Miss Jeannette Vargas displays George's T-170.

T-170

The size of most 1/3 scale airplanes, this T-170 with a standard 2.0 cu. in. Quadra, is capable of putting on an excellent performance.

By George R. Smith

Discussion

If all Quadra powered airplanes flew like that, there wouldn't be enough Quadras to go around! This was the enthusiastic comment made recently by another Quadra flier at the club's field in Huntsville. He was referring to the sparkling performance that the Huge T-170 was putting on with a standard 2.0 cu. in. Quadra up front. He probably wasn't far wrong, since there are a lot of larger airplanes flying today, using Quadras for power, whose performance are less than spectacular. Generally, this is because many of the larger airplanes were designed for size considerations alone and do not have an optimum mix of wt., wing loading, aspect ratio, and lift/drag ratio to obtain top flight performance from a 2.0 cu. in. engine. When these considerations are left to chance, the results are likely to be disappointing and, usually, satisfaction can only be obtained by replacing the engine with one of larger displacement. I have found the Quadra to be an excellent, reliable engine but it has been mis-applied too many times. The T-170 was specifically designed to be a correct application for this fine engine. It uses a well-proven design concept and it has been carefully adapted and sized for the task. The result is an aircraft, the size of most 1/3 scale airplanes, that is capable of excellent performance on a basic Quadra. As a matter of fact, the airplane from which the T-170 was adapted (Al Clark's Terrier, RCM March '84) is an approximate 1/6 scale model of Al's concept for a full size "home-built," so the T-170 might legitimately be called "1/3 scale." Al's Terrier achieved astounding performance with a .25 size engine even though the size of the airplane more closely resembles that of a .40 size trainer. This performance is directly creditable to Al's creative design and his careful mix of those design factors which produce the most performance from the available power. The possibility of achieving that kind of performance from a large aircraft using Quadra power fascinated me. The resulting T-170 was certainly satisfying.

Although the T-170 is large (100 in. span, 1600 sq. in. area), the weight is only 16¾ lbs. resulting in a wing loading of 24 oz. per sq. ft. — light for this size aircraft. This wing loading will allow short take-offs; slow landings; and slow, graceful, aerobatic maneuvers. Because of the large scale-like fuselage with open cockpit and the relatively thick, 15% airfoil, the level flight speed cannot get out of hand and, when flying aerobatics, the speed builds slowly even when you point the nose straight down. These characteristics allow complex, precision maneuvers to be performed even right down on the deck without producing the well-known "white knuckles" so prevalent with the "powered bomb" type of aerobatic sport plane. You can relax and just have a heck of a good time.

As on the Terrier design, one of the real keys to the excellent performance of the T-170 is the airfoil, a modified NACA 2415. This airfoil exhibits a very smooth lift/drag curve (with no drag bucket) which provides very predictable handling in pitch at all speeds. This is not a symmetrical airfoil so a little down stick is required to fly inverted, but very little. Outside maneuvers are easily accomplished, requiring only a touch more control than the same maneuver accomplished in the inside mode. Also, on final approach, the sink rate is less and is more predictable than the sink rate with a symmetrical airfoil. The modification of the NACA 2415 consists of a 40% reduction of the leading edge radius and appropriately recontouring the first 15% of the top and bottom surfaces to meet the smaller L.E. radius. The purpose of this modification is to allow cleaner snaps and spins. Entries are neat and easy and the maneuvers stop cleanly when the controls are released. The basic airfoil exhibits excellent low-speed stall characteristics which are not noticeably changed by the modification.

Very slow, nose-high landing approaches are easily performed without any tendency for a wing to drop. I have flown head-high passes, even inverted, at throttle settings not much above idle without any tip stall (this is helped partly by the ailerons not running all the way out to the tips). The 15% thick airfoil has additional benefits; the thickness allows a very strong, lightweight wing to be built and the extra drag (due to the extra thickness) keeps the level flight speed from getting out of the relaxed flying regime. This airfoil, combined with a large (100 in.) wingspan and a fairly high (6.25:1) aspect ratio provides excellent climb and glide performance. The large span gives a low span loading (weight/span) which results in a low gliding sink rate (since sink rate is proportional to the square of span loading). The relatively high aspect ratio gives a reduction in induced drag which requires less horsepower for a given rate of climb as well as increasing the glide ratio. These are the premises that the glider boys exploit to the extreme. We power fliers can take some leaves from that book as well.

While I'm on the subject of flying characteristics, I can give some ideas of what can be expected from the T-170. Take-offs are a snap! Apply gentle right rudder as throttle is added, hold gentle back stick as speed comes up and the T-170 will do a beautiful smooth take off everytime. Once airborne, the T-170 is totally at home with all the aerobatics you can conceive. The usual loops, rolls, spins, snaps and hammerheads can be done with ease, even with 1/2 throttle. You will be surprised at how quickly you will progress into 4-point rolls, tail slides, double snaps, 1/4 and 3/4 snaps to knife edge, vertical Figure 8's, square loops, and many, many others. You will be pleased to find how well the T-170 performs the outside loops, outside snap rolls, outside loops with included outside snap rolls and inverted spins, all of which are accomplished with equal ease to the inside maneuvers. The T-170 responds to controls more like a real airplane than any other model I have ever flown. An example of this is the side-slip to lose altitude on a landing approach. You simply hold rudder to establish a good yaw angle and direct your descent and maintain wings level with opposite aileron. With most other models this is very tricky at best — with the T-170 it will be easily accomplished and will show off your flying prowess at your field.

Landing and ground handling of the T-170 is easier than with any other tail dragger I have flown (and that's a bunch!). It worked out that the flare attitude for landing is the same as the 3-point attitude for touchdown. The very first landing I made with the T-170 on its maiden flight was so smooth that I never did know exactly when the wheels touched the runway. That landing characteristic can make you look like an expert on every landing. After you're on the ground and taxiing to the pits, you don't have to worry about dragging a wing tip even in strong cross winds because of the stability provided by the wide stance of the landing gear and its longitudinal location so close to the C.G. Also, the T-170 has no tendency to ground loop, a characteristic so prevalent with many other tail draggers.

After being so satisfied with the performance of the T-170, I felt that I had to let the airplane show itself off even more. I added the "piece de resistance" --- smoke. If you have flown with smoke before, you know that it can really show off beautiful maneuvers but it can sure emphasize the poor ones. In this case, the smoke graphically shows the extraordinary performance capability of the T-170. This was even true considering the extra 1¼ lbs. of smoke system consisting of electric motor and pump, batteries, tank, smoke muffler, and plumbing. The extra weight was slightly detectable in flight performance but not nearly as much as one might expect.

ABOUT THE AUTHOR

George R. Smith is an Aeronautical Engineer who graduated from Alabama's Auburn University in the 1950s. After many successful years in the aircraft and aerospace industries, primarily managing research and developmental projects, Mr. Smith is a Technical Project Manager, working for the US Army Missile Command in Huntsville, Alabama.

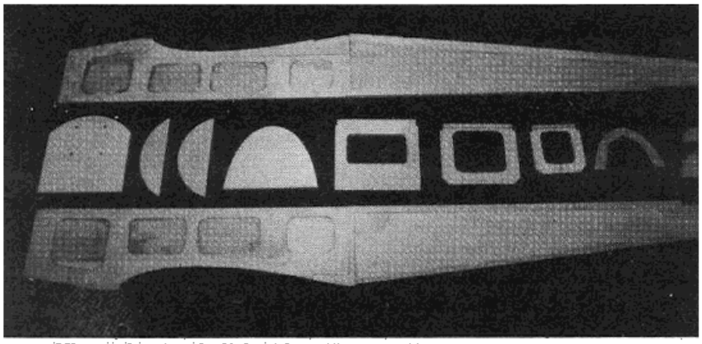
He is an active member and is currently President of the Rocket City Radio Controllers, Inc., of Huntsville.

When not on business trips for the Army, Mr. Smith spends much of his time at the club's flying site which is provided by the City of Huntsville at the, now inactive, old city airport. An avid modeler for almost 40 years, Mr. Smith expresses an interest in modeling of many types but admits to a true love and fascination for powered R/C aircraft. He has always derived great satisfaction from "scratch" building and has gained even more satisfaction from developing and building his own designs.

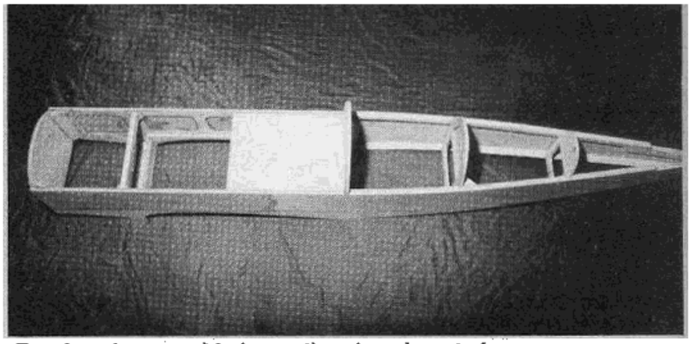
Several of Mr. Smith's designs are well-known among his modeling friends and a few have reached international prominence. Examples are the "Double Eagle" (RCM, May '79) and the "DE-40" (RCM, March '82).

Although maintaining active interest in pattern, sport, and scale aircraft, Mr. Smith is currently including super scale among his contributions. He considers the T-170 as, basically, a scale aircraft. He is proud to present his latest efforts in the field of high performance aircraft for individualized performance.

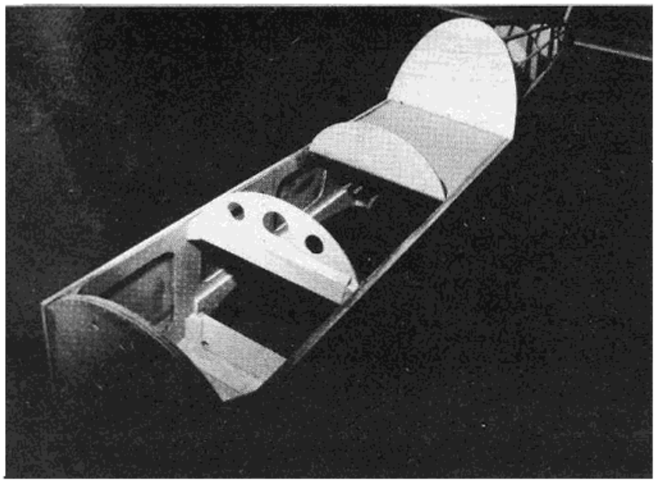
Ready to roll.



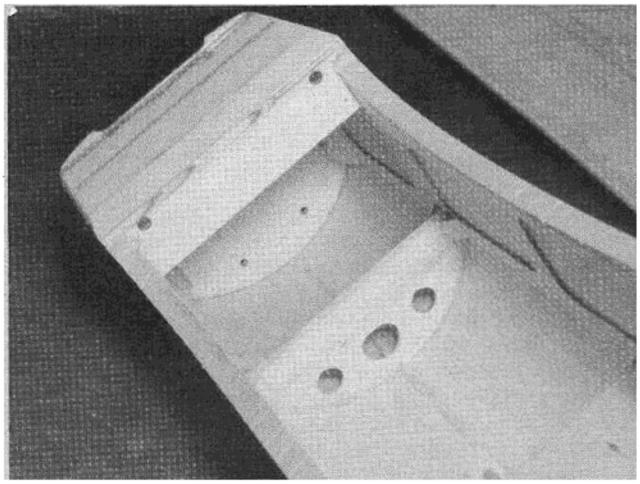
Kit made up of all fuselage parts.



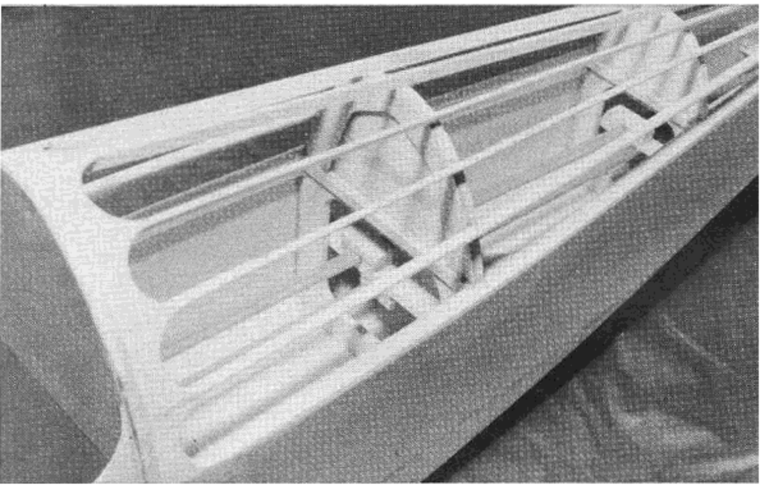
Fuselage is assembled over the plans inverted.



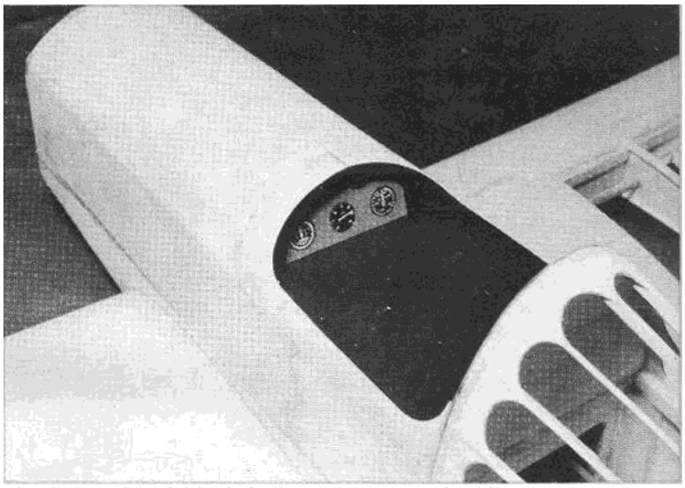
Cockpit deck in place along with top bulkheads. T1 has had lightening hole cut into it.



Looking into wing saddle of completed fuselage.



Turtledeck with stringers in place. Note Gold'N-Rod is held in place at each bulkhead station.

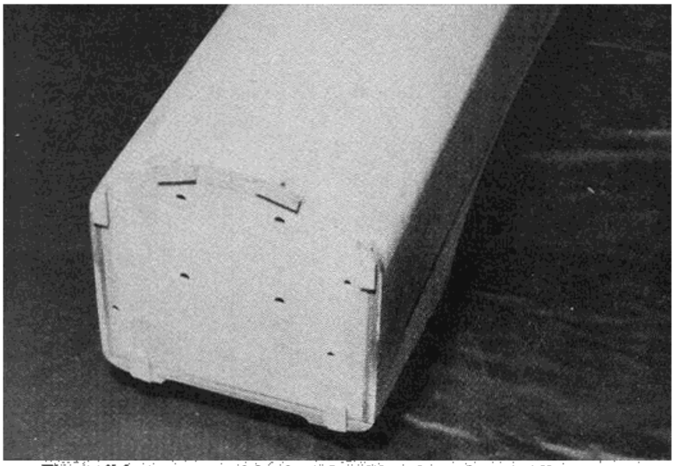


Cockpit painted black inside with sharp looking instrument panel.

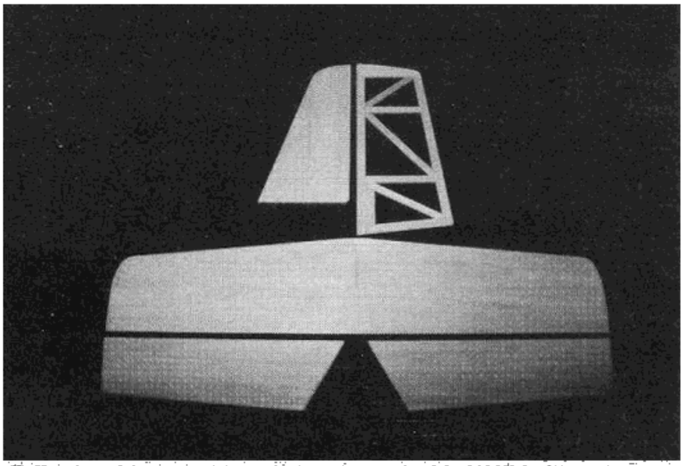
Design

I have probably succeeded in conveying the idea that I am pretty enthusiastic about the flight performance of the T-170. With that done, I'll get on to the specifics of the design. A scaled upsizing of the Terrier according to the standard scaling methods would give me the general parameters of the T-170 and would put me in the right ball park for overall configuration but the selection of the scaling factor was critical to assure that the flight performance would be correct. The engines, themselves, provided the determining data. The displacements of the two engines were, of course, known and a power factor for each, at measured rpm, was calculated. The ratio of power factors was used to derive the linear scaling factor that would produce an aircraft, sized to the larger engine, that is dynamically similar to the original. The exact scale factor so derived was 1.684 but, for practicality and editorial purposes, I call it 1.7 (in case you wondered where the name "T-170" came from, this is it, Terrier times 1.7). A few minor dimensional adjustments were made to the upsized outline, mostly to accommodate standard wood sizes and lengths but, on the whole, the scale factor was maintained true. The factors pertaining to aerodynamic performance were basically unchanged except for the addition of an aerodynamic cowling which was necessary, not only for looks but to eliminate the excessive drag that would be caused by an open engine compartment scaled up to this size.

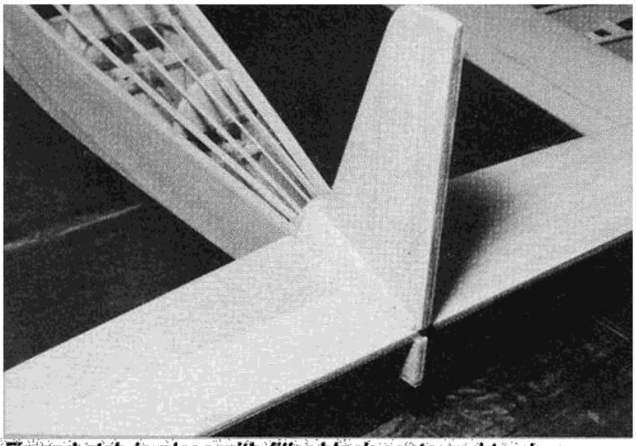
A general rounding off of the tips and a little cleaning up of the lines completed the outline design. As should be considered in any scaling up exercise, particular emphasis was



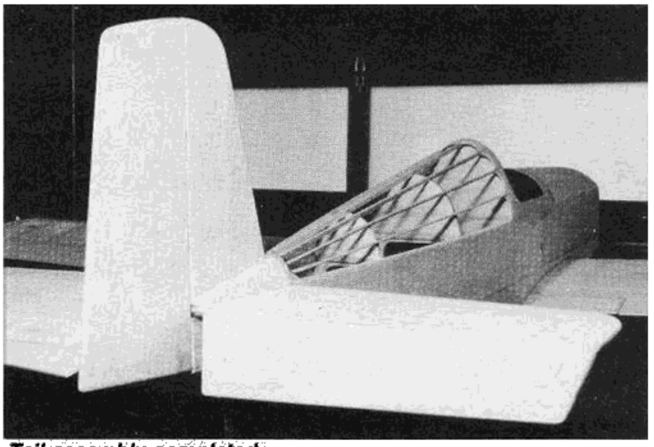
Firewall has spruce blocks glued in place for cowling screws.



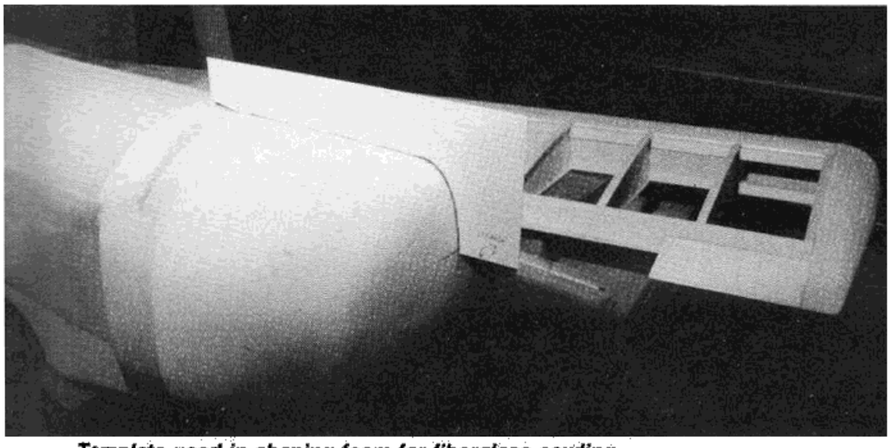
Tail assembly — rudder will be sheeted with 1/16" balsa.



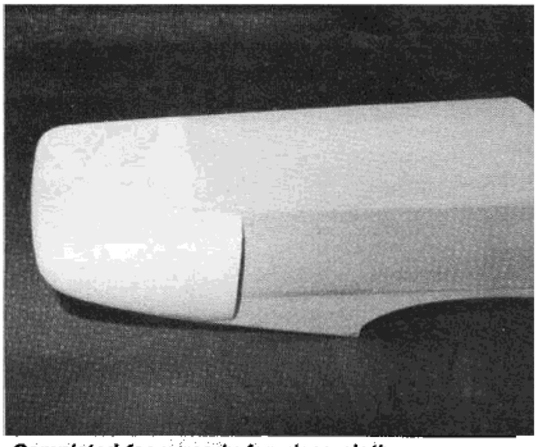
Fin and stab in place with filler block contoured to shape.



Tail assembly completed.



Template used in shaping foam for fiberglass cowling.



Completed foam ready for glass cloth.

placed on the aerodynamic drag function which increases, roughly, as the cube of the scale factor. This is the best reason that I can cite for cowling in and smoothing up every feature possible on the larger airplanes. Further examples of this line of thinking on the T-170 are a longer and more gently sloped windshield and the teardrop fairing on the landing gear struts. Both contributed to decreasing the total drag considerably.

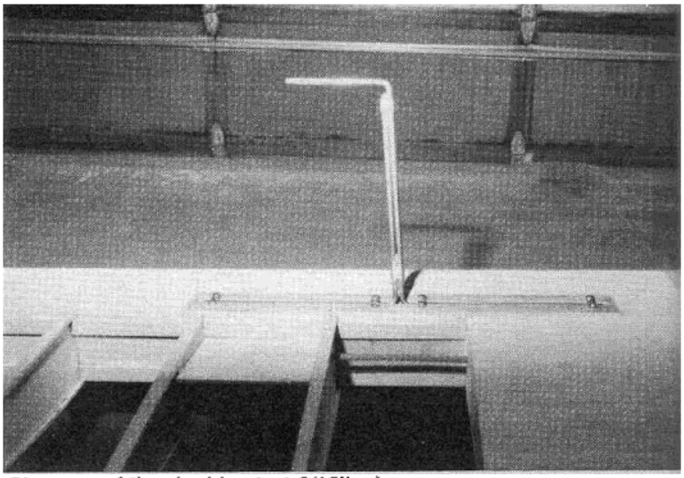
The structure of the T-170 is similar in concept to that of the smaller Terrier but there the similarity stops. The primary load carrying members of the T-170 structure were sized to withstand plus or minus 9g. maneuver loadings at an expected flight weight of 16¾ pounds. The rest of the structure was designed for ease of construction and lightness of weight, both of which were prime considerations.

The fuselage is a basic slab-sided structure with flat bottom and stringer turtle deck. 3/32" ply doublers with large lightening holes distribute the engine and wing loads. A 1/8" ply cockpit floor is the prime rigidizing member and provides the hard mount for servos and equipment. The size of the wing opening and the depth of the fuselage allow all equipment to be mounted in clear view, close to the C.G.

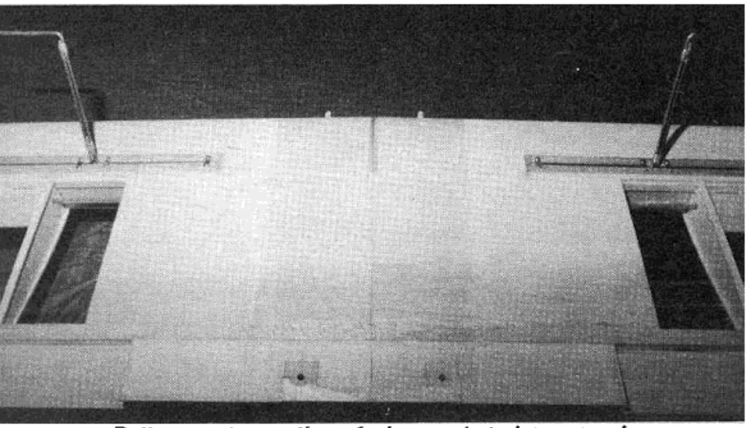
Rudder and stabilizer assemblies are of built-up construction with 1/16" sheet balsa skins. Spruce spars and active guy wires resist the aerobatic loads.

The wing is about as simple as can

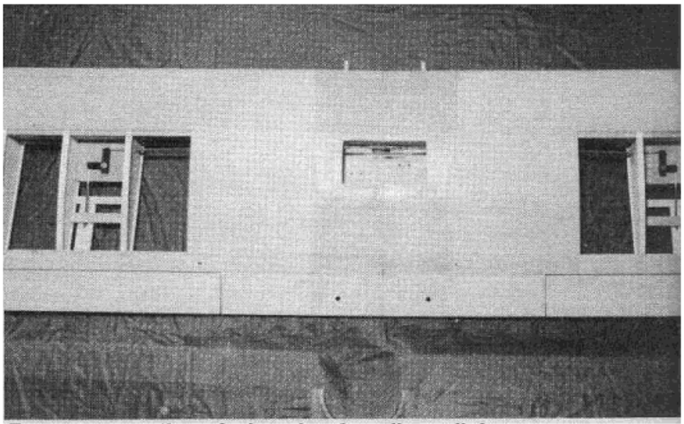
Designer George Smith, final sanding that 100" wing.



Close-up of the double strut 3/16" wire gear.

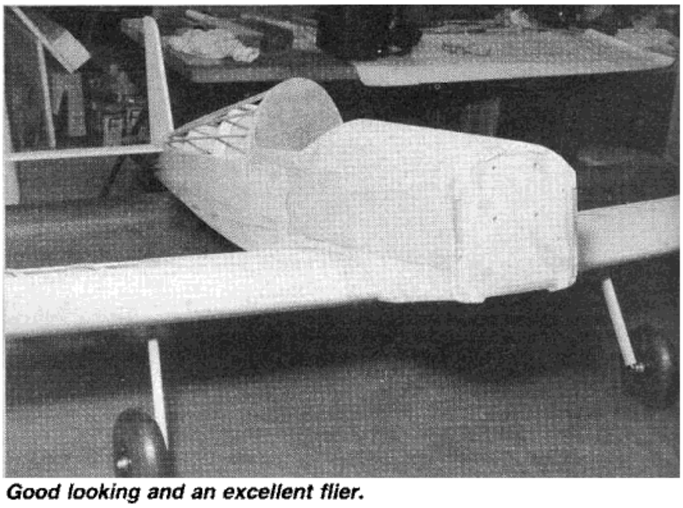


Bottom center section of wing ready to be covered.



Top center section of wing showing aileron linkage.

Completed model ready to cover. Nice and clean on bottom side.



Good looking and an excellent flier.

be built. A spruce capped I-beam spar integral with a leading edge D-tube resists both bending and torsion. The constant chord planform builds quickly and is finished off with strip ailerons for efficiency. The completed wing is light and strong.

The landing gear was designed to provide the strength required and still utilize small enough wire to be workable by the average airplane modeler. 3/16" wire and matching commercial benders are readily available. With the double torque rod configuration, the 3/16" wire is most adequate and the total strut system is lighter than a single torque rod strut would be, made from the 1/4" wire that would be necessary to withstand the load. The 3/16" is certainly more easily formed. I suggest that the builder form the landing gear pieces out of scrap coat hanger wire first to get all the angles right for left and right hand parts before bending up the big stuff. It's amazing how mixed up a fellow can get making mirror image bends.

The cowling is simply a fiberglass shell for aerodynamic smoothness and looks. It's weight is negligible compared to the drag it eliminates.

CONSTRUCTION

The T-170 is as easy to build as a .60 size trainer type airplane. If the prospective builder has had any experience in scratch building, he will have no trouble at all. I would hesitate to recommend this as a first time project simply because of the size and financial investment, but, for ease of construction, it would be a good

PLYWOOD

1/64" ply, 3" x 6", 2 required — landing gear fairing
1/32" ply, 2½" x 4½", 1 required — instrument panel
1/32" ply, 6" x 12", 1 required — cockpit fairing
1/16" ply, 6" x 24", 2 required — fuselage side doublers
1/16" ply, 2½" x 6½", 1 required — aileron servo plate
1/16" ply, 3" x 4", 2 required — aileron bell-crank plates
1/8" ply, 1¼" x 8", 1 required — gear mount ends
1/8" ply, 2¼" x 4½", 8 required — rib doublers
1/8" ply, 6½" x 8½", 1 required — cockpit floor
1/8" ply, 6" x 12", 2 required — dihedral braces
1/8" ply, 7" x 12", 1 required — T3 & F3 bulkheads
3/16" ply, 1¼" x 16", 4 required — landing gear mount
3/16" ply, 2" x 4", 1 required — tail wheel mounting plate
1/4" ply, 2½" x 6½", 2 required — T1 & T2
1/4" ply, 3" x 7", 1 required — wing dowel receiver
1/4" ply, 2" x 2½", 1 required — wing screw receiver
5/16" ply, 6½" x 6½", 1 required — firewall

SPRUCE

1/8" x 3/8" x 26", 7 required — turtledeck stringers
1/4" x 3/8" x 6", 1 required — cowling mount
1/4" x 1/2" x 12", 1 required — servo rails
1/4" x 5/8" x 36", 4 required — elevator & rudder spars
1/4" x 1/2" x 36", 1 required — stabilizer leading edge
1/2" x 1/2" x 48", 4 required — spar caps
5/16" diameter dowel x 3", 2 required — wing mounting dowels

BALSA

1/16" sheet, 4" x 36", 6 required — rudder & elevator sheeting
1/8" sheet, 6" x 48", 4 required — wing D-tube sheeting
1/8" sheet, 4" x 48", 11 required — ribs, center section sheeting & spar webs
1/8" sheet, 2½" x 4½", 1 required — instrument panel base
1/8" sheet, 1¼" x 48", 4 required — trailing edge caps
3/16" sheet, 4" x 48", 4 required — fuselage sides
3/16" sheet, 4" x 36", 2 required — fuselage bottom, turtle deck & spar webs
1/4" sheet, 3" x 36", 2 required — rudder and elevator tips, stabilizer center section T4, T6, F4, F5
1/4" sheet, 4" x 36", 3 required — T3 & F3 doublers, spar webs T5, wing saddle doublers, headrest, stabilizer mount doublers
5/16" sheet, 4" x 12", 1 required — fuselage "chin" plate
1/8" x 3/8" x 36", 8 required — rib caps
1/4" x 1/2" x 36", 8 required — T4 & T5 crosspieces, fuselage longerons, empennage structure
3/8" x 1" x 48", 2 required — rear spars
1/2" x 1/2" x 48", 2 required — leading edge
1/2" x 1/2" x 6½", 1 required — T1 crosspiece
1" x 3" x 48", 2 required — trailing edge, ailerons
1/4" triangle x 36", 1 required — cockpit reinforcement, landing gear fairing
1/2" triangle x 36", 4 required — lower longerons, fuselage & gear mount reinforcements
1¼" x 1¼" x 6" block, 2 required — tail section fairing
2" x 2½" x 16" block, 2 required — wing tips

T-170 HARDWARE

Sullivan Gold'N-Rod #505, 36" long, 6 pieces
Du-Bro #108 Kwik Link, 12" long, 7 pieces
Du-Bro #109 Clevis, 4 pieces
3/16" dia. music wire x 36" landing gear
1/8" dia. music wire 12" elevator connector
Rocket City #02 extra long control horn, 3 sets
C.B. Associates #5509 bell crank, 2 each
1/4" x 20" x 3/4" long hex. head bolt, engine mount, 4 each
Du-Bro #158 landing gear straps, 2 sets
C.B. Associates #5580 1/4" scale tail wheel assembly, 1 each
Du-Bro 3/16" dia. wheel collars, main gear, 4 each
C.B. Associates 5.0 dia. main wheels 2 required
Rocket City #21 nylon strip hinge one pkg.
1/4 x 20 nylon wing bolts, 2 each
6 oz. fiberglass cloth, 1 square yard required
1/32" sheet plastic, 6" x 12", windshield
Quadra #151210 radial mount, 1 required
P.K. Products, 90 degree carburetor mount, 1 required
Vortac manual choke assembly, 1 required
Kress Technology 24 oz. tank (for gasoline), 1 required
Worldtex, covering material, 5 rolls
DGA Designs, 1/3 scale pilot figure, 1 each
International RC Specialties 1/3 scale instruments, 1 pkg.
K & B Super Poxy color & clear, as required
Zinger 18 x 6-10 propeller
C.B. Associates 2½ dia. aluminum spinner
Aluminum or brass shim stock, 1/64" x 3/8" x 6" (for tail brace clips)
RTV, as required
Polystyrene foam (for cowling mold)

candidate to a new scratch builder.

I recommend starting with the tail surfaces to get used to the size of the parts. Do the wing next (since you must have the wing to complete the fuselage anyhow) and end up with the fuselage and cowling.

The T-170 builds up quickly but not if we don't get on with it. So, let's get started.

Tail Surfaces:

The structure of both the horizontal and vertical surfaces is built right over the plan. The main spars of both surfaces and the leading edge of the stab are noted on the plan as 1/4" by 5/8" spruce. Balsa is not structurally adequate. For ease in hinging, I laminate the spruce spars with 1/16" balsa (this process places an easily slotted balsa strip on centerline yet maintains the strength of the spruce spar). 1/16" balsa sheet is added to one side before lifting the structure from the plan, then the structure is lifted, and the other side sheeting is added.

The two halves of the elevator are connected with minimum 1/8" diameter piano wire even though both halves are pushrod actuated. The 1/8" connector wire prevents elevator flutter and guarantees trueness. The 1/8" wire is not adequate to transmit control forces between elevators so don't be tempted to use a pushrod on one side only (without substantially increasing the size of the connector wire).

Wing:

Make a wing "kit" first by fabricating all the parts. The use of a bandsaw (or scrollsaw) with a tilt table will greatly facilitate this but conventional hand methods, though slower, are plenty adequate. All the ribs are the same contour but are cut from two different thicknesses of material (or may be laminates of the thinner stock). Ribs 4 through 7 are modified to accept the plywood landing gear mount and are laminated with plywood doublers before assembly. Fabricating the trailing edge stock (from which the ailerons are also cut) to true cross section without power equipment is tedious but can be accomplished with a sharp razor plane and the application of reasonable care. The builder might elect to make "built-up" ailerons and trailing edge using ribs and sheet balsa covering. This would, of course, be satisfactory.

The leading edge is 1/2" by 1/2" balsa, shaped to fit the rib contour at assembly. The only adaptation required on the 1/2" by 1/2" spruce spar caps is the dihedral angle cut on the root end. A dihedral angle gauge is provided on the plan for this purpose.

Each wing panel is assembled separately and then joined at the proper dihedral angle.

Tack the lower trailing edge sheeting in place over the plan (using waxpaper in-between). Zap the rear spar to the trailing edge sheeting. Butt each rib against the rear spar and Zap in place, using a small drafting triangle or carpenter square to maintain perpendicularity. Work from the tip, assembling the inboard sections last. A piece of 1/8" sheet, laid along the main spar line will support the ribs during this assembly. Make certain that ribs 4 through 7 are correctly placed to receive the landing gear mount. The top 1/2" by 1/2" spruce spar cap is installed. Carefully align the spar cap at the wing root with the dihedral angle gauge.

Zap the 1/2" by 1/2" balsa leading edge into the notch in the nose of all ribs, again being careful to align with the dihedral angle at the wing root. Don't attempt to shape the leading edge to the rib contour yet. Add the top trailing edge sheeting.

Carefully lift the wing panel from the plan and turn it over. Pin or use weights to secure the trailing edge down to the flat work surface. Install the bottom 1/2" by 1/2" spruce spar cap. (Note dihedral cut.) The basic wing structure is now rigid enough to be removed from the work surface and put aside.

The wing plan must now be reversed for the opposite wing. I have found that about the simplest way is to spray the back of the plan sheet with a light vegetable oil like Pam. This makes the paper almost transparent, thereby showing a mirror image of the plan on the other side.

Build the opposite wing panel to the same degree of completion as the first.

Assemble the two panels together with the precut plywood dihedral braces. Either slow-cure Zap or 5-minute epoxy may be used here. Assure that the wing panels are not twisted or warped during this assembly and that no sweep angle is built in. The way I accomplish this is to butt the panels together with each tip blocked up the designated 1¾" and the chord line of each held parallel to the table. A long straightedge aligning the leading and trailing edges guarantees no sweep.

The two number 1 ribs are laminated together forming a center rib and are cut to fit in place to maintain the contour of the wing. Ribs number 2 are cut and assembled in the same way. The new center rib must be additionally relieved to allow placement of the aileron servo mount. This should be done now. Add the 1/4" balsa plates to accept the wing mount dowels but don't drill the holes for the dowels yet.

Assemble the plywood landing gear mountings and fit them into the notches provided in ribs 4 through 7, making sure that they are firmly glued to the lower spar cap. Slow-cure Zap is good here. Install the aileron bell crank platforms and the servo mounting pad. Trial fit the bell cranks and the servo in place and install the NyRod sleeves for the pushrods. This is best to do now before the wing skin is installed.

Now you can razor plane and sand the leading edge stock to fit the rib contour.

Install 1/8" balsa sheet to form the D-tube. Wet the outside surface of the balsa with water or ammonia to assist bending if necessary.

Cut each piece of spar web to fit closely between each rib and install. Add the rest of the 1/8" sheeting top and bottom and all 1/8" by 3/8" rib caps.

The preshaped trailing edge stock is attached. I secure the rear edge of a wing panel to the table and make sure that the installed trailing edge is true with the contour of the ribs. Repeat for the other panel. (Wait until later to hinge the ailerons in place.) Lightly sand all over, carefully contouring the leading edge according to plan. The addition of lightweight fiberglass to the center section is optional. If the builder chooses to add it, now is the time.

Tip blocks are fitted and sanded to shape. I like to hollow the tips to approximately 1/4" thickness. Every ounce counts, you know. Holes for the mounting dowels will be added later.

Set the wing aside until later. Be sure to lay it or stand it in a manner as to prevent possible warpage. It is not covered and sealed yet so temperature and humidity could take effect.

Fuselage:

Make a "kit" of all shaped fuselage parts to start. These include the bulkheads, doublers, ply cockpit deck, and wing dowel receiver plates. Note the beveled edges of the tops and bottoms of the bulkheads; it is best to sand these bevels before assembly. Add the 1/4" by 1/2" stiffeners to the balsa bulkheads and drill engine mount holes in the firewall. Start assembly with the fuselage sides which are built up of 3/16" by 4" wide balsa. If 48" balsa stock is used, only one splice in length will be needed, and that should be placed so as to be covered by a solid "strut" of the ply doubler. When you laminate the ply doubler to the balsa sides, don't forget to make one "left" and one "right" side. Add the stabilizer support doublers, the 1/4" by 1/2" longerons, the 1/2" triangle lower longeron and the wing saddle doublers.

The fuselage is built inverted right over the plan. It will facilitate assembly if the plan is placed so that the firewall is slightly over the edge of the work surface. (An alternate method is to assemble the fuselage all except for the firewall, remove from the plan, and add the firewall later.) Place the ply cockpit deck in place, stand the lower bulkheads in place, and Zap the sides in place on them using a small triangle or carpenter's square to assure the sides are vertical. The longerons, stab, doublers, and triangle lower longerons will have to be beveled at the rear to allow the sides to touch. Assemble the two pieces F-2 and F-2A together forming the wing dowel receiver. The dowel holes are drilled and reamed smooth. This is done before assembling the dowel receiver to the sides. The cross grained balsa forming the aft fuselage lower surface is put on using slow-cure Zap. The lower surface or "chin" plate, forward of the wing is to be installed later. The fuselage is rigid enough to be removed from the plan. Zap all triangle support gussets internal to the fuselage. The wing screw receiver plates and their support gussets are added into their slots in the saddle doublers. Holes into the receiver plates are not drilled as yet.

At this point, the wing is mated to the fuselage. With the fuselage inverted on the building board, fit the wing in place. Any fitting or sanding should be done to the saddle to fit the contour of the wing. I found the carbon paper method to be most effective. Tape a piece of carbon paper (carbon side out) to the top of the wing. Carefully place the wing in the saddle as close to correct alignment as possible, and "wiggle" the wing a bit. The carbon marks on the saddle will indicate the high points that should be sanded. Work carefully and check the fit often. It's awfully easy to go too far. The wing is set at 0-0 degree angle of attack and be sure that the wing is level tip to tip.

When you are satisfied with the wing saddle, the wing hold-down bolt holes are drilled through the wing and tapped into the fuselage bolt receiver blocks. With the wing securely weighted in place, the dowel locations are back drilled into the wing leading edge through the holes in the fuselage dowel receiver plate. Deepen the holes in the wing through the internal dowel support plates and secure the dowels in place with 5-minute epoxy.

Now the "chin" plate can be installed as well as the ply tail wheel mounting plate.

Installation of NyRod sleeves for rudder and elevator pushrods would be easier if done now, before the turtle deck is put on.

The forward upper bulkhead formers are Zapped in place ready to support the 3/16" balsa forward decking.

The decking is cut to shape as shown on the plan and joined along the centerline with Zap. Bevel the lower edges of the decking to mate with the sides. Wet the outer surface of the balsa, if needed, to allow the decking to be curved into place. The decking should be flush with the firewall on the forward end and the sloped bulkhead, T-2, on the aft end.

The aft upper bulkhead formers are Zapped in place to provide support for the 1/8" by 3/8" stringers, which may be added next.

The stabilizer is butted up to the last former and glued in place. Slow cure Zap or 5-minute epoxy is used. Absolute care is needed to assure that the stab is mounted on centerline, has 0-0 angle of attack, and is level tip to tip.

A little trick is used to help shape the balsa fillet blocks on either side of the vertical fin. A piece of 3/8" scrap balsa is used as a filler between the fillet blocks. The fillets and the scrap are sanded to a conical shape. The scrap is removed, leaving a neat slot for the vertical fin which is inserted with 5-minute epoxy. Before the epoxy cures, be sure that the vertical fin is perpendicular to the stab and parallel to the fuselage centerline.

The 1/32" ply cockpit fairing is put on next. Carefully align the fairing with the top of the fuselage side at the cockpit, butting the rear edge up to the headrest bulkhead. Roll the ply over the forward decking and lightly score the decking at the front edge of the ply. Remove the ply and carefully cut back the surface of the decking to the score line so that the ply will stay flush with the top of the decking. Replace the ply fairing in position and secure with Zap. Reinforce the centerline joint where the two fairings meet with a piece of scrap ply and reinforce the joint where the ply meets the fuselage side with 1/4" triangle stock.

Fiberglass Cowling:

After you have lightly sanded and shaped the wood fuselage and added the spruce strip to accept the lower cowl screws, you are ready to form the cowling. If you have never formed a fiberglass structure and have been reluctant to try, you will be surprised at the ease with which a really good structure can be produced. (We're not going to discuss making a mold for producing cowlings in quantity; we're going to make one.)

T-170

DESIGNED BY:
George R. Smith

TYPE OF AIRCRAFT
Superscale High Performance Sport

WINGSPAN
100 Inches

WING CHORD
16 Inches

TOTAL WING AREA
1600 Sq. In.

WING LOCATION
Low Wing

AIRFOIL
NACA 2415 (modified)

WING PLANFORM
Constant Chord

DIHEDRAL EACH TIP
1¾ Inches

O.A. FUSELAGE LENGTH
67¼ Inches

RADIO COMPARTMENT SIZE
(L) 16" x (W) 6½" x (H) 4¼"

STABILIZER SPAN
32 Inches

STABILIZER CHORD (incl. elev.)
10½" (Avg.)

STABILIZER AREA
320 Sq. In.

STAB AIRFOIL SECTION
Flat

STAB LOCATION
Top of Fuselage

VERTICAL FIN HEIGHT
13½ Inches

VERTICAL FIN WIDTH (incl. rud.)
10½" (Avg.)

REC. ENGINE SIZE
2.0 Cu. In. Quadra

FUEL TANK SIZE
24 Oz.

LANDING GEAR
Conventional

REC. NO. OF CHANNELS
4 (or 5)

CONTROL FUNCTIONS
Rud., Elev., Ail., Throt. (Smoke)

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa, Ply & Spruce
Wt. Ready To Fly	**16¾ Lbs.**
Wing Loading	**24 Oz./Sq. Ft.**

Take a piece of polystyrene foam large enough to make the complete cowling (or epoxy together several pieces) and mount it to the front of the airplane with a couple of large screws through the engine mounting holes in the firewall. Put a couple of foam pads on the fuselage sides behind the firewall with double sided tape. These pads, when sanded to shape, form the mold for the "cheeks" of the cowl.

With a sanding block and coarse paper, rough out the cowling shape using the cross sections shown on the plan. Note: you are shaping the inside contour of the cowling. The outside contour will be approximately 1/16" to 3/32" thicker. When you are happy with the contour, smooth sand the foam all over and seal it with one coat of white glue. Allow the glue to dry thoroughly. Using a felt pen, mark centerlines and reference lines on the foam. Wrap a layer of plastic wrap, or waxpaper over the foam and the forward edge of the wood, far enough back to keep any resin off of the wood.

Use glass cloth of about 6 oz. weight and either epoxy or polyester resin. I like the epoxy resin because it tends to stay less brittle than the polyester. Cut strips of the cloth about 6" wide and lay them on the form in a criss-cross diagonal manner, finishing up with a band around the rear, or mounting end, of the cowl, extending over the wood. Allow enough overlap for adequate mounting and for trimming. Using a 1" paint brush, coat the glass with resin, working the resin into the cloth. Work out all bubbles and voids. Don't worry about a little fuzzing on the surface but don't allow a layer to lift.

Block the fuselage up so the excess resin can drip from the lower, rear edge. Any hardened "drips" that cling can be trimmed or sanded off later. Allow the resin to cure completely.

At this point, you should be able to see the centerlines and mounting screw locations through the semi-transparent fiberglass. Mark the engine shaft center with a small drill or center punch and drill pilot holes for the six mounting screws holding the cowling to the bulkhead. This alignment would be difficult if you waited until the cowling were dismounted.

Using a rubber sanding block and wet/dry emory paper (used wet) sand the outer contour to smooth surface. Be careful and do not sand through the glass cloth. This sanding can be done on the airplane, but I prefer to remove the cowling and foam from the wood before sanding. (It keeps the wood dry.)

When you are satisfied with the surface smoothness, remove the foam from the inside. If you go ahead and cut the propeller shaft hole (using the mark you have made as a center) it will help by providing a hole to push through. If all efforts to slide the foam out fail, don't worry. It can always be dissolved out with a little gasoline.

Using a Dremel saw and drum sander, cut out and smooth the openings in the cowling. Trim and finish the rear edge. The finished cowling will fit the fuselage exactly.

Spray the cowling with a coat of epoxy or automotive primer. Lightly wet sand and fill any pin holes with automotive spot putty (I used Bondo brand). Wet sand with 400 grade paper and spray on your color. I used K & B Super Poxy paints and have never had a chip or cracking. This is important on a piece that has to take some vibration and flexing like a one-piece cowling.

Landing Gear:

The landing gear is formed, as was mentioned earlier in this article, from 3/16" piano wire. The bends must be made accurately and the two pieces of wire for each gear securely joined with wire wrapping and silver solder. Since the bending of the wire to the correct form is complex, I strongly advise forming all the pieces, both left and right hand, from easy to bend wire like coat hanger and use these as a guide to bend the piano wire. I built a little slotted jig to hold the pieces in a straight line for soldering.

The tear-drop fairings help the appearance of the wire gear greatly and cut the aerodynamic drag. Scrap pieces of 1/64" ply left over from sheeting a pattern airplane wing were used on the original T-170 but card stock (cardboard) or sheet plastic could be substituted. They could also be carved from balsa. The trick is to not glue them hard to the struts. The struts must flex a little and that would crack a hard glue. Mount the fairings with silicone rubber cement (like Dow Corning).

Covering and Finishing:

Use your favorite covering material and put it on just like covering a .60 size trainer. I used and highly recommend the lightweight Dacron fabric that is known by several trade names. I used "Worldtex" and was very satisfied. The matte finish was a little flat for my taste so I finished it off, after trim striping, with a sprayed on coat of Super Poxy clear. This also helped to seal the surface of the fabric.

Cover all the control surfaces separately before hinging them in place.

After spraying on the cover coat, the windshield is installed with Zap. Small, flat head nails, tacked into pre-drilled holes in the sloped former, T2, secure the tips of the windshield plastic. A 1/2" wide strip of matching covering material covers the Zap joint and strengthens the windshield attachment.

A piece of 1/4" black neoprene tubing, split, makes very realistic cockpit edging. Zap secures it well.

One third scale instruments (approximately 1" diameter) mounted on 1/8" balsa behind holes cut in 1/32" ply make a convincing instrument panel. I used International RC Specialties' instruments and they look great.

C.B. Associates' 1/4 scale tail wheel, 2½" diameter aluminum spinner, and 5" diameter wheels are the perfect finishing touches for the T-170.

A 1/3 scale pilot by DGA Designs adds the ultimate realism.

Diagonal Struts:

The diagonal tail plane struts are really optional since the spruce spars in the stabilizer are designed to resist the aerodynamic loads, but I recommend installing them for looks and to prevent possible flutter and bending.

Cut the six (6) angle clips from brass or aluminum shim stock and mount on spar centerline with #4-40 screws and lock nuts. Du-Bro clevis rods are cut to length and employ a solder link on one end and a threaded link, for adjustment, on the other. The lower rods use a terminal lug, soldered on, instead of a Kwik Link and are attached to the rear tail wheel mounting screw. To be functional, the struts must be adjusted to be tight. A tension rod that vibrates is worse than no tension rod at all.

Engine and Tank:

Bolt the Quadra to the firewall using large washers under the bolt heads to spread the load. Drill through the firewall for the throttle pushrod and fuel line.

It is advisable to add an engine kill switch for an ignition engine. Mount the switch on the side of the fuselage aft of the cowling where it is easily accessible. Run the wires through the firewall.

If you have used a 90 degree carburetor adapter, you can drill an access hole in the lower surface of the cowling to accept a screwdriver for mixture adjust.

A piece of Du-Bro clevis rod attached to the choke handle, long enough to extend back past the cowling cheek, provides simple choke actuation.

Mount the tank in foam, immediately above the leading edge of the wing. Provide filler and drain tubes as you desire. I used a 24 oz. tank, for gasoline, by Kress Technology Inc., it is excellent. By the way, it seems that 24 ozs. will run the Quadra forever. (Somewhere around 40 to 50 minutes at least.) Don't forget to use neoprene tubing for fuel line. Silicone will not hold up to gasoline.

Smoke:

If you decide to use a smoke system, a 12 or 16 oz. tank will fit easily directly above the fuel tank forward of the cockpit area. Motor/pump, batteries and servo controlled switch can all be foam mounted in close proximity to the tank. Be sure to use a check valve in the fuel line to the muffler to keep hot fluid from backing up into the pump.

Radio Installation:

Any of the modern radios with four (or five) channels and three heavy duty servos will be just fine for the T-170.

Adjust your servo location and, particularly, the battery location to place the total aircraft C.G. in the location shown. Wrap the receiver and battery pack in foam and soft mount the servos on good grommets to isolate them from vibration.

The cockpit floor provides ideal locations for the receiver on/off switch and for the charging plug — one on each side of the pilot.

Final Checkout:

Make sure the propeller is balanced. Different engines perform differently with different props so this is hard to recommend. The best performance I have found is with a Zinger 18 by 6-10. This is a special prop that is available from your supplier that shares the pulling characteristics of a 6 pitch and the speed characteristics of a 10 pitch.

Adjust the control surface throws to approximately what is stated on the plan.

Check to see that the main gear wheels are toed-in about 1 or 2 degrees each. This helps all tail draggers to track.

Final check to assure that the engine thrust line is 0-0 and that all trims are zero when the controls are centered.

First Flight:

Before flight make a final check to be sure that nothing has shifted in transportation and that the C.G. is correct.

Taxi out and get a feel of the movement. Notice that the traditional left yaw is present when you first apply throttle. Get used to that.

Center the aircraft on the runway and go!

Apply a little right rudder simultaneously with throttle. As the tail comes up, the need for "right" control will decrease. Build up a reasonable speed and ease in a little "up." Lift-off is neat and easy. Be ready to correct a little in trims to offset any little building bias.

Gently fly around to get used to the smoothness and grace of this aircraft.

While under full power pull up into a steep climb. Notice that as the climb steepens, the need comes in to add a little right rudder to keep the nose from drifting left. Have you ever flown a real aircraft? It's the same. You'll find that the T-170 handles more like a real aircraft than like a model.

When you set up for landing, just reduce throttle and hold the wings level and let it settle in. When you ease the nose up to flare and reduce the descent for touch-down, you'll find the three-point angle is the same as the flare angle.

If you prefer a sharper break for snap rolls and spins, move the C.G. rearward a little.

Adjust any trims required.

Now, go fly the heck out of it and enjoy. □