REVENGER

The Revenger is the newest and sleekest design to be offered to the modeler in years. One of the unique features of the Revenger is its laminar airfoil wing. The laminar airfoil provides the modeler with a wing that few model designers attempt to use. Literally years of testing and development has resulted in a design that will take a back seat to none.

As with any scratch-built airplane, one of the biggest tasks is preparing the parts for assembly. I have found that two sets of plans (one for templates and one for building) will save hours of work in the long run. I would suggest making templates from chrome-cote card stock which can be found at most of the large stationary supply stores.

Cut the parts from the drawing slightly oversize and spray with 3-M- 77 adhesive spray and bond to card stock. When dry (just a few minutes), trim to final cut size. A parts list has been provided as an aid in preparing your parts for assembly.

I have broken down the assembly into major components, i.e., fuselage, wing, empennage, etc. This will enable you to jump around during build up. Throughout build up, the writer will assume you are using templates.

Fuselage:

Cut two matching sides from 3/16" x 4" x 48" medium hard balsa, using the fuselage template as a guide. Be sure to cut the front edge (firewall) for 2° down thrust. Measure back (from firewall end) 3/8" and draw a line parallel to edge, cut two top stringers 1/4" x 1/2" x 39" and glue to top of fuselage sides(s) (using Wilhold Aliphatic Glue) starting 3/8" aft of forward edge (firewall). Clamp using clothespins. Cut off and retain the upper half of stabilizer opening (make cut vertical at leading edge of stab opening), which will be used later when installing horizontal stabilizer.

Cut two (2) forward fuselage doublers from 3/16" x 3" x 6½"soft balsa and two (2) wing saddles from 1/8" x 2" x 16½" hard balsa or light plywood. Place on fuselage side as shown on drawing. Using a felt tipped pen, draw an outline around doubler and wing saddle. Apply a light coat of contact cement to doublers, wing saddles and area outlined on fuselage sides. When contact cement is dry (to touch), place doublers and saddles and press firmly in place. Note: As an aid in installing the doublers and wing saddles in the exact position, place a piece of waxed paper over the contact cemented area. Place doubler(s) and wing saddle(s) on top of waxed paper. Slowly pull waxed paper out from under the balsa and press pieces firmly in place.

Cut two (2) lower stringers from 1/4" sq. x 25¼" balsa and glue to bottom of each fuselage side using Wilhold Glue. Lay the R/H fuselage side on plans and mark position for vertical stiffeners. Cut stiffeners to size and bond in place using "Hot Stuff". Note: Cut a relief in stiffeners to clear wing saddles.

Cut forward bulkhead from 1/4" (5 ply) plywood and mark location for wing hold-down dowels as shown on plans. Drill holes using a 1/4" drill. Epoxy to one side (using Devcon 5-Minute Epoxy) using a small square to make sure bulkhead is in straight. After bulkhead has dried, turn fuselage upside down and apply a film of epoxy to exposed edge of bulkhead and bond to opposite fuselage side. Note: Be sure to use a small square (or angle) to insure bulkhead is straight on fuselage. When dry, measure width of fuselage (just above bulkhead). Cut 5 cross braces (to length just measured) from hard 1/4" sq. balsa, and epoxy in to position shown on drawing.

The most important step in building a

fuselage is to build it straight and true. If you have a fuselage jig, the next step will be easy and straightforward. If you don't, I'll give you a tip on how I assemble the fuselage without a jig and still keep it straight.

Draw a straight line on your building board (a few inches longer than fuselage). Measure width of fuselage and draw a line parallel to line previously drawn. Draw a centerline between both lines (to represent centerline of fuselage). Pin fuselage (at mid-section) upside down, aligning sides with lines previously drawn. Join the sides together (at tail) and trim lower stringer (1/4" sq.) at an angle until stringers fit flush together. Bond together using Hot Stuff and pin to building board. Using 1/8" x 3" balsa sheet, cut bottom sheeting cross grain and glue to bottom of fuselage using Wilhold Glue.

Cut firewall from 3/8" (7 ply) aircraft plywood using dimensions shown on drawing. If 3/8" ply is not available, cut two pieces, one 1/4" ply and one 1/8" ply and glue together using Wilhold Glue. Clamp securely and allow to dry overnight. If you plan to use a Fox mount and Southern or Proline gear, you can layout the firewall as shown on the plans; if not, use the same relative location as shown on plans, but drill holes to suit mount and gear selected. For nose gear installation drill four (No. 25 drill) holes for 4-40 blind nuts and four (No. 21 drill) holes for 6-32 blind nuts for engine mount. Note: It is very important that the firewall be 3/8" plywood. By using the 3/8" (or larger) you get better vibration and load distribution of the engine specific firing impulses throughout the entire fuselage. This not only provides for increased power but can also reduce the possibility of radio failure due to vibration.

If you use the Fox mount, you will need to make some minor alterations to enhance installation. Using a Dremel Tool (or electric drill) equipped with a rotary file, remove enough material on back of mount to clear the 4-40 blind nuts. File each beam to a slight angle to clear engine cowling.

Next chamfer right and left sides of firewall 3 degrees and epoxy on front of fuselage. Clamp and allow to dry. When dry, remove fuselage from building board and install the remaining 1/4" sq. cross braces across aft fuselage section using Wilhold Glue. Stand fuselage tail end down and place a small amount of micro-balloons in apex of tail joint. Bond in place using Hot Stuff.

Temporarily install nose gear on firewall. Measure from top edge of fuselage down to nose gear and draw a line on inside wall(s) of tank compartment to locate tank floor. Cut two 1/4" (triangle) 6" long and Hot Stuff in place on line drawn. Next cut two 3/4" triangles 3-1/16" long. Cut out as required to clear nut plates and nose gear assembly. Apply a dab of vaseline to back of nut plates and epoxy triangles into corners of fuselage. Cut 3 pieces of 1/8" x 3" x 2-3/4" balsa (cross grain) for tank floor. Edge glue the pieces together (cross grain) using Hot Stuff and cut to shape as shown on drawing. Install in tank compartment using Hot Stuff.

If you haven't drilled the holes for the nose steering and throttle cable, now is the time to do it. I recommend using 1/16" music wire for nose steering and Su-Pr-Line Products Masterod for the throttle. Drill 1/8" holes in forward bulkhead. Install guides and secure with a light film of 5-minute epoxy.

Cut top block (tank cover) from 3/4" x 3-5/8" x 7" balsa. Place on top of fuselage and draw a line on block to shape of nose section and trim block to lines. Draw a line 5/16" inboard of block edge

By Dick Russ

A NEW AND SLEEK PATTERN AIRCRAFT FEATURING A LAMINAR AIRFOIL WING

THE REVENGER
Designed By: Dick Russ

TYPE AIRCRAFT
Pattern
WINGSPAN
70"
WING CHORD
10½ Inches (Avg.)
TOTAL WING AREA
747 Square Inches
WING LOCATION
Low Wing
AIRFOIL
Laminar
WING PLANFORM
Swept L.E.
DIHEDRAL, EACH TIP
1-3/16 Inch

56" (Inc. Spinner)
RADIO COMPARTMENT AREA
(L) 13¾" x (W) 2¾" x (H) 2½"
STABILIZER SPAN
25-5/8"
STABILIZER CHORD (incl. elev.)
7⅜" (Avg.)
STABILIZER AREA
178 Sq. In.
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Mid-Fuselage
VERTICAL FIN HEIGHT
6 Inches
VERTICAL FIN WIDTH (incl. rudder)
9" (Avg.)
REC. ENGINE SIZE
.61 cu in.
FUEL TANK SIZE
14 Ounce
LANDING GEAR
Tricycle retracts
REC. NO. OF CHANNELS
5
CONTROL FUNCTIONS
Rud., Elev., Ail., Throt., Ret.
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa, Ply
Wing ..... Balsa, Ply & Foam
Empennage ..... Balsa, Ply & Foam
Wt. Ready-To-Fly ..... 112-136 Oz.
Wing Loading ..... 21.59-26.21 Oz/Sq. Ft.

(on each side) which represents tank compartment. Remove material within this area for tank clearance. (I have found the Kavan 14 oz. tank works well for this installation.) Prior to installing the top block, coat the entire tank compartment with a good sealer, I personally prefer to use Hobby-Poxy Formula 2 glue. This way I can seal the tank compartment and glue the top block on, all in one operation. Hold the top block down (until dry) with rubber bands.

Using 1/4" balsa sheet (or scrap), lay out the formers 1 through 7 and cut to shape. Next glue the formers on top of fuselage using Hot Stuff (or Wilhold).

Fabricate nose cowl by cutting top, bottom, and two sides from 3/8" balsa sheet as shown on drawing. Glue assembly together using Hot Stuff. Note: The top and bottom pieces fit inside the side pieces. Cut four (4) 1/2" triangle stock 6" long. Using 5-minute epoxy, epoxy triangles inside corners of cowling. Install engine mount on firewall and fit cheek cowling. After cowling fits to your satisfaction, epoxy into place using 5-minute epoxy. Note: Cut or file a half round opening in bottom of cowl to drain fuel.

Draw a line (using felt tipped pen) 3/8" (down) parallel to top edge of sides (from top block to tail). Using and X-Acto knife (or plane) remove the balsa (on both sides) within this area forming a chamfered edge from top block to tail. Select a soft sheet of balsa 1/8" x 5" x 36" and trim length to 33". Using warm water, wet the entire sheet on one side only. Apply a film of Wilhold Glue to formers and along entire length of fuselage sides (chamfered edge). Carefully place the top sheet into position on fuselage and hold in place with masking tape (wrapped around sheet and fuselage). Set aside and allow to dry overnight.

When fuselage top is dry, remove masking tape and trim top sheet flush with sides.

Temporarily install nose gear on firewall. Cut two lower nose blocks from soft blocks 1-1/8"x x1-1/4" x 6-5/16". Trim each block as required until blocks fit (flush with sides) in nose area. Draw an outline of the fuselage sides on side of block. Remove excess material from blocks. Temporarily reinstall blocks and trim as required for nose wheel and gear operation. Carve out excess material from blocks to form a concave inner surface. The blocks are now ready to be glued in place but before you do, determine where and how you plan to actuate the gear. Personally, I like "Sonic Systems" pneumatic actuators and they work exceptionally well in this installation. Cut a small block of maple 3/8" sq. and drill a 1/16" diameter hole in block to hold cylinder attach lug. Epoxy block to forward bulkhead and tank floor. Temporarily install actuator using a No. 2 x 3/8" sheet metal screw. Fabricate a wire pushrod using a Goldberg 1/16"

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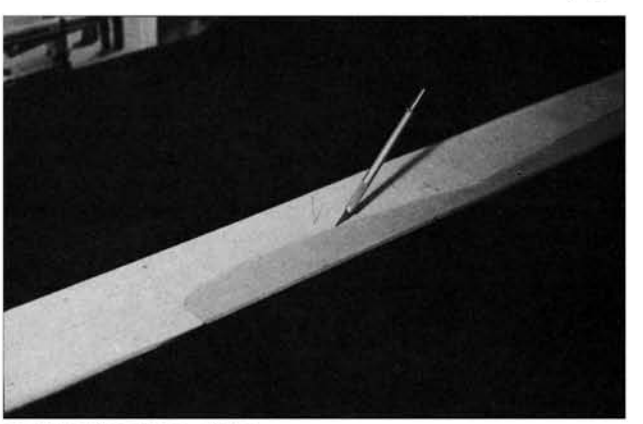
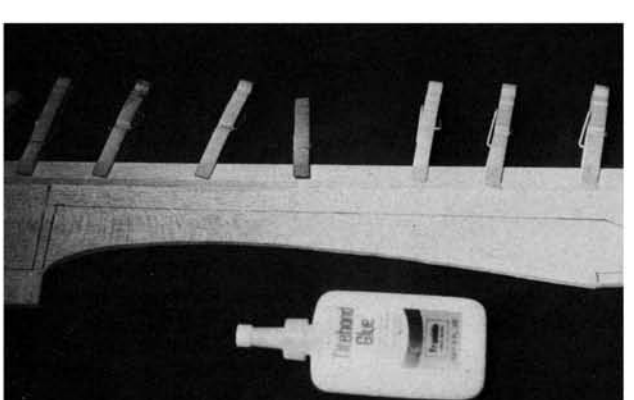
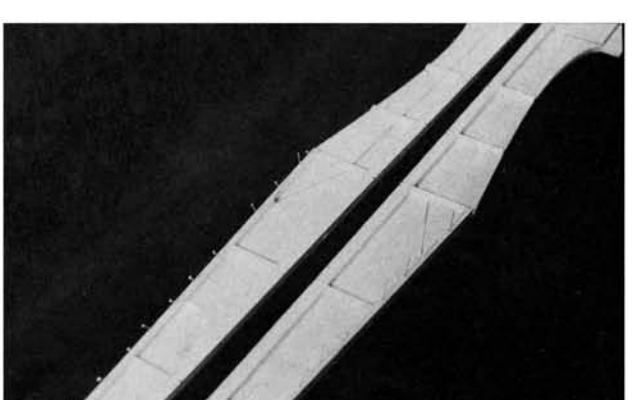


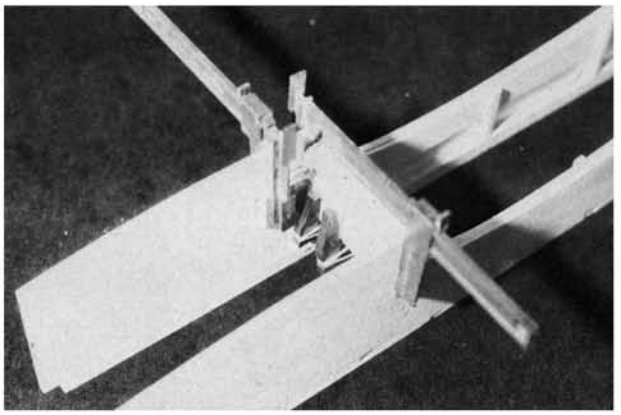
Cutting fuselage sides.



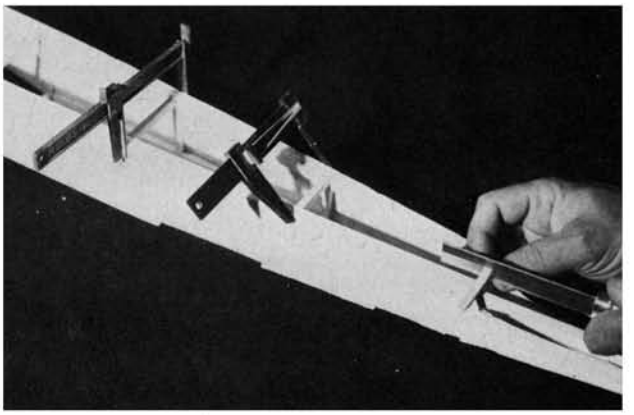
Gluing top stringer on side. Note outline drawn for doublers.



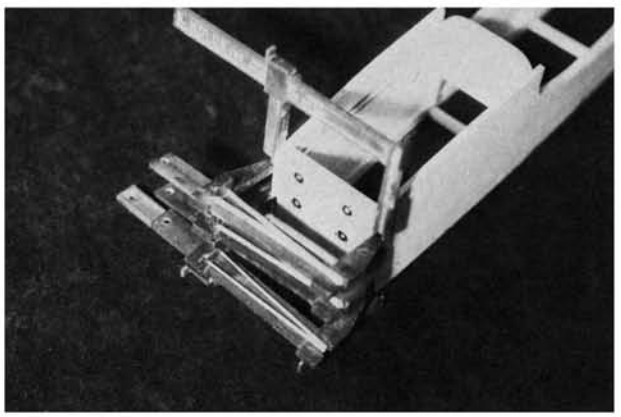
Fuselage sides built up showing vertical stiffeners and doublers.



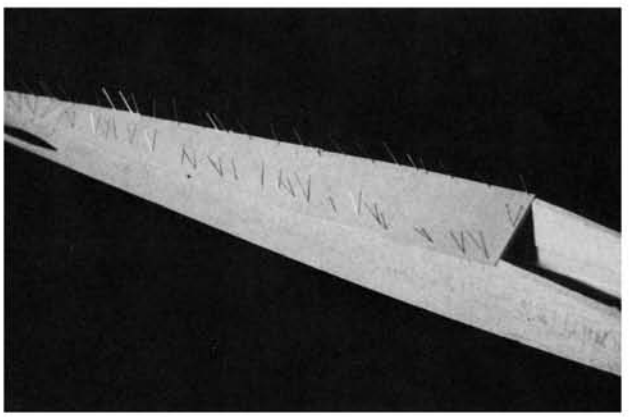
Joining sides at forward bulkhead. Note small aluminum angle brackets in corners for alignment.



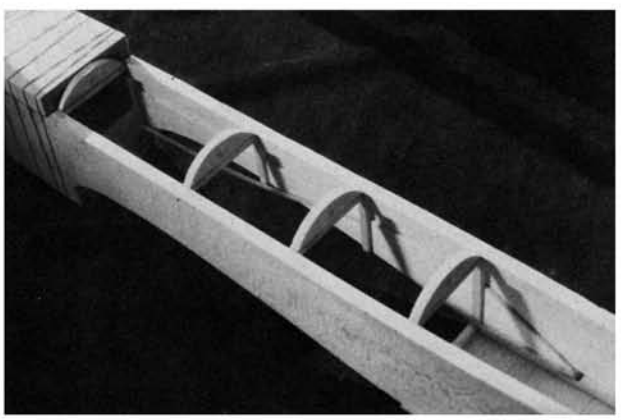
Installing upper 1/4"sq. cross braces in aft fuselage.



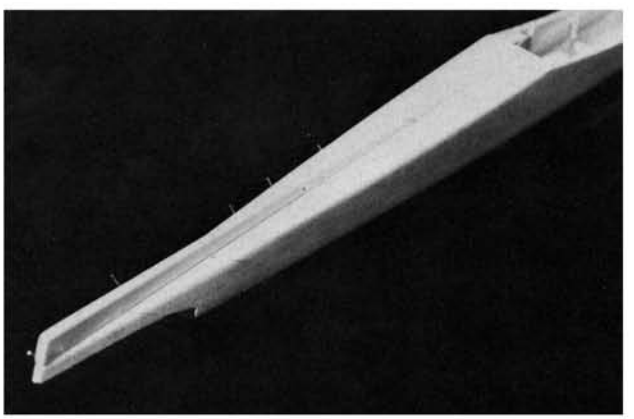
Installing firewall.



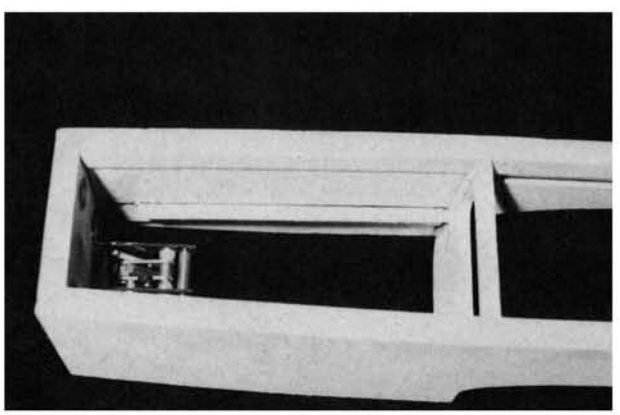
Installing 1/8" bottom sheeting (cross grain).



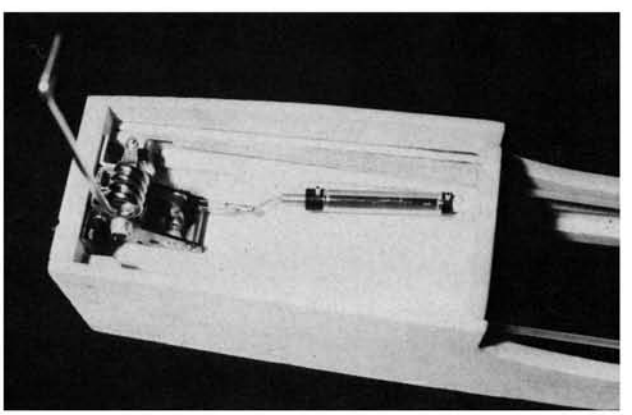
View of top formers and top nose block installed.



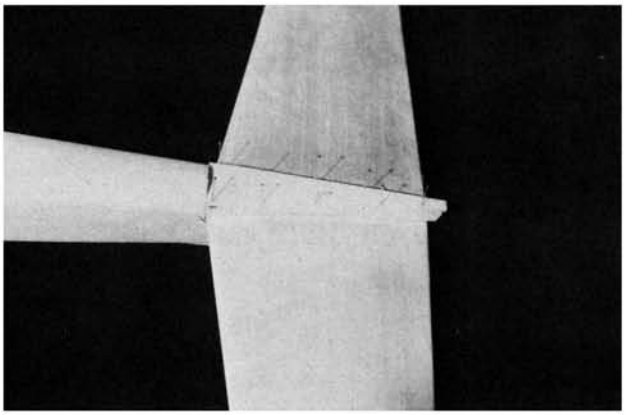
Ventral fin pinned & glued in place.



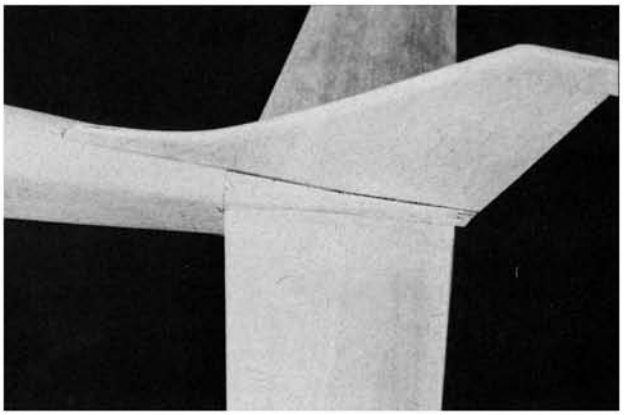
Check fit of nose gear prior to installation.



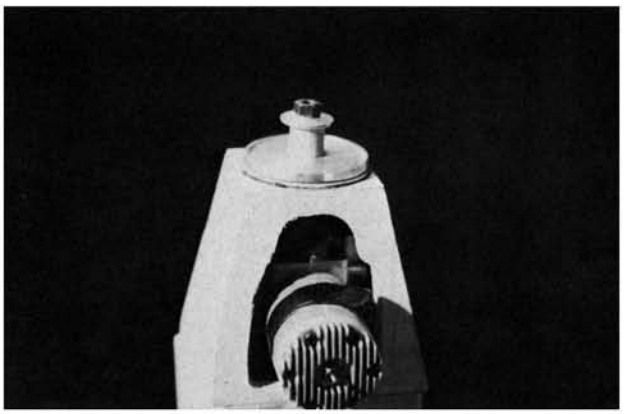
Nose gear installed along with actuator pushrod.



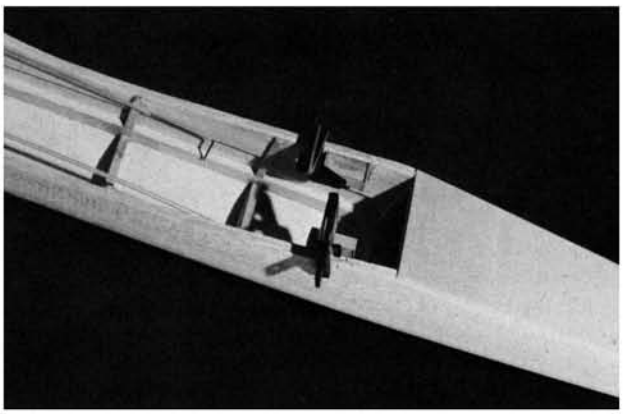
Build up of tail for fin installation.



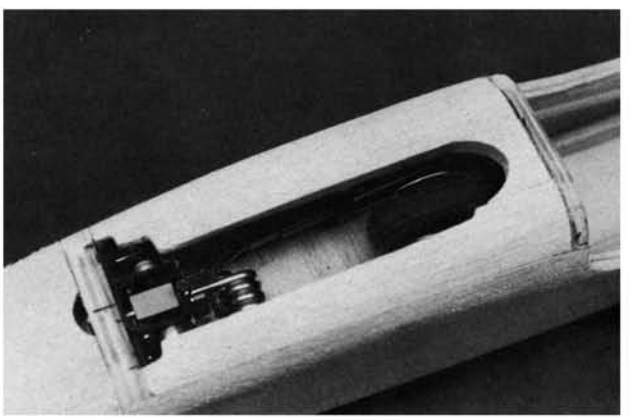
Fin glued in place.



Fitting ply nose ring to cowl blocks.

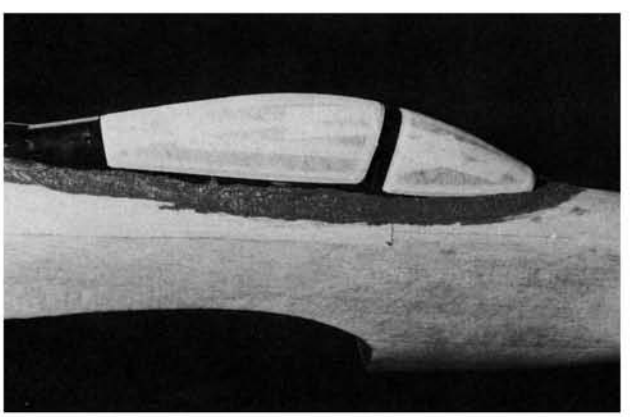


Installing hardwood wing hold-down blocks.



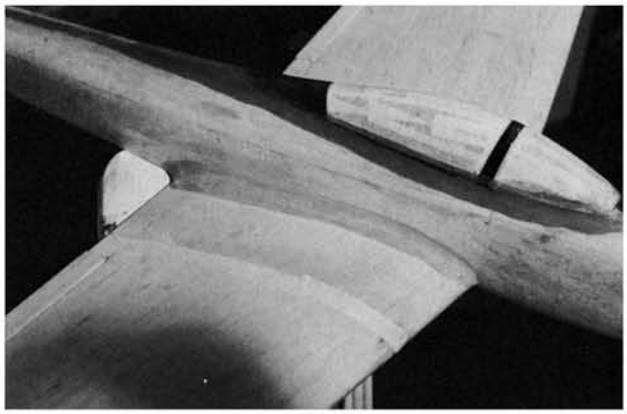
Lower nose block glued in place with cut-out for retract.

Canopy secured in place with cyanoacrylate adhesive and micro-ballons prior to making fillet.

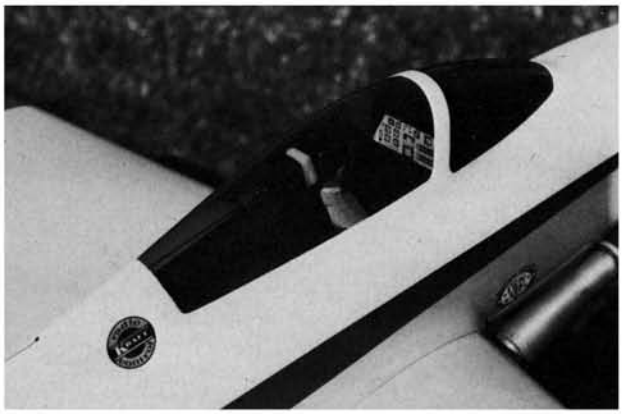


Fillet lay-up with Sears filled epoxy cement and micro-balloons.

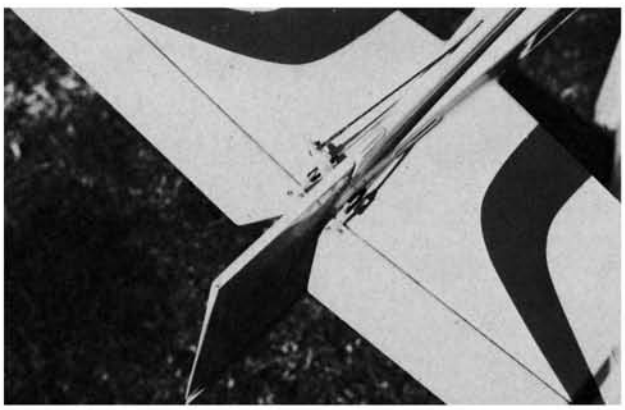
Wing fillets made from Sig Epoxolite.



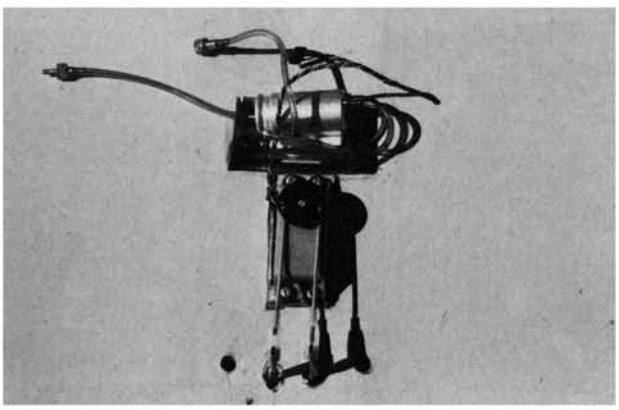
Canopy and wing fillets completed ready for final finish.



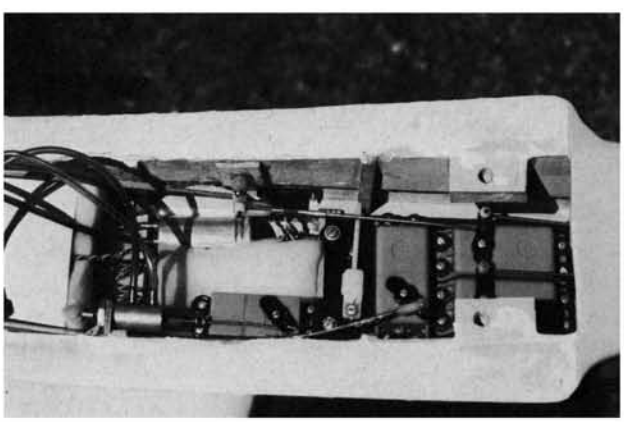
Completed job makes the time and effort worthwhile.



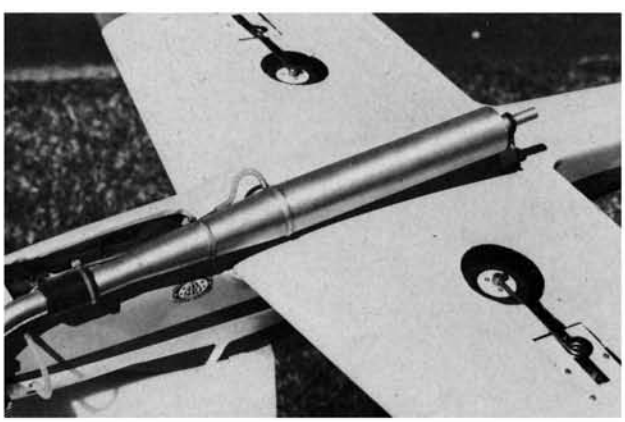
Bottom view of stab showing dual elevator pushrods. Ball link used on rudder horn.



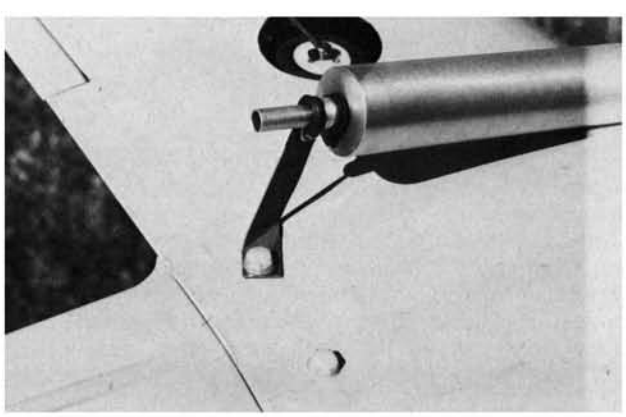
Aileron servo and pneumatic gear actuator installation. Note differential ailerons and Hydralock installation.



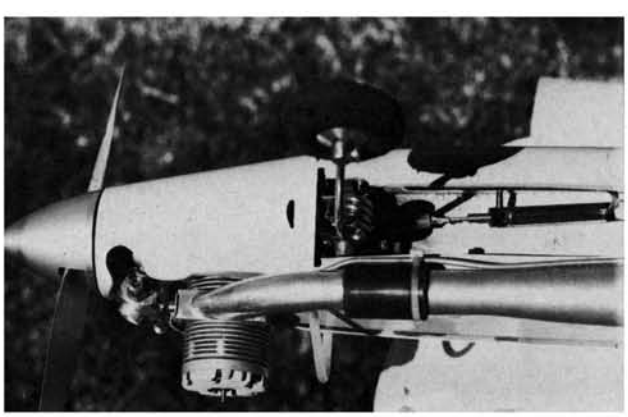
Servo installation in fuselage. Note Hydralock cylinder and nose steering reduction arm.



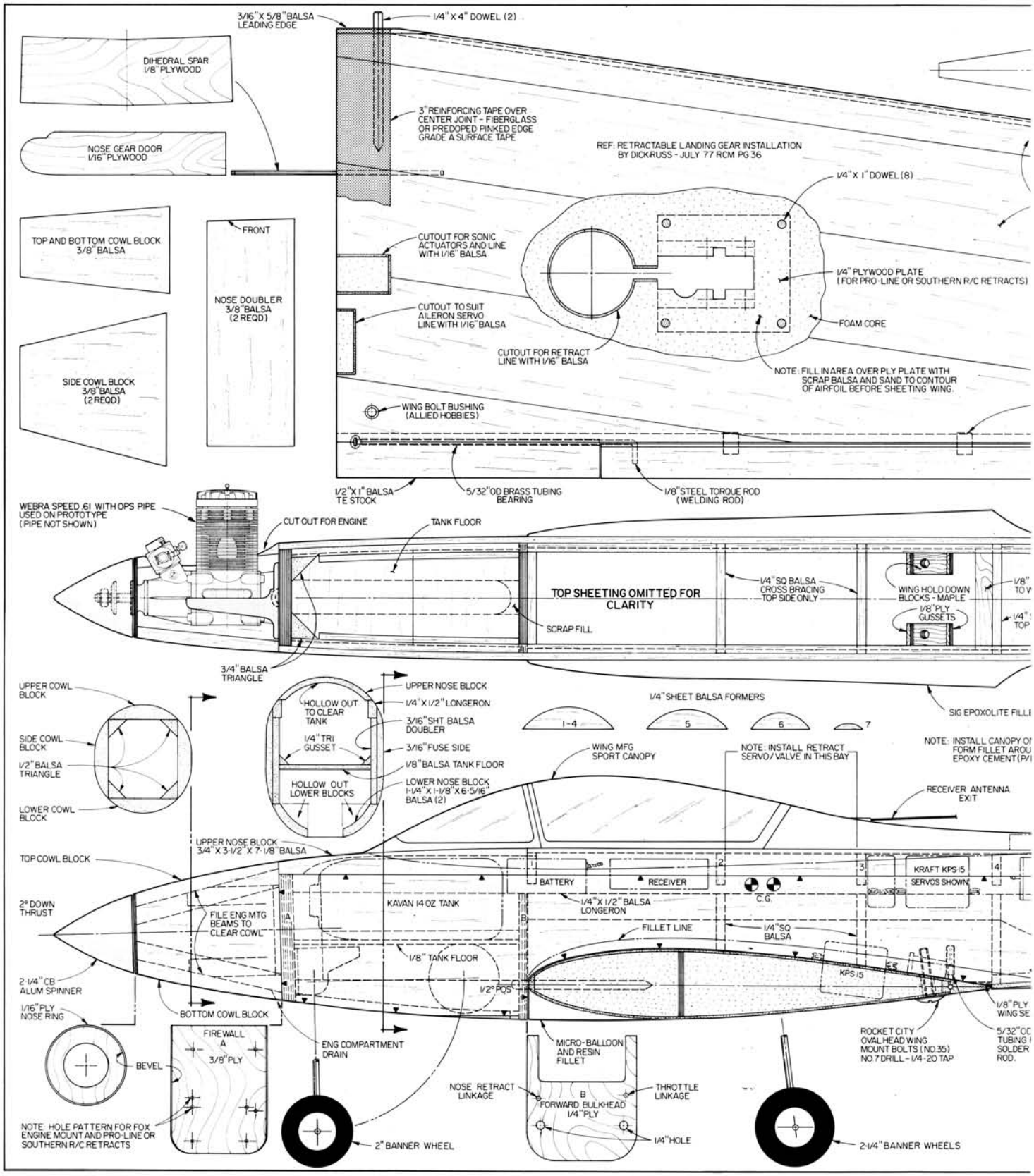
Tuned pipe installation.



Rear bracket on tuned pipe using wing hold-down bolt.



Webra speed .61 using OPS tuned pipe.



diameter Kwik-Link wire.

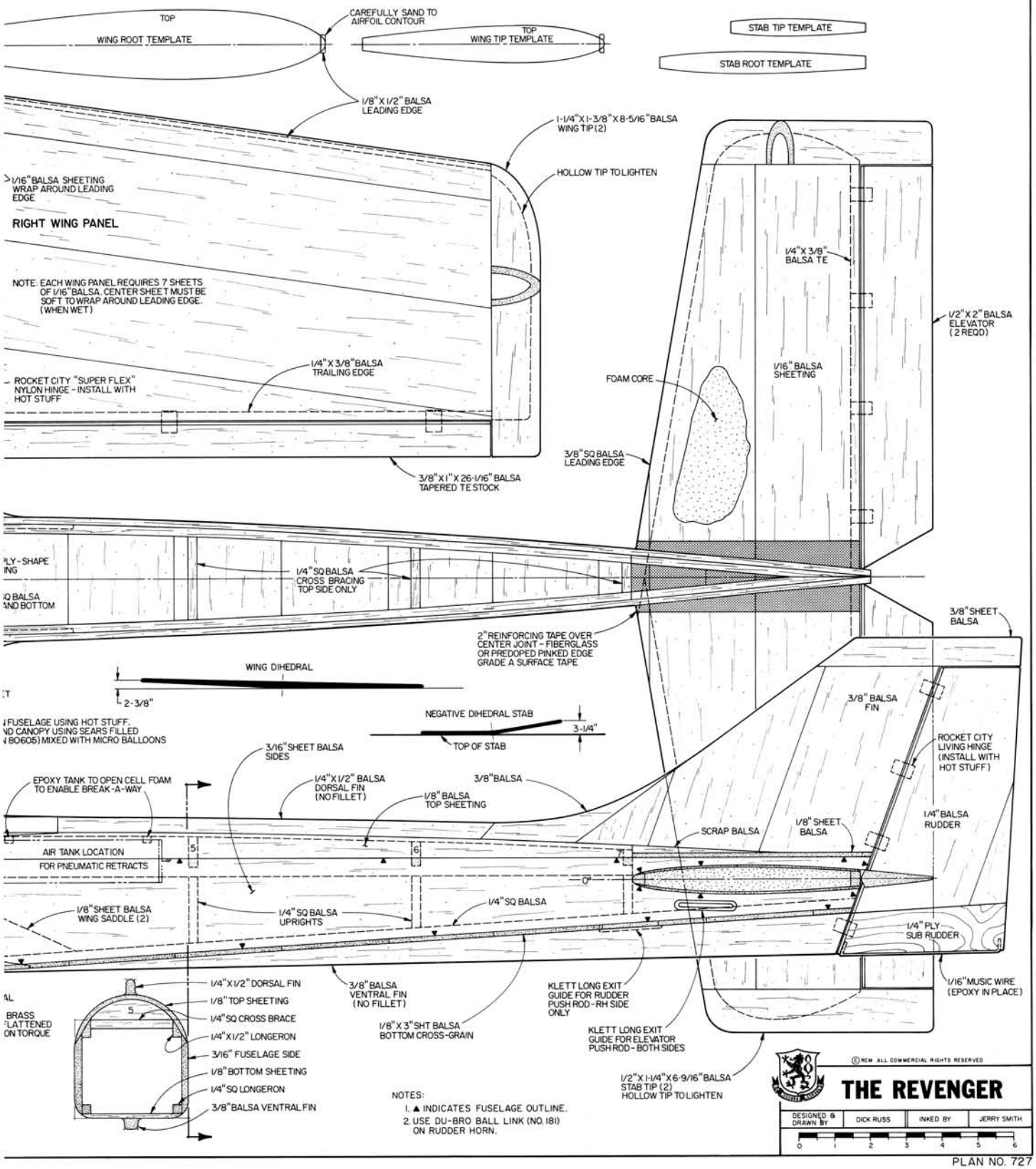
Remove actuator and nose gear assembly from fuselage. Mix up a batch of Hobby-Poxy Formula 2, and paint entire nose gear compartment. Coat lower blocks with epoxy and pin into position and set aside to dry.

Drill (or cut) a large hole in center of right cowl and gradually enlarge size of hole (to enable installation of engine) and temporarily install engine on mount. Install spinner and backplate on engine and check alignment of nose cowl (where nose ring fits) and engine position. Sand as required to obtain clearance and alignment needed for the 1/16" plywood nose ring. Remove spinner and engine and epoxy nose ring to engine cowl.

Using 80 grit (or 120 grit) sandpaper and sanding block, shape and contour fuselage as shown on drawing. After fuselage has been shaped, sand with 320 grit to remove heavy scratches, finishing off with 400 grit.

Wing Buildup and Assembly:

On both wing cores, glue on the 1/8' 'x 1/2" balsa leading edge and the 1/4" x 3/8" balsa trailing edge using Wilhold Glue. When glue has dried,



sand and shape the leading and trailing edges as shown on drawing.

Select 14 sheets of medium to soft 1/16" x 3" x 36" sheets of balsa (to be used for wing sheeting). Sheets are to be edge glued to form a large one piece panel, but prior to joining, the sheets must be straight. Using a straight-edge and X-Acto knife (or razor blade) trim both edges of each sheet to be joined. Select two sheets for the leading edge (or center sheet) and draw a centerline (using a felt tipped pin) down center of each sheet. Note: Both center sheets must be straight grain and soft balsa to enable wrapping around leading edge of wing panels. Starting with the center sheet, join the remaining six sheets (three on each side) by joining with masking tape (one side only). Turn assembly over and one at a time bend each sheet back over tape (using tape as a hinge) and apply a light bead of Wilhold Glue along entire joint. Lay down on a flat surface and wipe off excess glue and join with masking tape. Place the wing core (leading edge) on the centerline of the center sheet. Carefully lay the core down (in a rolling motion) as if sheeting wing. At trailing edge,

draw a line on sheeting approximately 1/4" from trailing edge. Repeat the preceding for the other side of sheeting. Remove this area from sheeting and glue onto opposite end of sheeting forming a wedge shape sheet.

When glue has dried, remove masking tape. Lay wing sheeting on a smooth flat surface and sand both sides with a flat sanding block and 320 grit paper.

I won't go into any details on installing the landing gear in this writing. The drawing should be clear as to how I recommend installing Southern R/C retracts. If you plan on using a different gear, I would recommend that you follow their instructions. For further assistance I would like to refer you to an article I wrote in the July 1977 issue of RCM on installing retractable landing gear.

Using 320-400 grit sandpaper and flat sanding block, lightly sand both cores to remove ridges made by the wire cutter. Carefully vacuum both cores to remove the styrofoam dust, and also vacuum both balsa wing sheets to remove balsa dust.

Using warm water and a sponge, wet the center sheet of balsa sheeting panel (wet on side opposite that being glued to core). **Note: Be sure to test your wing core to make sure it is compatable with 3-M-77 before spraying entire core and sheeting.** Turn panel over and spray entire panel with 3-M-77 adhesive spray (caution - - do not use 3-M-77N). Set sheeting aside while you prepare core. Spray one side of wing core (using 3-M-77) starting at trailing edge and working towards leading edge. Be sure to spray partially around leading edge (towards other side) to insure a good bond. Allow core to dry a few minutes (at least until the panels become very tacky) before continuing. Lay sheeting on a smooth flat surface. Take wing core and place leading edge on centerline of wing sheeting. Very carefully (with rolling action) pull on sheeting and press core down on sheeting. Spray opposite side of core and allow to dry as before. Pick up entire assembly and carefully press core down pulling on sheeting as core is being joined. Place covered core on scraps core was cut from and place on a flat surface and weight down with books or similar weights. Let stand for at least 48 hours. Repeat preceeding steps for opposite wing.

When both wings have dried, trim sheeting flush with tips, wing root and trailing edge. Sand wing roots to angle shown on drawing. Coat spar and wing root(s) with 5-minute epoxy and join wings together. Hold tightly until epoxy sets up. Temporarily glue wing tip blocks on each wing using a small dab of 5-minute epoxy on each tip. When epoxy has dried, sand each top to size and shape shown on drawing. Carefully break away each tip from wing and hollow each tip as shown on drawing and reinstall on wing using Devcon 5-Minute Epoxy.

PARTS LIST*

Nomenclature	Size	Material	# Req'd.
Fuselage sides	3/16" x 4" x 48"	medium balsa	2
Fuselage doublers	3/16" x 3" x 6½"	medium balsa	2
Wing doublers	18" x 2" x 16½"	hard balsa	2
Top stringer	1/4" x 1/2" x 39"	medium balsa	2
Bottom stringers	1/4" x 1/4" x 25¼"	medium balsa	2
Bottom sheeting	1/8" x 3" x 24½"	medium balsa	1
Forward bulkhead	1/4" x 3⅛" x 3⅝"	5-ply plywood	1
Firewall	3/8" x 3¾" x 4¾"	5-ply plywood	1
Stiffeners	1/4" x 1/4" x 44"	medium balsa	as req'd.
Firewall gussets	3/4" Tri x 3¾"	medium balsa	2
Tank floor	1/8" x 3" x 6"	hard balsa	1
Tank floor gussets	1/4" Tri x 6"	medium balsa	2
Lower fuselage blocks	1⅛" x 1¼" x 6-5/16"	soft balsa	2
Top sheet	1/8" x 6" x 36"	soft balsa	1
Cowling sides	3/8" x 4⅛" x 4⅜"	medium balsa	2
Cowling top	3/8" x 4¼" x 2½"	medium balsa	1
Cowling bottom	3/8" x 4¼" x 2½"	medium balsa	1
Cowling gussets	1/2" Tri x 6"	soft balsa	4
Nose ring	1/16" x 2¼" dia.	plywood	1
Wing cores		styrofoam	2
Wing trailing edge	1/4" x 3/8" x 36"	medium balsa	2
Wing leading edge	1/8" x 1/2" x 36"	medium balsa	2
Wing sheeting	1/16" x 3" x 36"	med & soft balsa	14
Wing spar	1/8" x 2" x 6"	plywood	1
Ailerons **	1/2" x 1¼" x 36"	medium balsa	2
Wing tips	1¼" x 1⅜" x 8-5/16"	balsa	2
Aileron torque tube bearing	1/8" I.D. x 6¾"	brass tubing	2
Aileron torque tube	1/8" O.D.	steel welding rod	2
Stabilizer foam cores		styrofoam	2
Leading edge	3/8" sq. x 12"	balsa	2
Stab trailing edge	1/4" x 3/8" x 12"	balsa	2
Stab sheeting	1/16" x 3" x 12"	balsa	8

* Sizes are approximate minimum sizes needed.
** Cut wing fixed trailing edge (houses aileron torque tubes).

Carefully locate the wheel well and gear box and cut out as required for clearance. Wheel well can be lined using 1/16" balsa or thin cardboard. I would recommend sealing the gear box with Devcon 5-Minute Epoxy.

Aileron Torque Tube:

Cut two pieces of 1/8" ID brass tubing 6½" long. Cut two pieces of 1/8" OD welding rod (or equivalent) approximately 9½" long. Bend one end approximately 3/4" long. Lubricate rod with vaseline and insert into brass tube. Bend 1" of opposite end of wire 90° to first bend. Fabricate the other assembly keeping in mind the bend for the servo linkage must be opposite of that just completed.

Cut a piece from each balsa aileron stock 7½" long (for aileron linkage) using an X-Acto gauge (or equivalent), cut a groove approximately 5/32" deep and 5/32" wide down centerline. Place the right hand and left hand aileron torque tube in groove and bond with Hot Stuff (use caution when applying so as not to get Hot Stuff on inner rod). Cut a half round opening on upper surface to allow movement of torque rod. Fit check on wing and cut a corresponding opening in wing. When satisfied with fit, apply a bead of Devcon 5-Minute Epoxy to edge and bond into place on trailing edge of wing. Cut two pieces of 1/8" ID brass tubing 1¼" long. Flatten 3/4" of each tube and drill a series of 1/16" diameter holes for linkage. Install tubing on torque tubes and sweat solder into place.

Determine location for aileron servo as shown on drawing and remove this area from wing. Line with 1/16" balsa and epoxy into place. Install hardwood rails for servo attachment.

A strip of 3" reinforcing tape should be installed at the wing center section. I prefer to use pre-doped pinked edge grade "A" surface tape that is used on fabric aircraft (which can be found at most airports) but fibregalss cloth will serve the same purpose. If you use the grade "A" tape, bond onto wing with nitrate dope. If you use glass tape, bond onto wing with epoxy.

Horizontal Stabilizer:

On both stab cores, glue on the 1/4" x 3/8" trailing edge and 3/8" x 3/8" leading edge using Wilhold Glue. When glue has dried, carefully (using a sanding block and 320 grit sandpaper) sand the leading edge to match the airfoil as

shown on drawing.

Select eight sheets of 1/16" x 3" x 12" soft balsa. Cut four forward sheets the shape of stab leading edge. Place pieces on a flat surface and tape the forward and rear sheets together using masking tape. Turn assemblies over (4), using tape as a hinge and apply a bead of Wilhold Glue to each seam. Wipe off excess glue and join with strips of masking tape.

When assemblies are dry, remove masking tape. Place on a smooth flat surface and lightly sand both sides of each sheet. Lightly brush all dust off the cores and sheeting. Vacuum both the cores and sheets to remove any traces of sanding dust. Spray one side of each core and sheeting with 3-M-77 paying particular attention to the leading edge and trailing edge. When adhesive becomes tacky (approximately 3 to 5 minutes) carefully join both the balsa sheeting and the core. Repeat the above for the other side. Place in core scraps and press down for 24 to 48 hours. After removing cores, sand the tip ends and epoxy the tips in place. When dry, sand each stab half and contour leading edge and tips as shown on drawing.

Sand stab roots to the angle shown on drawing and bond together using Devcon 5-Minute Epoxy.

Using 2" wide fiberglass tape or predoped grade "A" fabric, apply tape to center section of stab. Ref: Wing section for specific taping instructions.

Elevators:

Elevators are constructed from 1/2" x 2" elevator stock that is available in most hobby shops. Cut elevator stock to size and shape as shown on drawing. Draw a line (using felt tip pen) down leading edge of both elevators. Using a plane (or sanding paper) chamfer leading edge to line previously drawn.

Fin:

Using 3/8" x 3" (medium hard) balsa, cut three pieces of balsa the size and shape as shown on drawing. Assemble the three pieces on a flat building surface and join one side with strips of masking tape. Turn assembly over and bend at seams using tape as a hinge. Apply a bead of Wilhold Glue to each joint. Wipe off excess glue and tape joints with strips of masking tape.When dry, remove tape and sand entire assembly to airfoil shape shown on drawing. Note: Do not sand dorsal fin at this time, (will be sanded after assembly).

Rudder:

Fabricate rudder from 1/4" hard balsa. Rudder is made from two pieces of balsa and a sub rudder made from 1/4" plywood. Cut pieces from balsa and plywood as shown on drawing. Glue pieces together using Wilhold Glue. Tape seams and set aside to dry.

Ventral Fin:

Ventral fin is a straight cut triangle fabricated from 3/8" sheet, cut to size and shape as shown on drawing.

Assembly:

I will assume that all components of the Revenger have been shaped and sanded to where they are ready for either finishing with a pre-finished covering (such as Solarfilm, MonoKote, etc.) or Coverite (or what have you). As with any competition pattern plane, whether being flown in competition or for just plain sport flying, weight is a critical factor. With the Revenger, to keep weight to a minimum, I would recommend covering the wing with MonoKote and painting the fuselage with K & B Super-Poxy, but again this is up to the builder.

Cut two wing hold-down blocks (from 1/2" hard maple) 3/4" x 1". Using Devcon 5-Minute Epoxy, epoxy into position in the location shown on drawing. Note: Apply epoxy on 1" width and install flush with wing opening. Position wing on fuselage and measure distance from each tip to fuselage. When wing is centered on fuselage, draw a line on wing (next to fuselage) using a felt tip pen (to aid in aligning wing). Cut two 1/4" dowels approximately 1/2" long. Grind or sand each dowel to a sharp point. Insert dowels (point out) into holes in forward bulkhead. Place wing on fuselage and align fuselage with lines previously drawn. Carefully slide wing forward until wing contacts the two dowels (indenting leading edge of wing), then remove wing. Cut two 1/4" dowels 4" long. Grind or sand each dowel to a point, and force into leading edge of wing until it stops against front spar. Remove each dowel and pour a small amount of Devcon 5-Minute Epoxy in holes. Coat dowels with epoxy and insert dowels in holes. Wipe off excess epoxy and set aside to dry.

Mark location (on side of fuselage) of wing hold-down blocks. Install wing on fuselage and mark location (on wing) for wing hold-down bolts. Drill a small pilot hole (for each bolt) through wing into hold-down blocks. Remove wing from fuselage and verify pilot holes are approximately in center of blocks. Drill and tap hold-down blocks using a #7 drill and 1/4" x 20 tap. Drill holes in wing using a 3/8" drill. Coat inner surface with Devcon 5-Minute Epoxy and insert on Allied Hobbies Wing Bolt bushing (or equivalent). Trim bushing flush with surface of wing. Fasten wing to fuselage using Rocket City oval head wing hold-down bolts (part #35).

Position horizontal stabilizer on fuselage and align with fuselage, and wing. Prior to installing, permanently check for decallage angle using a Robart Incidence Meter. Note: If you do not have a Robart Incidence Meter, I would highly recommend buying or borrowing one, as this check is very important. As with any airplane, the angle of incidence and decallage can mean the difference between a good flying plane and one that just flies!

After you are satisfied with the fit of the stab, install stab permanently using Devcon 5-Minute Epoxy. Install the two upper pieces (that was previously cut off during fuselage build-up) using 5-minute epoxy. Fill in voids with scrap balsa using epoxy. Install fin and dorsal fin using epoxy. Use caution to make sure fin is straight and vertical. Build up remaining area using scrap balsa, maintaining contour of fuselage. All that remains to complete the emmpenage is the fillets. You may have your own ideas on building fillets, but I'd like to share mine with you. I have tried many different types of materials but have found "Sears Filled Epoxy" cement mixed with micro-balloons to make the smoothest, strongest and lightest. Mix up equal parts of the catalyst and resin, and mix in a large amount of micro-balloons. Blend to a smooth consistency. Using a tongue depressor or coffee stirer, start building up the fillet. Fair in fillet using your finger (wet with water). Keep smoothing fillet until satisfied with contour. Set aside to dry.

On upper surface of wing, cover upper surface (in fuselage area) with Saran Wrap (or equivalent) held down with masking tape. Reinstall wing on fuselage and tighten bolts securely. Mix up a large amount of Sig Epoxolite and build up wing fillets. Note: The Sig Epoxolite is very strong and durable and builds beautiful and large fillets. The fillets should be approximately 3/4" wide at trailing edge and start approximately 3/4" above wing, tapering to a small fillet at leading edge.

Fillets may be contoured using your finger dipped in water and smoothed out to where very little sanding is required. Allow to dry overnight prior to separating wing from fuselage. Use K & B Finishing Resin, mix with micro-balloons to form the wing lower fillet (use cardboard as a mold).

The next step brings up a lot of controversy regarding the canopy and what to do with it. I personally like a detailed cockpit with pilot and instrument panel. The Wing Manufacturing canopy (with insert) lends itself to this type of installation. One of the most attractive is one with the insert (or interior) done in a krinkle finish. Krinkle finish is available in an aerosol spray can in many different colors. I personally like the black krinkle. Bond insert on fuselage in position shown on drawing using contact cement. Cut and trim the canopy to fit contour of fuselage and install using Hot Stuff (sparingly) around outer edge of canopy. Using 1/4" masking tape, mask off canopy approximately 3/8" above edge of canopy. Mix up a batch of Sears Filled Epoxy Cement and a lot of micro-balloons. Build fillet around canopy from fuselage to slightly past edge of masking tape. By keeping your finger wet (with water) you can mold the fillet to where very little sanding is required. When fillet

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has dried (approximately 8 hours), apply another strip of 1/4" masking tape on top of the previously applied tape. This will provide a guide to cut the upper surface of fillet. Using caution, cut through epoxy using the tape as a guide. Remove both strips of tape from canopy. Trim as required to provide a smooth edge. Apply another strip of tape around canopy next to the fillet edge, then mask off entire canopy. Fillet can now be sanded to a feather edge without scratching the canopy.

Rigging:

Rigging is academic for the seasoned builder but for those who are relatively new, I'll briefly tell you how I install my radio gear.

First of all, install the servos in the fuselage as far aft in the fuselage as possible. Install the servos or servo tray on pine rails 3/8" square. Mount rails across fuselage and secure in place using Devcon 5-Minute Epoxy. Cut four reinforcement strips from 1/8" balsa in the shape of a "U" and epoxy on fuselage sides at end of each rail.

Assuming you are using pneumatic actuated landing gear, I recommend you install the fill valve and storage tank at this time. Be sure the ends of the tubing are new (cut back if using used tubing) to prevent line leakage or possibly blowing off. Experience has proven that one time or another the tank will have to be removed. If you epoxy the tank to a couple of pieces of hard or firm foam, the tank can be readily removed by breaking away the foam.

Fabricate pushrods from 5/16" square spruce. The pushrod for the elevator(s) should be a dual output to enable elevators to be adjusted independently.

Balancing:

I recommend that the radio be installed in the relative location shown on the drawing. The CG should fall within the forward and aft range as shown on drawing, if not, use Allied Hobbies stick-on weights, (or equivalent) to bring it into the above mentioned range. **Do not** fly until the CG is correct.

Next check the lateral balance of the wing/aircraft. Place the airplane on a flat table. Using an X-Acto knife, slowly pick the nose up (using knife edge on end of spinner) and observe which way (if any) the wing falls. Install finishing nails nailed in end of light wing until balance is perfect.

Flying:

Almost every construction article I've ever read makes the statement "If this is your first high performance airplane, get someone with experience to help you on your first flight." I must admit this information is sound advice.

Prior to the first flight, check controls for ease of movement and freedom of binding. Make sure the ailerons are rigged properly, i.e., right aileron is up and left aileron is down when right aileron is commanded. Check elevator, aileron and rudder throws to verify they are as called out on drawing.

Triming:

Trimming can be a very long and tiring process. If the plane has been built true, the trimming will be relatively easy.

Before going into the fine trimming, let's check to see if the throws are adequate or too much. After take-off, trim the plane for straight and level flight and check your trims on your transmitter. If the trims are approaching full throw to one side or the other, land the plane and adjust the throws accordingly.

I'll assume the plane is now trimmed for straight and level flight, now let's check CG location, with airplane flying straight and level, introduce a reasonably sharp bank to the right or left and then neutralize the controls (with hands off) and watch the plane. It should continue in the bank for some distance without gaining or losing altitude. If the plane climbs, it's tail heavy, and if it dives or loses altitude, it's nose heavy.

Now let's check for aileron position; with plane flying straight and level, pull up vertically and neutralize controls (hands off). Observe if the plane continues straight vertically or pitches forward (as in an outside loop) or back (as in an inside loop). If the plane pitches back, raise both ailerons until plane climbs straight vertically. If plane pitches forward, lower both ailerons until plane climbs vertically up.

Now let's check for yaw. Fly the plane straight at you, pull back on the elevators, as plane climbs vertically, observe if plane yaws right or left. Re-trim plane until plane climbs vertically without using rudder.

Next we'll check for proper thrust angle. Again with plane flying straight and level, chop throttle, plane should continue straight and level for a hundred feet or so. If plane climbs, the engine has too much down thrust. If the nose drops, the plane doesn't have enough down thrust.

Now let's take a look at the loops. First of all, how much elevator do you need? The most important thing is to have enough to make the size of loop **you** want without running out at the bottom. Pull up into a nice big inside loop using elevator only. Watch the wing tips, does it track through or does it pull out with a wing tip low? Repeat this several times and observe which wing tip is low. Add weight to the light wing tip a little at a time until the plane will track true.

As with any plane, each has its own flight characteristics. The Revenger is no different, it has its own. I have found the preceding to work well for me, but you might have some ideas of your own.

I have found the Revenger to be a true and honest airplane that not only is enjoyable to build and fly, but also attracts a lot of attention at contests, especially with the competition. Good luck with your new Revenger. □