ARADO 96B

By David P. Andersen

Part 1

March 1945: Berlin is in flames, the Red Army is advancing door-to-door from the east. Russian fighters control the airspace above. Adolf Hitler's bunker will be captured in a few hours. He is offered one last chance to escape.

The plan was to rescue Der Führer from his bunker, take off from the bomb-cratered street and fly west at roof-top level through the streets of Berlin well below the fighter cover that patrolled above. A nimble and aerobatic two-place aircraft piloted by the best of Germany's remaining pilots was needed.

The famous test pilot, Hanna Reitsch was flown into Berlin in the jump seat of a Focke Wulf 190. An Arado 96B that had been hidden in the National Zoo was wheeled down Unter Den Linden to Hitler's bunker. There, Hanna Reitsch and Ritter von Greim whom Hitler had appointed to replace Goering as the new Oberbefehlshaber der Luftwaffe, tried to persuade Der Führer to escape in the Arado. Exhausted and crazed, Hitler declined.

Hanna Reitsch and Ritter von Greim flew the Arado through Russian fighters to sanctuary in the west. Much of what we know of Hitler's final days are the result of that flight.

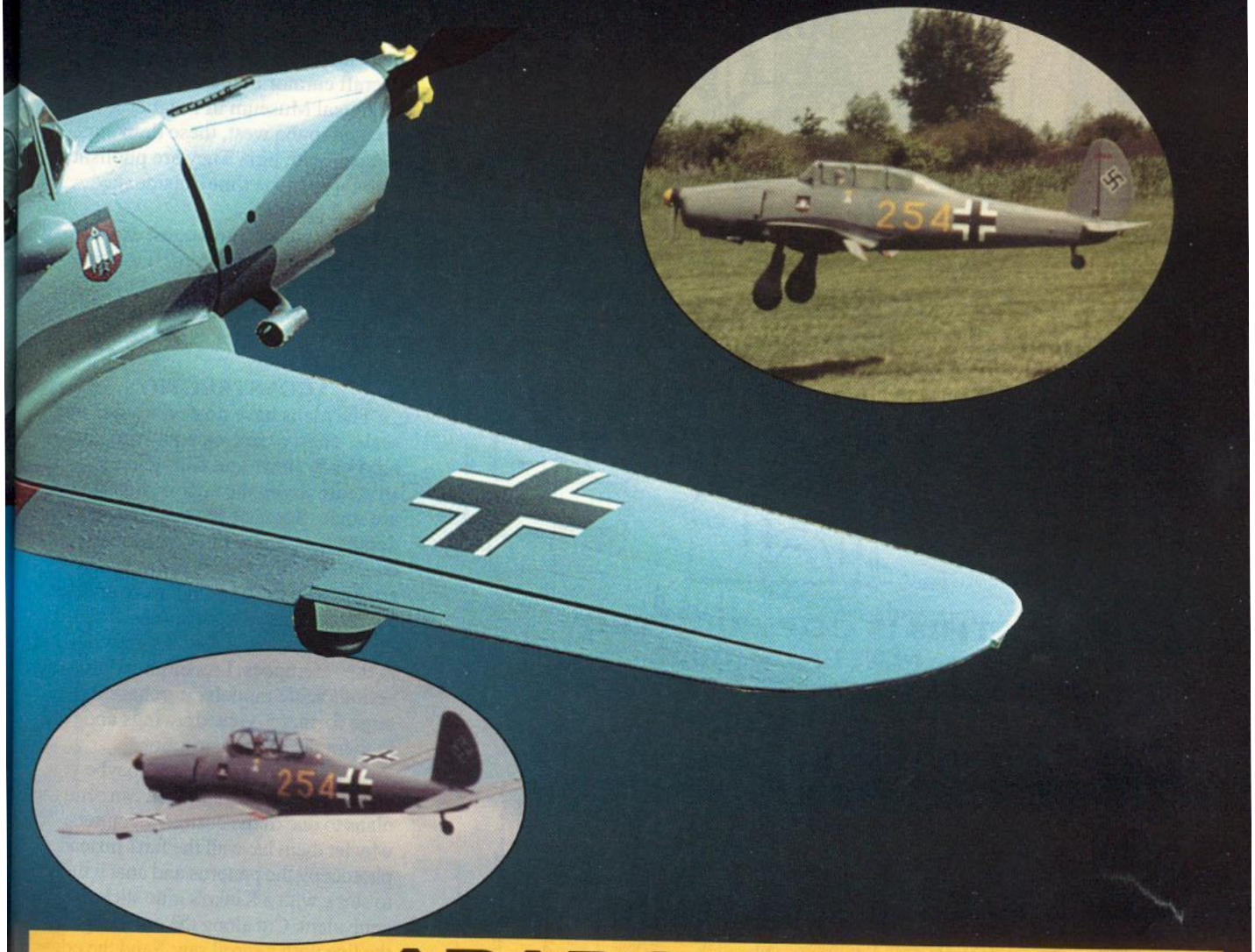
Arado was the only German aircraft manufacturer to refuse to cooperate with the Nazis. Consequently, it was the only company to be nationalized by the Reich.

The AR 96 was a technically advanced aircraft when it first flew in 1938. For comparison, the British production fighter at the time was an open-cockpit biplane. By far the most important advanced trainer in the Luftwaffe, it was adopted in 1940 as the standard training aircraft. Distinguishing features were the narrow nose and the typical tall Arado fin and rudder. The main production variant featured the Argus 465 hp inverted V12 engine and a single MG 17 gun in the cowl. A later version added underwing bomb racks.

The AR 96B had a wingspan of 36 ft., a fully loaded weight of 3747 lbs., and a max speed of 205 mph.

Much of the early production was carried out in the Arado plant in Warnemünde, but the overwhelming need for the German aircraft industry to produce combat aircraft meant that

A One-Fifth Scale Model of WWII Germany's Standard Advanced Trainer

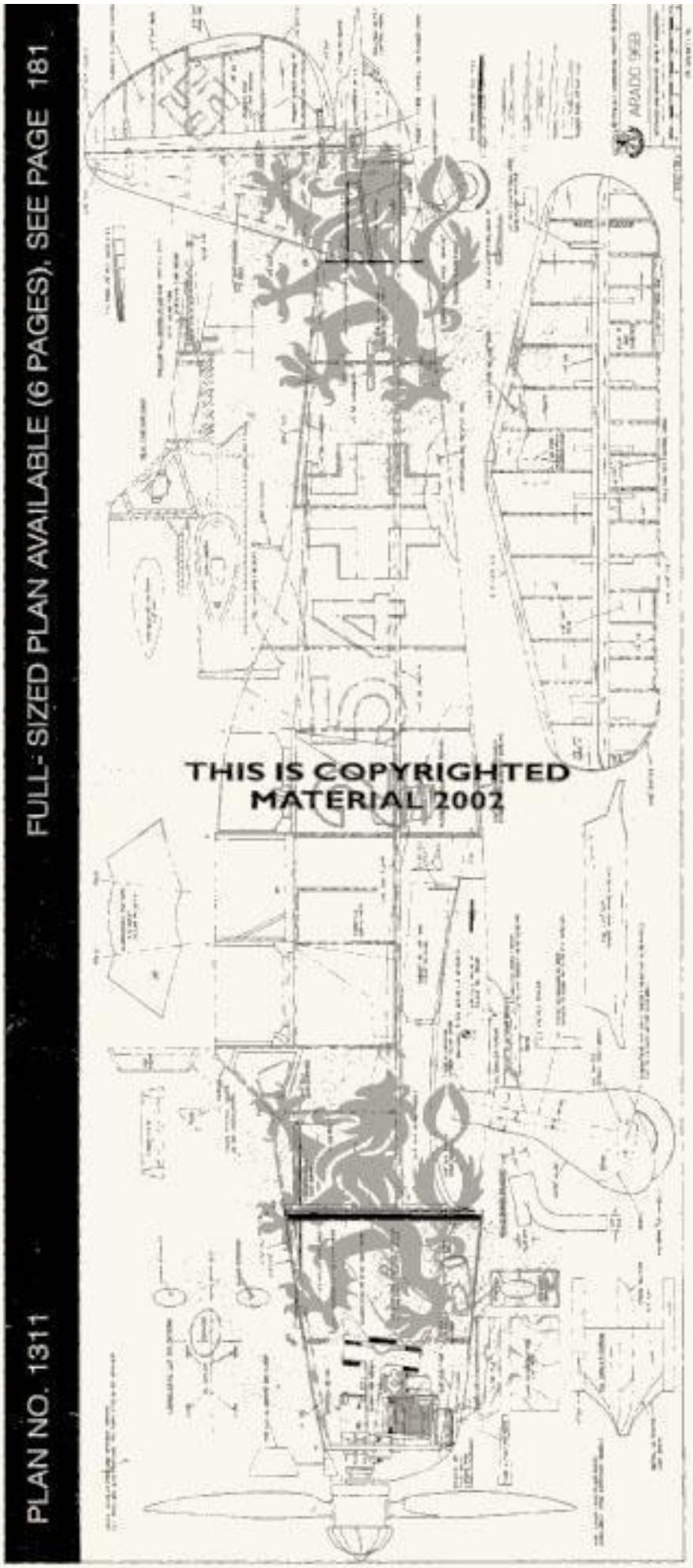


ARADO 96B

Designed by:
David P. Andersen
TYPE AIRCRAFT
Scale (1/5)
WINGSPAN
86 Inches
WING CHORD
15 Inches (Max.)
TOTAL WING AREA
1060 Sq. In.
WING LOCATION
Low Wing
AIRFOIL
Scale Semi-Symmetrical
WING PLANFORM
Swept Leading Edge
DIHEDRAL, EACH TIP
5 Degrees
OVERALL FUSELAGE LENGTH
71 Inches
RADIO COMPARTMENT SIZE
Ample

STABILIZER SPAN
27-1/2 Inches
STABILIZER CHORD (inc. elev.)
6-3/4 Inches (Avg.)
STABILIZER AREA
185 Sq. In. (18% of Wing Area)
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Mid-Fuselage
VERTICAL FIN HEIGHT
12 Inches
VERTICAL FIN WIDTH (inc. rud.)
9 Inches (Max.)
REC. ENGINE SIZE
1.5-1.8 4-Stroke
FUEL TANK SIZE
24 or 32 Oz.
LANDING GEAR
Conventional Retractable
REC. NO. OF CHANNELS
6

CONTROL FUNCTIONS
Rud., Elev., Throt., Ail., Flaps, Retracts
C.G. (from L.E. at Rib 3)
5-3/4 Inches
ELEVATOR THROWS
3/4" Up — 3/4" Down
AILERON THROWS
3/4" Up — 3/4" Down
RUDDER THROWS
2-1/4" Left — 2-1/4" Right
FLAP DEFLECTIONS
0, 10, 45 Degrees
SIDETHRUST
0 Degrees
DOWNTHRUST/UPTHRUST
0 Degrees
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa & Ply
Wing ..... Balsa & Ply
Empennage ..... Balsa & Ply
Wt. Ready To Fly ..... 240 Oz. (15 Lbs.)
Wing Loading ..... 33 Oz./Sq. Ft.



production of trainer aircraft was slow. In mid-1941, the Avia company in Prague took over production of the Arado 96. Approximately 12,000 Arado 96s were built. The Czechs continued production until 1949.

The second escape of the Arado resulted in this article. The excellent 5-view drawings of the full-sized aircraft were developed by Joe Krybus from factory drawings when he was aircraft curator of the Czech National Technical Museum in Prague. When he escaped to the west, these drawings escaped with him. They are published here for the first time outside the Czech Republic.

Unfortunately, no known example of an Arado 96 has survived. It is a pity that this important artifact of history has been lost. So it is left to us R/C modelers to recreate its image in the air.

CONSTRUCTION

The plans have no deviation from scale. They were created by tracing the Krybus 5-views and filling in the structure. Even the airfoil and washout are scale. Some of the smaller surface details, i.e., brake lines, hardpoints, etc., which are known in the scale community as "hoo-ha," were omitted for clarity, but extremists can find these details in the Krybus drawing and in the references. I recommend that the serious scale modeler purchase the large format 5-view drawings and refer to them during construction.

If you hate cutting parts, maybe you need a better scroll saw. You can send the plans to one of the custom kit cutters, but why let them have all the fun? Instead, photocopy the patterns and attach them to stock with a Kinko's glue stick or equivalent. Cut along the outer edge of the line with a scroll saw. Sand the edges to the center of the line. Peel off the pattern. For metal parts, attach the pattern with double-faced Scotch tape.

Use only 4-6 pound balsa except as specified. Light weight is important for good performance. Horsepower compensates for excessive weight only when going straight up.

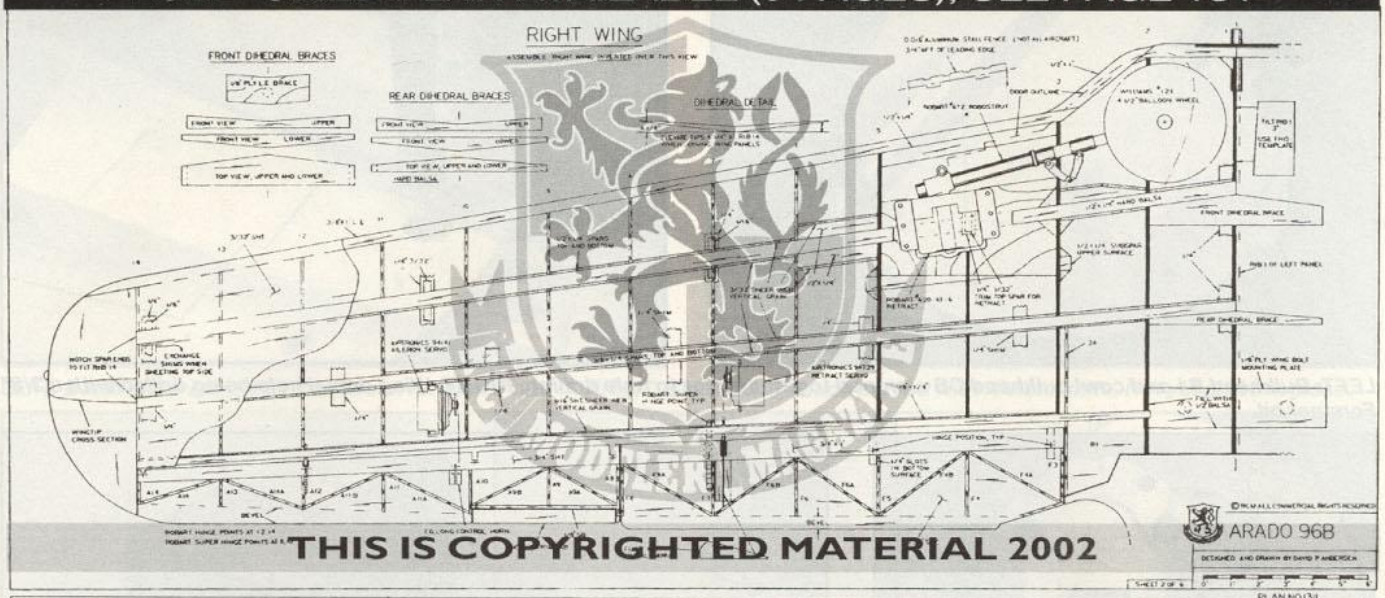
Some of the parts are best molded by vacuum-forming. Nowadays vacuum-forming is cheap, easy and fun to do -- make your own machine from a cake pan and a shop vac (see the references). But if you don't want to get sucked into this technology, all of the vacuum-formed parts can be purchased from AeroTech Models.

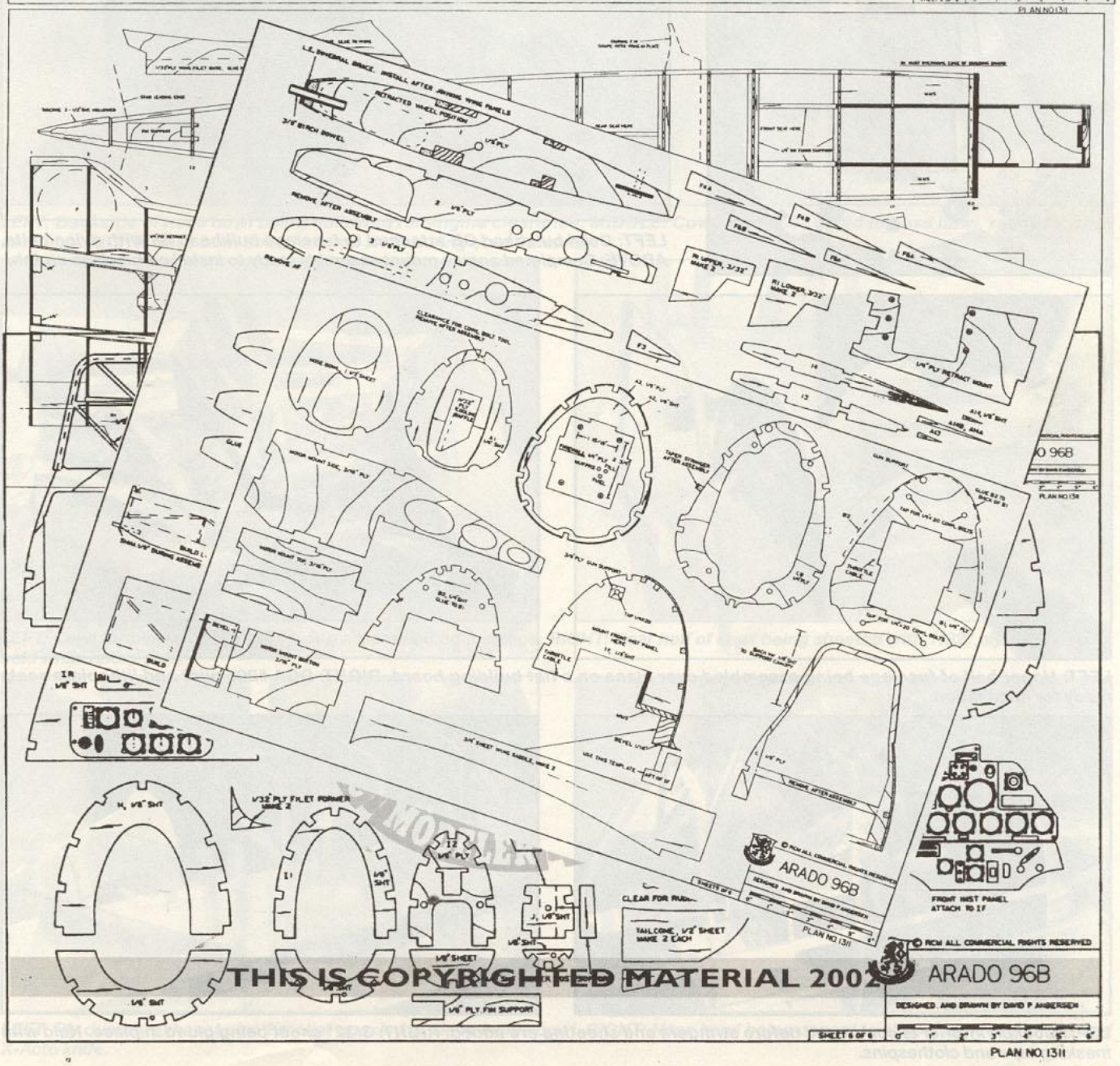
Cowl Bulkhead:

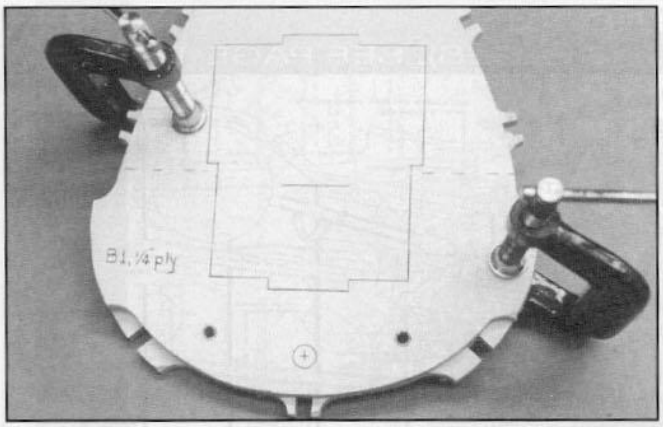
The cowl will be attached to the

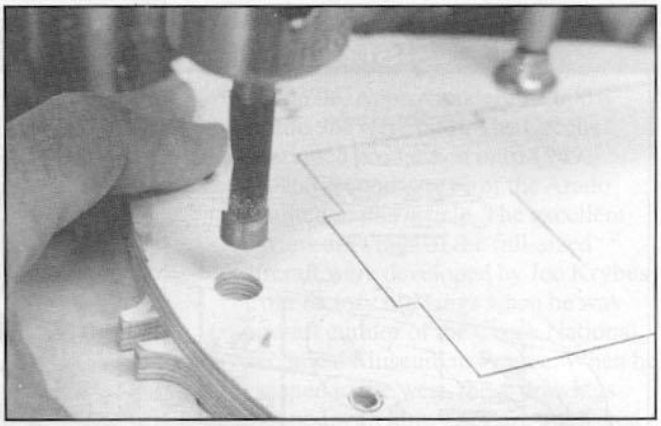
PLAN NO.1311

FULL- SIZED PLAN AVAILABLE (6 PAGES), SEE PAGE 181

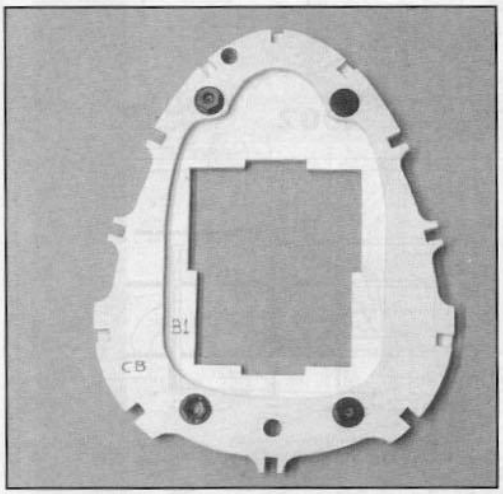


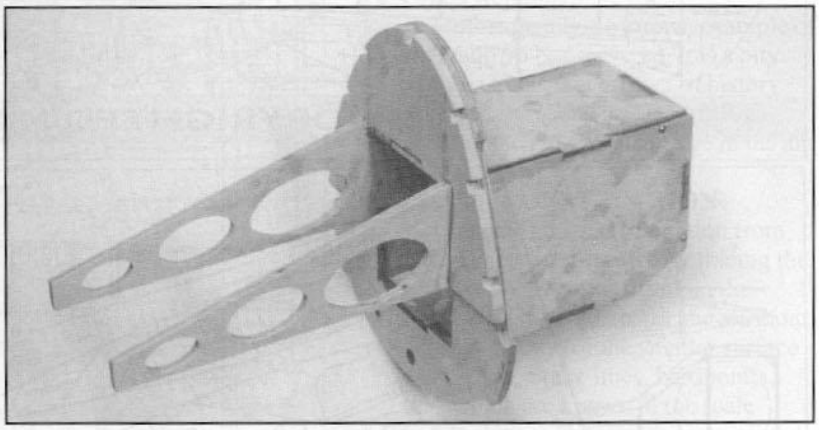




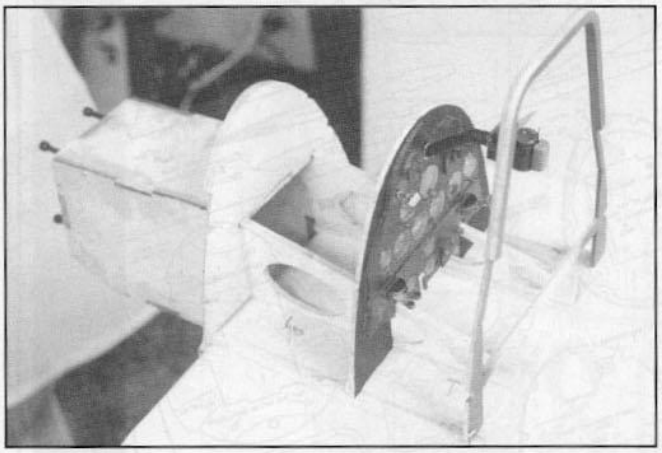


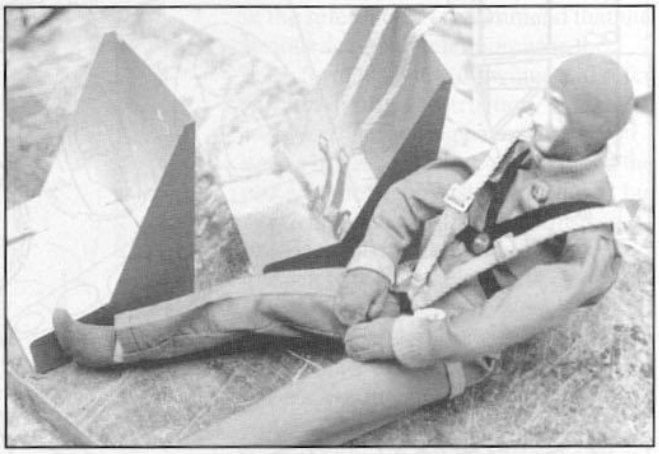
LEFT: Bulkhead B1 and cowl bulkhead CB clamped together prior to hole drilling. RIGHT: Wing dowel hole being drilled with a 3/8" Forstner bit.



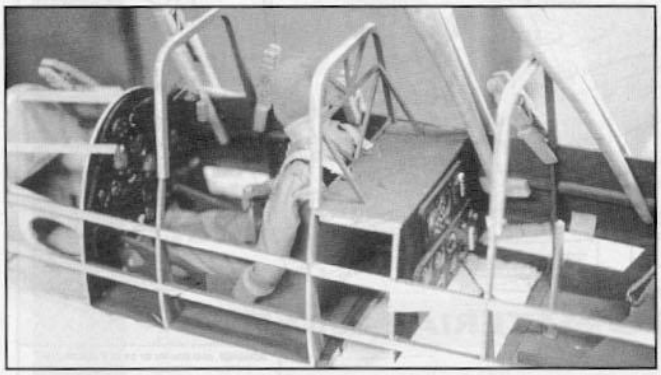


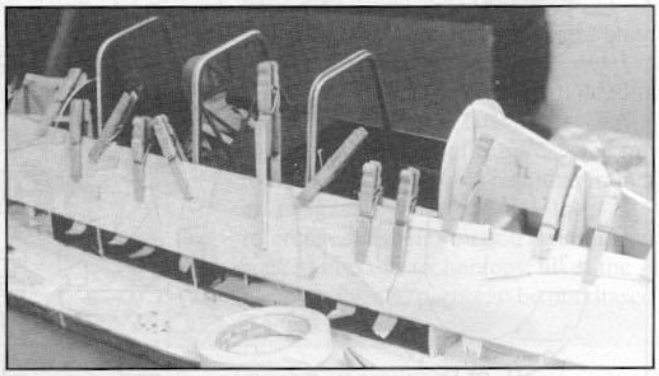
LEFT: Cowl bulkhead CB attached to fuselage bulkhead B1 with nylon bolts. ABOVE: Completed engine mount assembly ready to install on fuselage crutch.



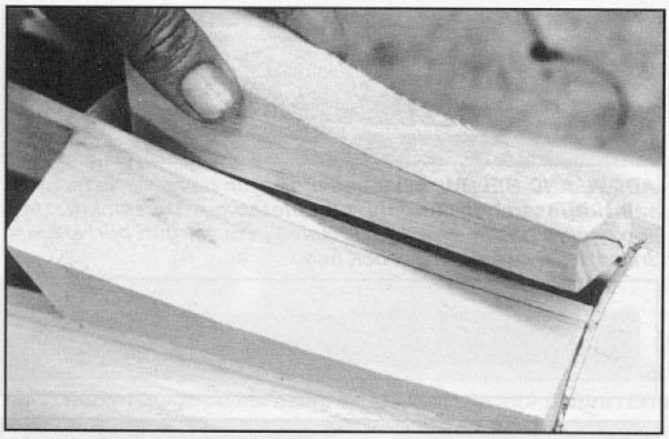


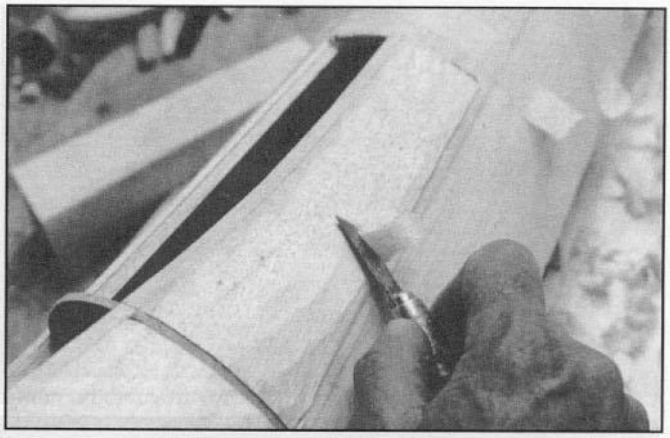
LEFT: Upper half of fuselage being assembled over plans on a flat building board. RIGHT: DGA #205 pilot and lithoplate seats ready for installation.



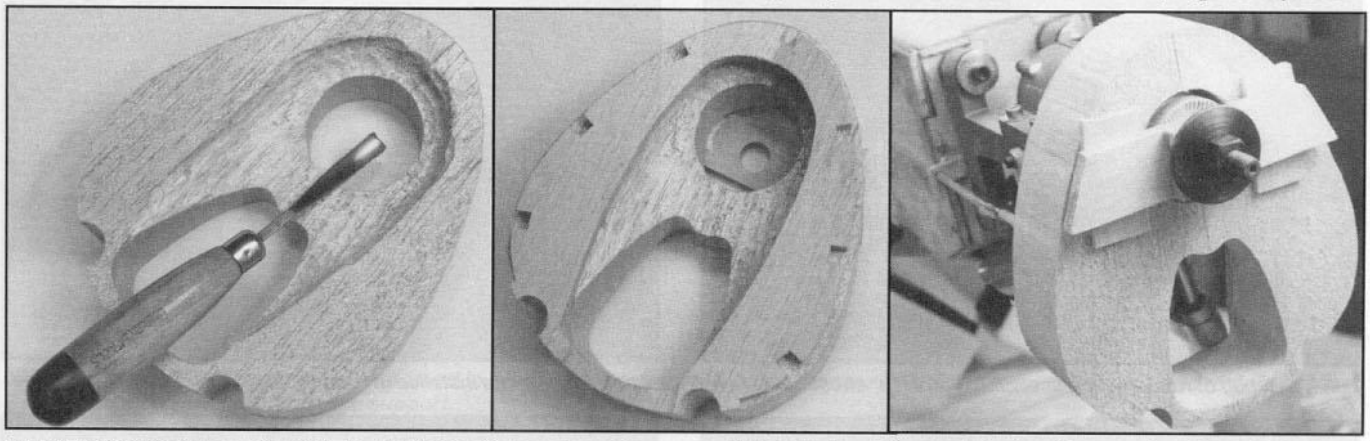


LEFT: Cockpit interior is completed before stringers and sheeting are added. RIGHT: 3/32" sheet being glued in place. Held with masking tape and clothespins.

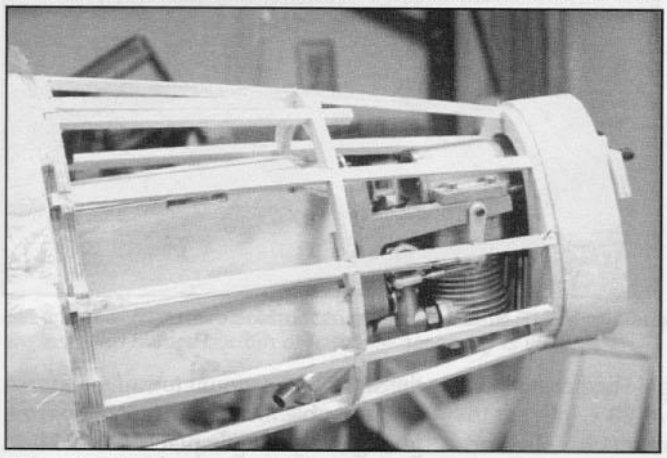


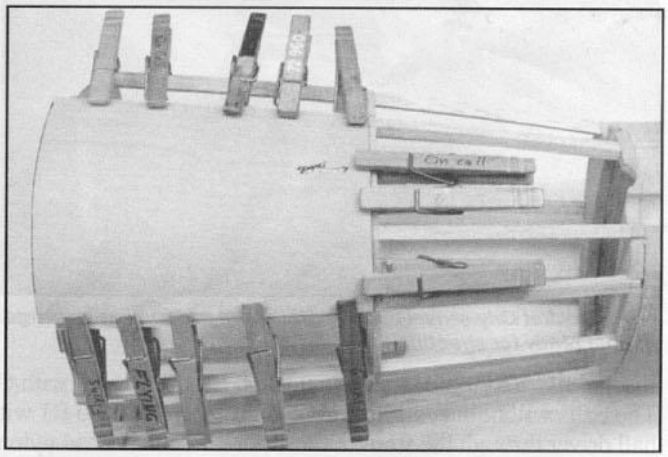


LEFT: Balsa block being fitted between formers F and G. RIGHT: Block being rough carved with X-Acto knife. Not yet glued in place.

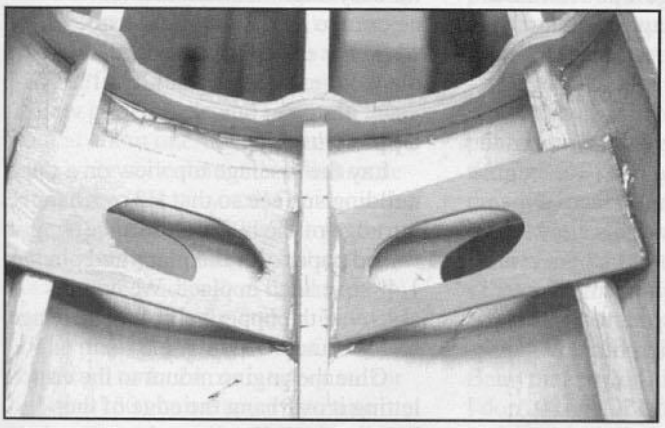


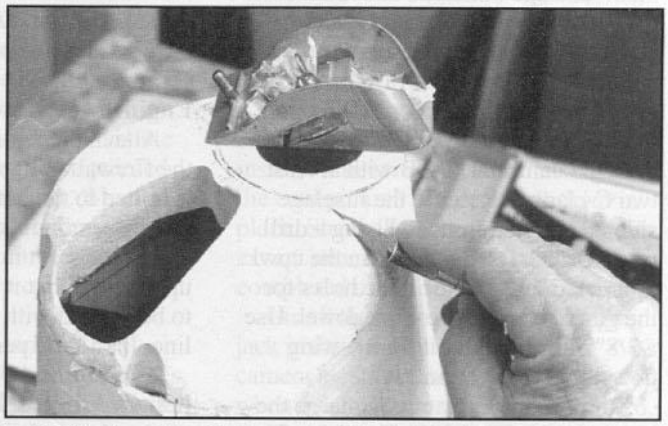
LEFT: Backside of nose bowl being hollowed for engine clearance. MIDDLE: Cowl former A1 glued to nose bowl, ready for cowl assembly. RIGHT: Nose bowl bolted to prop shaft during cowl assembly.



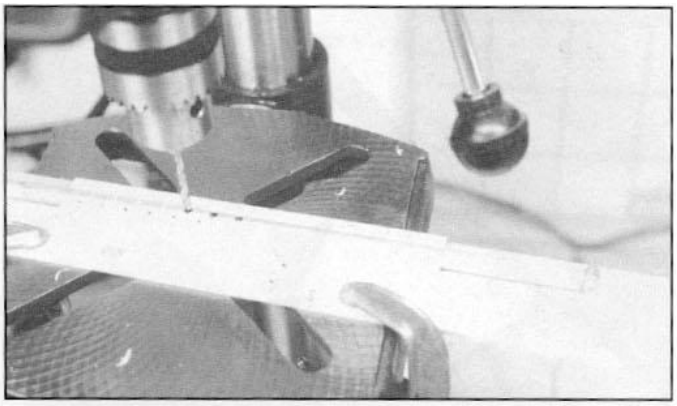


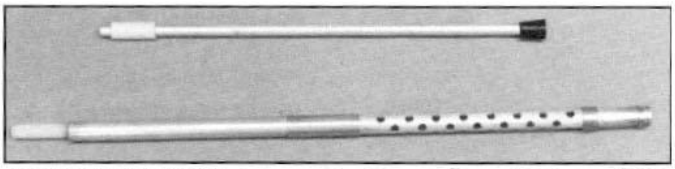
LEFT: Cowl formers and stringers being assembled on fuselage. RIGHT: Rear half of cowl being sheeted with 1/32" ply. Clothespins hold while epoxy sets.

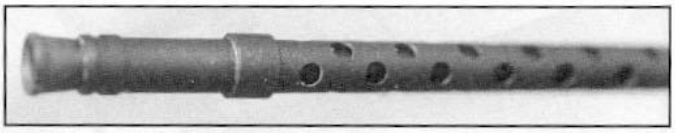




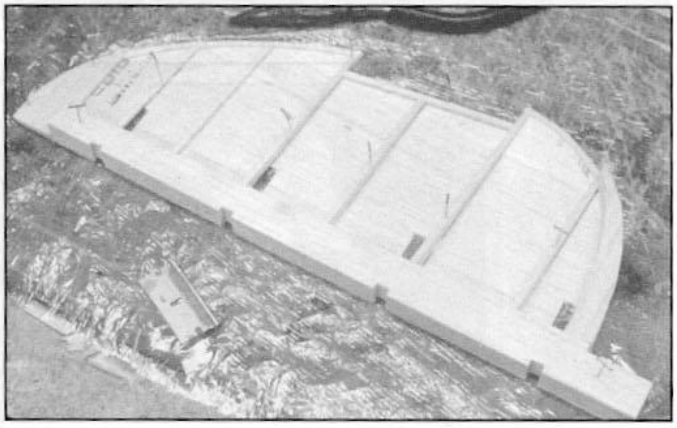
LEFT: Ply dummy exhaust pipe bracket epoxied in place inside cowl. RIGHT: Nose bowl being carved to shape with razor plane and X-Acto knife.

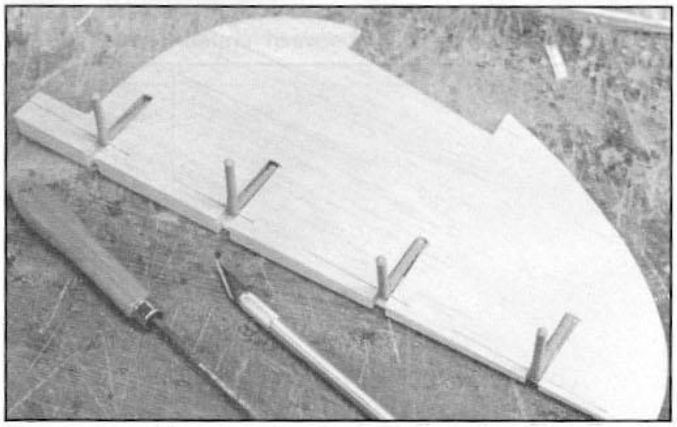




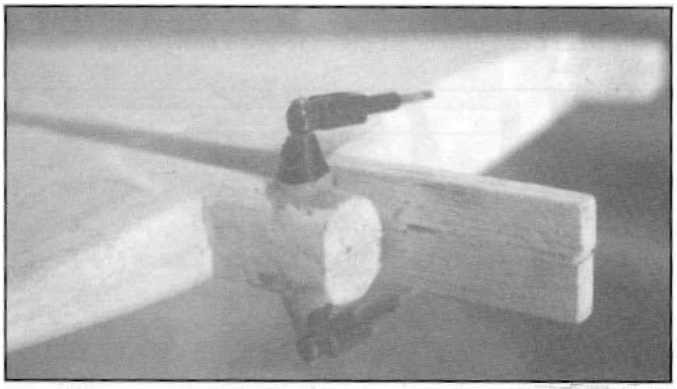


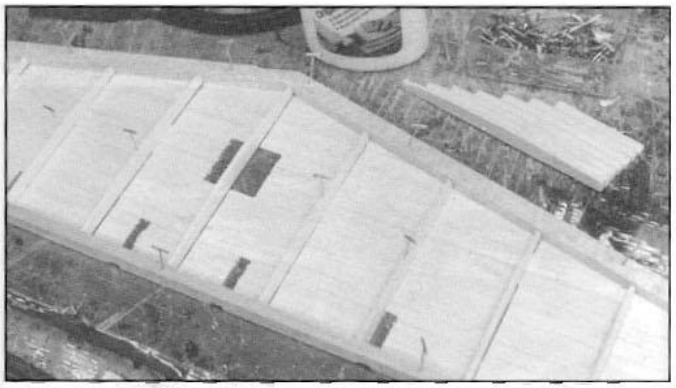
ABOVE AND BELOW: Inner and outer gun barrel parts ready for painting/assembly, and the completed gun barrel. Muzzle is epoxy glue bottle cap. LEFT: Holes in outer gun barrel being drilled. Held by jig and hex bolt head.





LEFT: Left half of rudder being assembled on 1/16" sheet base. RIGHT: Robart hinge points installed in rudder before right side is completed.





LEFT: Rocket City swivel horns installed on rudder leading edge extension. RIGHT: Stabilizer being assembled over 1/16" sheet base. Almost ready for sheeting.

fuselage with four hidden nylon bolts. The bolts will be accessible with a long ball driver through the front of the cowl. We begin construction with the main fuselage bulkhead and main cowl bulkhead while they are accessible.

Cut the bulkhead B1 and the cowl bulkhead CB from 1/4" ply, but don't drill. Leave the pattern on B1 in order to show the position of the holes to be drilled. Clamp B1 to CB with at least two C-clamps. Refer to the fuselage side view for alignment. Using a drill press, drill 3/16" dia. holes in the cowl bolt positions. Also drill the holes for the gun barrel and the wing dowel. Use a 3/8" dia. Forstner bit for the wing dowel for a very clean cut.

Remove the C-clamps. Enlarge the bolt holes in CB to 1/4". Tap the bolt holes in B1 with a 1/4-20 tap. Harden the threads with CA glue and re-tap. Bolt CB to B1 with 1/4-20 x 3/4" socket-head nylon bolts.

Glue B2 to the rear surface of B1. Note from the fuselage side view how B2 supports the fuselage sheeting while the cowl surface ply overlaps B1.

Engine Mount:

Attach the Du-Bro engine mount to the firewall with blind nuts. The engine is bolted to the bottom surface of the Du-Bro engine mount. This allows the crankcase to fit in the rather narrow upper cowl, but it requires the firewall to be slanted with respect to the thrust line. It's a little peculiar, but it works.

The engine mount shown is designed for the Saito 150 or 180 engine, but it can be adapted for other engines by lengthening or shortening the sides of the mount to suit.

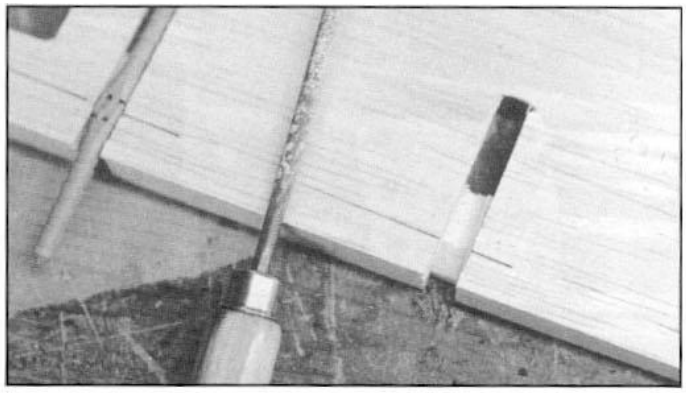
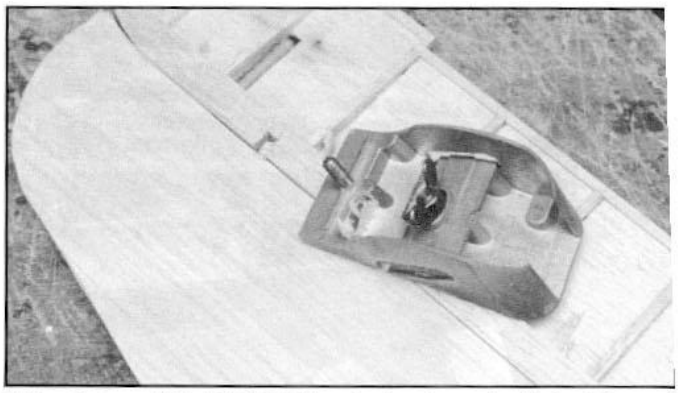
Assemble the engine mount box, gluing everything in place with slow-set epoxy. The parts are all tab-locked for easy alignment. Small screws can be used to hold everything together while the epoxy sets. Leave them in place for extra strength.

Upper Fuselage:

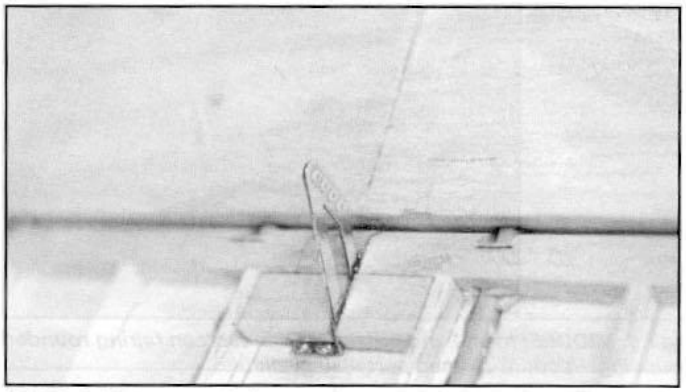
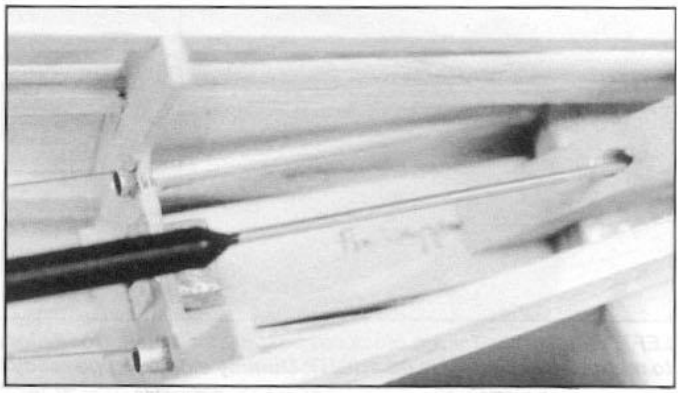
Lay the fuselage top view on a flat building surface so that B2 overhangs the edge of the building surface. Lay waxed paper over the plans and pin the 1/4" sq. crutch in place. We now assemble the upper half of the fuselage on the crutch.

Glue the engine mount to the crutch, letting it overhang the edge of the building board.

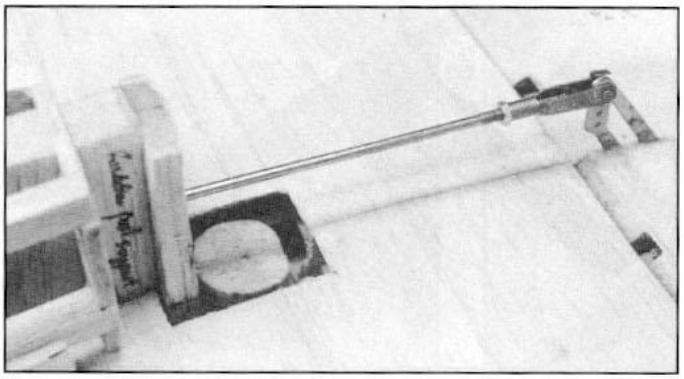
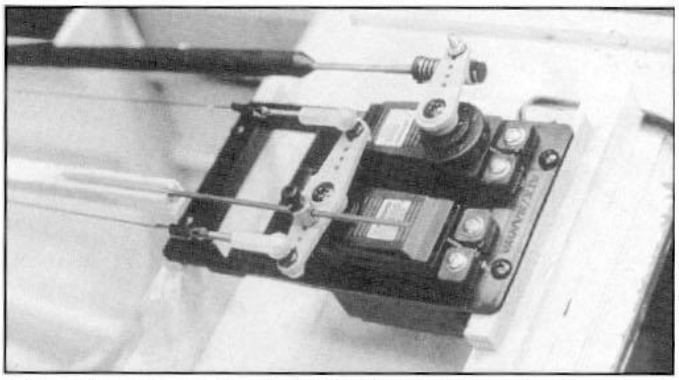
Install the engine. If necessary, shim

LEFT: Robart hinge points being installed in elevator before rib installation is complete. RIGHT: Elevator leading edge being trimmed to shape before hinges are glued in place.

LEFT: Sullivan metal elevator horn epoxied in place. Supported with balsa blocks. RIGHT: Aluminum tubes guide rudder cables. Elevator pushrod runs through stab support.

LEFT: Elevator pushrod connected to horn with 4-40 clevis. Note end of rudder extension in stab. RIGHT: Elevator and rudder servos are installed before bottom of fuselage assembly is started.

the engine bearers so that the thrust line is exactly parallel to the crutch. This thrust line will allow the pilot to control climb rate or glide slope with throttle, just like the full-sized aircraft. That is, with a neutral (and scale) thrust line, the aircraft can be trimmed to a gradual climb at full throttle, transition to a shallow glide at idle and maintain level flight at about one-third throttle. But if your flying style demands full throttle all the time (not very scale but to each his own), then add 1°-2° of down thrust so that it will not climb at full speed and not dive at idle. Don't add right thrust, learn to use the rudder instead.

The plans show a choice of 24 oz. or 32 oz. fuel tank. 24 oz. is adequate for the Saito 150 engine and 10 minute flights. Consider using the large tank if you choose the Saito 180, like longer flights, or you like to fly full throttle all of the time.

Make scale instrument panels from the patterns shown on the plans or purchase completed panels from SAC Headquarters, Inc. (ask for the AR96B 1/5th scale instrument panel set).

Paint and install the cockpit floor, seats, and completed instrument panels. Everything that will be visible through the canopy should be painted now while it is so accessible. We even install Franz Grübermann, the pilot figure, in place at this time. He will wait patiently while we construct his airplane around him.

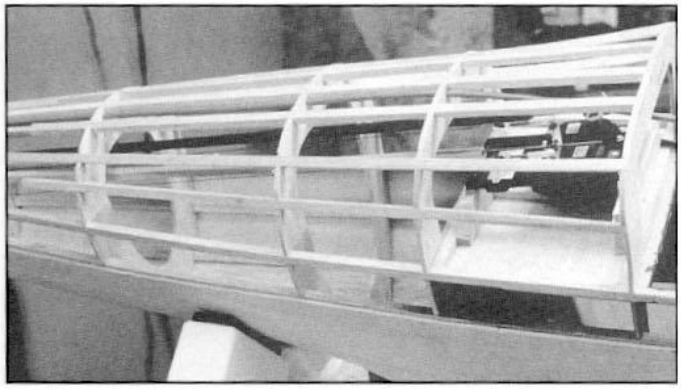
I agree with my friend, Del Barryman, who said, "I build airplanes, I don't make dolls!" If you are not a doll maker either, find a good seamstress, preferably one who collects or makes dolls. Give her a DGA #205 pilot kit and ask her if she would like to work for the Luftwaffe.

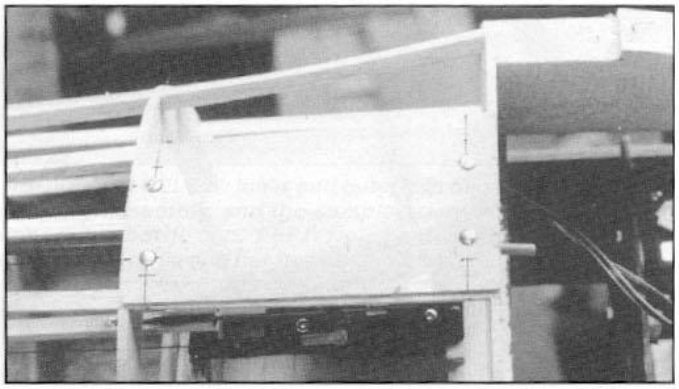
If a gun is to be installed (not all versions of the AR 96 had guns), build and fit the gun now before sheeting the fuselage. See "Gun Construction" (p. 109).

Install the stringers followed by the 3/32" sheeting. It is best to paint the inside of the stringers and sheeting in the cockpit area before gluing them in place. Sheet all of the upper fuselage except near the tail -- that cannot be completed until the tail is installed.

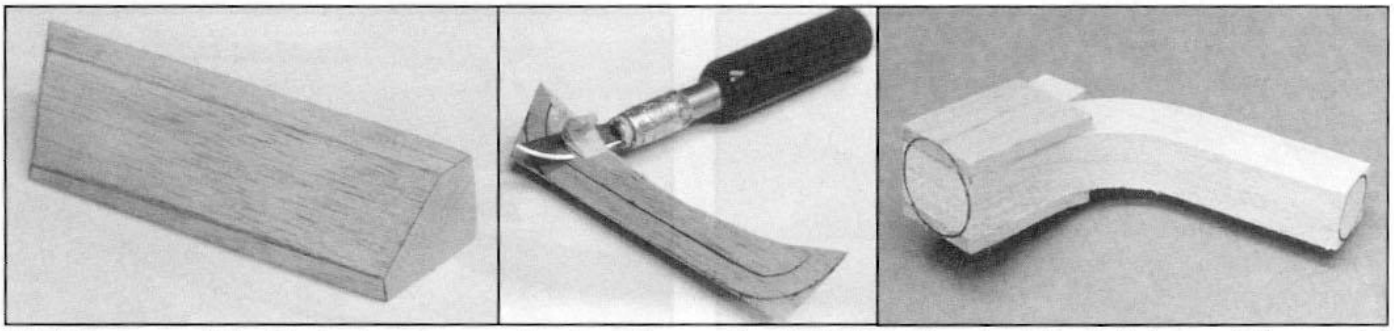
Install the radio switch and charging jack in the fuselage side at the gun camera location. They will be hidden when the gun camera fairing is installed.

The fairing aft of the cockpit has a slightly concave surface, requiring

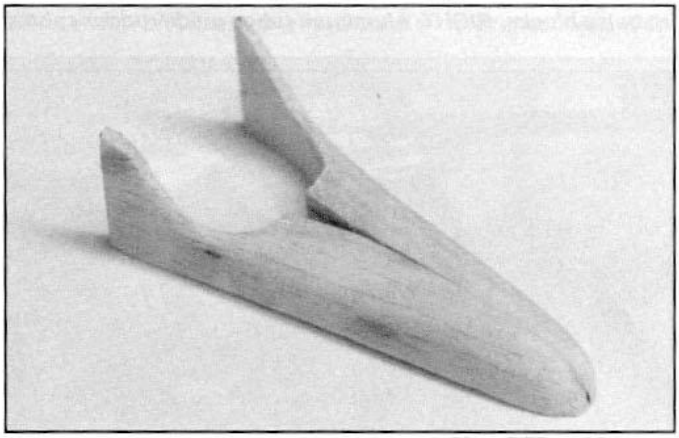


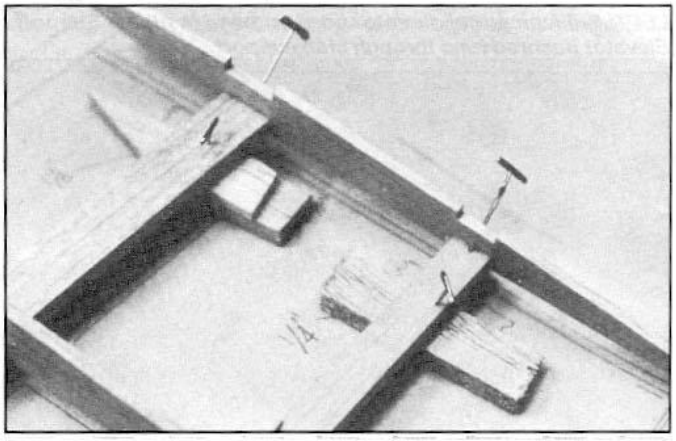


LEFT: Lower fuselage formers and stringers installed after rudder and elevator controls in place. RIGHT: Ply hatch installed over servos for easy access. Countersunk flat head screws used to secure hatch.



LEFT: Windscreen fairing block cut per views on plan. Ready for rounding. MIDDLE: Inside and outside of windscreen fairing rounded to match windscreen frame. RIGHT: Dummy exhaust pipe ready for rounding. Vacuum-formed part also available.





LEFT: Two-piece balsa tail fairing, filled and primed before installation. RIGHT: Wing is assembled inverted over plans. Spars are elevated by shims to form proper washout.

some wood carving to complete. Place a balsa block alongside T1 between formers F and G. Trace the outline of T1 on the block, remove and cut with a scroll saw or bandsaw. Place it back on T1 again and trace the bottom. Remove and cut with a scroll saw. Place it on the fuselage and rough shape with an X-Acto carving blade. Remove again and thin the inside to save weight. Using this method, carve the blocks between G and H as well. Do as much sanding as possible before gluing them in place.

Cowl:

The Arado has a unique nose -- long and narrow. Do a good job of building it because it draws attention on the flight line. The cowl can be constructed as soon as most of the fuselage has been sheeted.

The rear half of the cowl sheeting is ply in order to look like sheet metal at the openings. The front half is balsa for ease of rounding.

Glue A2 to A3, noting that A2 is 1/16" smaller than A3. That's because the cowl forward of A2 will be sheeted with 3/32" balsa and the aft will be sheeted with 1/32" ply. The result will be a flush seam.

Place Saran Wrap over bulkhead B1 so that glue will not stick to it. Bolt the main cowl bulkhead CB to B1 with four nylon bolts.

Now is a good time to make a long ball driver. We will need a ball driver Allen wrench longer than the cowl. A cut-off ball driver, brass tube and an old screwdriver handle glued together with JB Weld epoxy will work. Build it now because we will need it to remove the cowl when it is completed.

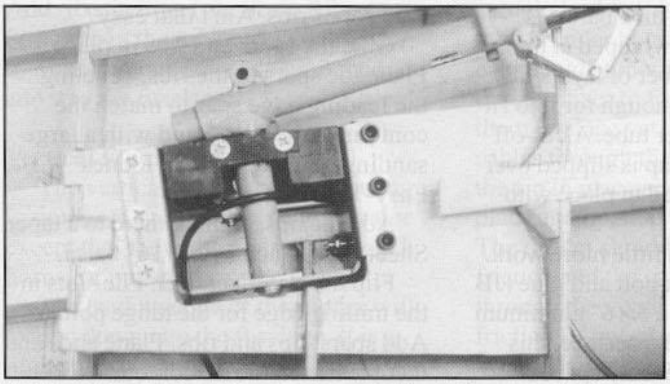
Place A1 on the 1-1/2" nose bowl. Trace the inner contour of A1 on the nose bowl. Remove.

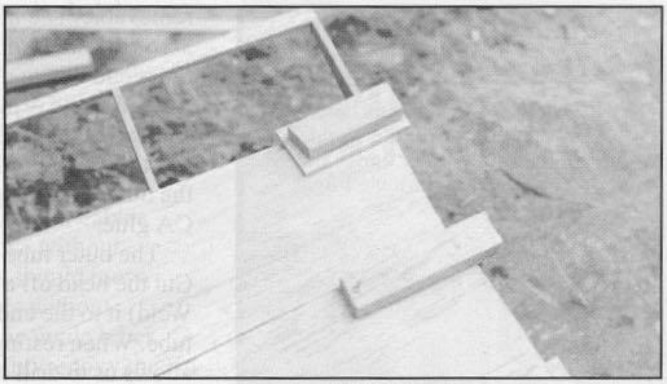
Using the engine as a guide, recess some wood from the inner surface of the nose bowl so that the engine will clear. You can use a woodcarver's gouge for this job.

Tack-glue a ply brace with a 1/8" spacer across the front of the nose bowl. Drill a hole in the center of the brace for the prop shaft, centered in the hole in the nose bowl.

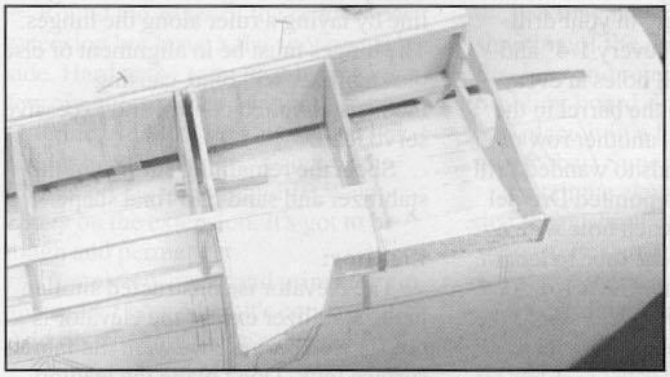
Slip A2/A3 over the engine mount. With the engine installed, slide the nose bowl onto the prop shaft and bolt it in place.

Glue the cowl stringers in place, measuring the position of A2/A3 to be 6" ahead of B1. An easy way to do this

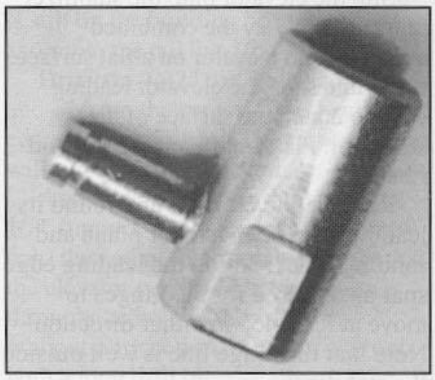


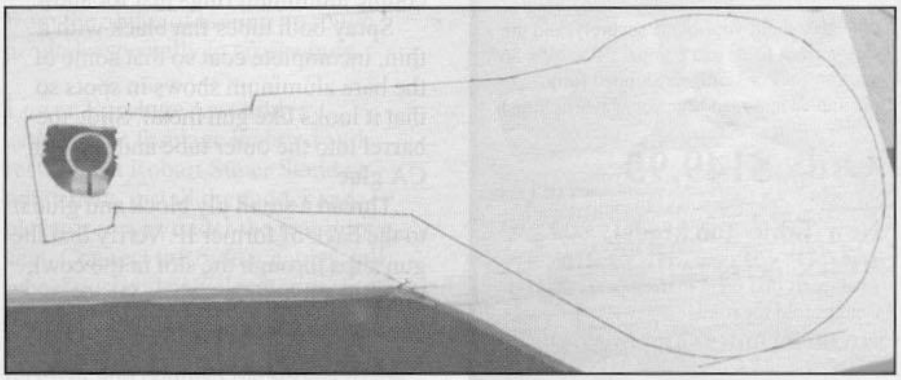


LEFT: Robart AT-6 retracts are used. Mounting plate is also structural support for lower wing spar. RIGHT: Shims are reversed and moved to other side of wing to complete top sheeting.



LEFT: Top surface is sheeted while wing is pinned to building board. Rear section left open for flap and aileron assembly. RIGHT: 1/32" deep recess is drilled in wheel hub for close fit of Sig wheel pant mount.





LEFT: If necessary, the retract angle can be fine-tuned by filing a flat on the cam unit. RIGHT: Wheel well drawn with felt-tip pen by centering pattern on retract socket.

is to put a mark 6" from the rear end of each stringer before it is installed, then align A2/A3 with the marks.

When all cowl stringers are in place, glue a 1/4" x 1/16" layer to the rear half of each stringer. This elevates the stringer surfaces to match the differences in sheeting thicknesses.

Sheet the rear half of the cowl with 1/32" ply. The ply sheeting overlaps fuselage former B1 with cooling air gaps on the side and bottom. This gives the cowl its sheet metal look.

Using the pattern on the plans, cut the exhaust and dummy exhaust holes in the cowl. Install the dummy exhaust pipe bracket inside the cowl, aligned with the scale exhaust holes.

Sheet the forward half of the cowl with 3/32" sheet balsa.

Wrap masking tape around the balsa sheet next to the nose bowl in order to protect it. Then round the nose bowl to shape while referring to the photos and drawings of the full sized Arado.

Verify that the cowl fits around the engine and muffler with at least 1/4" clearance. Remove the valve covers for cowl clearance if necessary. Saito 150s are notorious for shaking their mufflers loose. The soft mount makes this problem even worse. High-temp Loctite 272 will hold the muffler, but it is permanent.

If the model is to have a gun, cut the gun clearance hole in the cowl.

Copy the tube cut-out pattern onto the bottom of the cowl aft of the two holes in the nose bowl. Cut away the sheeting following these patterns, tapering the inside of the holes. Fit a 4" length of K&S 5/8" dia. aluminum tube or Estes model rocket tube into the hole. Trim for a snug fit. Adjust the tube so that the tube points to the cowl bolt in the cowl base CB. You should be able to look down the tube and see the head of the bolt. These two tubes are perfectly scale air intakes. They also provide access to the lower cowl bolts.

After the cowl is completed, attach a socket-head bolt to the needle valve and slip a piece of fuel line tubing over it. Cut a tiny hole in the cowl in line with the needle valve. This allows the needle valve to be adjusted with a ball driver while the engine is running and the cowl is on. The fuel line tubing keeps the ball driver from being shaken off.

Gun Construction:

The optional gun is constructed of two aluminum tubes, and must be

removable. The inner tube barrel is 3/16" dia. aluminum wrapped at the inner end with a number of layers of masking tape -- just enough for it to fit snugly inside the outer tube. A cut-off plastic epoxy bottle cap is slipped over the other end and glued in place with CA glue.

The outer tube is a little more work. Cut the head off a hex bolt and glue (JB Weld) it to the end of a 5/16" aluminum tube. When resting on a surface, this allows us to drill six evenly spaced rows of cooling holes.

Make a wooden jig to hold the outer barrel and clamp the jig in your drill press. Mark the barrel every 1/4" and place it in the jig. Drill holes at every other mark and rotate the barrel to the next position and drill another row of holes. If your drill tends to wander, drill pilot holes first with a pointed Dremel deburring bit. Debur each hole with a rat-tailed file and cut the tube to length, removing the bolt head. Cut a 1/4-20 nylon bolt and glue (JB Weld again) the threaded part into the rear end of the tube.

Dress up the end of the gun with a couple aluminum rings just for show.

Spray both tubes flat black with a thin, incomplete coat so that some of the bare aluminum shows in spots so that it looks like gun metal. Slide the barrel into the outer tube and set with CA glue.

Thread a small ply block and glue it to the back of former IF. Verify that the gun slips through the slot in the cowl, through the hole in former B1 and screws into the threaded block. Remove the gun and set aside.

Stabilizer:

The horizontal stabilizer and vertical fin have similar construction schemes -- a 1/16" sheet base with ribs on either side, then sheeted with 1/16" balsa.

Photocopy the stabilizer pattern and attach it to 1/16" sheet with a Kinko's glue stick. Cut along the outer edge with a single-edge razor blade. Cut the clearance for the rudder post and notches for the Robart hinge points.

Remove the pattern and use it to mark the positions of the ribs. Pin the base to a flat building board.

Stack four 3/32" sheets, attached with double-stick Scotch tape. Attach a photocopy of the stab rib pattern with Kinko's glue stick. Cut the largest set of ribs with a scroll saw. Move the pattern over and cut the next largest set. Move the pattern again, applying more glue if necessary and cut the next set of ribs. Ain't that easy?

Glue the spars and ribs in place. Plane the spars to the ribs, beveling the leading edge spar to match the contour of the ribs. Sand with a large sanding block or a Great Planes Easy-Touch bar sander.

Add the tips, planing them to a taper. Sheet the surface with 1/16" balsa.

Flip the stabilizer over. File slots in the trailing edge for the hinge points. Add spars, tips and ribs. Plane and sand them to match the rib contour.

Epoxy the stabilizer hinges in place. Verify that the hinges are in a straight line by laying a ruler along the hinges. The hinges must be in alignment or else the stabilizer will bind, causing inconsistent pitch control and excessive servo load.

Sheet the remaining surface of the stabilizer and sand it to final shape.

Elevator:

The elevator is constructed similar to the stabilizer except the elevator is not sheeted because we want the fabric-surface look. Don't plane the leading edges yet.

Slip the elevator onto the stabilizer hinge points. Lay the combined stabilizer and elevator on a flat surface. Plane and sand the elevator leading edge to match the surface of the stabilizer. Plane and sand the tips and ribs also.

Remove the elevator and round its leading edge with a razor plane and sanding block. Notch the leading edge spar as required for the hinges to move at least 45° in either direction. Note that the hinge line is well outside the stabilizer.

Install the elevator on the stabilizer again and verify that it swings up and down without rubbing or binding.

Add the scale counterbalance. Cut a rounded slot in the stabilizer for it as shown on the plans. Sand this slot smooth with sandpaper wrapped around a dowel.

The counterbalance slot does indeed weaken the stabilizer slightly, so you might be tempted to add reinforcement. Don't. This is a low stress area that is strong enough. Extra weight in the tail isn't worth it.

Install the Sullivan metal elevator horn. Block it in place with hard balsa blocks and epoxy.

When all fits well, epoxy the hinges to the elevator being careful to not get epoxy in the hinge pins. Most hinges are next to ribs. Web the epoxy up the walls to distribute stress.

Cover and prime the stabilizer now.

Add rib stitching (see Scale Rib Stitching in the references). It's easier to work on now. Set aside until ready to add it to the fuselage.

Vertical Fin & Rudder:

The vertical fin and rudder structure is similar to the stabilizer and elevator except that the rudder has dual swivel horns for pull-pull cables.

The leading edge of the rudder will extend down into the fuselage. It is a high stress area that will not be readily accessible for repair so we must do it right the first time.

Round the edges of the rudder spar extension but leave a flat spot on each side. Harden the extension by poking a few pin holes in it and saturating it in CA glue. Add Rocket City swivel link rudder horns to the extension. Use Loctite on the threads and JB Weld epoxy on the extension. It's got to be tough and permanent.

Completely cover and prime the fin and rudder now when it's convenient. Add rib stitching to the rudder.

Tail Assembly:

While the upper half of the fuselage is still on the building board, we assemble the tail onto the fuselage.

Drill two 7/32" dia. holes 2" apart and 1" from the center of the leading edge of the stabilizer. The rudder cables will run through these holes.

Assemble the ply fin support, its 1/2" support, and the upper tail cone onto the end of the fuselage. Verify that the elevator pushrod wire will pass through the hole in the tail cone without obstruction. If not, drill it out with a long drill bit.

Trial-fit the stabilizer in place. It should be exactly parallel to the building board and set at an incidence angle of 1°. Trim or shim as necessary. Glue in place with slow-set epoxy. Before the epoxy sets, verify that the stabilizer is square with the fuselage by measuring the distance from the stabilizer tips to any center point on the fuselage. Shift the stabilizer until the distances are equal. Hold it in place with a heavy weight while epoxy cures.

Trial-fit the fin and rudder to the stabilizer. The rudder post must pass completely through the stabilizer to mate with rudder post support beneath the stabilizer. Trim away stabilizer material as necessary to accomplish this. The fin must rest flat against the ply fin support while the leading edge of the fin fits into the slot in former I2.

Remove the fin and rudder and connect a generous length of Proctor stranded cable (it's actually fish leader) to the rudder horns. Install the rudder cable guide tubes in the leading edge of the stabilizer to former I2 but don't glue them in place yet. Run the rudder cables through the guide tubes and put the fin in place again. Pin the fin in place and operate the rudder cables. The rudder should move without friction and the cables should move through the guide tubes without friction. If not, align the guide tubes. When all works smoothly, epoxy the fin in place, then spot glue the guide tubes in place.

You may now complete the sheeting of the upper half of the fuselage and remove it from the building board. Invert the fuselage and place it in a holding cradle such as a Robart Super Stand.

Install the elevator pushrod. Verify that the pushrod does not bind in the support. It is not too late to re-drill the support if it does.

Install the tail wheel bracket. Add a balsa pushrod long enough to reach former F. A balsa pushrod is preferred for the tail wheel. Its light weight and flexibility protects the rudder servo from the abuse of taxiing on rough ground, especially in crosswinds.

Lower Fuselage Assembly:

With the fuselage inverted and resting in a Robart Super Stand or equivalent, install the rudder and elevator servos under the rear pilot's seat. Connect the rudder cables, tail wheel pushrod and elevator pushrod. At this point, everything is so open and accessible that it's a joy. Install the receiver and connect the servos to the receiver. Verify correct movement of the tail stuff.

Install the throttle servo and throttle cable, then add the lower fuselage formers.

Install an outer NyRod from former E through all the formers to the end of the fuselage. Push the antenna into this tube and seal it with a piece of tape at the forward end.

Install all of the lower fuselage stringers.

Add a removable hatch over the rudder and elevator servo area and attach with small flat-head screws into balsa. Harden the screw holes with CA.

Add the 3/4" wing saddle between formers B2 and E. Shape the surface to be flush with the formers B2 and E and the crutch. Note that the sheeting will overlap the wing saddle. This means that part of B2 will project 3/32" outward from the wing saddle. Also

note how former E is slightly concave where it meets the wing saddle.

Sheet the lower half of the fuselage.

Windscreen Fairing Carving:

The pesky little fairing at the top of the windscreen must be dealt with. Basic wood carving techniques make it easy and fun. Here's how:

Trace the top view of the fairing onto a block of balsa. Cut out with a scroll saw. Tack-glue the pieces back. Trace the side view onto the side and plane the block to the side view lines. Remove the tack-glued ends. Bevel the ends with a disk sander or sanding block to the angle shown on the plans.

Hold the block to the top of former and trace the former shape to the rear of the fairing. Remove material from the bottom to the traced lines. Round the corners on the outside of the fairing, but don't touch the lower 1/4" of the fairing because this is where the windscreen will be attached.

If desired, cut a rectangular hole in the center of the fairing per the 5-view and add a tiny lithoplate air scoop. This is the cabin air vent. It helps keep the inside of the model cool too.

Completely shape and sand the fairing before gluing it in place.

Exhaust Pipe Fabrication:

A unique feature of the Arado 96 is the odd exhaust pipe. There are four ways to make it: carve from wood; make a mold and lay up fiberglass; vacuum-form, or buy it from Aerotech Models.

If you choose to form your own, you will need to carve one from wood first. Trace the pattern onto balsa wood and cut it out with a scroll saw, then round the edges and sand smooth. For vacuum-forming or fiberglass molding, split the pipe in half -- easy if the material is two layers of sheet tack-glued together.

When gluing the final halves together, use a thick bead of epoxy so that the seam looks like a weld.

Paint the pipe before attaching it to the finished cowl. To get a scorched brass look, brush the inside with flat black to look like soot. Spray the outside of the pipe with copper dope followed by a thin, uneven coat of flat black followed by some ash-grey on the rear lip.

Hold the pipe in place on the cowl and trace the edge of the pipe support bracket on the pipe. Remove the pipe and cut it about 1/16" outside the line. Remove paint from this area. Re-insert it inside the cowl and epoxy it in place.

It would be really scale to have a functional exhaust pipe with real exhaust coming out of it. But this would require a metal pipe. Any ideas?

Wing:

Each wing panel is assembled inverted over the plan on a flat building board. Washout is a uniform 3° negative twist from root to tip. Washout is built in by shimming the spars during construction.

Two aileron servos are used, one in each wing. Two servos are much simpler than one because of the linkage eliminated, and there is less play in the linkage. Some say that redundancy improves reliability.

Begin by pinning the washout shims where shown on the plans.

Select spars at your local hobby shop that are straight-grained and warp-free. Lay the front and rear spars on the shims over the positions shown on the plans. Pin in place.

The Robart retract will be practically inaccessible after the airplane is completed, so it must work perfectly before the wing sheeting is completed.

Put a strut in the retract unit and operate the unit. In order to get the gear to lock properly, it must lock when the strut is exactly parallel to the retract mounting flanges. If it moves past this position, as some do, reduce the up-locking angle by filing a flat spot on the cam assembly so that it slips into the upper notch in the front housing when the strut is 90° to the frame.

Retracts have been known to lose screws from vibration, so prevent this by adding Loctite to all of the screw threads.

Remove the strut and fit the retract unit to the 1/4" ply mounting plate. The outboard bolts are flat-head and countersunk for a flush fit. This is necessary in order for them to clear the wing sheeting. Attach the retracts to the mounting plate with blind nuts and Loctite. Add the air lines to the retract units.

Epoxy ribs 3 through 5 and the retract mounting plate in place. It will be necessary to notch the upper spars near rib 4 in order to squeeze the retract units into the wing. Glue the remaining ribs in place. Use the template to tilt rib #1 by the dihedral angle of 3°. Thread the air lines through rib 1. Add the dihedral braces, tips, bottom spars, and the fore and aft spar shear webs as shown, with the grain vertical. Don't install the trailing edge shear webs yet; wait until after the flaps and ailerons are installed. Add the leading edge spar.

In order for the wheel to fit close per

scale to the strut, it is necessary to countersink the Sig wheel pant mount (which doubles as a wheel collar) into the wheel hub. Drill a 15/16" dia. hole 1/32" deep into the hub. Don't drill any deeper or else you will weaken the hub which is hollow. Put it aside for later.

Bevel the leading edge with a razor plane and sheet the bottom surface with 3/32" balsa from the leading edge to the rear spar. Plane and rough-sand the surface. Don't sheet aft of the rear spar at this time in order to leave room to install the aileron and flap stuff.

Turn the wing over. Remove the shims from the building board and spot-glue them to the sheeted side of the wing in the same position except that the front spar shims are now placed on the rear spars and the rear shims are placed on the front spars. Place the wing on the building board. It should lay flat on the shims. Weight it down to make sure all the shims are in contact with the building board. This locks in the washout.

Sheet the top surface of the wing only from the leading edge to the front spar and from the rear spar to the trailing edge. This leaves room for installing flaps and ailerons. We will complete the wing sheeting after the wing panels are joined.

Remove the wing from the building board.

Wheel Well Cutout:

Cut away the sheeting in the lower wing, just enough to expose the socket for the landing gear strut. Cut out the wheel well pattern. Slip the 1/2" hole in it onto a strut and insert the strut into the socket. Lay the pattern flat on the wing, positioned as shown on the plans. Trace around the pattern with a felt-tip pen and cut away the sheeting with an X-Acto knife. Cut away the removable portions of ribs 2 through 4. Put a wheel on the strut. Cross your fingers and operate the retract unit. Trim away material if necessary so that the wheel and strut operate without binding.

Final fit of the wheel in the well will be done later when the gear door is added.

Flap:

The copy machine is your friend. Set the intensity on extra dark. Make a copy of the flap pattern. Then set the copier to "reverse image" (not all copiers have this feature -- find one that does) and make another copy. This gives left and right flap patterns.

Place the pattern face down on 3/32" sheet and iron the paper with a hot iron set on "cotton." This transfers some of the ink from the paper to the wood.

Cut out the pattern to make the lower surface of the flap. Pin it to a flat surface.

Cut the flap horns from K&S aluminum. Both horns must be exactly alike or else the plane will roll when the flaps are lowered. Do this by stacking two pieces of 1/16" aluminum stuck together with double-stick tape. Attach the pattern, also with double-stick tape, drill the hole and cut out with a bandsaw or scroll saw (fine blade). Roughen the surface of the horn with sandpaper or a file so that epoxy will have more surface to grab onto. Add a clevis to the horn and epoxy the horn in place on the flap, reinforcing the bond with scrap wood on either side of the horn.

Install the flap hinges, being careful that the hinge pins are in a straight line as shown on the pattern. Glue the leading edge, ribs, and cross-ribs in place. The cross-ribs resist warping. Bevel the trailing edge with a razor plane. Bevel the leading edge spar, reducing its height down to the ribs. Remove irregularities by sanding the whole flap with a large sanding block.

Glue the upper sheeting in place. Round the leading edge of the flap with a razor plane and sanding block. Copy the shape shown on the plans.

The hinge line is recessed 'way into the flap, leaving not much to be glued to the wing. So we lengthen the wing side of the flap hinges by adding Robart hinge pockets. Epoxy them permanently to the hinges.

Bevel the wing's trailing edge as shown in the cross sections.

Pin the flap in place on the wing using short lengths of 3/32" sheet. Epoxy the flap hinges in place. Just a spot of epoxy on each hinge will do for now.

Install the flap servo now using proportional retract servos. I use two new identical servos for the flaps, one in each wing panel. Roughen the surface of the servo and glue it in place to the underside surface of the upper sheeting. Use a flexible glue such as Zap-A-Dap-A-Goo.

Nowadays there is no longer a reason to make flap or aileron servos removable or even accessible. They are cheap and will outlast the airplane. But always install new, tested equipment in a new airplane, especially a high quality scale model.

Operate the flap servo to verify non-binding operation. Epoxy small blocks of balsa around the hinges to complete their installation.

For the second half of the build instructions, download and read ... ***Construction Article Part B***