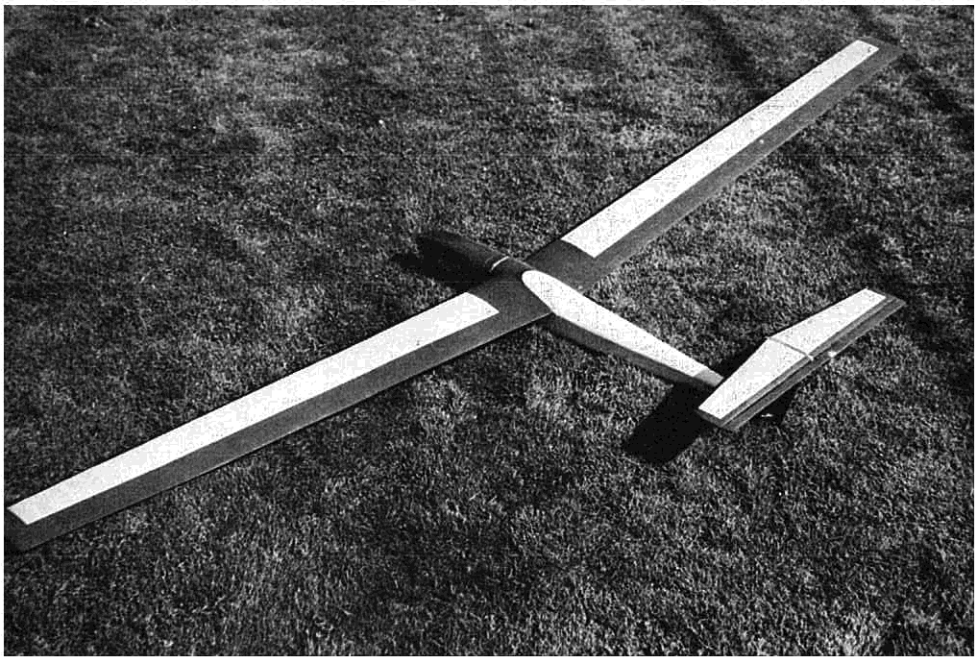


DUOFLEX

BY HARLEY MICHAELIS

BOTH A SUPERB SLOPE AND THERMAL SOARING MACHINE, THE DUOFLEX WAS DESIGNED WITHOUT RESORT TO LIMITING COMPROMISES. FULLY AEROBATIC, THIS GLIDER FEATURES INTERCHANGEABLE WING TIPS, OPTIONAL POWER POD.

The Duo-Flex is a graceful and efficient soaring machine, functionally designed and sturdily built. Without resort to limiting compromises, it is both a superb slope and thermal soarer. It utilizes interchangeable wingtips secured by a fool-proof plug-in system. At once, you have a 99" wing for thermals, or sloping in winds from 12 to 25 knots. Or, with the short tips, you have a 79" wing for greater speed and penetration.

Separate hatches, one for the purist and one for powered flight, add further versatility for variable weather conditions and mode of flying. Small car? . . . worry not. The main wing section fits into a V.W. "bug"!

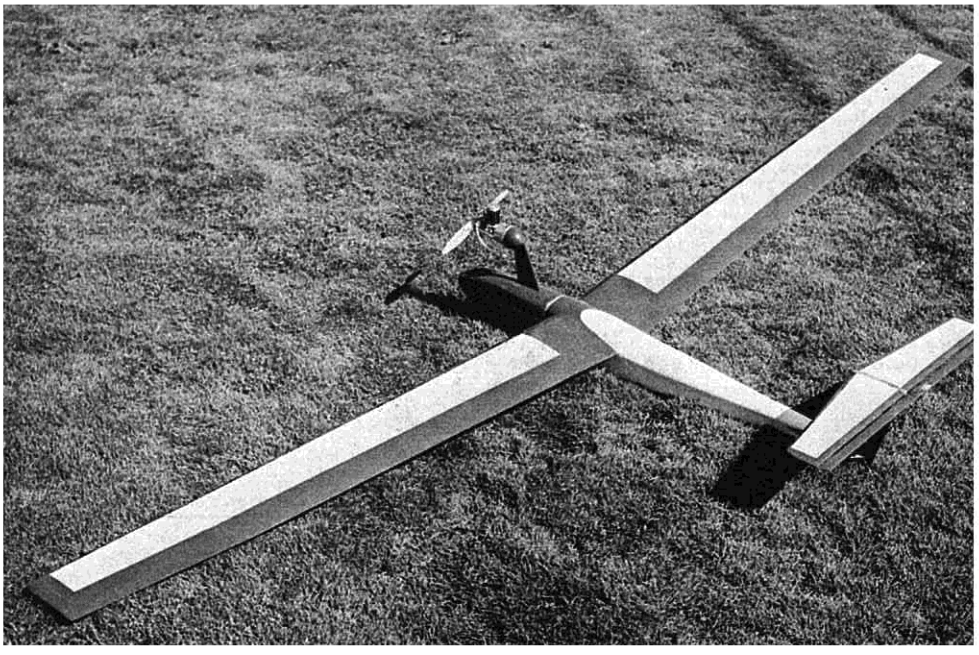
While the ship will handle satisfactorily on rudder-only when properly trimmed out, its full potential is best realized with true proportional control of rudder and elevator. It then becomes quite aerobatic and will loop with power, deadstick and on the slope. It will turn tightly, in spite of a seemingly small rudder. On the slope you have a free ride until the lift is gone or your batteries are tired. With a hot .09 you are quickly in thermal country and the Duo-Flex can be kept in an optimum turn by transmitter trim alone, permitting relaxed, sustained flight until it is time to come home.

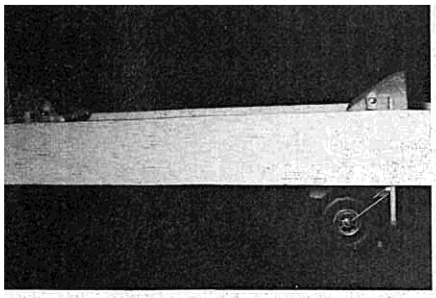
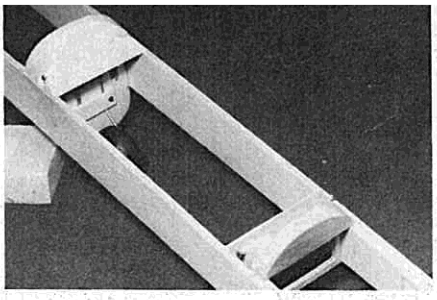
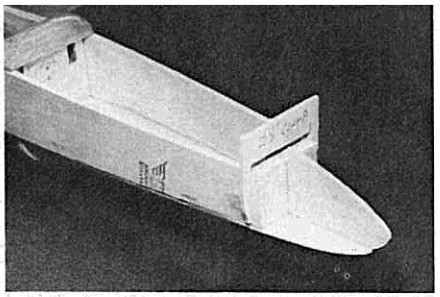
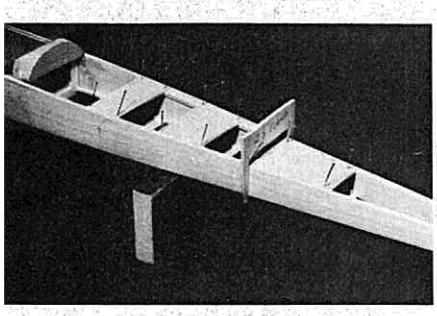
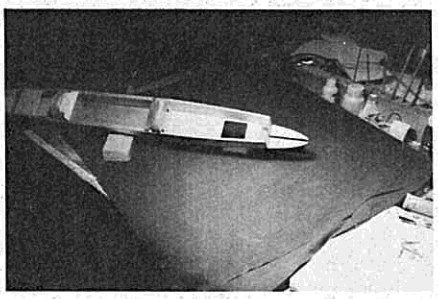
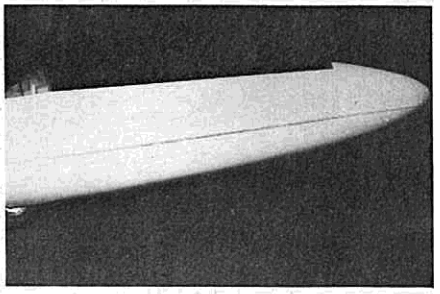
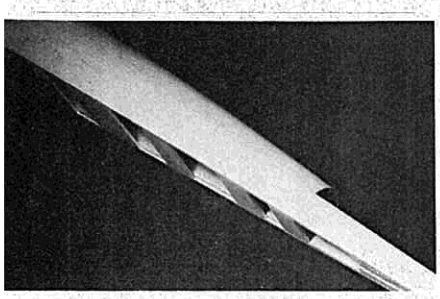
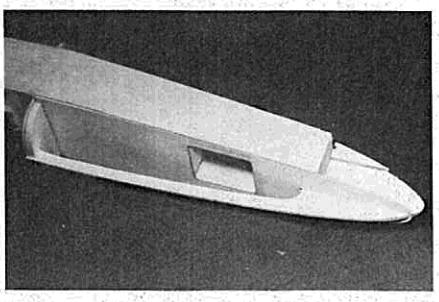
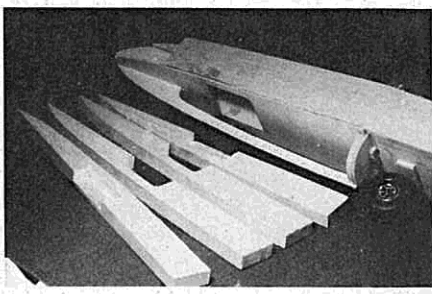
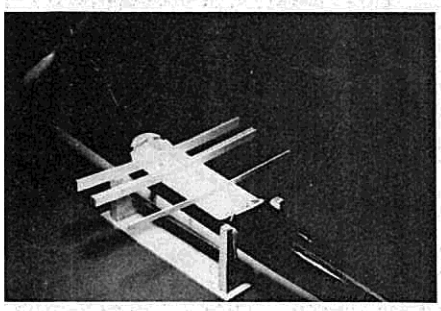
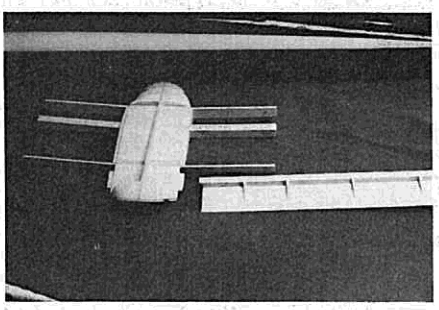
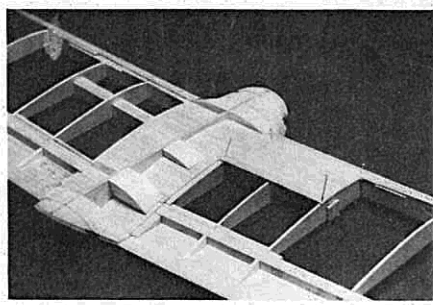
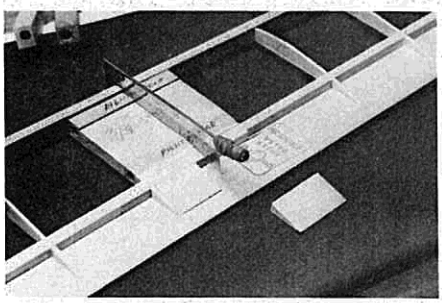
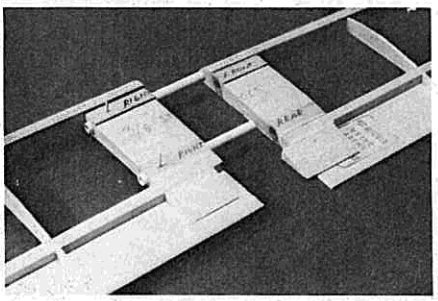
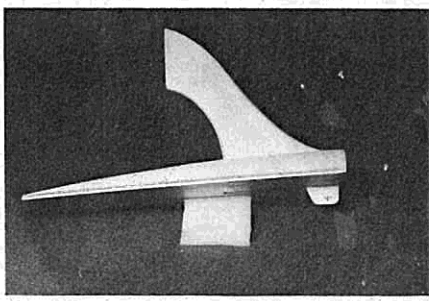
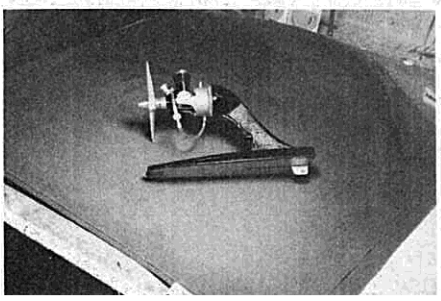
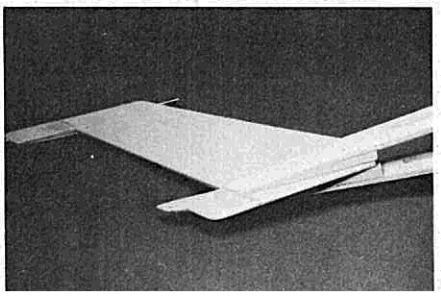
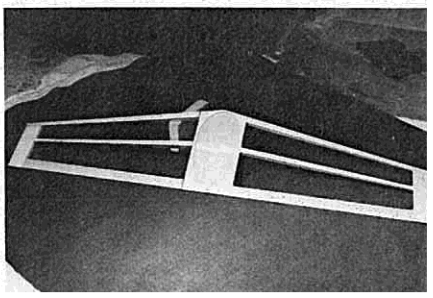
With a slow sink rate and high glide ratio, landing approaches are long and flat. A little up just before touchdown and it will flare for long distances and grease in, light as a feather.

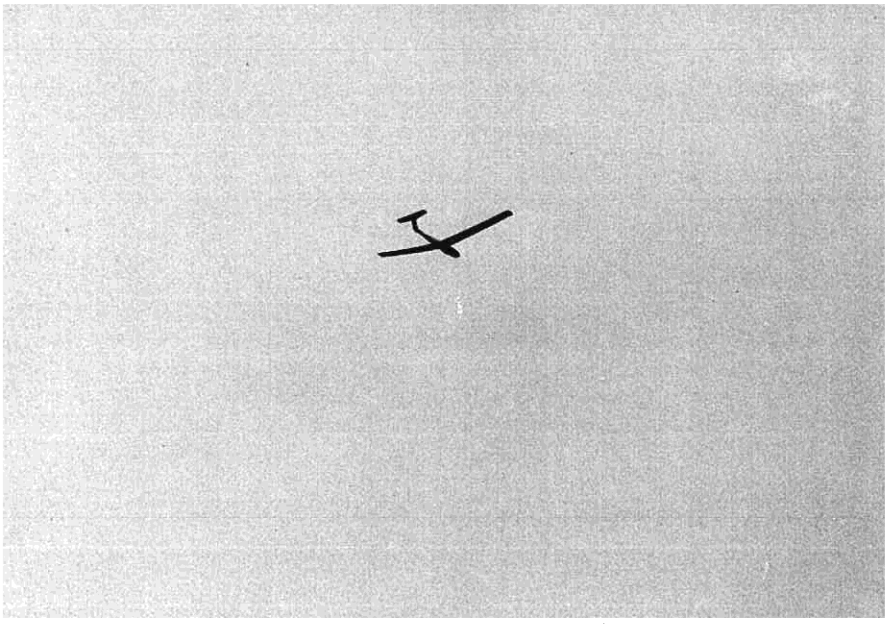
For you more experienced soarers, try a Duo-Flex for a NEW TASTE! You OTHER guys, who don't even know what we mean, START SOARING, for a NEW WORLD of R/C pleasure!

Construction

Use Tite-Bond glue except where epoxy is specified. Select your balsa with care. The wing must be built last. Form the two wing saddle blocks from hardwood, such as birch or maple. The rear block is narrower since it will be planked over. Cut the slots for formers L and T in the blocks on a table saw and bevel on a joiner or work down with a wood rasp. File a groove for the rubber bands in the contoured outside edges, about 1/4" deep. The beveled ends of the wing center section are also grooved and the wing is neatly secured by just 3 or 4 rubber bands (red rubber newsboy bands are ideal) tightly doubled over the beveled extensions of the wing. Bike spoke heads





are nicked up and deeply set in the hardwood blocks with epoxy to tie on the rubber bands.

Next make formers L and T and glue these in their respective beveled blocks. Make and attach the complete landing gear unit to rear of L. Cut the slab sides (which will end up rounded) from a matched pair of 3/16" by 3" by 36" hard balsa sheets. Epoxy L and T in position on one and, when cured, carefully align and affix the other side. A 3/32" rectangular ply base fits between the slab sides, flush with their bottoms between L and T. Add the 1/8" balsa doublers between L and T, leaving 3/32" clearance at their bottoms so the ply base may be inset. The use of epoxy in attaching the doublers will avoid any warping tendencies. Epoxy is also recommended for laying in the base and other items associated with the front end to better withstand bursting stresses. The base holds servos, is a dirt seal, and works with the wheel to give an effective friction brake. The wheel should clear the base approximately 1/8" using shims if necessary.

The last 6" of the slab sides are reinforced with 1/16" ply to strengthen the narrow cross section just ahead of the fin and this, coupled with the celastic covering suggested later, gives a stout fuselage at all points. Glue on the 1/8" sq. rails that hold the 3/32" sheet semi-formers bases. Prepare the bases and semi-formers and pull the slab sides together with a U clamp about 2" wide and made from 1/8" ply. Note that semi-formers go just to the INSIDE edges of the slab sides and are planked with 3/32" balsa. Notch the bottom of former L and that semi-former to accept the end of the 1/8" ply nose core, noting that 1/16" of space is left above the semi-former into which the front floor slips. The planking goes to the extreme ends of the semi-formers with solid balsa beyond that point.

Prepare the nose core from 1/8" ply and the front base from 1/16" ply. Notch the base so that the core will slip into it. Note that the core and the base form the outside contours of the fuselage. Cut a hole in the base and the underplanking (to be added later) if your gear requires more overhead space. The slab sides are joined to the core by spacer blocks made from 1/2" hard balsa stock. These two blocks fit flush with the ends and the top and bottom of the slab sides. First glue them to the sides, then slip the floor in position, followed by the core. Smear epoxy on the assembly and pull together with a plywood U clamp at the front. Note that the front base, or floor, lays across the bottom of the slab sides.

Cut two pieces of 3/16" ply to fit the uppermost 1/2" of the nose core and glue one on either side of the core. Place a piece of 1/32" ply over the slab sides and file a slot in the nose core and its pair of 3/16" ply reinforcers for the hatch tabs to slip into in order to key the front. Cap either end of the slot with 1/16" ply.

Now add the nose blocking. The 1/32" gap will be taken up by Fuseal. Completely fuelproof the front and rear compartments with epoxy glue after the doublers and triplers are in place. The bottom of each hatch has a plywood keel (integral in the power unit) through which a dowel passes to secure the rear and yet permit breakaway. When the power unit is finished and Fuseal attached, hold it tightly to the fuselage, and in a single operation, drill a 1/8" hole through both sides and this keel. In the plain hatch, loosely set a pre-drilled keel in a slot in its underside and shift about until a dowel will pass through. Leave it in this position until the glue sets up. Use 1/8" birch dowel to secure the hatches. Keep the hole tight with epoxy.

The fin and rudder have 1/16" ply cores and 1/16" balsa sides, laminated together with epoxy. Do not further thicken the fin or it will blank out the rudder and make the ship difficult to turn. Epoxy the stab wires in the core before attaching the sides. Balsa wedges support the fin between the slab sides, and the ply platform that supports the stab is epoxied at 0-0 degrees. Use the clear CitizenShip covering material or MonoKote for rudder hinges. Note that the outer portion of the ply piece, from which the platform was cut, is glued under the stab to provide a keying system.

Work the fuselage down to a nice contour, eliminating all plane surfaces. Celastic is highly recommended as a covering. This is applied in staggered strips and goes over the exposed upper edges of the slab sides. Spaces between the strips can be filled with an epoxy filler such as Epoxolite. The final sanded down fuselage and also the hatches can be beautifully finished with the HobbyPoxy "Easy Does It" treatment. Do not put celastic on the fin, rudder, front block, bevel of rear block or hatches (except to help hold the firewall to the balsa cheeks).

Note the position of the bolt on which the bellcrank for the elevator linkage pivots. Seat the head down to the plywood and form your bellcrank from 1/16" Plexiglas. Determine the shape and hole positions by trial and error with 1/16" ply and make several spares. The Plexiglas will break on hard impacts when the stab pops forward and will avoid tearing out the horn. The stab horn and bellcrank are linked with a threaded rod with a clevis on one end. The other end can be bent in an L and retained with the little Midwest C-2 retainer. Retain the bellcrank with a nylon lined nut.

Make a simple stand on which to support the fuselage. The center section of the wing is now fitted to the saddle. Start by making a pair of end caps of 3/32" ply to fit the beveled blocks and secure to blocks with

Scotch tape. Make 3 strips of 1/16" sheet balsa about 1" wide and 3" long and, similarly, secure these across the center and ends of the saddle. By trial and error, prepare a balsa template to fit this opening and also form a proper contour with the upper fuselage. Use this template to make the actual core for this center section, which is fabricated from 1/16" ply. Also from 1/16" ply make a rectangular base, 3" wide and the exact length of the bottom of this core. Remove the 3 balsa stripsand bevel the edges of this base to fit the end caps and fuselage.

This next step is HIGHLY CRITICAL in order to assure proper positioning of the dihedral braces on the base and to properly space the spars so that the ribs will fit. At a point on the core, exactly 1-7/8" from the REAR end of its base, cut the FRONT line of the notch for the REAR brace. The front line of the front brace is exactly 6-3/16" from this same point. The position of the center braces is not critical. The balsa between them simply makes the pinning of the sheeting much easier. Cut all notches in the core to fit the braces.

Using epoxy, assemble the plywood elements of the center section, right on the fuselage if you wish. Attach the four ribs that go on the base, noting that the end pairs have one rib on and one off the end of the base. Then add the 1/16" sheeting over the first two ribs to give the structure rigidity.

Choose a matched pair of 3/4" square sturdy balsa strips for the leading edges of the main wing section, or use preformed stock of suitable dimensions. Mark with a long straight edge and double taper with a razor plane. Allow for capstripping, top and bottom, and for sheeting. Impart the final shape after the ribs, capstripping, and sheeting have been added. Although the wing is tapered, the rear spar is of similar height and bevel at all stations, and can be readily put to shape with a few runs of the razor plane. Likewise the portion of the ribs behind the rear spar are of similar size and shape and any minor irregularities resulting from cutting them all the same can be sanded down after they have been glued to the bottom trailing edge sheeting. Rather than building a pair of panels and attempting to join to the braces, the wing can be built by first gluing the leading edges and trailing edge units ((rear spar and bottom sheeting) to their respective braces, and the ribs then glued between them. The rear spar can be sprung forward to give the proper taper to the assembly, and can be held with a balsa brace pinned across the wing between the leading edge and the rear spar. A beveled brace joins the rear bottom sheet to the base of the center section, while one is used at the extreme tip to hold top and bottom sheets together.

Study the plans and photos that show how the plug-in wing tip system is made. The holes are drilled in the hardwood sticks before assembly, and these are glued to 3/8" or 1/2" sheet balsa to form a unit that splices the tip section to the main section of the wing. This is then sawed in two, and the hollow fiberglass rods (Nemo pushrod or arrowshaft material) are epoxied and pinned to the main section. The holes are drilled to give a friction fit with the rods and a 9/32" drill gives a snug fit on the Nemo rod and can be kept tight with coats of dope. Alder is a good wood to use here and a drill press and table saw will help in fabricating the drilled sticks so as to give a nice hole running straight down the middle. Six sticks are needed if you want to also build the short stub tips to give a 79" wing. Here you simply build a solid balsa tip 2" long around the extra pair of drilled sticks while they are on the rods. A tab and slot system made from a piece of trailing edge material is put on the lower sheeting at the joint after it is sawed through. (See photos and plans.) The extreme trailing edge can be strengthened with a good bead of glue and you can weigh down a couple of yardsticks to hold the top sheeting down when you put it in place.

The washout in the tips is extremely important and this can be built in or warped in after the covering is applied. The main section of the wing is to remain flat, and the tips should have 1/4" washout to avoid tip stall . . . check this frequently.

Note in photos how individually contoured pieces of balsa block are affixed to the top sheeting of the 3" center section to give it a rounded look that merges nicely with the cross sections of the fuselage. The grain is parallel to the core where retaining bands will be bound down. The grooves can be cut with a 1/4" round file and this 3" wide center section should be covered with celastic and worked into the grooves to further strengthen the surface where the bands will be drawn tightly down. Just three or four bands will hold beautifully in flight and eliminate the use of the cumbersome and unsightly dowels and large wad of bands commonly employed to hold one-piece wings. On hard impacts, the small bands will snap to release and spare your wing.

The plain hatch will wear better if its bottom edges are reinforced with 3/32" ply, and then the front tab can be glued directly to the balsa underside. The rear end can be capped with 1/16" ply and a split dowel glued vertically on this cap will key into a vertical groove in the front hardwood block. Some 5 to 6 oz. of lead will be needed to balance the ship for slope work. The heavily built power hatch with a Cox .09 on a Tatone Tankmount will most likely give proper balance without additional ballast being required. When balanced 1/3

back from the leading edge, the Duo-Flex presents a profile to the side wind on the slope for almost perfect traverse without need of constant correction of heading. This is also the point of optimum balance for powered flight. Thus, you need but prepare a pack of ballast to balance the ship in the same place as with the power unit, and you can readily interchange without elevator retrim.

The firewall should have blind nuts for the tank mount, and should be epoxied to the upright and further secured with celastic wrapped around its front and back and around the balsa cheeks. The 3/32" ply tab should be inlaid in the underside of the 3/16" ply base of the power unit so it can tear out and avoid damage to the slot in the nose. Make both tabs of 3/32" ply, 1" square. Let 3/32" protrude beyond hatch ends and trim to fit the 1/2" wide slot of the nose. Downthrust or upthrust were not needed on the prototype, but a bit of right thrust was needed and achieved with shim washers. Hatches should be fuelproofed with epoxy glue and the "Easy Does It" treatment makes a nice finish. Put Fuseal on their undersides. You will find that airspeed is quite fast, requiring a mighty heave to get the ship airborne. It should be trimmed to fly fast under power and will achieve maximum altitude in this manner, rather than by attempting to horse it up. When trimmed for optimum glide, a soarer is near the point of stall, and up elevator must be applied with care, particularly in approach turns near the ground. On occasion you will experience an abrupt snap and fall off when the stall point is inadvertently achieved. When landing, it is recommended that some down trim be given to build up speed and reduce this chance of unintentional stall near the ground. The extra airspeed will then permit judicious use of a little up elevator. It will be wise to become familiar with the turning and stall characteristics by simulating the approach at safe altitudes.

As you become more proficient with the ship you will find that you can spin it and also use combinations of rudder and elevator to attain a very tight spiral ascent and descent. In loops the wing will flex sharply, but will hold under considerable stress. The all-up weight will be around 4 pounds, and while not in the lightweight category the ship has excellent thermal ability as well as being a fine penetrator at the slope. On a good .09 you can expect 500 to 600 feet of climb on the engine run on the Tatone Tankmount, and the descent in dead air will last 5 to 6 minutes. On thermals, it can quickly become a mere speck and it helps to have a friend along to periodically relieve you of the strain of constant lookout. Be sure and put some identification on your Duo-Flex and DON'T FORGET THE AREA CODE!

Happy soaring! ●

The author and his Duoflex on a local slope soaring site. Combination machine features power assist for thermal soaring away from slopes.