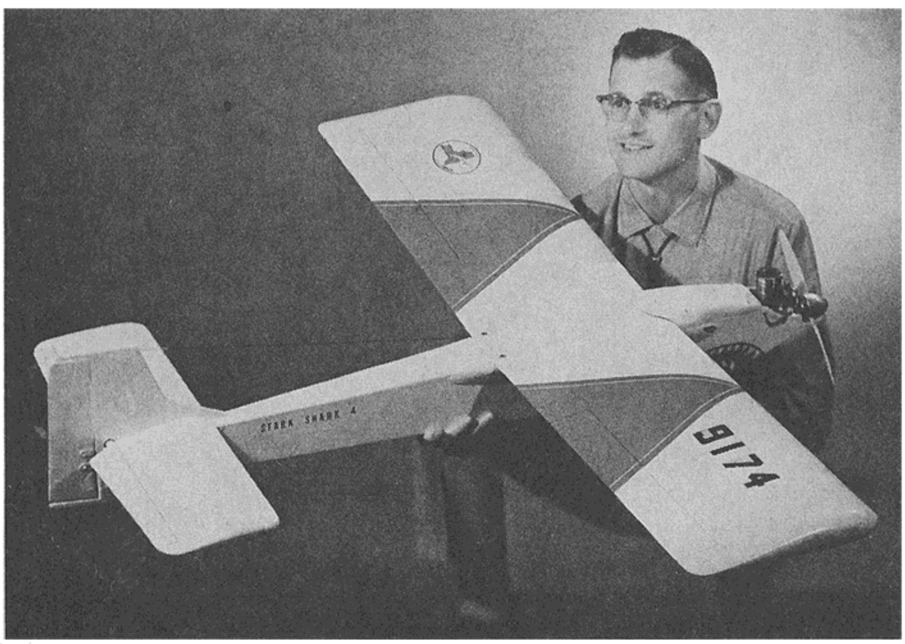
Coast-to-Coast Celebrity!
National Intermediate Class II Champ!
Many-times big-event Multi winner!

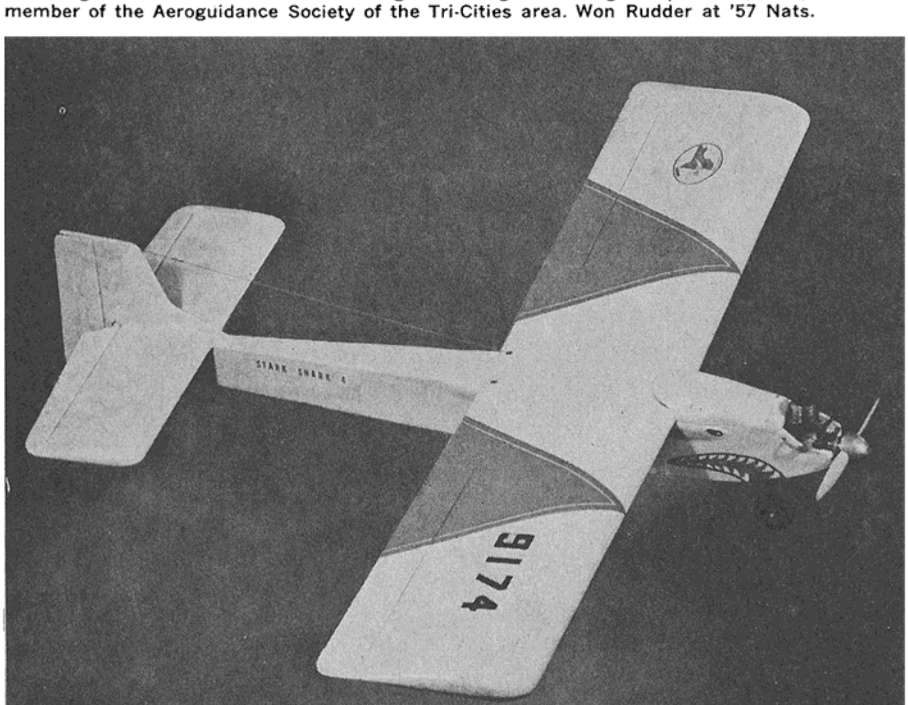
Stark Shark

Don't let its wolfish, toothy gleam scare you away; this is a very forgiving radio control job that's racked up a splendid record in two categories.

BY RICHARD C. ALLEN



Designer R.C. (a great pair of initials for an ardent R/C'er!) Allen with latest in a long series of "Long Gone" and "Stark Shark" designs. An engineer living in Apalachin, N.Y., Dick is a member of the Aeroguidance Society of the Tri-Cities area. Won Rudder at '57 Nats.



Stark: "No frills, bare essentials only, unadorned." (Webster). Stark Shark was built on the premise that top performance could be obtained from a simple straightforward airplane, one which could be built quickly and whose design would lend itself to accurate construction. A primary performance objective was to develop an extremely stable and forgiving airplane, which would not fall out of the air following a tight climbing turn, or whenever the glide was stretched past the ordinary stall point.

Its achievements as of this writing include a first place in Class II at the '63 Nats, which was its third contest. This intermediate version was built and flown by Ralph Jackson, a fellow member of the Aeroguidance Society, who performed what was generally regarded as the best tailslide at the meet. Its two-flight score of 157 points would have ranked it about 16th among the Multi qualifiers.

Ralph's Stark Shark won the New York State championships in Rochester the day after it was built. And the Eastern States Championships in Syracuse. And the Tri-County Wing Snappers Annual at Deer Park, Pa. This 4-out-of-4 record should indicate something about the design of the model, Ralph's piloting technique, or both!

While my Class III (Multi) version has not had a record to compare with Ralph's Intermediate job, it has gained some recognition, as follows: Although it failed to place at the '63 Nats, it did qualify. It posted the highest score for any single flight in the finals, even though its other two flights were scored incomplete ("bonehead" type mistakes). Thus, 10th place was some consolation to us. This Multi version won the Eastern States Championships and took third in the N.Y. State Championships the day after it was built. This was the Mark III version (low stab). Its predecessor, Stark Shark II, won the LIDS contest on Long Island (Sept. '63 AM, p. 71), and the Milton, Pa. meet. It established a field record of 50 consecutive touch-and-goes in a single flight at the Grand Opening of the Flying Bisons' new grass field at Buffalo, N.Y.

Stark Shark is as much at home at informal get-togethers as at contests. Its wide speed range makes it a natural for such cut-ups as dead-stick rolls or loops just prior to landing. For something different, try the "Dying Shark" maneuver as follows: Out of an inverted climb, apply full down elevator, full right rudder, and full left aileron. The ship will gyrate wildly as if fatally wounded, flop over, then head down in an inverted spin at full throttle.

You may already have a good airplane, capable of doing the entire AMA pattern and will wonder if it would be worth the trouble to build a Shark. Since this is a fair question, I propose two flight tests with your current craft as follows:

1. In a glide, slowly bring the stick all the way back and hold it there. Can you still maintain directional control with either the rudder or ailerons as your plane gently mushes down?

2. On a take-off, pull up into an Immelmann, then do a roll, and then a Split-S into a landing. Can your airplane do this—take-off to touchdown—consistently in less than 20 seconds? This maneuver which was introduced to me by the Wilmington, Dela., flyers is a good test for stability and control response in many different flight speeds and attitudes.

3. Can your present plane do a fairly good loop or roll out of a high-speed glide? Do you have enough confidence in it to perform these maneuvers on the final landing approach? Dead-stick?

If your answer is "yes" to the above questions, then don't bother building a Stark Shark (but I would like to see the plans of yours). The Stark Shark project was undertaken after a survey of available R/C kits revealed that most of them were developed for reed-type flying and would not necessarily take full advantage of the faster yet smoother control response inherent in the new proportional systems.

Actually, the design development dates back to a pylon racer I flew at the '58 and '62 Chicago Nats. It was called Long Gone due to its long moment arms, unusual at that time. Long Gone handled so well that I decided to build a Multi version—this became Long Gone II. Later, when Long Gone III was being finalized, I happened to make a trip to Seattle, where I met and talked with Dr. Ralph Brooke. After a few bull sessions and flying sessions, I became convinced of the superiority of the Whistler-type wings, where a blunt L.E. and flat rear camber are featured in the airfoil.

Since the resulting design bore only superficial resemblance to the Long Gones, the new monicker, Stark Shark was adopted. Trials with both tapered and constant-chord wings proved the latter to be the superior type, aside from the fact that straight wings are easier to build accurately.

Main difference between Stark Shark II and III is a thicker stab on III as recommended by Harold deBolt. The stab airfoil is somewhat unorthodox, having the same thickness ratio (16%) as the wing, with a blunt L.E. and having its maximum thickness well forward. Since many successful R/C wing airfoils use this configuration, it was thought that a symmetrical version might be equally beneficial for the stab. Present flight performance is a marked improvement over the diamond-cross-sectioned stab on Stark Shark II.

Latest modification, made last October, was to move the stab from bottom to top of the fuselage. This lines up the center of drag with the thrust line and removes the stab out of the wing downwash. It betters many flight characteristics, especially outside loops and the high-to-low speed transition, which is now absolutely linear.

Before getting into construction details, it should be noted that the cowl is held on with four 4-40 bolts. Two 3/16" dowels are glued into channels cut into the underside of the top cowl. These dowels fit into holes in the wing L.E. Trailing edge is secured with two Dzus ("zuss") AJ4-65 fasteners. An alternate method is two 6-32 bolts in place of the Dzus fasteners, but the bolt system takes longer to assemble-disassemble and is weaker. This makes both the cowl and wing a structural part of the airplane for maximum rigidity. Dzus fasteners are certainly neater and more convenient than gum bands and after seeing several smash-ups of planes using them, I'm convinced that the wreckage is no worse.

Assuming you have been Shark-bit, let's get to construction details. Select even-grained medium 3/32" balsa sides and 1/16" doublers for fuselage. Laminate at slight cross-grain angle indicated. Cement ⅛" sq. vertical bulkhead stiffeners and 3/16" sq. top rear longerons. Cut bulkheads, mark vertical centerlines on B to G. For equipment other than Space Control, you may have to revise the push rod clearance holes. Or else mount servos so servo wheels are in positions duplicating those on plans. Cement fuselage sides together at tail and set them astride a straight line drawn on a flat surface (I used a Magna-Jig).

Cement in bulkheads B to G working from back towards front. Be sure centerlines coincide for an arrow-straight fuselage. This is simplified by the straight fuselage bottom. Shape engine mounts and cement on fuselage sides (epoxy) or resin-type fastening is fine, too). If you consistently build light, you will prefer the smaller displacement engines mentioned; follow dotted lines for wider mounts allowed (*Continued on page 70*)

by narrower crankcase dimension. Install 3-piece firewall assembly. Note 3° right offset has been figured in, just drill out mounts for engine you intend using. Once you've checked holes to agree with crankcase hole spacing, install 4-40 blind nuts under mounts and fit in lower cowl block. Drill oil drain hole shown—this also takes care of fuel overflow. Apply fuel-proofer along sides to keep block from soaking up oil and fuel.

Plywood nose gear mount is from high-quality aero or marine-grade 3/16" plywood. Drill holes to match L.G. strut you will use and glue or epoxy in place. Note corner braces in this area and floor for clunk-type tank. Trim two 5/16" x 1¼" tapered T.E. stock and cement in to match wing undercamber curve cut into top-sides of receiver compartment (make sure you have a left-right pair before cementing them). Use lots of pins to hold these wing rest doublers securely while cement dries. A pair of 5/16" sq. cowl hold-down rails line top edges of tank-cowl compartment; paired to each side they are hard balsa and are securely glued or epoxied. Drill for 4-40 bolts and mount 4-40 blind nuts underneath (4 places).

While fuselage is finished conventionally, note second layer of 3/32" sheeting on bottom is spanwise. This sheet butts into 3/32" ply L.G. platform, then continues up to bulkhead C position, where it ends in smooth feather edge. Paint inside of engine and fuel compartments with fiberglass resin or Hobbypoxy.

Wing is similar to Dr. Ralph Brooke's Whistler (July '63 AM). Ours uses an airfoil with flat undercamber along its rear portion, making it easy to pin to any flat working surface during construction. Each rib fits exactly the same allowing a geometrically true wing. You can follow the Whistler article if you have already built one, or you can build one panel at a time as follows:

Place bottom rear 3/32" x 3" sheet balsa on flat building board (here again, I prefer Magna-Jig). Cement bottom rear ⅛" x ¼" spars to it. Note T.E. sheets are just shy of 3" wide to allow for edge trimming with steel straightedge ruler or metal T-square. Place front bottom ⅛" x ¼" spar in position—block up to height and angle. Ribs will position this spar accurately as they are added. Cut all ribs, making note of differences in shape. The 3 center portion ribs are trimmed as per plan dotted lines since they have full sheeted top and bottom plus a doubler in front bottom area. Adjacent 6 ribs are notched to accept 3/32" x 1" strip ahead of rear spars; remaining ribs are as per template.

Cut shear webs from firm 1/16" sheet, 1-15/16" wide and 1¾" deep, with grain vertical (parallel to short edge). Overall dimensions must be exact, as 1/16" of rib thickness plus 1-15/16" of shear web gives desired 2" rib spacing. Make 26 shear webs.

It is best to make wing panel from tip working toward center. Then if all shear webs run undersize, at last rib space we can cut that shear web to a corrective size and still come out with correct span dimension. So cement all ribs in, alternating between each with

(*Continued on page 74*)

Shark

(*Continued from page* 70)

a shear web. If last 1/16" rib is off, make the correction and who will be the wiser. Install last rib (1/4" thick) at 3.3° angle, top inclined toward tip. Add top spars, front and rear. Cut small slots in lower rear sheet at aileron corners if Class III version. These will serve as guides later when cutting ailerons.

Cement leading edge to rib ends. Fit and cement center filler blocks near T.E., sand flush with rib tops when cement has dried. For Class III, fit and cement diagonal anti-warp ribs throughout aileron area. Leave enough clearance so they will not interfere with aileron L.E. which is attached after cutting ailerons. For Class III, cement in soft filler blocks at all hinge stations. Attach top rear 3/32" x 3" sheet (hold flat with weights). Rearmost 1/4" can have slight bevel to enable neat butt-joint with bottom sheet.

Cement short (6") top center spar (firm 1/8" x 1/4" stock). Bevel L.E. to match rib contour, then install top front 3/32" x 4" planking. Remove wing from building jig, bevel bottom of L.E. Fit and cement 1/2" sq. filler blocks at center section, leaving space between it and L.E. to accommodate A and B later. Cement center 1/16" doubler sheets on bottom only. Replace wing on jig inverted; add bottom front 3/32" x 4" sheeting. Build opposite wing panel, following above instructions.

Bevel each wing panel center edge at 3.3° if you put 1/4" root ribs in at 90°. If they were angled correct 3.3°, trim sheet covering to match 3.3° angle. As per plans, remove portion of center ribs for aileron servo compartment. For Class II, 3.3° bevels mentioned above are increased to 7°. Also re-plot center dihedral braces A, B, C and D to increased dihedral angle. Use two flat rectangular boards propped up at tip ends to match dihedral you want (3.3° for Multi; 7° for Class II). Cement panels together and add C and D, cementing each brace securely. Re-install portion of center ribs previously cut away. Cement top 3/32" x 1" x 18" strip forward of rear spar. Cover remaining area of center section with 3/32" sheet and let stand 24 hours before removing wing from jig.

Remove wing assembly from jig, slot bottom planking at L.E., insert braces A and B. Hollow out tips and cement in place. Complete remaining bottom sheeting—try not to have any twisting action when this is done. Cement 1/16" ply Dzus reinforcements where shown, add Celastic or light fiberglass to areas indicated. For Multi, assemble aileron bellcrank and main push rod before covering, but leave off short push rod linking aileron to bellcrank. This, added after final assembly, is removable at any time. Cut ailerons either before or after wing covering is completed. Shape and sand front face of ailerons to accept 3/32" sheeting and cement in place, sealing front of aileron and exposed section of wing where aileron was cut away. Slide Midwest control horn (riveted to 1/16" ply stub) into inboard end of each aileron and cement securely. Cap end of aileron with shallow balsa triangle that matches angle formed by upper and lower rib edges.

Special wing construction note. For those wishing to assemble their wing in one single unit, making a "dihedralled" jig is no hard task, as long as both panels match as to incidence. However, though this jig may be flat in relation to your workbench, the ribs on it have their T.E. down, tilting the ribs to a 5° incidence. Therefore wing's L.E. and T.E. would be in a straight line NOT when viewed from directly above, but from a 5° angle aft of true vertical. Net result is an apparent sweepback during construction of .29° (Class III) or .61° (Class II) in relation to jig board edges. T.E. thereby is 5/32" (Class III) or 5/16" (Class II) closer to rear edge of board at tips than at center. Construction remains the same except all dihedral braces can be added prior to center ribs, top spars and top sheeting. Wing is removed from jig to cement bottom front 3/32" x 4" sheeting to bottom front spar only. Then wing is returned to jig and bottom front sheeting is cemented and pulled up into position, overlapping L.E. Allow 24 hour drying and setting period before removing wing from jig for adding final section of sheeting at wing center.

My wing utilizes a 60-20 aileron (i.e., 60% of the half-span and 20% of the chord). This was described as "ideal" in a borrowed aeronautical engineering textbook. The rolls they produce are a joy to behold. Wing framework should weigh 14 ounces if you've used light firm balsa throughout. Complete wing with servo installed should tip the scales at 22 ounces. Use large Williams nylon hinges for ailerons. Cement in securely and peg in place with 1/16" dowels (available in drugstores as swab-sticks). A little oil on nylon peg and socket prior to assembly will keep cement from seeping in and tightening up the hinge action.

On Dzus fastener installation plans show hole location in wing quite accurately, so measure carefully and drill 1/4" hole. Pin hard balsa 1/2" x 3/4" x 2 1/2" blocks in approximate position in fuselage. Place wing on fuselage and mark blocks with an awl aimed through center of wing holes. Remove blocks, bolt on Dzus springs, centered over marks made with awl tip. Use 3-48 bolts and blind nuts. Measure length of Dzus fastener projection below bottom of wing. Lay straight edge across fuselage, cement and pin block so that spring falls at measured distance below straight edge. Final adjustment is made after foam wing-cushion strips are added to fuselage. If fasteners are too loose, force spring down into balsa block. If they fail to engage, shim up the spring with washers. When springs are properly positioned, there should be mild resistance encountered when Dzus fastener is twisted home, with an obvious reduction of resistance as spring slips into its detent position. (Last 1/32" or so of twist is easy). Conversely, it should take a fair twisting action with a screwdriver to loosen fastener; once out of detent slot, it should slip out of engagement easy. (If you can't obtain Dzus AJ-465 fasteners locally they are available from Aircraft Plan Co., Box 45, Babylon, N.Y.; 75¢ per pair, with matching springs. Quantity club price is 60¢ per pair if four or more pairs are ordered.)

Assuming you've built the wing already as described, stab should be a snap since flat-sectioned airfoil is quite similar in both wing and stab. Recess edges of four center section ribs so 1/16" sheeting will be flush with spar top edges, L.E. and T.E. Use very soft balsa and hollow out the tips. Elevators are of deadsoft 3/8" sheet balsa, or (if you are a purist) built up of 1/16"

(*Continued on page* 76)

Shark

(*Continued from page* 74)

sheet. Note spar connecting two halves is hard balsa, not hard wood. Balance at point indicated should be no problem with a Super Tigre .56, Merco .49 or Veco .45, but with a Super Tigre .46 or K & B .45 you'll want to concentrate a bit harder on keeping tail weight down. Use Williams nylon hinges (small) for elevator.

Fin is built up into conventional diamond cross-section often used on stabs. Lay 1/8" x 1/4" center spar and 1/4" sq. L.E. and T.E. on flat surface over plan. Place diagonal 1/8" x 1/4" surface strips shown. Complete first side of center "I-beam" by filling in between diagonals with vertical 1/8" x 1/4" strips. Turn fin over, block up outline with 1/8" scraps and repeat procedure. Rudder is deadsoft 1/4" balsa. It may look large, but Stark Shark is inherently a very stable airplane, needing a large rudder to turn it or to spin it. Use sheet nylon or small Williams nylon hinges, pegged in place with 1/16" dowels. Note rudder is even larger on Class II version, but that is what we need to produce three consecutive rolls with no sweat.

Apply two coats of butyrate dope to entire framework surface, sanding after each. Lay dry silk over framework, then wet it thoroughly by dragging wet sponge or soft cloth over surface. This lets the silk adhere to the wood, making it easy to pull tight. Apply one coat of dope through wet silk onto sheeted areas only. Let dry 15 minutes. Re-wet silk as above, but over open areas only to fill silk pores with water. Immediately brush on one coat of dope over this wet silk in open areas of wing and tail. Allow an overnight drying before applying 2 or 3 more coats of clear dope (filler also, if desired). Apply colored finish. If using Hobbypoxy, wait three days for dope to cure, then sand lightly and clean with tack cloth before proceeding further.

Both Nelson and deBolt nose gears have been used—both proved reliable. Shorten as indicated on plans with a kink. The 1/8" music wire main L.G. is both lighter and more rigid than one of sheet aluminum. Do not omit the 1/16" wire stiffener.

After trying many brake combinations, I settled on a Du Bro on the nose wheel and drag brakes on main L.G. Drag brakes are made by slipping neoprene fuel tubing over axle on both sides of each main wheel. Tubing is forced against wheel hubs by wheel collars. Use enough drag so that airplane will nearly stop on a runway without need of nose brake. When flying from runways, I use 2 1/2" Du Bro nose wheel and 3 1/8" Williams vintage scale main wheels. For rough grass, switch to 3" Du Bro at nose and 3 3/4" Williams main wheels. While the Williams WW-I scale wheels may look a little out of place, they are lighter and have less bounce than the softer semi-pneumatics.

When flying Stark Shark, you will be able to make steep climbing turns or Immelmanns on take-off and knife-edge turns in the glide. Your low-wing friends will be green with envy. While these maneuvers have no contest application, they do illustrate the great stability and margin of safety built into this airplane. Landings are Stark Shark's strong point. Approaches can be fast or very slow. She can be slowed down to where tail skid will drag the ground first, while maintaining directional control with ailerons or rudder.

The more stable an airplane is, the more difficult it becomes to stall or spin. Rather than sacrifice stability for easy spins, I use about 3/16" extra up-elevator, via a special "spin button" on the transmitter. This was obtained on my Space Control and Ralph's ACL transmitters by switching in a resistor in series with the elevator pot. Using this, neither airplane missed any of spins at the Nats. A device similar to that on the Taurus plans should also produce satisfactory spins. It will spin without this extra "up", but not with the consistency required for contest work.

If a clunk tank is used, make the overflow vent *vertical* and extend it upwards with a short piece of neoprene fuel tubing which will lay against inside top of tank. Lacking these two points of wisdom gave me a partially-filled tank and an incomplete finals flight at the Nats. To prevent tank from shifting around, pack area around it with pieces of sponge.

Initial trim is obtained by putting in enough right thrust so airplane continues on straight course when throttle is moved from full bore to idle with rudder and ailerons in neutral. Final rudder trim is obtained after noting which way airplane drifts during outside loops. If it corkscrews in either direction, set in enough opposite rudder to correct it. It should now fly straight and level at all speeds, upright or (with slight down-trim) inverted.

Class II flyers will be happy to know that they won't have to reverse their rudder-throw direction for inverted flight—right rudder (right stick) will still give a right turn and vice-versa, when inverted. Here we summarize statistics for both Class III and Class II versions, as flown at '63 Nationals:

	Class III	Class II
Wing area	708 sq. in.	708 sq. in.
Wing span	60"	60"
Dihedral (at each tip)	1.75"	3.75"
Dihedral angle (each side)	3.3°	7°
Weight	6-lb 2-oz	5-lb 5-oz
Elevator and stab area	194 sq. in.	194 sq. in.
Fin and rudder area	57 sq. in.	76 sq. in.
Engine	Merco .49	Super Tigre .46
Fuel tank	8-oz clunk	8-oz clunk
Radio	Space Control	A.C.L.
Fuselage length	49"	49"

The author is indebted to Ralph Jackson for his many helpful suggestions regarding the original Class III version, and his modifications which have fitted it so well for Class II competition.

WOOD LIST. *Wing:* Ribs, 5 sheets 1/16 x 3 x 36, med.; L.E. Planking, 4 sheets 3/32 x 4 x 36, soft; T.E. and Center Planking, 7 sheets 3/32 x 3 x 36, soft; Spar Webbing, 3 sheets 1/16 x 2 x 36, soft; Main Spars & T.E. Spars, (8) 1/8 x 1/4 x 36, med.; L.E., (2) 3/8 x 7/8 x 36 (may be cut from sheet), soft; Center Ribs & Dihed. Braces, (1) sheet 1/4 x 3 x 36, med.; Wing Tips, (2) 2 x 2 x 12 Block, soft.

Stab and Elevator: Ribs, Center Sheeting and Webbing, (2) 1/16 x 3 x 36, soft; Elevator, (1) 3/8 x 3 x 36, soft; L.E., (1) 1/4 x 1/2 x 36, med.; Spars, (4) 1/4 x 1/8 x 36, med.; T.E., (1) 1/4 x 1/2 x 36, soft; Tips, (2) 1 x 1 1/4 x 8 Block, soft.

Fuselage: Sides, (2) Sheets 3/32 x 4 x 48, med.-soft; Bottom & Top Planking, (3) Sheets 3/32 x 4 x 36, med.-soft; Fuselage Formers, (1) Sheet 1/16 x 4 x 36, med.; Doubler Formers, (2) Sheets 1/16 x 3 x 36, hard; Dowel, 3/16 x 36, hardwood; Engine Mounts, (2) 1/2 x 5/8 x 9, maple; Wing Supports, (1) 5/16 x 1 1/4 T.E. Stock, med.; Cowl Block, (1) 1 1/4 x 4 x 9; Longerons, (2) 3/16 x 3/16 x 36, soft; Cowl hold downs, (1) 5/16 sq. x 14, hard; Reinforcements, 3/16, 3/32, and 1/16, plywood; Pushrods, (3) 1/4 x 1/4 x 36, hard.

Fin & Rudder: (1) 1/4 x 1/2 x 36, med.; (1) 1/4 x 1/4 x 36, med.; (1) 1/4 x 3 x 36, soft; (1) 1/8 x 1/4 x 36, soft.