

CONSTRUCTION



*Build a .20-size
forgotten fighter*

Arado

76

by Stan Rutz



THE SEPTEMBER 1938 ISSUE of *Model Airplane News* contained plans for a 20-inch-span, rubber-powered Arado 76: "... a new German fighter/trainer." I built it, and when .049 glow engines emerged a

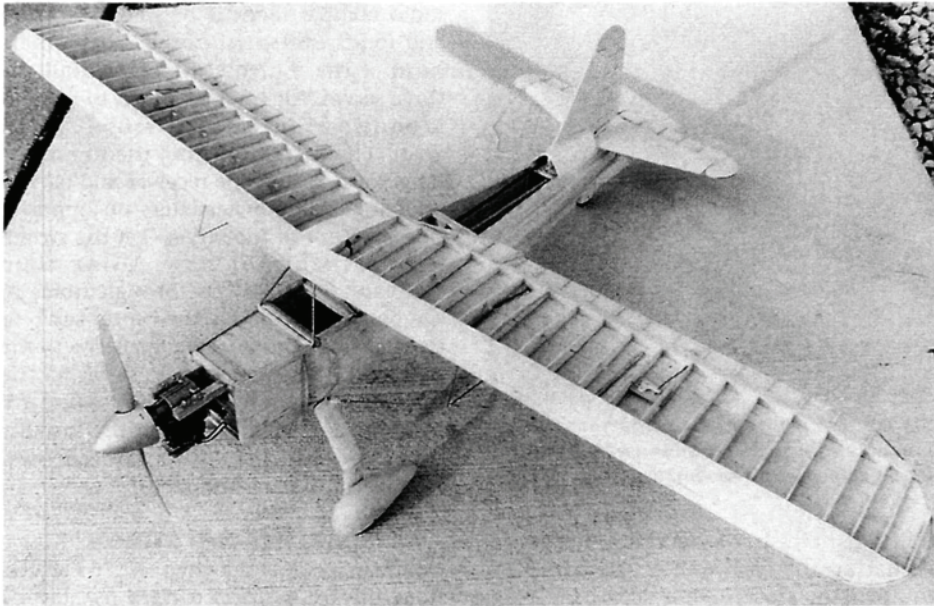
decade later, I turned it into a Wasp-powered U-control and flew it indoors. It was a crowd pleaser—especially when it landed, and I was too dizzy to crawl to it! Because it was a natural for R/C scale, the Arado remained high on my "planes to build again" list. More years passed before I came across a set of 3-views that agreed with my collected photos. Those drawings inspired this small, inexpensive, sheet-balsa R/C version built around a 4-stroke O.S.* .20 and Sig* Smith Mini wheel pants. The

R/C Arado is gorgeous and flies even better than the previous versions. On its first flight, it took off from grass and flew 24 low passes for the photographer, with all trims centered. Now it's a year old and still unscratched.

WING CONSTRUCTION

Select five, 1/16x3x28-inch balsa sheets. Split one down the center and make two, 7 1/2-inch sheets (hold them together on a flat surface and apply thin CA along the seam). Trace the wing halves, excluding leading edges (LEs) but including ailerons and rib spacing. Cut them out, crack them at the outermost full rib line, raise the tips 1/2 inch and CA the crack. Install the rear spars (tapered up to 1/8 inch beyond the crack). With a 1 5/8-inch block under the crack at one tip (4 degrees dihedral), CA the halves together; then add the LEs. CA 1/8x10-inch basket reed (or laminated balsa) to the ends of the wing.

Using a light aluminum pattern, cut out the balsa ribs and CA them into place. Add the LE capstrips and aileron spars and sand them to shape. Add the aileron ribs, cut the ailerons free and bevel the front bottom edge for down-throw.



Top view of sheet balsa substructure.

Hinge the top edge of the spar to the top of the wing spar with a strip of MonoKote* (or polyester chiffon). Fold the aileron back and join the spars with a second strip. CA the control horns (cut the base off) in blocks inside the aileron with their tips protruding from the bottom. Install the miniservo (on its side), pushrods and bellcranks through the ribs and bottom of the spar. Route the servo lead through the wing bottom behind the servo. Fire up the radio and adjust the installation. Remove the servo.

Drill $\frac{1}{8}$ -inch-diameter centerline (CL) holes in the LE and trailing edge (TE). Insert a waxed dowel through the holes. Build tight balsa boxes around its front and rear ends, and CA a stopper across the end of the boxes. Cut two, $\frac{1}{16} \times \frac{1}{4}$ -inch slits for the cabanes through the box and the bottom of the wing at 1 and $5\frac{1}{4}$ inches from the LE. CA triangle-stock fairings below the 10th rib from the center. Flatten each end of two, $\frac{1}{16} \times 5\frac{1}{2}$ -inch aluminum rods and use a $\frac{1}{32}$ -inch-diameter bit to drill them. Make 90-degree bends $\frac{1}{2}$ inch from each end, and poke the rods through the wing and fairings, $1\frac{1}{4}$ and $5\frac{3}{4}$ inches from the LE to anchor the wing struts; liberally apply thick CA.

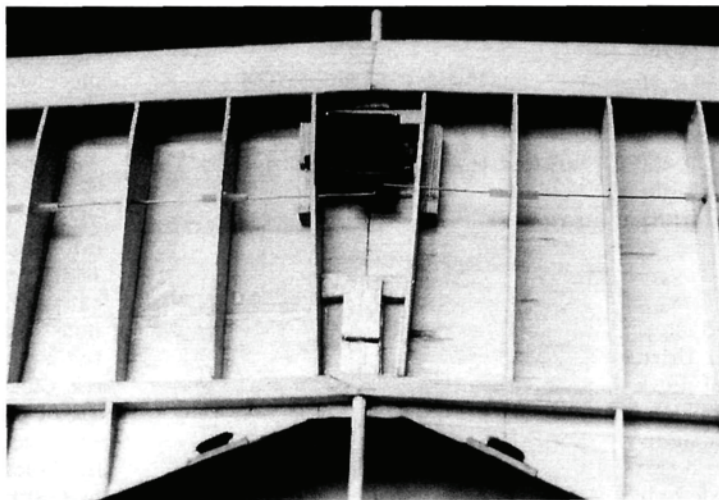
FUSELAGE ASSEMBLY

CA the longerons and stiffeners to the inside of each sheet-balsa side. Taper the tails and CA them together. Invert them on the plan top view and add the crosspieces. Add upper and lower side stringers and the sheet tail

cap. Bolt the engine to the maple mounts with socket-head bolts and blind nuts. Center and CA these (with the engine inverted) to the bottom of the front and second top crosspieces (ends should be flush with the back of the second—no thrust offset). Add an extra crosspiece between the front stiffeners to support the motor mounts.

Build a bulkhead around the mount ends, tying them to the second crosspieces and stiffeners. Cradle the fuel tank in the bottom of the mount, with $\frac{1}{2}$ inch of it protruding through a hole in the bulkhead. Build a bulkhead around its neck (gaps between this and the outer walls will be cooling tunnels). CA cowl formers to the outer walls 1 inch forward of the second stiffeners, and cut out the outer walls back to the stiffeners to form the tunnel outlet.

Bevel the front bulkhead, second stiff-



Center section of the sheet balsa wing with servo and boxed cabane dowels. Note the scrap Gold-N-Rod pushrod bearings.

SPECIFICATIONS

Model: Arado 76—a German defense fighter and aerobatic trainer (1934 to 1944)

Type: sport-scale

Wingspan: 50 in.

Length: 37.5 in.

Weight: 3 lb.

Wing area: 372 sq. in.

Wing loading: 18.6 oz./sq. ft.

Airfoil: thinned Clark Y (flat bottom)

Radio: 4-channel with four miniservos and 270mAh pack

Engine: 4-stroke O.S. FS .20 or FS .26 Surpass

Comments: designed by Stan Rutz, this strong, sport-scale model of an overlooked WW II-era aircraft is candy for the eyes and offers easy-to-fly realism. Building time is cut by extensive use of sheet balsa to exploit the no-pin advantage of CA and by the use of Sig replacement parts intended for other models.

eners and stringer ends, and fit the inner tunnel walls. Sheet over the stringers between the gills and the third stiffener. Drill the front bulkhead for the throttle rod. Inlay sheet balsa, longeron to longeron, on the mounts and between the front and second crosspieces to form tunnel tops, and tie them to the bulkheads. Repeat in the bottom. Inlay sheeting flush with the longeron tops in the triangle behind the fifth crosspiece. Draw a fuselage CL on it.

Cut a slotted hardwood block for the torsion-bar landing gear. CA two spruce strips to the block to form a tight center slot for the gear legs. Use two scrap wires to gauge the slot. Remove a section of the bottom longerons to allow the block to replace the second crosspiece. CA $\frac{1}{4} \times \frac{1}{2} \times 1$ -inch hardwood blocks upright on the ends of the block and to the backs of the second stiffeners and outer walls. Use the scrap wires in the slot to position and drill the landing-gear holes through the slot into the upright blocks.

For wing-strut anchors, hammer and drill both ends of two aluminum rods to accept the strut clevises. CA one across notches in the bottom longerons at the rear of the slotted block, and the other $5\frac{1}{2}$ inches behind it. Add four equally spaced bottom stringers from slotted

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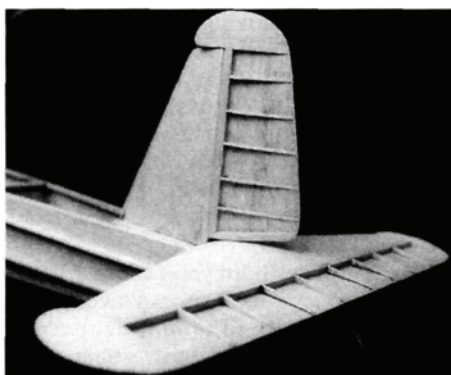
block to tail. Taper them at the tail to fit. CA $\frac{1}{8} \times \frac{3}{16}$ -inch scrap between their front ends to form a bulkhead.

BUILDING THE TAIL

Trace the fin, rudder, stab and elevator on sheet balsa. CA the ribs, LEs, tips and spar to the top of the stab sheet. Sand them to the lifting cross-section on the plans, and sheet the top. CA the spar, sheet tips and ribs to the top of the elevator sheet and sand them.

Bevel the elevator's front bottom edge for down-travel, and join the elevator to the stab with a MonoKote hinge. Test the movement. Draw a CL on the top, perpendicular to the TE, line it up with the fuselage CL, and CA the stab to the longerons (note overhang). CA the elevator horn in a slot at the center of the elevator to hang in the middle of the gap between the tail cones.

Remove $\frac{3}{16}$ inch of the front edges of the fin and rudder blanks. Make a duplicate of the fin blank, and CA both to the back of the fin's LE and to the sides of its spar. Taper with scrap to fill the top and bottom. CA the rudder sheet to the center of its spar and add long wedges to its sides. Sheet both sides of its top and bottom and sand the fin/rudder.

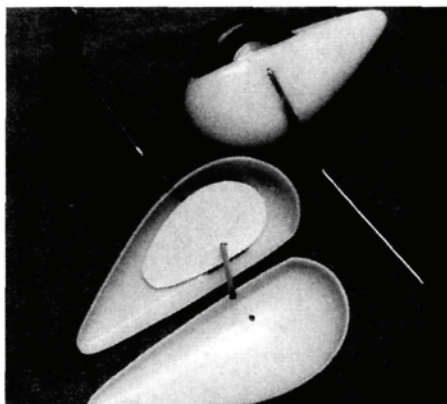


Completed sheet balsa tail assembly with strip hinges.

Bevel the right (starboard) front of the rudder to allow right travel. Hinge it to the fin with MonoKote. CA the fin to the CL of the triangle and the front of the stab, perpendicular to the stab. CA the rudder horn through an angled slot in the lower front corner of the rudder to protrude on the right side.

LANDING GEAR

The Ar.76 had faired, cantilevered, steel tube wheel legs, with the lower third welded into a knee to allow vertical shock travel. Oil-damped rubber rings took the shock. The painted tailwheel was a static-conducting whitewall. To start, bend two music-wire legs. Drill an $\frac{1}{8}$ -inch axle hole in the inner halves of Sig SH-563 wheel pants. On them, mark the leg angle from the plan, and Zona saw the slots for the legs. Cut two inner pads out of lite-ply,



Sig Smith Miniplane ABS pants with lite-ply inner pad and sawed alignment slot. The wheel served as an assembly jig.

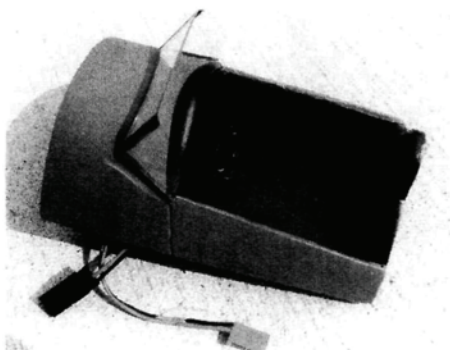
drill axle holes and bevel the pad edges to lie flat on the back wall of the pant. CA the pads in place. Use a wheel for a jig while using thick CA to glue the legs in the pant slots.

Mark and drill the axle hole in the outer halves. Trial-fit and add spacers on both sides of the wheel to allow it to turn without touching the paint. Align and CA the halves. Build up the bottom and rear of the pants with soft balsa and CA. Sand them to plan contours. Insert the legs in the slotted blocks. Secure them with gear straps near each end.

Bend the tailwheel strut out of piano wire. Build the tailwheel pant around the wheel from scrap balsa, rough-shaping the outside and leaving one side open while you smooth the inside. Allow $\frac{1}{16}$ inch clearance all around. Sand and CA the inside surfaces. Groove the outside for the strut, and CA the strut to the pant. Add the wheel and spacers, cover the open side and finish the outside. Sandwich the strut's triangular top in three plies of $\frac{3}{32}$ -inch sheet balsa, and CA it to the inside of the lower longerons. The gear doesn't need to steer, but make it roll straight and free.

RADIO INSTALLATION

It's time for the radio. I used a 4-channel Futaba* but substituted a 270mAh pack and four Hobbico* CS31 miniservos. The

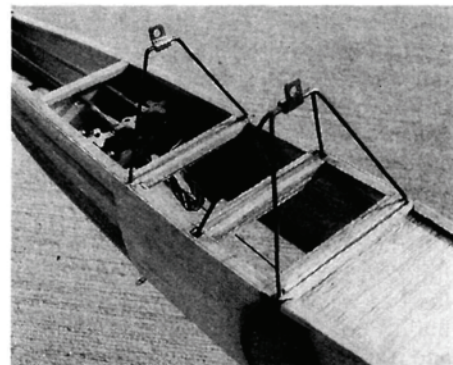


Close-up detail of cockpit/radio hatch. Note crash pad, cockpit-door line, switch and headrest.

radio compartment is between the third and fourth stiffeners. Install a balsa bulkhead at the fourth stiffener. Install the three servos side by side, 1 inch in front of it on two $\frac{1}{4}$ -inch-square rails $1\frac{3}{8}$ inch apart, $\frac{1}{4}$ inch down from the top of the longerons. Mount the receiver and battery on hook-and-loop fasteners on opposite sides in front of the servos. Let the switch harness hang for now. Using rigid Sullivan* Gold-N-Rods through holes in the bulkhead, connect the center servo to the elevator horn and the left servo to the rudder. Connect the right servo to the throttle arm with light piano wire (use a V bend to tune its length). Test the installation, and adjust centers and throws. Remove the engine and radio.

CABANES AND STRUTS

Contrary to some drawings, Ar.76 cabanes slant inward to form a rigid pyramid. I modified the similar Sig Skybolt setup to suit my model. It locks the parasol wing into place but allows quick removal. Bend the three triangular cabanes out of piano wire. Insert the ends of each cabane into a 3-inch length of $\frac{3}{32}$ -inch-i.d. plastic tub-



The $\frac{3}{32}$ -inch-diameter wire cabanes are mounted in tubing between added cross-members. Note brass dowel fittings and wing-strut anchors.

ing. Notch the top longerons for the cabanes, one just behind the second cross-piece, another $2\frac{3}{8}$ inches behind it, and the rear just in front of the third cross-piece. Add four extra crosspieces to sandwich them, and liberally add thick CA.

Drill an $\frac{1}{8}$ -inch hole at each end of a $\frac{1}{16} \times \frac{1}{4} \times 1\frac{3}{4}$ -inch soft brass strip. Cut it into strips of 1 inch and $\frac{3}{4}$ inch. Roll the 1-inch strip around the center of the front cabanes, forming a pyramid with the hole's center $\frac{3}{16}$ inch above the wire. Roll the $\frac{3}{4}$ -inch strip around the flat of the rear cabane with the hole's center $\frac{3}{16}$ inch above the wire. Silver-solder the brass to the wire. Run an $\frac{1}{8}$ -inch dowel through the holes. Line it up with the fuselage CL by heating and moving the rear strip.

Form the core of each side's pair of wing struts using a $28\frac{1}{2}$ -inch piece of piano wire. Make right-angle bends 12 inches from the ends. Pass one end

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through the holes in both anchors in the wing's strut-attachment fairings, working the first bend through the second hole. Silver-solder a threaded coupler to each end and attach two small plastic clevises. Attach the wing to the fuselage by putting the cabane's brass strips through the slits in the wing bottom and running two dowels through the LE and TE (it should be a tight fit) and through the brass strips. Plug the strut clevises into anchors in the bottom longerons. Adjust as required to align with the stab.

Make the short vertical struts out of wire. Invert the plane and hang these near the midpoint of the wing struts, parallel to the fuselage CL. Poke them through the wing bottom. Adjust and trim their lengths, if needed. Silver-solder the bends to the wing struts.

Cut soft sheet-balsa fairing strips for the wing and cabane struts and landing gear. Center a shallow V-groove in each, then gouge it to a half-round with strut-size wire. Fit the strips, and sandwich the wire between them with CA. Sand them all to streamline the cross-section.

Build scrap-balsa mandrels the shape and size of the fillets with 2-inch necks like the struts. With a heat gun, shrink battery shrink-wrap on these. These fillets slide over the struts to cover the clevises and the gap between the gear and the fuselage. Later, after covering the tail, CA $\frac{1}{16} \times \frac{1}{4}$ -inch balsa to two bamboo skewers, streamline them, poke them through the MonoKote and CA them between the bottom longeron and the fin. Slit a scrap of plastic tubing and CA it over the tailwheel strut between the pant and stringers.

SUPERSTRUCTURE

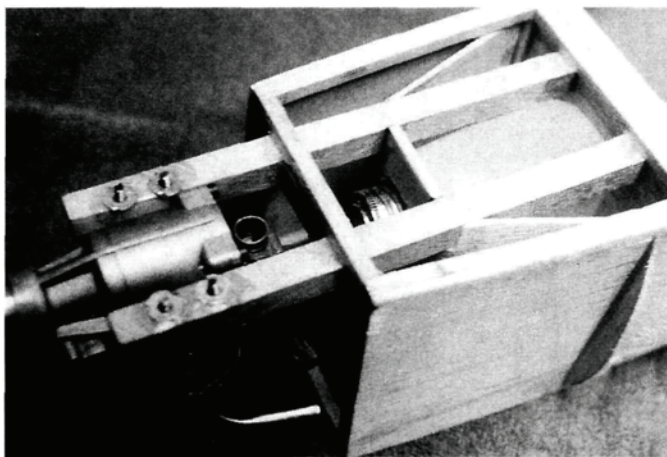
On the full-scale Ar.76, cowls and removable sheet metal over formers made up the rest of the plane. For me, the easy way was to piece it together from soft sheet balsa and parts salvaged from another plane. A Skybolt ABS top, available from Sig, yielded both the top rear fuselage where the headrest flows into the vertical fin and a perfect removable belly pan for the engine cowl.

Cut about $4\frac{3}{8}$ inches off the rear of the molded ABS top (at the base of the curve) and slide it down the fin. Carefully cut away the inside, following the curve of the fin, until the bottom rests on the longerons. Bend a $\frac{3}{8} \times 8$ -inch strip of thin ABS at the center, and fit it inside to extend

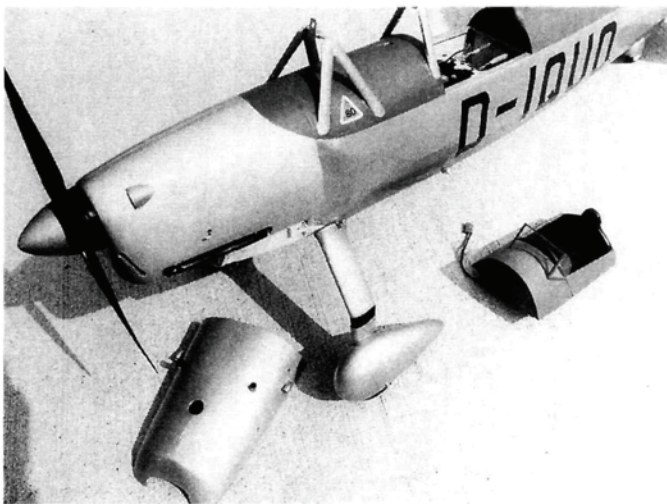
the upper walls to match the plan. When everything fits, CA it all together. Reroute the rudder Gold-N-Rod to exit through the right side of this.

The deck and headrest behind the cockpit are just three formers connected by strips of soft balsa. On the plan top view, join the formers with two strips at the side bottoms, a center strip at the top and two more at the base of the headrest. Checking the fit on the fuselage as you go, fill in between these with beveled and tapered strips. Sand the outside contours and remove excess inside wood. Fit the deck into the fin fairing, and CA it in place on the longerons. Add the front plate.

Build the deck forward of the cockpit on



Top view of the bulkhead at the neck of the fuel tank, motor mounts and inner walls of the cooling tunnels.



Finished fuselage with cockpit hatch cover and Sig Skybolt belly pan removed. Note faired struts, dummy exhaust and gear leg fillet.

the fuselage. CA a balsa spinner-size ring to its backplate. CA a plywood ring (same o.d.) to the balsa. Put the spinner on the engine (spacer replacing prop, openings taped) and mount the engine. CA the formers to the crosspieces. Tie top formers to the top of the ply ring with a center strip. Check the curve with the plan. If it doesn't match the side view, fix it now. Build up a block of soft sheet behind the ply ring, and carve the triangular nose-bowl like that of the full-

scale AR.76's inverted, air-cooled Argus V-8.

CA two more strips, interrupted by cabanes, on the longerons at the ends of the formers. Extend them to the sides of the nose-bowl block. Check the curves with the top view. Fill in between these with beveled and tapered strips and sand to shape. The rest of the cowl forward of the cabanes and slotted blocks is made of sheet balsa and the belly pan. To create the pan, saw the front 7 inches off the Skybolt top and split this down the center. Narrow its front by removing a $\frac{3}{4} \times 7$ -inch wedge from the inside of each half and rejoining the halves with CA. CA a scrap ABS strip inside to reinforce the joint. Square off the rear of the pan.

Test-fit the pan. Round the fuselage side walls and longerons to make it fit the engine's rocker cover and the formers at the front and second crosspieces. CA two pan pads (gill former to nose block) to the outer walls so the lower half supports the pan's upper edges. CA four hardwood blocks to the outer walls below these pads, at the front and gill formers. Round them to fit, press the pan into position, and drill four $\frac{1}{32}$ -inch-diameter holes through the pan into them.

Enlarge the holes in the pan for servo screws, and mount the pan. CA the sheet sides and longeron in place. Scribe a line across the top of the deck at the end to simulate a cowl break. Sand the nose to shape. Cut out the exhaust slots on the bottom at the pan. Finish the cooling-air intake. Remove the pan and cut a glow-plug-heater hole in it, centered 2 inches behind the nose-bowl break. Reinforce the screw-hole area and rear edge with scrap ABS. Cut a needle-valve hole, then remove the spinner and all traces of the balsa disk. Remove the engine and fuelproof the inside of the compartment, tunnels and gills with CA.

Build the cockpit as a removable hatch on the radio compartment. Cut a sheet-balsa rectangle to fit inside the hole and another (cross-grained), $\frac{1}{2}$ inch wider. CA them together with $\frac{1}{4}$ -inch overlaps. Trim this floor to just span the longerons. CA the seat-back, front former and decking to it, using the hole as a jig. Sand it to blend with the front and rear decks. Simulate a roll of padding on the front edge of the cockpit with scrap balsa. Mount the radio switch in the floor, forward of the servos. CA a block under the center of the right longeron and install a Goldberg* angled hold-down (end slot). After you cover the model, CA two thin ABS trim tabs to each aileron, and a long one with center pushrod and horn to the elevator.

FINISHING

Paint the engine compartment with white Aerogloss* and add scoops, cooling slits and dummy exhaust manifolds (my 4-cycle exhausts through the front end on the left). Prep all other balsa and ABS areas to be painted with Hobby Poxy* Stuff cut 50/50 with methanol, and sand to a metal-like surface. Mask and spray these with Aerogloss aluminum dope. Paint the cockpit interior, prop, spinner, exhaust manifold, gun trough, etc., with Formula U flat black. CA the windshield into place.

Cover the wing, tail and lower fuselage with aluminum MonoKote. Mix flat tan and olive-drab Formula U to paint the green/brown windshield frame and anti-glare panel around the cockpit. Cut the markings out of MonoKote trim sheets.

From 1933 to 1936, registration codes for this class of aircraft all began with D-I followed by three letters assigned at random. The all-silver first prototype Ar.76 was D-IRAS. Subsequent Ar.76s had the brown/green panel around the cockpit. With the onset of war, field conditions cost them their silver paint and wheel pants. They flew into oblivion in training squadrons, pantless and dressed in earth tones.

THE PAYOFF: FLYING

I used up my first tank of fuel taxiing across my lawn and up and down a blacktop street to check power, cooling, rudder response, tracking and range. Acceleration was so good with the scale-like 10x6 Tornado show prop that I left it on for the first flight—and it's still on! I know the engine would do better with less prop, but that black prop with the yellow logo goes so well with the black and silver spinner!

At the field, I pointed it straight into the wind, with a little right rudder and enough up-elevator to prevent it from tripping in the grass, and opened the throttle. In 20 feet, it was flying straight and true, fast and solid as a rock. No trim corrections were needed. We wanted pictures, so I made low passes and 180s until we were out of film. With the engine idling, the landing was uneventful. The lifting stab helps.

At a fly-in, I found that the tall landing gear could get you into trouble when a photographer knelt directly upwind of me on takeoff. I had to do some tight maneuvering to miss him; I hooked a wingtip and cartwheeled. No damage, but lots of embarrassment. The plane has proven to be too stable to be fully aerobatic with the original power setup, but it sure is realistic. It won't do anything vertical and even wants to roll out of the top of loops. For the upcoming season, it has a new O.S. .26 Surpass (interchangeable with the FS .20) and may even get a different prop. The fun never ends!

*Addresses are listed alphabetically in the Index of Manufacturers on page 134. +

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