LIKI-TIKI

HAWAII'S 'LIKI-TIKI'

A truly magnificent amphibian for twin .35's . . .

By Lt. Jan Sakert, USMC

THE first remark that is usually provoked by the sight of a twin-engined flying boat is, "Whatever made you want to build a twin-engined flying boat?" In case you are wondering the same thing I'll submit a reason or two which I hope will defend my sanity.

This particular locale (Hawaii) is a peninsula that extends into Kaneohe Bay. The series of causeways that connect it to Oahu proper form several large seawater ponds. These ponds, because of their shallowness (3-6 feet) and large size (800 x 1500 feet) are ideally suited for model work if you overlook their high salt content. The availability of such an excellent area was one persuading factor that kept beckoning to me. Also, I had two relatively new KB .35 R/C mills and no immediate use for them. I had flown one of them in a couple of early NMPRA Goodyear racers but the current state of that art precludes their use as a competitive racing mill. Thirdly, the repetition of Class III flying was becoming fairly hum-drum and I was vulnerable to, and looking for, a change of pace. The growing epidemic of sport bipes may be an indication that

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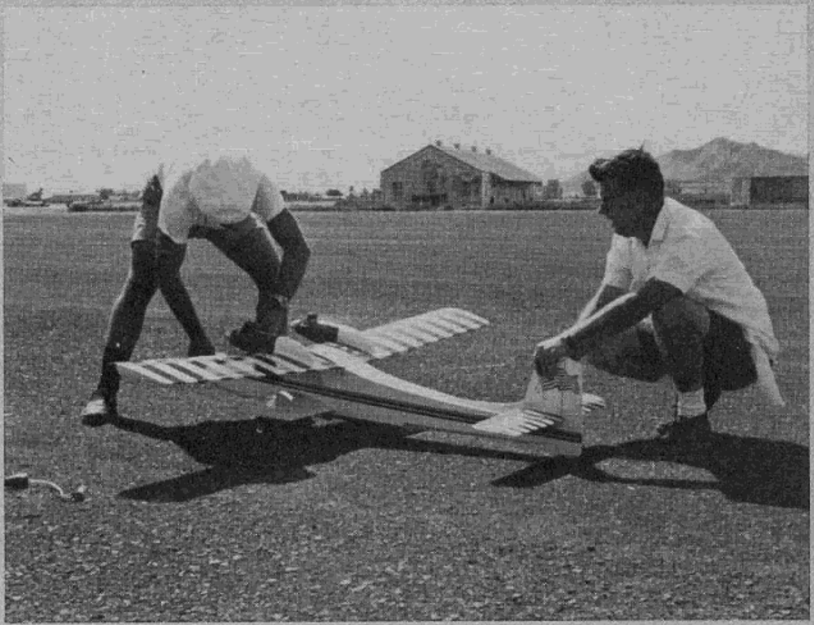
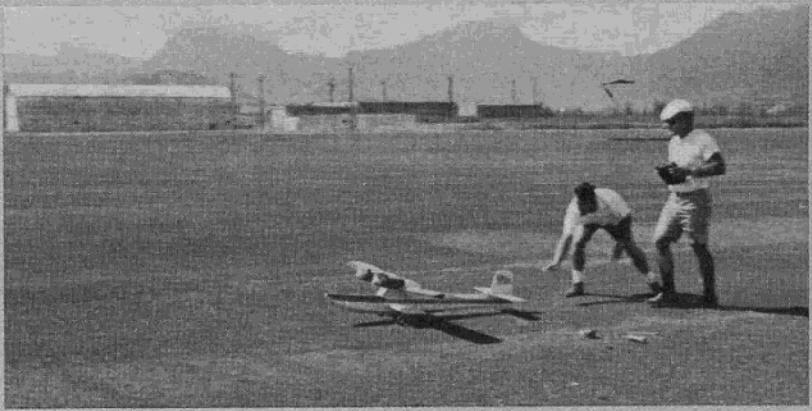


On land or water, a clean, well-powered flying boat that responds with the vigor expected of a Class III aircraft.



In a rut? The Liki-Tiki is a "something different" project that will serve to revitalize your interests.

several modelers may also have been subject to this desire for a change of pace. As a "something different" subject, and for the reasons just explained, I cleared off the drawing board and started carpeting the floor with erasure crumbs.

It seemed that just as most Class III airplanes are more or less jokingly referred to as being a "modified Taurus," so could most current flying boats be related to the Sea-Cat.

Henry Struck probably gave little thought back in 1941 to the fact that the aircraft which he was designing would evolve as the matriarch of all subsequent flying boats. Undoubtedly, the Sea-Cat was, and still is, a fine airplane and served its design intent with no shortcomings. However, it was originally designed as a free-flight aircraft and this character seems to have been somewhat preserved in latter day multi-controlled flying boats. With due respect to Mr. Struck's pioneering efforts and successes, it seems that modern day science and technology have elevated the state of the model art to a point where free-flight characteristics are no longer desirable and much less required in a multi R/C aircraft.

The design characteristics of the LIKI-TIKI were intended to produce a full blown R/C flying boat that did not suffer from this FF/RC compromise. The current flying boat norm seemed to represent a lightly-loaded, under-powered airframe, with a high drag coefficient due to attachment of tip floats and engine pod. My desires were for a clean, well powered flying boat that would respond with the vigor of a Class III aircraft.

Tip float drag and inherent structural weaknesses could be precluded by using a sponson. The twin engines would obviate the pod and also serve to put the thrust couple closer to the drag couple. These two features dictated the general arrangement of the proposed aircraft, so more pencils were sharpened and more erasure crumbs were strewn while the design was developed.

A flying boat has a necessarily large frontal area (deep hull) so a relatively thin airfoil and 7:1 aspect ratio was selected to hold the drag down. This would serve another advantage since the prevailing tradewinds blow at an average 10-15 knots on this (the windward) side of Oahu and good penetration is very desirable. Ballooning during a water landing could have some very bad consequences and dampen one's spirit (pun).

A large aircraft is beyond my storage, transport, and work area (would you believe a clothes closet) capability so the wing was held down to 720 inches of area. This could be considered as somewhat small for an aircraft that could be expected to gross out at near nine pounds! However, it seemed that a good lifting airfoil, in combination with the considerable thrust and airspeed provided by twin 35's, would be adequate compensation. The idle-glide and approach would be well served by the built-in 15 knots of airspeed provided by the trades.

The wing-mounted nacelles caused some apprehension about spray effects and water ingestion since the prop arcs would be relatively close to the water surface. Some reduction of these phenomena could be arranged by locating the props as far forward as wing and nacelle strength would allow. This would put them forward of the bow-wave and any splash coming off the sponson.

The forward location of the props dictated the fuselage dimensions. A relatively long bow and two step hull would be required to dampen (another pun) pitch moment since very much of a pitch-down would put the prop tips to churning water.

Sponson arrangement and dimension

was quite perplexing. The available engineering manuals didn't even mention them. I was sure there must be a very good reason for their deletion and some doubt was cast on the wisdom of using them. However, their ease of construction, and the fact that they would serve admirably as a place to mount the gear blocks, made them preferable to tip floats. I did locate a Japanese language text on Dornier flying boats. My seven years of service in the Orient provided me with a fluency that would get me by in all but the highest class tea-houses but I somehow failed to acquire the vocabulary common to an engineering text. (???) It was all Greek to me! So, here I was, a U. S. Marine of Italian descent sitting in Hawaii poring over a Japanese text on German airplanes to facilitate the development of an all-American airplane with a Polynesian name! Anyhow, the book did contain many illustrations and I was further perplexed by the fact that there seemed to be as many sponson arrangements as there were flying boats. Each was different. Any sponson that attended this airplane was going to have to be of my own invention.

Volume displacement was computed using the estimated gross and a predicted water-line was drawn on the gull side view. The sponson was placed so that the trailing edge would be just awash when the craft was dead in the water. An angle was cranked in that would raise the leading edge above the water-line and, hopefully, also above the bow wave. This amounted to +5 and provoked some thought about its stall characteristics. Undoubtedly it would stall before the wing. The worst that could be foreseen was that a more vertical descent would be induced after the sponson stalled. This might contribute to a more or less "bell-smacker" landing and reduce the hazard of plowing the nose under as might happen on a relatively fast fly-on. Sponson span was another unknown. Precision "guess work" was employed.

All the sketching now provided a general arrangement of the aircraft and a few minutes were spent in smoothing out her curves for more eye appeal and also in working out construction details.

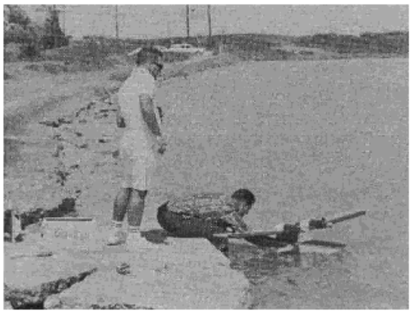
A description of the actual flight characteristics of this craft is in order before we get into the construction. I'm sure that just my design considerations didn't fire your interests or enthusiasm for this project. Let's allow the aircraft to speak for itself.

FLIGHT CHARACTERISTICS

On the day that initial flight off-the-water was planned the tradewinds were blowing at their normal velocity. The ponds are large enough that wind waves are readily formed and the leeward shore of the selected pond showed 3 to 5 inch wavelets running with the wind in random period. An occasional light gust would generate a series of 6 inch wave crests with about a 6 foot length that would run for several yards.

The aircraft was placed on the surface and it seemed to ride out these waves with acceptable pitch and roll stability. Engines were started and several taxi runs were made past the causeway to familiarize myself with water borne techniques and to please the numerous spectators and photographers that were summoned by the delightful harmonics of twin engines.

It didn't take long to discover that to turn and taxi downwind was quite a difficult task. The aircraft acts like a perfect windvane and 12 knots of wind was quite a bit of force to overcome. I learned that the aircraft could, in fact, be sailed with more precision rather than to be purposely steered. Directional corrections could best be accomplished by using short bursts of power and full



aileron deflection to lower the wing in the desired direction of turn. The wind would then get under the opposite (raised) wing and induce sort of a "tack" in the desired direction. Downwind turns could be made by using full aileron deflection and holding high power until the selected wing was forced down onto the water. Power was then held on while the craft pivoted around the dragging tip and was reduced when it pointed into the desired direction. This maneuver causes considerable spray and splash and is not recommended except when absolutely necessary to retrieve the aircraft. The fact that I fly from a pond that is accessible around its entire circumference practically negates the necessity of taxiing and steering. The constancy of the trades means that if the craft is landed directly upwind it can be left alone and will sail (be blown) tail first right back to the launching point. With less ideal flying sites and an off shore wind I would suggest keeping a boat nearby.

Anyway, being impatient to get the craft airborne, spectators and photographers were cleared from the causeway and into a safer (just in case) area. I lined her up, poured on the coal, and was shortly very disappointed. It wouldn't come off. The craft would literally leap from one wave crest to the next. Each crest would smack the sponson causing a deluge of spray and a loss of all the forward speed that it had acquired. So, the first attempt resulted in a series of leaps or surges across the pond. A quartering take-off run was also tried with even less success. The weather cocked yaw threw up water like Old Faithful. Sometime during these abortive take-off runs some amount of spray was driven past what I thought was an adequate sealed wing-fuselage saddle. It got to one servo and the receiver and I don't think it's necessary to relate the consequences of salt water bathing of electronic components. That, of course, ended any further take-off attempts that day. The radio gear was packed off to Orbit while the compartment that had contained it was fitted with the hatch that is illustrated on the plan. While the quad single-stick was being repaired I installed my new 7-14 but had some reservations about hazarding it on the briny deep. Therefore, the wheels were screw into the beast and further trials were committed to terra-firma until the quad could be returned.

Engines were started and all systems were go so a speck of down trim was nudged into the box and my helper was signaled to "let 'er roll." Roll it did not! It shot into the air at an angle that seemed surely would provoke a horrible stall and fatal snap roll before I could get the nose over. The airplane soon showed me that there was no cause for alarm. Those twin 35's . . . "clean and jerked" . . . that craft off the ground and weren't about to allow it to slow down to stall speed no matter what rate of climb was established. This high angle and high speed climbout was allowed to continue while I held in a little right stick to compensate for visible torque effects. At a reasonable altitude some more down trim was rolled in to achieve level flight but it still wanted to climb. It was becoming obvious that in my zeal to produce a "vigorous" flying boat I had been somewhat excessive in my selection of power. With that combination of airspeed and airfoil the craft could probably gross something over a ton before lift and gravity reached equilibrium. RPM was reduced until level flight was achieved and it acted more like an airplane rather than a runaway Atlas booster. With the reduction of power any evidence of torque disappeared and the trim was brought back to center. Turns and loops were executed with no indication of any bad characteristics. Full throttle, however, would result in an immediate paint-scorching climb. Having such a ball, the clock was forgotten and the starboard engine ran dry. This, then, would be a real test of this aircraft even though it wasn't planned that way. Much to my relief, single-engine flight was only little different than when both were turning. Neutral trim and about 50% throttle resulted only in a very wide turn into the bad engine. At full throttle it required a moderate amount of rudder-induced yaw to keep it from spiraling around the dead mill. Power was brought back to idle and a left circling approach was made. Rudder and aileron effectiveness decreased in direct proportion to the decrease in airspeed and liberal doses of control were required to turn final and keep the approach straight with one engine out. Pitch stability in the approach was excellent and the touch-down was uneventful. Apparently the stall of the sponson has no noticeable effects on the round-out.

The climb tendency under full power cried out for investigation. The glide/idle power characteristics of the bird indicated that it must be aerodynamically sound. Any aft location of C.G., faulty arrangement of decalage or improper distribution of horizontal surface area would surely have manifested themselves in the glide pattern also. Since they didn't, all indications were that the power arrangement was the culprit. The thrust line serves as datum for the 1½° positive wing and 0° horizontal stabilizer. The high thrust couple opposing the low drag couple should contribute to a pitch down tendency. Since the tendency was a pitch-up, I could only conclude that the craft was being flown well beyond the airspeed required for lift/gravity equilibrium. Several solutions were applicable. Lift could be decreased by decreasing the decalage, changing the airfoil, redistribution of horizontal areas, or reducing the airspeed. All but the last would involve more or less major airframe modifications and also disturb the glide/idle-power pattern. Reduced airspeed then was indicated as the most feasible solution. This could be accomplished by lower pitched props (had been using 3-blade 9 x 6), lower RPM, less power by virtue of less displacement, or a combination of all three. Subsequent flights were made with 10 x 4 props and two flat washers worth of downthrust which was all that was possible without taking a saw to the forward ends of the nacelles. The climb tendency was considerably reduced but, nevertheless, still apparent. Level trim was accomplished by reducing RPM after take-off and climbout. If you're the type that likes to let it all hang out then by all means stick with the 35's and 9 x 6 props. Cruise her at reduced throttle and save that power reserve for when you need it and to silence the kibitzers with vertical take-offs and near supersonic climbouts. Most of your Class III flying partners will submit that all flying-boats must fly with the docile character of a China Clipper and your good standing within their ranks will suffer when you unveil this bird. However, odds are much better than even that more than a few will beg you for stick time once they witness the anxious response of this hot-blooded water-nympho. (Ed's Note: Nymph, Jan . . . Not Nympho!)

If you're looking for the aforementioned docile qualities then screw in a couple of 19's. You'd have an entirely adequate airplane but I'm afraid it would be "just another flying boat."

SOLVING THE WATER-BORNE PROBLEMS

Since the flight tests revealed that the basic aircraft was indeed a vigorous performing flying boat, she was deserving of a solution to her water-borne frivolity. The aircraft demonstrated its tremendous ability for getting off the ground in a fractional instant and I was of the opinion that it would do the same thing off calm waters.

Calm waters anywhere on or near windward Oahu might happen a half dozen days a year so the necessity of solution is apparent.

Dick Riggs, under whom I served my R/C apprenticeship, and Don Lindley, school chum, mentor of my youth and roommate when we both were in the employ of NACA, were each sent a detailed description of the costly folly in my vain attempts to get this craft to lift off the water. The experience of these two gentlemen need no qualification.

Replies were received in short order and both submitted that I had insufficient planing surface forward of the CG and/or the sponson was too far aft. Lindley suggested a sponson modification and Riggs proposed an addition to forward hull area by attachment of chine rails. Riggs' suggestion, being the least formidable, was undertaken. Half-inch triangular stock was epoxied along the chine from the fore step forward and faired into the prow. Theory here was that more hull area forward would cause the bow to ride up over the wavelets instead of slicing through them. This would rock the craft up out of the water and cause it to assume an angle of attack that would reduce sponson and wave collision.

The day of the second water trials saw less wind than on the first and the water was significantly smoother. The surface could best be described as rippled rather than being covered with the random 3 to 5 inch wavelets as previously discussed.

Some amount of taxiing was done to see what improvement the reduced wind would allow. At best, it was still difficult, and it can evidently be concluded that in anything less than a dead calm, flying boat steering is largely wishful thinking. At higher taxi speeds steering quality did improve somewhat while running into the wind. Downwind runs required aileron, rudder, and prop blast as before. One new aspect that was revealed by these taxi runs was that the chine rails did reduce the spray to some degree.

The nose was put into the wind and I poured on the coal. The craft jumped forward, went chattering across the surface for about 75 feet, heaved herself off and left the pond far behind and well below. No transition from plough, to plan, to lift-off rotation was noticeable, nor was any induced. The craft just accelerated until it achieved flying speed, and at that point, it quit acting like a boat and began acting like an airplane.

Whether the calmer waters or the added chine rails were responsible for this success I can't really say. Certainly the chine rails cannot detract from hull performance so they are included as a feature of this aircraft. The proof of the chine rail solution will be had when the aircraft is again subjected to rough water similar to her first trials.

Water landings are not unlike what you've been used to and no new techniques are required. Personal preference is to drag it in on final and hold it off until a frightening angle is achieved just before touchdown. With a little practice you'll learn how long you can safely hold it off which will facilitate a nearly tail-first touch-down. Full stall landings seem preferable to "wheel" landings. The latter could probably result in a "skip-off" with subsequent porpoise and hazard of an uncalled-for dousing.

This flying boat episode has been quite pleasurable and many times worth the effort. An occasional "something different" project serves to revitalize one's interest, and I highly recommend anything that will accomplish that end, whether it be bipes, boats, canards or ornithopters. You must be in agreement or else you would not have plowed your way through this voluminous text. So, let's not keep talking about it. Let's get on with it.

CONSTRUCTION

Building time was limited, so the structure inclines toward simplicity and rapidity. Honolulu's one model shop stocks a minimum of R/C essentials so no exotic accessories or techniques were included in the craft's composition.

Crank in your own short-cuts and building techniques if they suit you but a word of caution is appropriate at this point:

Don't compromise the water-tight integrity of the radio compartment! I did and it cost me a receiver and one servo. The illustration seal was installed "after the fact." If you have a better system, then by all means use it, but don't try to get by with anything less. An occasional shower of spray is unavoidable and the convergent prop blast will drive some of it under the wing saddle. The hazard of a drop or two flowing down the wiring and into a servo or receiver case is very real.

The original aircraft was slightly tail heavy and three ounces of lead shot was poured into the compartment behind the prow block to achieve proper balance. This could best have been prevented by fiberglassing the bow and forward hull. I highly recommend it even though I didn't do it. These areas will suffer numerous nicks and gouges from dragging her up onto the beach and any collision with floating debris at take-off velocity will tear through the hull like a fusillade of grape-shot! Fiberglass is worth the effort.

Don't exceed the amount of dihedral that is called for. Any more dihedral will aggravate the natural turn into the dead engine if one happens to cut. Dihedral will convert to yaw into a turn and this we certainly don't need in a twin configuration.

The sponson position serves an 8½ pound gross and a smooth water surface. If you intend to fly off rough water the sponson must be moved forward if lift-off is to be accomplished. My suggestion is to leave the sponson alone and leave the breakers and surf to the surfboarding crowd.

Enough said! Clean off the workbench (meaning dump the ashtray) and let's make the chips fly.

FUSELAGE: Cut the fuselage sides making sure that the splice coincides with one of the rear diagonals. Lay flat, insides up, and mark all former stations. Cement on all longerons, uprights, diagonals and doublers. When dry, set up inverted on flat surface and cement in formers 5 and 6. Take care to maintain squareness. When dry, bevel tail-post, pull together and cement. Centerline alignment must be absolutely accurate. The long fuselage will amplify any error and the result will be an unequal curvature of the fuselage sides. Cut crosspieces as illustrated on section A-A and cement in. This will establish the taper and curvature of the rear fuselage. Cut remaining crosspieces to fit between sides at upright stations. Cement in. Let dry well. Cement in forward formers, again paying special attention to centerline alignment and equal fuselage side curvature. Cut crosspieces to fit between forward fuselage sides halfway between formers 3, 4, and 5 and also halfway between former 5 and the forward step. These crosspieces reinforce the hull and are cemented only to the bottom. Cut to fit, and cement in crosspieces at each step station. Cut out the three keel pieces and cement them into formers and onto the crosspieces. Make keel and step formers by cementing sheet stock on each side of keel at crosspiece and step stations. When dry, trim to proper angle which will be dictated by straight line drawn from keel piece to fuselage side. Let structure dry thoroughly. With a sanding block make several careful lengthwise swipes along the hull. Make sure that the sanding block makes contact with the keel and fuselage side at the same time. This will true the keel formers, vee the keel pieces, and bevel the edge of the fuselage side all at the same time. Sheet the hull taking care not to pull the fuselage out of alignment. Best bet will be to shut the aft hull first and work forward. The forward hull sheeting will require some bending, and wetting the sheet will make this task easier. Let the structure dry thoroughly. Any handling at this stage could spring a seam and ruin an essential glue joint. When dry, turn over and run a bead of cement or fiberglass resin on the inside of the hull along all seams and joints. Cement in the battery compartment floor, for forward top deck, the cabin block and the prow block. Sheet the rear deck. Carve the prow, top deck and cabin to shape. Sand entire fuselage structure making sure that the stab mount area remains flat and true. Carve a streamline shape into the stab platform block and cement onto the fuselage. Cement on the ½-inch triangular chine rails and fair into the prow. Set entire structure aside and let cure.

SPONSON: The original aircraft had a foam core sponson. Find a friend with a wire or see if any of the foam core advertisers in this magazine will cut a section to your specification at reasonable cost. If this is too involved for you then build up the structure like a wing. Use any 12-18% symmetrical section. An 8½-inch chord and 24-inch span will keep you in the ball park. Epoxy gear blocks and plywood anti-twist ribs into the core. Sheet the sponson, rolling a single wetted sheet around the leading edge. Contact cement makes sheeting a foam core quite an easy task. Sand, seal, and cover with silkspan or silk. Slide through fuselage cut-outs, align and cement into place from the inside. On the outside, form a fillet with one of the many putty type epoxies that can be found in hobby shops and hardware stores.

TAIL SURFACES: Build stabilizer frame and sheet entire structure. A smoother sheeting job can be obtained by sanding the sheet smooth before application to the frame. Cement elevators to hard balsa spar and inset the plywood joiner. Tack glue to stabilizer and very lightly sand to smooth taper. Cut apart, bevel elevator leading edge and hinge to the stabilizer. For hinges I use .007 Mylar drafting film which costs about a buck for a square yard and is available at any big stationery or engineering supply store. Cement completed assembly onto the platform mount. Cut the rudder, fin and strake from the softest sheet you can find. Cement the ¼" x ½" stiffeners to the trailing edge of the fin and to the leading edge of the rudder. Notch the fin stiffener to accommodate and clear the elevator spar. Cement fin atop the stabilizer and cement the strake to fuselage and fin. Sandwich 3⁄32" plywood between 3⁄32" balsa and cut out to skeg outline. Cement to rear hull and fin stiffener. Fillet with epoxy putty. Bevel rudder leading edge and hinge to the fin.

NACELLES: Cut sides and trim together to ensure likeness. Mark off reference line for engine bearers again making sure that all four sides are identical. Cement on the bearers. When dry, join sides by cementing in the plywood spinner ring, firewall and the rear balsa former. Check and maintain squareness and alignment. When thoroughly dry set in the engine, attach Veco extension shaft and spinner back plate. Position engine and mark mounting bolt holes. Remove engine, drill holes and epoxy in blend nuts. Drill holes in firewall for throttle cable and fuel line. Drill hole diagonally up through appropriate bearer to allow passage of throttle cable. Bevel top inside edge of bearers behind firewall to seat the tank.

DO NOT install tank yet. Cement in the bottom block and carve to shape. Pull the AFT ends together and cement well. Hold together with clamps or clothespin while drying. Cut rear block to top outline shape and cement between sides. Put nacelles aside and begin the wing.

WING: Cut 26 wing ribs. 16 ribs will be notched for four spars and 10 will be notched for 4 spars. Wing halves will be built right side up. Pin down the 3" wide bottom trailing edge sheet. Cement ¼" square spar along the forward edge of the sheet allowing the spar to overlap the edge by ⅛". Cement the ribs down over the spar and onto the sheet. The first five ribs from the center towards the tip must be the five-notch variety. The remainder will be four notch. Fit 1¼ inch trailing edge stock against the ends of the ribs and cement in place onto the trailing edge sheet. Cement the ¼" square rear top spar into the ribs. Cement rear top sheeting on making sure that the sheet is adhered to trailing edge stock. Pin well and let dry. Cement forward full span top spar into the ribs. Butt glue ½" square leading edge onto front of ribs. Cement 4 inch wide top center sheeting on. Let this structure cure while you repeat the process for the other wing half. Take up first wing half and turn over. Cement in forward bottom spar. Cut to fit cement in 3⁄32" shear web between top and bottom forward spar. Cement on the 4 inch wide bottom center sheet. Razor plane leading edge to triangular shape that conforms to airfoil. Cement on the bottom leading edge sheet. Turn right side up. Lay in R/C Craft nylon tubing for throttle cable. The placement of this tubing within the wing will be dictated by your brand of radio gear. The Orbit servo mounts nicely lengthwise just ahead of the forward bottom spar. Each brand of servo will require a different mount and arrangement so use what you've found best for your purpose. The tubing must exit the top surface of the wing where it will be just under the engine bearer on the side from which the throttle must be worked. Keep the radius of bend as large as possible to reduce binding of the cable. Epoxy tubing where it passes through the ribs. Cement in the short ¼" square auxiliary spar. Cement on the top leading edge sheeting allowing the tubing to protrude by cutting a small slot for it. Cement on tip blocks. Complete remainder of other wing half, paying close attention to correct throttle tubing position. Carve tips to shape. Razor plane and sand leading edges to shape. Sand entire surface of both wing halves. Mark and saw out ailerons. Dress both wing roots to proper dihedral angle. Block up tips and join halves taking care to maintain proper alignment. Rout channels to receive aileron horns. Several manufacturers make this type of horn so you may install a suitable pair or make your own. I made my own from 3⁄32" wire and tubing. Set in horns and fill channels with epoxy putty. Fiberglass top and bottom of wing center section. Hinge and attach ailerons to wing. Use epoxy where the horn goes into the aileron. Mark nacelle location on top of each wing panel. Thread throttle cable through holes drilled in engine bearer and firewall. Slide nacelle onto wing. Check alignment and fit. Epoxy onto wing from the inside of nacelle. Form fillet on outside with epoxy putty. Cement in tank using G.E. Silicone rubber adhesive. Relieve bottom of nacelle top block to clear tank and cement between sides. Carve nacelle to desired shape and sand.

ASSEMBLY: Install servo plate and hatch frame in radio compartment. Keep switch inside compartment. Digital drain is very low and the switch can be turned on, the hatch battered down, wing strapped on and a day's flying put in without fear. However, don't forget to open her up and turn the switch off when you're finished. Make and install pushrods. I prefer fiberglass arrow shafts but can't get them over here. ⅜ inch dowels will do, even though they are somewhat heavy and they load the tail of a long moment aircraft. Make throttle and aileron servo mount in wing. Build sheet balsa wall around them and cover with foam to keep any water off them. Be meticulous and adjust wing and saddle for closer fit than you ever thought possible. Fair cabin into top of wing using any suitable putty filler. I prefer the epoxy varieties. Drill holes for wing dowels.

FINISH: Fiberglass forward hull and prow. Paint engine compartments with remaining resin. When set, sand entire airframe. Use large sanding block on all surfaces to prevent ripples and finger gouges. You may prefer to cover entire aircraft with silk or silkspan at this point. I'm of the opinion that the time and effort is barely worth the advantage. Use your own finish method but for the sake of making this text longer, here's mine. Slobber on a thick coat of lacquer sanding sealer which can be purchased at any paint store for around $3.00 a gallon. This has a nitro-cellulose base but don't worry about it. When dry, sand off and brush on another coat. Sand down and brush on a 50-50 coat, sand smooth with 400 paper. The beauty of this type of sealer is that it can be sanded within thirty minutes of application; it is non-tautening. Anyone who has cried while butyrate has lifted off the fillets and bridged across joints will appreciate this. Now, find a spray rig. If you can't borrow one then go buy one.

Anyone who brushes a finish on anything larger than a ½A ukie job must love to suffer. Several adequate spray rigs are on the market for less than $50.00. The J. C. Penney people make a fine one that goes for thirty bucks. Spray on one **dry** mist coat of light gray Martin-Senour 6252 auto lacquer primer. This will flash off before the nitro-cellulose that's under it even knows it's there. Let set about ten minutes and spray on a medium wet coat. When dry, hog it off with 320 paper, leaving primer in only the knicks and grain. Spray on one more dry mist coat. When dry, buff with 000 steel wool. Devise the color scheme of your choice. Use Martin-Senour Acrylic Lacquer for the color coats. Thin out with **acrylic** reducer and spray on. If you're good with the gun one coat will do it. If you want a showroom lustre wait a few days and rub it out with a fine grit compound. That's my way. I've tried them all and this is the quickest, cheapest, and prettiest. With the exception of Hobbypoxy, it's also the lightest.

The rest is up to you. Find a pond, convince the game warden that you're not going to kamikaze the fish, and go have yourself a ball like I'm doing.

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