DUREX V

Designed by Bob Hansing **Article by David P. Andersen**
Photos By Michael Kuller

Built from all balsa, the "Durex" is an unlimited class competition sailplane. It was overall champion of the 1979 Suds City Soar-In, placed 4th in 1979 AMA Nats and 5th in 1980 AMA Nats. It has acquired the name of "The Minnesota Floatah."

Winner of the 1979 Suds City Soar-In and fifth place in the 1980 AMA Nationals, Bob Hansing's Durex is an unlimited class sailplane that was designed for competition. It combines a light wing loading with a strong wing. The sink rate is extremely low, which makes it a floater in the Duration events, but when ballasted with up to 34 ounces of lead it can be very competitive in the speed and distance events as well. But light wing loading and a strong wing are important for another reason, too. In sailplane competition, it is necessary to first get a high launch; and the height of the launch is simply a function of the sailplane's lift to weight ratio. This also requires a strong wing and light weight.

The attractively streamlined fuselage has a round cross section with wing fillets. In turbulence or circling flight in a thermal, a glider is always yawing to some extent, and the wing fillets smooth the wing to fuselage airflow during flight. In addition, the wing fillets reinforce the fuselage sides in the wing root area, and increase the support of the wing rods. Adding this reinforcement to the outside of the fuselage, where it helps aerodynamically, leaves more room inside for ballast.

The thick symmetric stabilizer airfoil gives exceptionally smooth handling at all airspeeds.

Five Durex prototypes have been built and tested during the last two years. Early versions had a shorter wingspan and a longer tail moment, and their outer wing sections used turbulator spars. Later versions improved the speed range by a change to a faster airfoil. Strength was improved based upon experience. The wingspan was lengthened, and the fuselage shortened when it was decided that the predecessor had more stability than required. An all moving rudder was changed to a hinged design with a slight amount of sweepback. This change traded off excess rudder control for drag reduction, and no buffeting in speed runs. Wing incidence was reduced based upon appearance in the air. Much experimentation was also performed to determine the best towhook and C.G. location. Many of these changes were evaluated by using the "poor man's wind tunnel"; the new version was flown side-by-side with the old version. Differences in speed, sink rate and control response were observed this way.

The design presented here is a well proven competition sailplane that is a joy to build and a thrill to fly. If your joy is to build, and your thrill is to fly, then you'll be pleased with this design.

CONSTRUCTION

Fuselage:

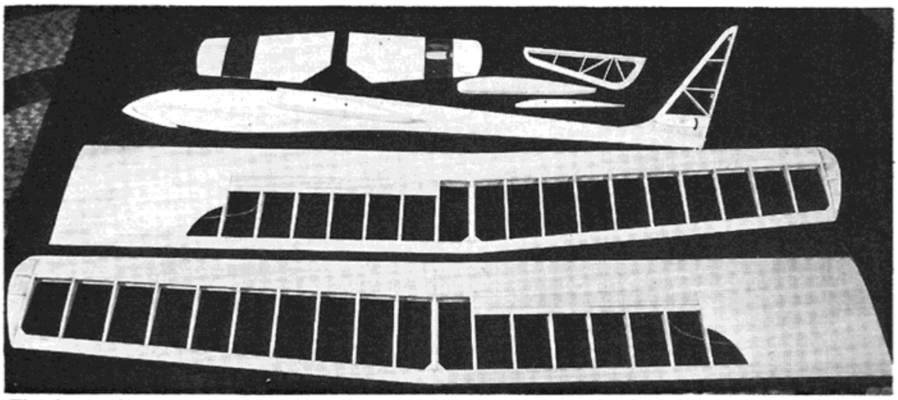
The fuselage has a round cross section with large wing fillets. Impossible to build? Look again! The fuselage is the traditional box and former construction. The important difference is that the sides are thick, and the corners have triangular stock gussets. Extreme rounding of the corners with a razor plane and sanding block reduces the box to an almost round cross section. The wing fillet is a sheet of 1/2" balsa carved to shape with a wood carver's gouge or an X-Acto ring blade.

The fuselage shape is similar to the Borne Free sailplane (R/C Modeler Magazine, Nov. 1977), but Durex's fuselage is easier to build. Start by cutting the fuselage sides from 1/4" medium balsa. Because these sides are more than 48" in length, it will be necessary to splice two pieces of balsa sheet. The diagonal splice midway between the two wing rods is the best place for the splice. If you are expecting some hard landings, you may use medium hard balsa for the forward part of the fuselage sides.

The two fuselage sides should be as identical as possible. One way to do this is to trace the fuselage outline with carbon paper over one sheet of balsa. Trace the canopy outline also, it will be needed later. Then stack this sheet on top of another sheet with a few strips of double sided Scotch Tape between them. Cut out on a jig saw, and drill the wing rod holes on both sheets simultaneously. Then separate and add the inside 1/32" ply doublers.

The 1/2" triangular corner bracing may be installed either before joining the fuselage sides or after, whichever you prefer.

The noseblock is two pieces of 1⅛" balsa (you probably won't find any 1⅛" balsa at the hobby shop, so use 1" sheet plus 1/8" glued together with Elmer's Woodworking glue). Lay your battery pack on one of these pieces and trace around the battery with a felt tip pen. Now clamp the two pieces together and lay the battery pack on one end of the aft side and trace around it again. Unclamp the two pieces and carve out the wood according to these outlines. Rough out a small hollow in front of the battery cavity in case nose weight needs to be added later. If you don't keep the tail light, you



The framed-up components, fuselage bottom ready for sheeting.

Mrs. Lori Allen — daughter of Bob Hansing and a stewardess for Northwest Airlines, displays the long, sleek lines of the Durex V.

might have to add 3 or 4 ounces of weight. A soup of lead shot and epoxy poured into the nose weight ballast hole can be a final trim adjustment after the rest of the airplane is completed.

Remember that every ounce of unnecessary weight in the tail required three ounces of unnecessary weight in the nose to balance it, for a total of four unnecessary ounces of weight.

The top of the fuselage from the tail to the leading edge of the wing is flat, so the fuselage may be assembled upside down on a flat surface directly over the plans. The only bending of the fuselage sides occurs between formers F2 and F3.

Do not sheet the bottom of the fuselage at this point.

Cut out the wing fillets from 1/2" balsa sheet. Drill the holes for the wing tubes and glue the fillets to the fuselage, aligning the holes in the fillets with the holes in the fuselage.

The wing tubes will be aligned using the completed wing as a guide. Insert slow epoxy in the fuselage holes and insert the tubes, being very careful not to get any epoxy inside the tubes. Add the 1/8" plywood ribs to the fuselage, insert the wing rods and slip the wings on the rods. (It might be a good idea to try all this without the glue first.) Remove the wing and wing rods as soon as the epoxy sets. Then add some more epoxy where the wing tubes meet the inside of the fuselage. Cut the 1/8" plywood root rib slightly oversize and slip it on the wing rods. Add the wings too. Trace the outlines of the wing roots on the ribs. Cut to shape and glue them to the fuselge with epoxy. Note that the wing fillets and the 1/8" plywood ribs are very important structural supports to the wing tubes.

Next add the vertical fin to the fuselage and install the pushrods. When the pushrods are proven to be friction-free, sheet the bottom of the fuselage.

Most of the fuselage bottom is sheeted with the grain running across the fuselage. This prevents lengthwise splitting during hard landings, but a portion of the fuselage bottom ahead of the tail has lengthwise grain. This protects the tail during "dork" landings.

You may ask --- why does hitting the ground hard on the nose cause a bending stress near the tail? One spot landing technique is to approach the landing spot fast and straight. Then push down elevator to dive the nose into the ground. This is known as "dorking" or "spiking the point," and it is frowned upon by most flyers because it lacks the beauty of a flared landing --- but it wins precision landing points, so it is commonly used. The strain on the tail is caused **after** the nose hits. The force on the nose has a strong upward component which slams the tail downward. The portion of the fuselage forward of the tail is flexed upward, hence the need for lengthwise wood grain along the bottom of the fuselage in this area. If you are a sport flyer, or you swear never to dork your sailplane, you will still need this strength because sudden downdrafts caused by the wind, irregular surface terrain, or pilot error can cause the same stresses as an intentional dork.

Draw the remaining canopy outlines on the fuselage and cut it free with a razor saw or X-Acto blade. Next, drill holes in the canopy for the hold-down pegs. Insert and glue the pegs in place in the canopy. When dry, put the canopy in place with the front peg against the nose block and push just enough to leave a slight indentation in the nose block. Carbon paper will help leave a mark. Drill a hole at this mark and slip the canopy in place. Now push down on the rear of the canopy to leave two impressions of the rear pegs. Drill holes at these marks and coat the insides of all three holes with glue. When dry, the canopy should slip in place and remain in place due to the friction of the hold-down pegs.

Rough carve the fuselage to a well-rounded shape with a razor plane. Don't plane too much in the area below the wing, because a flat surface is required here in order to hold onto the fuselage with one hand when launching.

Wing fillets are concave surfaces. These can be carved with a wood carver's small gouge or a ring shaped X-Acto blade. Final carving and sanding should be done after the 1/8" Siglite ply root ribs are trimmed to shape using the completed wing as a pattern and glued to the fuselage.

Fin and Rudder:

Modify the Craft-Air bellcrank as shown on the plans by cutting it short, filing the end flat, and drilling a 1/16" hole. Be sure to use the black bellcrank with the diagonal crossbrace. This is the same bellcrank that Craft-Air supplies with the Sailaire.

Stack two pieces of 1/32" plywood and cut out two crank box sides at the same time so that they are identical. Glue the 1/16" plywood bearings in place.

Build the fin over the plans, omitting the stab fairings. Insert a piece of 1/8" tubing into the forward hole in the crank box before the glue dries and verify that this tubing is exactly perpendicular to the surface of the fin. Adjust the position of the left crank box side as required.

After the glue dries, remove the fin from the plans and add the 1/4" stab fairings. Insert the 1/8" inside diameter brass tubing into the forward crank box hole, installing the modified Craft-Air bellcrank at the same time. The tubing extends through the crank

DUREX
Designed By: Robert Hansing

TYPE AIRCRAFT
Competition Sailplane
WINGSPAN
135 Inches (projected)
WING CHORD
Root 10½" — Tip 7½"
TOTAL WING AREA
1273 Sq. In.
WING LOCATION
Upper Mid-fuselage
AIRFOIL
9% Flat Bottom
WING PLANFORM
Constant Chord Center
Double Taper Tip Panels
DIHEDRAL EACH TIP
3⅜" Break, 7⅜" Tip
O.A. FUSELAGE LENGTH
57¼ Inches
RADIO COMPARTMENT AREA
(L)12" x (W)2" x (H)2"
STABILIZER SPAN
27 Inches
STABILIZER CHORD (incl. elev.)
6⅜ Inches (Avg.)
STABILIZER AREA
166 Sq. In.
STAB. AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Lower Fin
VERTICAL FIN HEIGHT
12 Inches
VERTICAL FIN WIDTH (incl. rudder)
10" At Stab
REC. ENGINE SIZE
N.A.
FUEL TANK SIZE
N.A.
LANDING GEAR
N.A.
REC. NO. OF CHANNELS
3
CONTROL FUNCTIONS
Rud., Elev., Spoilers and Towhook
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage .... Balsa and Ply
Wing .... Balsa and Spruce
Empennage .... Balsa
Wt. Ready To Fly .... 56-58 Oz.
Wing Loading .... w/o Ballast 6.6 Oz/Sq. Ft.
.... With 34 Oz. Ballast 10.5 Oz./Sq. Ft.

box and the stab fairings. It is the bearing on which the flying stab rotates. Epoxy or Hot Stuff the tubing in place. The 1/8" forward stab wire fits inside this tubing, and the wire is removable.

Install the fin in the fuselage by gluing it in place in the 1/2" slot cut in the top of the fuselage. Align the fin by sighting the front stab wire to one of the wing rods. They should be parallel.

Build the rudder over the plans. Use light balsa. Bevel the leading edge of the rudder to a point as shown in the rudder cross section view. Notch the leading edge slightly where the hinges will be installed. Also cut a V-groove in the fin's rudder post at the hinge location.

Install the hinges without gluing, for a trial fit. Cover the leading edge of the rudder with MonoKote, and epoxy or Hot Stuff the hinges in place.

There should be as little air gap in the rudder hinge line as possible. Any air that can flow through the hinge line will reduce the effectiveness of rudder control and increase drag.

Horizontal Stabilizer:

The stabilizer is 3/4" thick at the root and has a symmetric airfoil. This contrasts with the 1/4" flat plate stabilizer of many popular sailplanes in Durex's class. It is believed that the airfoil shape produces no more drag than the thinner flat plate airfoils, but the extra thickness makes the stab rigid without an increase in weight. But, most importantly, the thick symmetric airfoil gives a smooth response that does not become overly sensitive at high speed, but retains positive control at low speed. Pitch response is smooth and positive at all speeds.

The structure of the stab is not very new. It is similar to the stab of the Buzzard Bombshell, a forty-two year old design.

Start by cutting out the spars, diagonals, root ribs, and tips. Then follow this sequence:

(1) Pin or nail the shims to the building board at the positions shown on the plans. **Fasten them securely.** They must stay in place when the structure is turned over.

(2) Pin the 1/4" sheet root ribs in place.

(3) Pin the 1/4" x 1/8" leading edges in place. Do **not** add the 3/16" x 1/4" leading edge caps at this time.

(4) Pin the front spars to the building board.

(5) Pin the rear spars in place.

(6) Pin the trailing edges in place.

(7) Pin and glue the tips and diagonals in place.

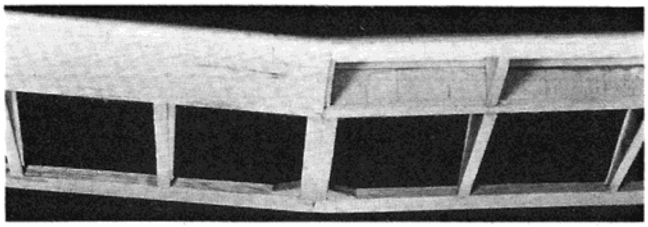
(8) Pin and glue the upper surface 1/16" x 1/4" rib strips in place.

Build both stab halves at the same time. Epoxy the stab tubes in place. Measure the distance between the tubes. There should be 1¼" between them. You may use the Craft-Air stab crank to align the stab tubes if you like, but micrometer precision in locating the tubes is not necessary because a little friction of the tubes on the stab wires will be required anyhow.

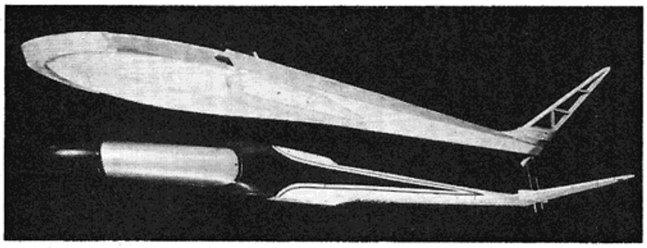
(9) When the glue is dry, unpin the stab from the building board, flip it over and pin it back down.

(10) Add the remaining 1/16" x 1/4" rib strips.

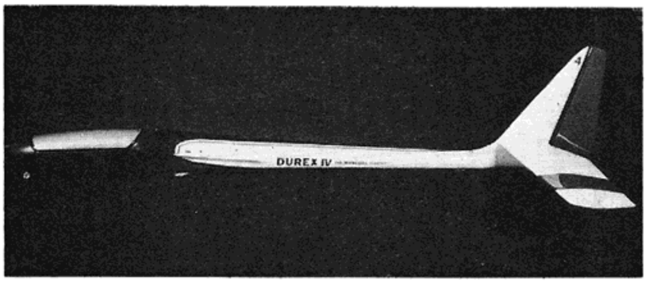
(11) When dry, remove from the building board, cut away the rudder swing area, and separate the two halves by cutting the tubes with a razor saw.



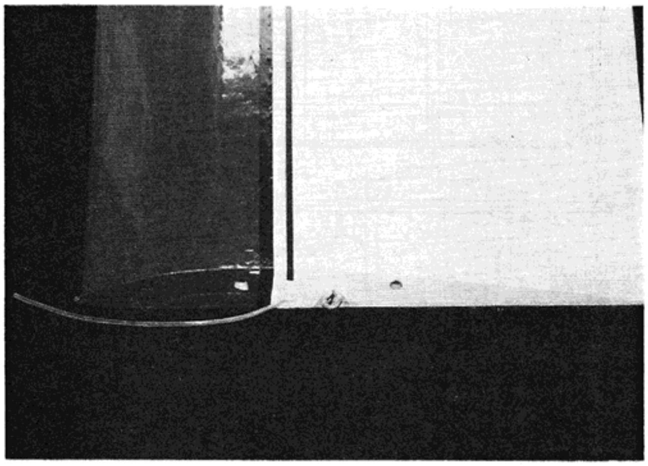
Wing bottom at polyhedral joint. Bottom of outer section is not sheeted. Full chord capstrips instead.



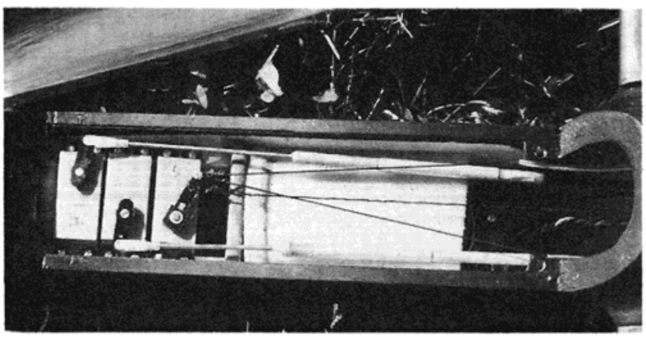
The fuselage before and after shaping.



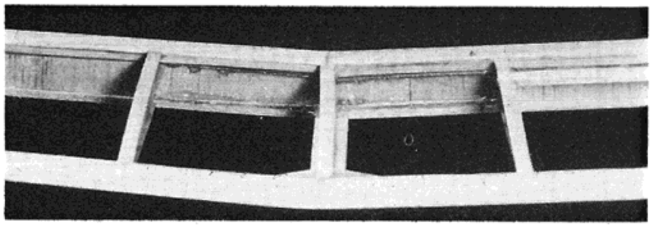
The completed fuselage. Note wing fillet.



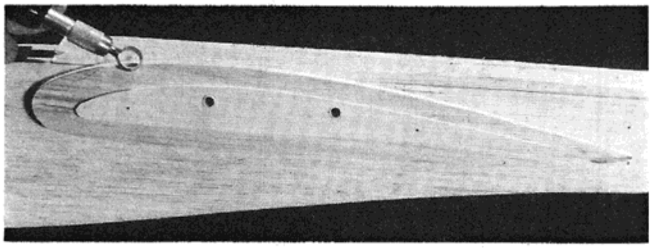
Wing root. Tube holds spoiler cable. The screweye connects to rubber band through fuselage to other wing.



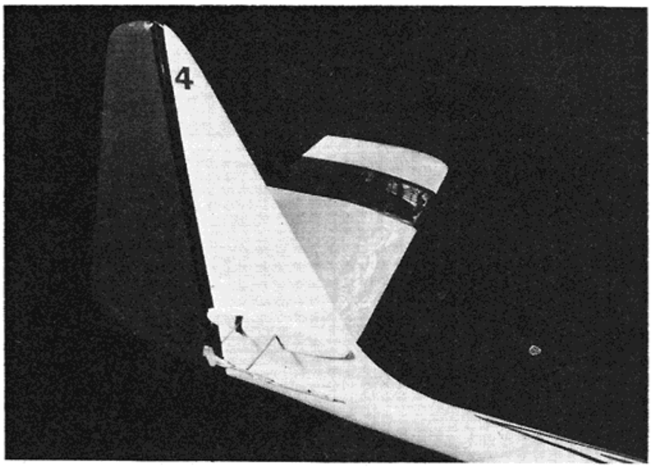
The radio compartment. Spoiler servo also operates releasable towhook. Canopy is friction fit.



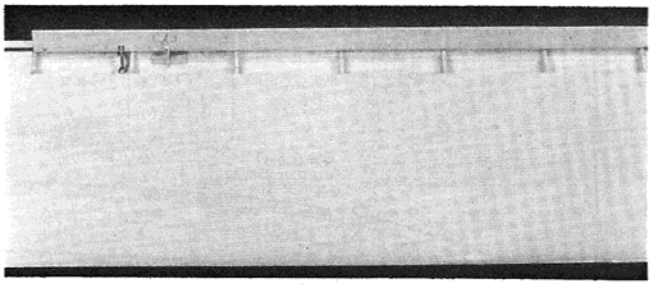
Polyhedral joint. Note wire epoxied to spar and shear web.



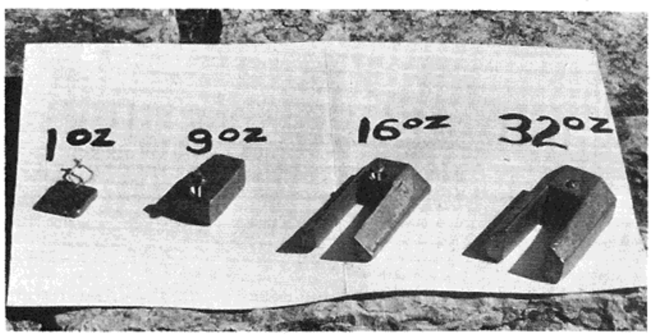
Fuselage wing root detail before shaping. An X-Acto blade is used to carve wing fillets.



Stab rods and rudder pushrod details.



Completed spoiler. Note the spoiler horn and the elastic sewing thread hold-down.



Lead ballast weights — bolt to fuselage floor.

(12) Add the 3/16" x 1/4" leading edge strips and plane and sand the edges of the stab to shape.

The completed stab should slip onto the stab wires with enough friction to prevent the stab from coming off in flight. If the fit is too loose, bend the tips of the rear stab wire **slightly.** The amount of bend required is really miniscule, so don't overdo it.

Wing:

The wing is, of course, the most important part of a sailplane. If it is accurate, strong, light and true, you'll have a winner. If not, you'll have a dog. Select materials to be warp-free. Check the grain in the spruce spars. The grain should be straight and parallel to the length of the spar. The leading and trailing edge materials should be absolutely warp-free. Match materials by weight and grain so that the same weight and grain are used in both wings. Soft balsa may be used for the capstrips and wingtips.

The completed wing is used for aligning the wing tubes in the fuselage, so the wing must be built before the fuselage can be completed. Start the wing construction by making the **outer panels.**

Panels:

Stack two sheets of 1/16" x 3" x 36" medium balsa. Attacn them together with double sided Scotch Tape between them. Then trace the ribs onto the upper sheet from the plans and cut out the ribs. This guarantees that the ribs in each wing will be identical. Build the outer panels over the plans. Note that the 1/16" leading edge sheeting is only on the top surface of the outer panels. The bottom surface is capstripped.

Lay the bottom capstrips and the lower spar on the plans. Shim up the leading edge of each capstrip with a scrap of 1/32" balsa. Glue the ribs in place. Cut the shear web accurately. Making shear webs is a tedious task that no one likes, so a pattern is provided on the plans to speed up the process. It is important that the shear web grain is vertical.

The inner panels have construction similar to the outer panels, except that sheeting appears on both top and bottom. Cut and drill ribs W1, W2, and W3 very accurately.

Install the spoiler cable tubes before sheeting the top surfaces.

Make the spoilers before sheeting the top surfaces also, and use them as guides for positioning the sheeting around the spoiler's bays.

Inner and outer panels are joined before the inner top sheeting is attached by laying the inner panel on a flat surface and butt-gluing the outer panel to it, raising the wingtip by 4". After the glue is dry, cut away part of rib W8 and epoxy the 1/16" welding rod dihedral braces in the corner where the spars meet the shear web. The wires should be nicked and scratched so that the epoxy will grip them well. This method has also been used on the Sailaire and several other sailplanes. A dihedral brace failure has not occurred.

Fiberglass wing tubes made from arrow shafts are recommended, but brass tubes may also be used if they are well roughened before gluing. Install the tubes in both wings with the wing rods in place and check the alignment with both wings elevated 3⅛" at the dihedral break. Spot glue with 5-minute epoxy. Puddle in lots of 5-minute epoxy all around the tubes. When dry, stand the wing on its trailing edge and fill the remaining space around the wing tubes with micro-balloons and 5-minute epoxy. Note the addition on the 1/4" section to the inner portion of the upper and lower spars. This addition will allow the wing tubes to be completely encased in the micro-balloon and epoxy mix.

Add the top sheeting last.

Spoiler hinges are not shown on the plans. Use small Klett hinges, MonoKote or high tack tape.

Cut the 1/32" poly end cap rib slightly oversize and glue it to the wing root. Trim away the excess. The root of the completed wing may now be used as a pattern for trimming the 1/8" Siglite fuselage root rib to shape.

A screweye may be added to the wing root rib. A hole through the fuselage to connect the two wings via a #64 rubberband doubled over will hold the wings snugly to the fuselage.

Use dacron thread for the spoiler cable. Goldberg 1/2A control line string is a good source. Don't use nylon fish line. It will sag in humid weather.

The wing should be covered with MonoKote. It has the stiffness required for glider wings. Both sides of the spoilers should be covered to prevent warping in wet weather.

Flying:

Note that the towhook is aft of the Center of Gravity. The towhook position shown on the plans will get the highest possible launch height. But this configuration requires that flying air speed is reached before the airplane leaves the pilot's hand. So launch with plenty of tension on the winch line or high start line and throw hard. If you haven't had much experience with winches, or if you are not very experienced at sailplane flying, it is recommended that the towhook be moved forward 1/2" and that the more forward C.G. setting be used. In any event, first flights should be launched conservatively.

Launch with mid trim and, when well settled on the tow, ease in full up trim. Watch the amount of bending in the wings. If excessive, either ease off the winch tension or put in a little down trim.

Durex, or any other glider, should be flown with as little movement of the control surfaces as possible. Deflected control surfaces cause drag which, in turn, increase sink rate, and reduce speed. This effect was observed and measured while flying two identical Durex. One plane was assigned to follow the other. Regardless of which plane or which pilot was the leader, the follower always came down first. This is because the follower had to use more rudder and elevator motion than the leader.

It's always windy on contest days, it seems. Ballast should be added depending upon the wind velocity. No ballast at all is needed for wind speeds of up to ten or twelve miles per hour. After that, one or two ounces of weight should be wedged between the battery and the first servo to move the C.G. forward. Any additonal weight should be added at the C.G. To penetrate strong wind, or to increase speed for the speed and distance events, up to two pounds of lead weight bolted to the fuselage floor around and ahead of the towhook may be added. Note the shape of the weights in the pictures.

Although Durex was designed for competition, its inherent stability and smooth control response, as well as its sturdy construction, make it an excellent choice for the sport flyer as well. Whatever the context of your flying, this high performance sailplane is fun to fly. We hope you have many high, long and thoroughly enjoyable flights. □

Editing By Hlsat.
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