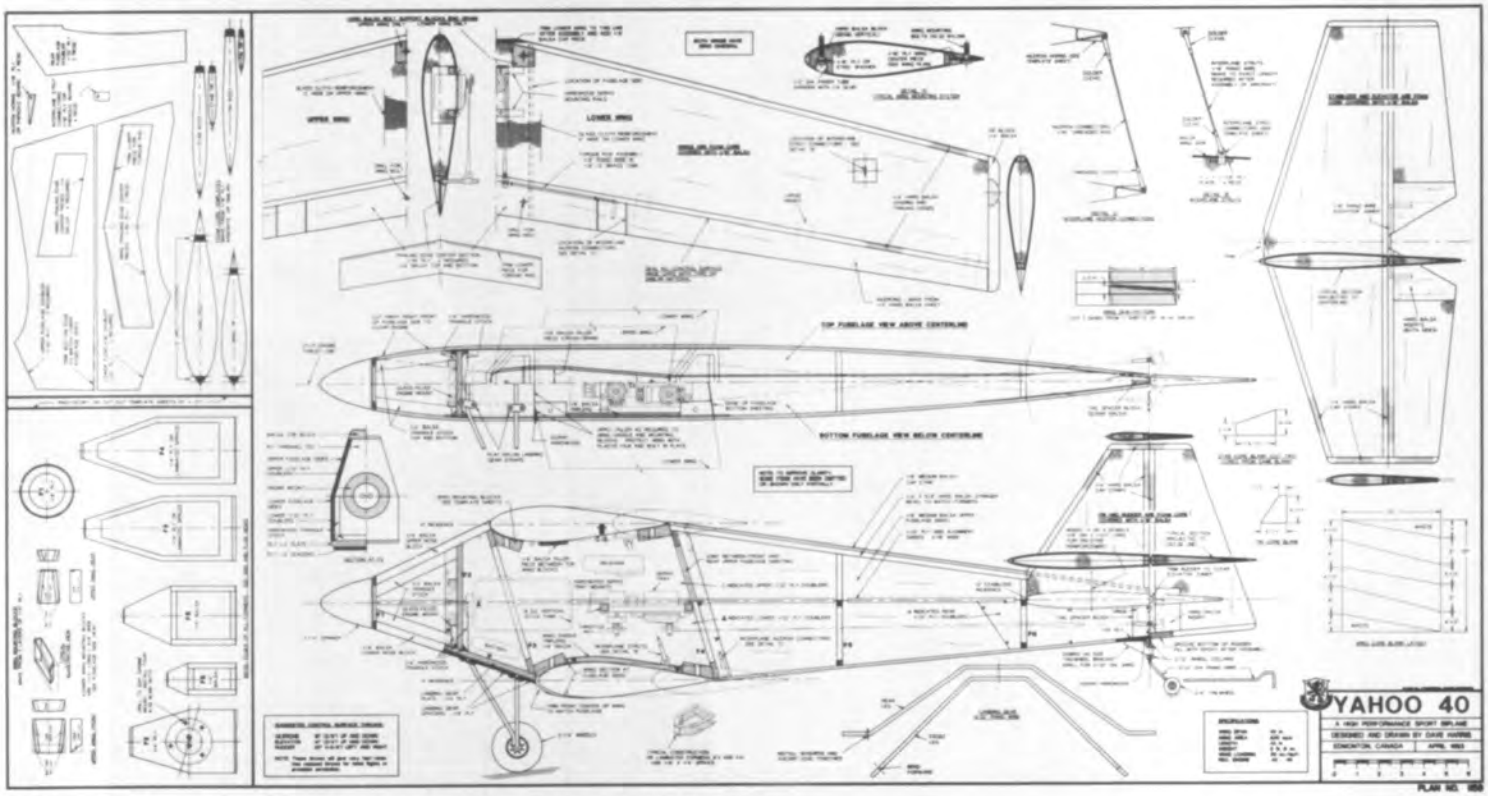
Fuselage:

Cut the lower sides from 1/8'' medium hard balsa. Cut the 1/32'' ply front and rear doublers, and glue them to the balsa sides with contact cement. Lay the right-hand side over the plan, and mark the locations of the fire wall and formers; transfer these locations to the left fuselage side.

Cut the fire wall (F2) from 1/4'' ply. Cut to the outside dimensions shown, then bevel the top and bottom edges as shown on the fuselage side view. The side edges are also very slightly beveled to match the inward taper of the nose. Using your engine mount as a pattern, mark and drill the fire wall for the mounting bolt holes, and install the four 6-32 blind nuts. Note that the mount and engine must be rotated slightly from the horizontal position, so that the muffler will clear the fuselage. Drill the holes for the fuel lines and the throttle cable.

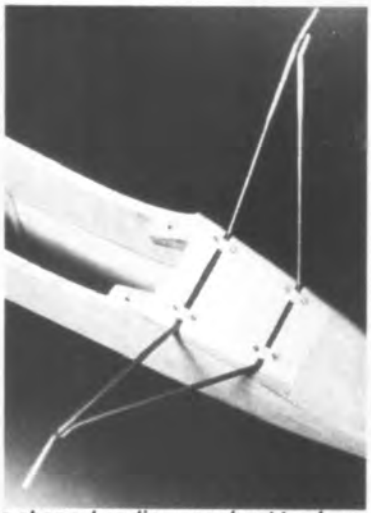
Construct formers F3 and F4. I make formers such as these by laminating two thicknesses of hardwood strip, overlapping the joints as shown in the sketch on the plans. These are much stronger than plywood formers of the same weight, because there is no cross-grain wood doing virtually nothing for you except adding weight; but plywood would be okay. Construct formers F5 and F6 from 1/4'' balsa.

Glue F3 and F4 to the right-hand fuselage



FULL-SIZE PLANS AVAILABLE — SEE PAGE 238

LEFT: Upper rear fuselage sides trimmed to approximate shape of fin and stab. RIGHT: Stab saddle sanded to give zero stab incidence. Measure from airfoil centerline to a line drawn parallel to fuselage datum line, leading and trailing edges.



LEFT: Fin/stab assembly attached to fuselage; filler applied as needed. RIGHT: Fuselage sanded to shape. Landing gear bent to shape and attached to fuselage. Bind together with copper wire, then slip washer on and solder.

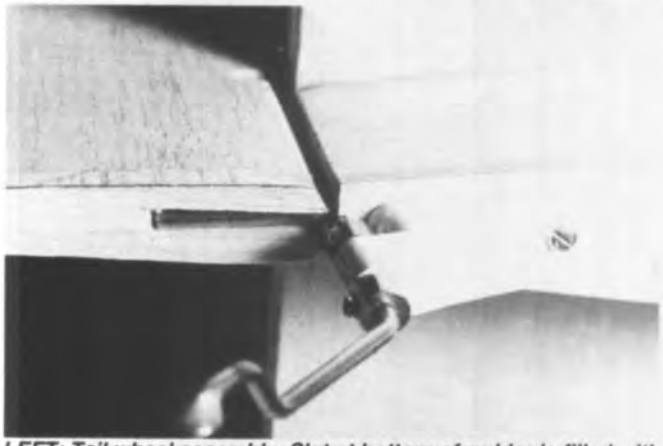
side at the marked locations, making sure that they are perpendicular to the fuselage side and that their bottoms are flush with the lower edge of the fuselage side. Trial fit the left-hand side, check that everything lines up properly and is square where it should be, then glue the left fuselage side in place.

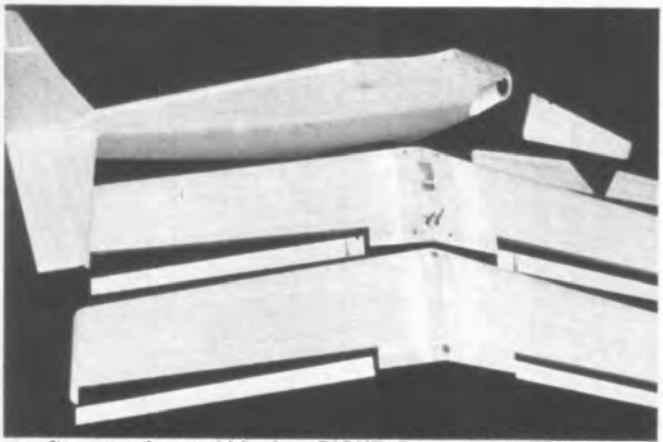
Use some rubber bands to pull the front end of the fuselage sides slightly inwards, and trial fit the fire wall using the location marks. Run some CA onto both sides of both edges to glue the fire wall in place.

Cut the tapered rear fuselage spacer from hard balsa. Position the fuselage assembly over the plan top view, draw the tail ends together, insert the tapered spacer, and clamp together with clothespins. Check that the whole assembly is symmetrical when viewed from the top, then run some thin CA into the tail joint. Install formers F5 and F6 at their marked locations, making sure everything is still square.

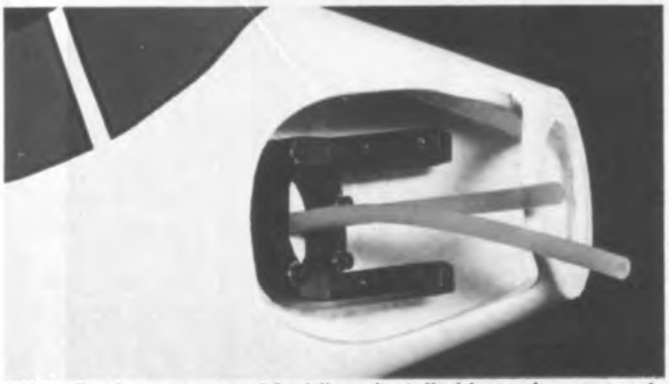
Drill and tap your engine mount, and bolt the mount and the engine to the fire wall. Make the nose ring from 1/8" ply; cut it slightly oversize and leave the edges square — it's easier to do the final shaping later. Tack glue the nose ring to the backplate of the spinner you'll be using, and mount the spinner/nose ring assembly on the engine (trim away some of the fuselage side on the right to clear the engine and mounting bolts). Note that no additional spacer is used between the nose ring and the spinner — rather, a shim (about 1/16" thick) is inserted between the fire wall and the engine mount during final assembly. This allows fine adjustment of the gap and alignment between the spinner and the nose ring.

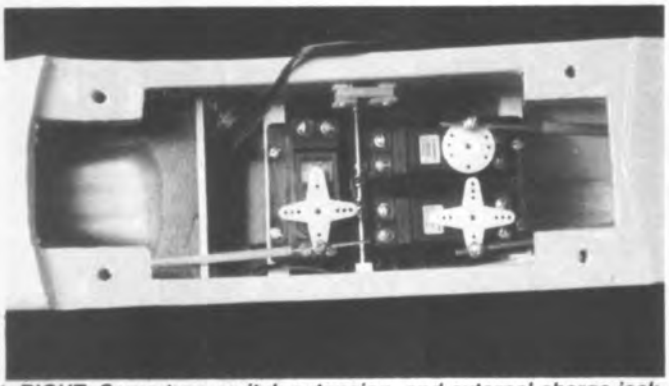
Bend the front ends of the fuselage sides inwards and trim so that they just butt up against the back of the nose ring. Using CA and accelerator, glue the ends of the fuselage sides to the nose ring, with the outsides approximately in line with the outside of the spinner. Keep the sides vertical (that is, don't try to bend the bottoms inwards to follow the outside of the



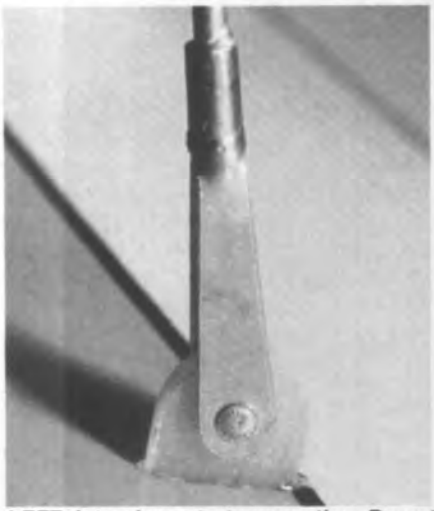


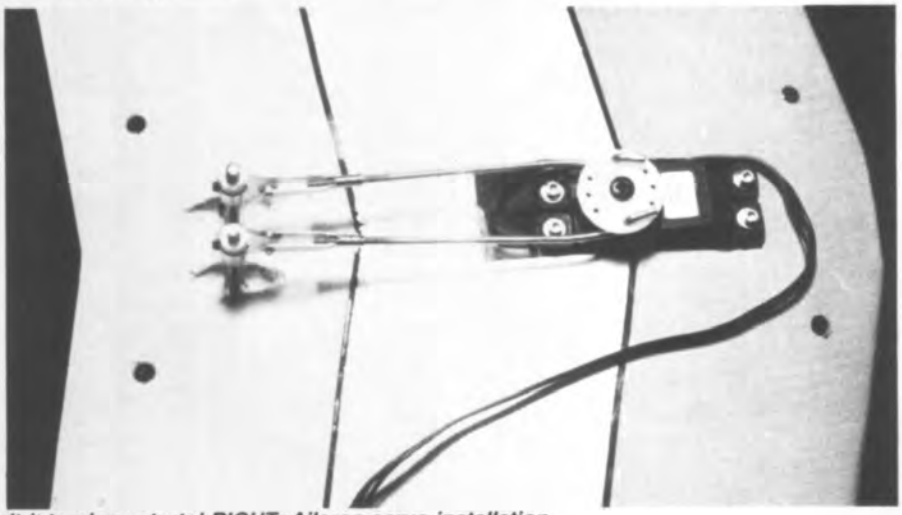
LEFT: Tail wheel assembly. Slot at bottom of rudder is filled with epoxy after covering and hinging. RIGHT: Parts ready for covering.





LEFT: Engine mount and fuel lines installed in engine compartment. RIGHT: Servo tray, switch extension, and external charge jack mount installed. Note lite ply insert and foam cushion for fuel tank.





LEFT: Interplane strut connection. Do not omit interplane struts! RIGHT: Aileron servo installation.

nose ring). Tack glue a temporary brace (1/4'' sq. balsa or similar) between the top of the nose ring and the top of F2, to hold the nose ring vertical. Remove the engine and mount.

Glue 1/4'' hardwood triangle stock between the fire wall and the fuselage sides, front, and back, using thick CA. Add the lower hardwood triangle stock reinforcements for the landing gear plate and the bottom edges (front and back) of the fire wall. Also add the 1/2'' balsa triangle stock to the lower nose section forward of F2. Sand the bottoms of the fuselage sides flat between F2 and the nose ring.

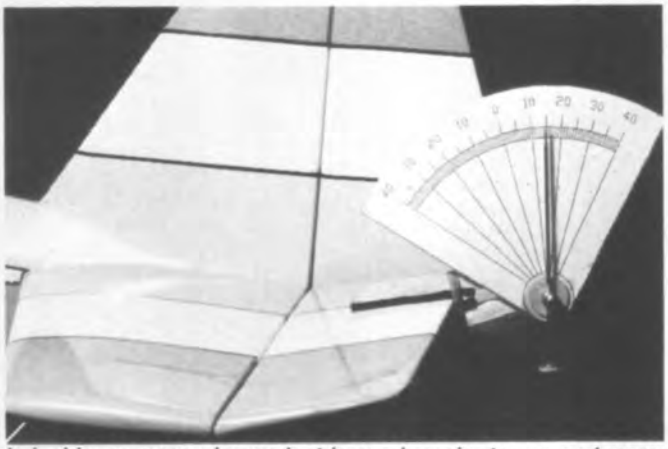
Cut the landing gear plate from 1/4'' ply and glue in place using CA. Add the 1/8'' ply spacer pieces to the landing gear plate, using a piece of 5/32'' wire to get the proper spacing. Cut the 3/8'' balsa lower nose block to approximate shape and glue it to the fuselage sides, the landing gear plate, and the nose ring. Glue the 1/8'' medium balsa rear fuselage bottom in place.

If you are using NyRod type pushrods, install the outer tubes in the fuselage at this time. Brace the tubes with cross pieces of scrap balsa at F4 and F5 to prevent flexing. Install an antenna guide tube, if used.

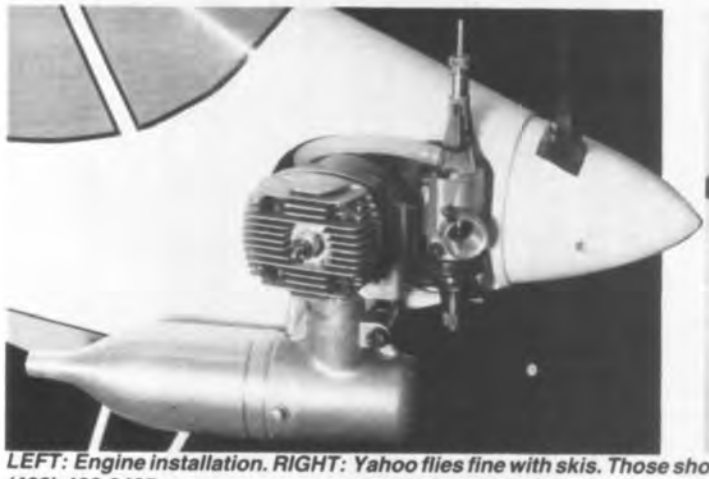
Install the upper rear fuselage stringer and sand to match the shape of the formers. Cut the upper front fuselage sides from medium 1/8'' balsa, and the doublers from 1/32'' ply; glue the doublers to the balsa sides using contact cement. Note that these pieces are about 1/4'' wider than shown on the fuselage side view, because of the slope of the sides; use the actual shapes shown on the template sheet rather than the shape on the side view. Trim and bevel the bottom edges to fit the lower fuselage sides, and glue in place.

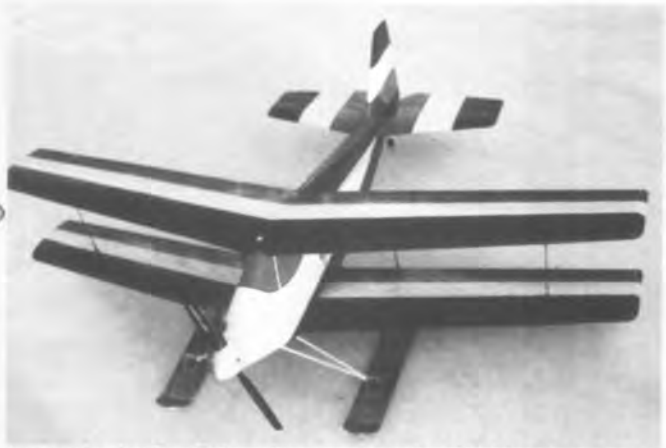
Similarly, cut the upper rear fuselage sides (slightly oversize) from 1/8'' balsa, trim and bevel the lower edges, and glue in place.

Sand the upper fuselage sides to match the tops of the formers (forward of F3) or the top of the upper stringer (aft of F4). Remove the temporary nose ring brace and install the upper front nose block. Install the upper rear



LEFT: Tail area. RIGHT: Adjusting control surface throws. Homemade incidence measuring gadget is much easier to use and more accurate than a ruler.





LEFT: Engine installation. RIGHT: Yahoo flies fine with skis. Those shown are by Jay Dee Enterprises; see your local hobby shop, or call: (403) 462-9485.

capstrip and the ply tail wheel mounting piece.

Make the upper and lower wing bolt blocks from 1/2" plywood (made by laminating two 1/4" pieces with CA). All blocks are 1½" long. The four lower blocks are 5/8" wide, beveled at the ends as shown on the drawings. To make the upper blocks, lay out the top and bottom faces using the patterns shown on the drawings. Trim the block to the bottom outline, then mark and trim to the end bevel. Finally, trim the side bevel (between the top and bottom surfaces). Trial fit in the fuselage, then lay the blocks aside until later.

Now we come to what is probably the most crucial step in determining the flying characteristics of the airplane — aligning the flying surfaces. Correct alignment is important on any airplane, but especially so on a biplane. It really can make the difference between a good airplane and a real dog. I'll describe the method I use to align the flying surfaces; if you have your own preferred method, feel free to use it. You'll need the wings and stab for these steps, so if you haven't built them yet, do so now.

Mark accurate centerlines on the wing leading and trailing edges, about 1¾" (half a fuselage width) from the center of the wing. Install the lower wing first. Support the fuselage upside down on some foam rubber or in a cradle, and set the lower wing in its saddle. Measure the distance between the fuselage datum line (the joint between the lower and upper fuselage sides) and the leading and trailing edge centerlines. These

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ABOUT THE AUTHOR

Dave Harris, a consulting environmental engineer, started building model airplanes in 1952, at the age of nine, in Rhodesia (now Zimbabwe) where he grew up. These airplanes were mostly small diesel-powered control line and free flight models, usually not very successful but a lot of fun. One of his clearest and fondest memories is the demonstration by visiting American fliers of the original R/C Smog Hog and Astro Hog, on reeds, in the late 1950's. These airplanes did mind-boggling things like loops, rolls, and landing on the same field they took off from. Dave left the hobby in 1960, to attend university, get married, move to Canada, and raise a family. He returned to modeling for one brief season in 1978, when he built his first R/C model, then "permanently" in 1989. Since that time, he has designed several airplanes, all quite successful. The Yahoo is his first published design.

LIST OF MATERIALS

Qty.	Description	Purpose
12	1/16" x 4" x 36" soft balsa sheet	Wing and tail surface skins
4	1/8" x 4" x 36" med. hard balsa sheet	Fuselage sides and bottom
1	1/4" x 4" x 36" hard balsa sheet	Wing and tail capstrips, wing T.E. center pieces, formers
1	1/2" x 4" x 36" medium balsa sheet	Ailerons, fuselage nose blocks, wingtips
1	1/4" x 6" x 12" aircraft ply	Fire wall, landing gear plate, wing mounting blocks
1	1/32" x 12" x 24" aircraft ply	Fuselage doublers
1	1/8" x 3" x 6" aircraft ply	Nose ring
2	1/8" x 1/4" x 36" spruce	Formers*
1	1/8" x 3/4" x 36" spruce	Formers* (*or 1/4" x 6" x 6" ply)
1	5/16" x 5/16" x 12" spruce	Servo and servo tray mounting rails
1	5/32" dia. x 36" piano wire	Landing gear
1	1/8" dia. x 18" piano wire	Aileron torque rods, elevator joiner
1	3/32" dia. x 6" piano wire	Tail wheel gear
1	1/8" i.d. (5/32" o.d.) x 6" brass tube	Aileron torque rods
1	2" x 24" x 48" foam sheet	Wing and tail surface foam cores
1	1/16" x 1" x 2" phenolic board (or ply)	Aileron and interplane strut connectors
1	4" x 36" fiberglass cloth	Wing center reinforcement

Adhesives: cyanoacrylate (thin, thick, odorless, accelerator); 5-minute epoxy; 3M 77 contact adhesive
Blind nuts (4, 6-32)
Bolts and washers (8, 6-32 for engine and mount)
Clevises (6 solder type, 7 threaded type)
Control horns (2 large T-type)
Covering and finishing material as preferred
Engine mount (glass-filled, to suit engine)
Filler (spackling compound or similar; microballoons or equivalent)
Fuel line (12" medium)
Fuel tank (8 oz., vertical style)
Hinges (19 large Klett type)
Landing gear straps and screws (1/2" flat nylon type)
Nylon bolts (6, 10-32)
Pushrod materials and fittings as preferred (approx. 60" total length)
Spinner (2¼" dia.)
Strip aileron horn set (nylon)
Tail wheel (3/4" dia.)
Tail wheel bracket (Du-Bro, 40 size)
Threaded adapters (3, 1/16" dia.)
Threaded rods (4, 0.074" or 1/16" dia.)
Wheel collars (3, 3/32"; 2, 5/32")
Wheels (2, 2¼" dia.)
Miscellaneous small items as required — washers, screws, switch mounting hardware, etc.
Four channel radio, .40-.46 engine, propeller

Giant Scale TR-260+ Pre-Built

(All wood – no foam – Ultracote covering)

John Eaton's
TR-260+
List Price $895.
Sale Price $595.
S & H $20.

Fully aerobatic lazer-type hand-built in Thailand of balsa and ply. Covered in two-tone Ultracote. ABS cowl, hatch cover & wheel pants, instruction book. Approx. 20 hrs. assembly time. Good 1st giant scale plane. 92" wingspan, 16-19 lbs, 2-4 CI engine.

Giant Scale TR-260 Kit

(All balsa & ply – no foam)

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Kit version of the pre-built. Aerobatic lazer-type symmetrical air foil mid-wing. Kit includes full-size plans, instructions, gear, canopy, ABS cowl, hatch & wheel pants. 86" wingspan, 15-18 lbs, 2-4 CI engine.

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True scale outline designed with precision, accuracy & detail. Fiberglass fuse with 101" foam & balsa wing. Scale accessories avail.; molded cockpit, wheels, struts, complete retract system (inc. tail wheel assembly) with air supply. 30-35 lbs., 4.2-5.8 CI engine. This kit was designed for experienced builder & flyer.

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This fully aerobatic airplane was designed with the average pilot in mind. Will perform all aerobatic maneuvers and still land like a trainer. Kit incl. full-size plans, gear, canopy, ABS cowl. (Wheel pants optional.) 86" wingspan, 15-18 lbs, 2-4 CI engine.

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distances, on both sides of the fuselage and at the leading and trailing edges, should be the same to within about 1/64". If they are not the same, sand the wing saddle until they are. Also sand the saddle to shape so that it conforms to the wing contour reasonably close.

Now glue the lower wing bolt blocks in place using CA (not epoxy). Glue them to the fuselage sides and to formers F3/F4. Install the balsa wing saddle tripler pieces. Replace the lower wing in its saddle and carefully check alignment by measuring from the junction of each wing trailing edge/tip block to the tail of the fuselage. Also check that the vertical sides of the fuselage are square with the wing. When satisfied, pin or tape the wing in position and drill through the wing and the mounting blocks using a 9/64" bit. Remove the wing, and complete its construction as described in the section on building the wing. Tap the mounting blocks in the fuselage for a 10-32 bolt. Bolt the completed lower wing to the fuselage and again carefully check the alignment. The lower wing is now used as a reference for aligning the upper wing and the tail surfaces.

Install the upper wing in a similar manner, sanding the saddle to achieve proper incidence. Check the distance of the front and back centerlines to the fuselage datum line and to the lower wing centerlines. Sighting from a few feet above, adjust the upper wing so that the leading and trailing edges are aligned with the lower wing. This adjustment is important to ensure proper tracking in inside and outside maneuvers.

When satisfied with the alignment, install the ply mounting blocks, and drill and tap as for the lower wing. Install the 1/8" cross-grain balsa filler piece in the upper wing saddle area. Complete construction of the upper wing.

Now we need to apply some filler to the wing saddle areas. Because of the taper and the sweep of the wings, it's almost impossible to get an exact wood-to-wood fit. First, tape some plastic wrap to the center sections of both wings where they

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mate to the fuselage. Take some hard filler, such as a mixture of microballoons and epoxy, and apply it liberally to the wing saddles and mounting blocks (don't use soft spackle-type fillers). Mount the wings and tighten the mounting bolts snugly. Check to make sure that you have used enough filler, particularly in the leading edge areas. When the filler has thoroughly dried or cured, remove the wings and sand the filler flush with the fuselage inside and outside.

Carve and sand the fuselage to shape, starting with 80-grit sandpaper and working down to about 200-grit. Use a hard, flat sanding block, rather than a flexible one or just a piece of sandpaper held in your hand. Before doing final shaping in the nose area, mount the engine and spinner. Make a plywood shim to go between the engine mount and the fire wall, to get the desired clearance (about 1/16") between the rear of the spinner and the fuselage nose ring. Then sand the fuselage nose area to match the rear of the spinner.

Bend the front and rear landing gear legs from 5/32" piano wire. Mount these pieces on the fuselage using flat nylon mounting straps. Check that the two wire pieces align properly, and that the rear leg is approximately vertical when viewed from the side. Clean the joint areas with sandpaper, and wrap tightly with thin copper wire. Slip a flat washer over each axle and solder the assembly at each end. Remove the assembly, clean it up, and give it a couple of coats of fuelproof paint.

Assembly:

Trim the upper rear fuselage side sheeting to clear the stab and the fin. Note that the fuselage sides are "blended" into the fin — in other words, the fuselage sides do not extend all the way to the rear at the top edge.

Check the incidence of the stab. Draw a line each side of the fuselage, about 1" below the stab, and exactly parallel to the fuselage datum line. Mark the front and rear airfoil centerlines on the stab. Place the stab in its saddle, and measure between the center marks and the lines on the fuselage, both sides and front and rear. These distances should all be the same, to within about 1/64". Sand the saddle if necessary.

Remove the stab from the fuselage, and trim and sand the bottom of the fin so that it is a good fit to the top of the stab. Adjust the fin so that it is exactly at right angles to the trailing edge of the stab, and vertical to it; then glue in place by running CA into the joint. From the bottom, drill three or four 1/8" diameter holes about 1" deep through the stab and into the fin. Glue lengths of 1/8" dowel or skewers into these holes. Place the stab/fin assembly on the stab saddle, align carefully, and glue with CA.

Now do the lateral balancing. Bolt on the wings, and install the engine and muffler. Push a pin into the trailing edge of the stab, exactly at the centerline of the fin. Lift the airplane by placing your fingers under the engine prop shaft and the pin at the rear; the right wing will drop because of the weight of the sidemounted engine. Add weight to the left wingtips until the airplane balances. Depending on the engine, about 1 to 1½ ounces of tip weight will be needed in the left wingtips. Don't ignore this lateral balancing.

Covering and Finishing:

Go over the whole airplane, filling any dings and final sanding all surfaces. Use your favorite finishing method, but don't add too much weight. I generally use film covering; film has its disadvantages, but it's light, quick, easy, and gives a reasonably good finish.

After covering, install the interplane strut connectors in the wings using CA. Apply wing mounting foam tape to the wing saddles, and bolt the wings to the fuselage. Measure the distances between the holes in the interplane strut connectors, average them if slightly different, and make up two identical interplane struts using solder clevises and 1/16" or slightly larger piano wire. Do not omit the interplane struts!

Install your radio, making sure that everything is firmly packed with foam or otherwise anchored. You'll probably be doing some pretty violent maneuvers with this airplane, and it's important that things don't move about. I generally install lite ply sub-formers or braces to partially enclose items like the receiver and fuel tank.

Take some time setting up the control surface throws. I use a simple home-built indicator to show the deflection angle in degrees, rather than trying to measure the movement of the edges with a ruler. The

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ESCAPE

SPECIFICATIONS:

Wing Span	62½ inches
Wing Area	770 square inches
Engine Size	10 cc
	90 or 120 four stroke

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XLT

SPECIFICATIONS:

Wing Span	65 inches
Length	65 inches
Wing Area	845 square inches
Recommended Engine Size	10 cc
	90, or 120 four stroke

The XLT is designed for tuned pipe and retract landing gears. Capable of the A.M.A. or Turn-around pattern. Rear or side exhaust.

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SPECIFICATIONS:

Wing Span	63¼ inches
Wing Area	700 square inches
Engine Size	.50-.60 (Glow)
	.90 four stroke

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indicator is much easier to use, and more accurate. The throws shown on the plans will give very high rates, and are intended for "hot-dog" style flying. Smaller throws should be used for initial flights, general sport flying, and precision aerobatics. If you have a dual rate radio, adjust the high rate control surface throws to approximately those shown on the plans, and set the low rates to about two thirds of the high rates. If you have no dual rates, set the throws to about two thirds of those shown on the plans. In either case, you can adjust the throws to suit your flying style later, but for initial flights use the reduced throws. I haven't found any noticeable benefit from using more aileron differential than you'll get from using the type of linkage shown on the plan, but you may want to try it if you have a programmable radio.

Flying:

Check that the C.G. is approximately where shown on the plans. The C.G. location is not particularly critical; I've tried moving it up to 3/4" each side of the location shown, with not much apparent change in flying characteristics. Further back, loops are a bit tighter and snaps are "snappier," but it will stall a little easier; the opposite is true for a more forward C.G. Use the indicated location as a starting point, and adjust to suit your own preference later on.

Range check your radio, fire up the engine, and go for it. The Yahoo tracks straight and true down the runway, and will lift off with just a touch of up elevator when flying speed is reached. Go easy on the rudder during the take-off run, and don't try to horse the airplane off before it reaches flying speed.

The Yahoo has no bad habits that I'm aware of. Although it's a hot airplane, it's not a mean one, and can easily be flown by anyone at or past the Ugly Stick stage.

The airplane will do all the usual maneuvers, and a lot more. Not being a very good flier, I can't really tell how it would do in precision aerobatics, but I suspect rather well. It certainly does excel at its intended purpose, which is a wide range of sport-type aerobatics and "hot-dogging." The Yahoo goes where you point it, and stays that way until you tell it to change. Rolls are truly axial, and there's very little drop-off even after several in sequence. Be careful with inverted flight — hardly any down elevator is needed for level flight, and it's easy to get into a steep climb with a little too much down elevator. Snaps are too fast to count if you hit full everything with large control surface throws, but can easily be slowed down if you like. Outside maneuvers are identical to inside ones.

The Yahoo really excels in knife-edge flight. From level flight at full throttle, flip the wings vertical with aileron, and apply just enough opposite rudder to keep the nose up (you don't need much). There is no tendency to pull towards the top or bottom of the airplane. You can fly in the knife-edge for as long as you want, using

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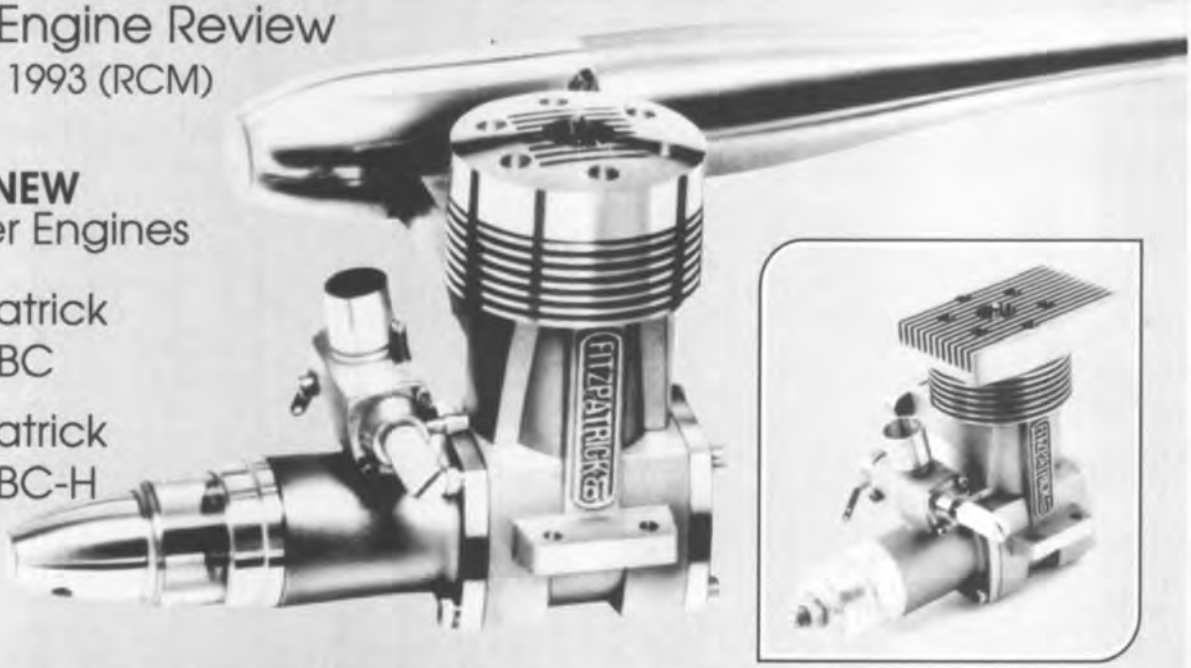

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Upright left	Left	Left	Up
Upright right	Right	Right	Up
Inverted left	Right	Left	Down
Inverted right	Left	Right	Down

ailerons to keep the wings vertical, rudder to point the nose up or down, and elevator to steer. Apply a little more rudder and with enough speed and power, it will climb up and over the top of a knife-edge loop, just as easy as you could want. The hard part is getting it to "tuck under" to make the last quarter of the loop, and I'm not a good enough flier to do it every time. The airplane will certainly do it, though. I've found that it helps to back off throttle and rudder at the top of the loop, then hit full throttle and rudder when the airplane is vertically down at the three-quarter position.

A couple of maneuvers you may not have seen are the knife-edge circle and the knife-edge spiral. From the normal knife-edge position, apply and hold some up or down elevator (I find down easier) and the airplane will make one or more circles, still in the knife-edge position. You can hold this for as long as you like. Increase or decrease the rudder throw a bit, and it will describe an ascending or descending spiral (depending on the amount of rudder held in). These maneuvers do require a fair bit of practice to get the proper coordination of controls.

Spin characteristics are great. You can enter a spin in the normal way, by applying rudder just before the stall point to swing the tail around, then elevator and aileron. With the Yahoo, I prefer to enter a spin under full power. From just about any attitude, apply

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full everything, depending on the type of spin you want (recall that rudder effect is reversed when inverted):

The airplane will do four or five fast snaps, then fall out into whichever spin you have called for. You can keep the power on for high speed spins, or cut it back for slower spin rates. Because the Yahoo has a good bit of drag and a large side area, spins with the throttle at idle are very slow and graceful. Recovery from any spin attitude is instantaneous, even with a dead engine, just by releasing the sticks.

The Yahoo is quite predictable in the stall. Like most high performance airplanes, it will eventually drop a wing if you try hard enough (low power, and full up elevator for too long). But the stall is not at all vicious (more like a gentle turn) and it happens at quite a low speed.

Landings, even dead stick, are no problem. The airplane can be slowed right down and flared at the end in the normal way; just don't try to "stretch" the glide too much or you could eventually drop a wing.

That's about it. I'd be pleased to hear your comments (good or bad) on the Yahoo, as well as about the effects of any changes you may care to experiment with. My address is 6223 — 186 Street, Edmonton, Alberta, Canada T5T 2T3. I'll also be pleased to help you in any way I can if you run into problems or have any questions.

I wish you good building and flying. □

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