CENTURION

A 75" Span Maximum Performance Sailplane Designed By Don Dewey For All-Out Competition In The Standard Class.

Several years ago, our good friend Willie Richards, came up to the shop with a prototype of an original sailplane design he had just completed. On the initial test flights he had experienced difficulty in achieving satisfactory flight performance and asked for some assistance in correcting the problems he had encountered. After making a few suggestions as to incidence changes, modifying the stab area, etc., the Gus was born. Within a few months after the publication of the Gus, this design became one of the most popular sailplane plans ever to be published.

My own experience with the Gus consisted of three prototypes built from the finalized plans and well in excess of a thousand flights with these prototypes over a two year period. Although designed primarily as a sport sailplane, the 75" span Gus had placed high in numerous sailplane contests around the country and I even managed to miss a first place win by one point flying this amazing little ship.

Yet, during the two years in which we flew the Gus against many different sailplane designs, the experience we gained indicated a need for a higher performance machine that would be capable of the tasks required by present day sailplane contests. Thus, I kept notes on the modifications I felt would be necessary to take this design to a higher plateau of competitive performance while retaining many of the desirable characteristics of the original design.

The Centurion is the result of these two years of "research" on the original design by Willie Richards. First of all, one of the greatest areas of maximum drag on a sailplane is at the junction of the wing to the fuselage, accounting on some sailplanes for as much as 30% of the total drag. Thus, it was decided to have a custom fiberglass fuselage made for the Centurion by one of the master craftsmen in the field of fiberglass lay-up. The criterion I established for the construction of the fuselage seemed to me impossible to accomplish in fiberglass, but it was decided to give it a try.

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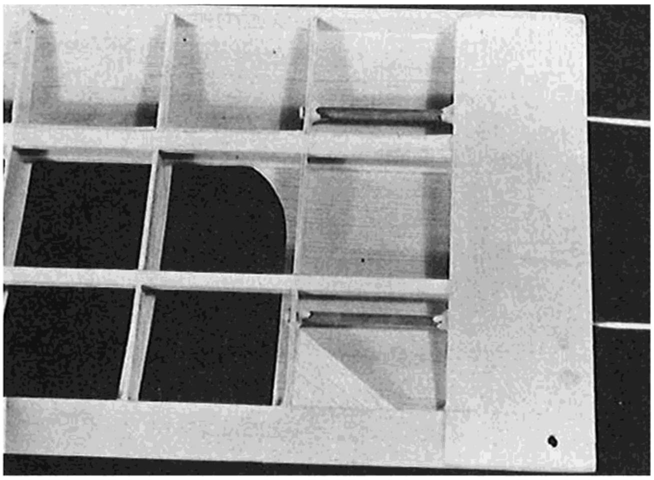

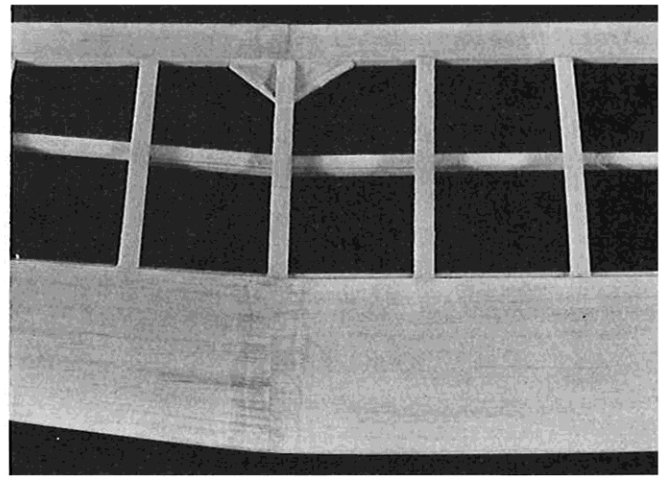

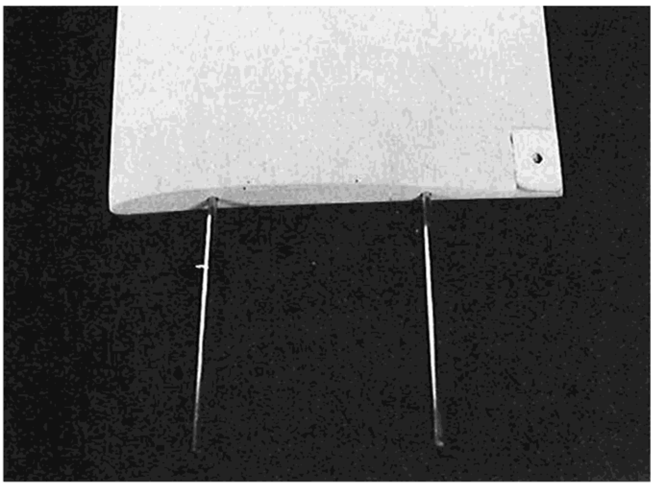

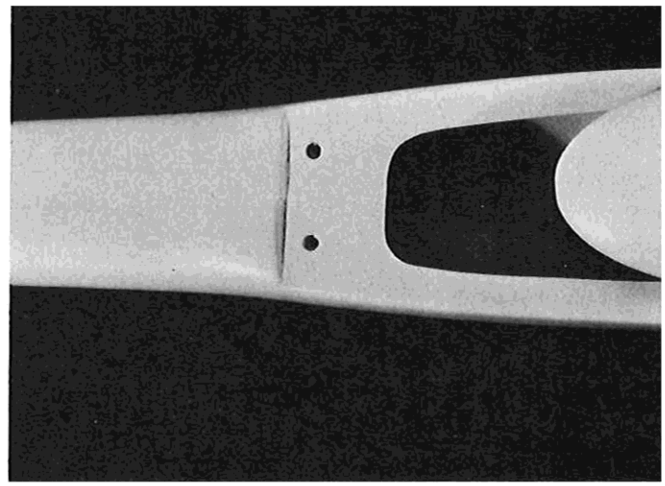

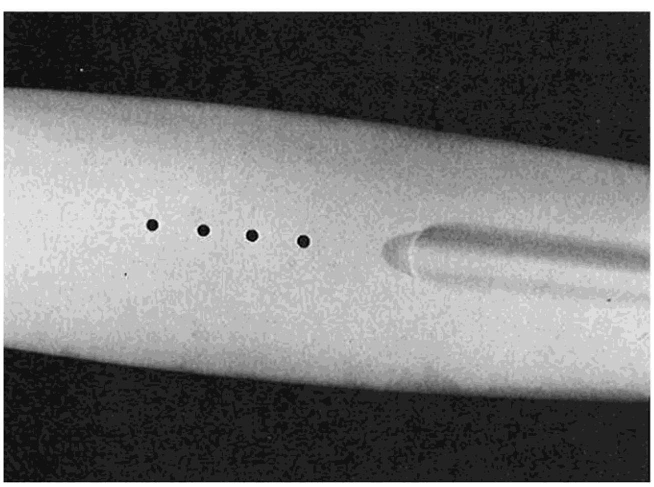

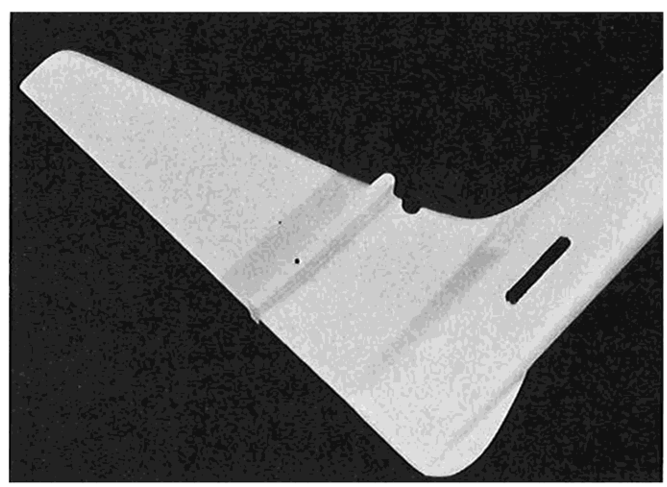

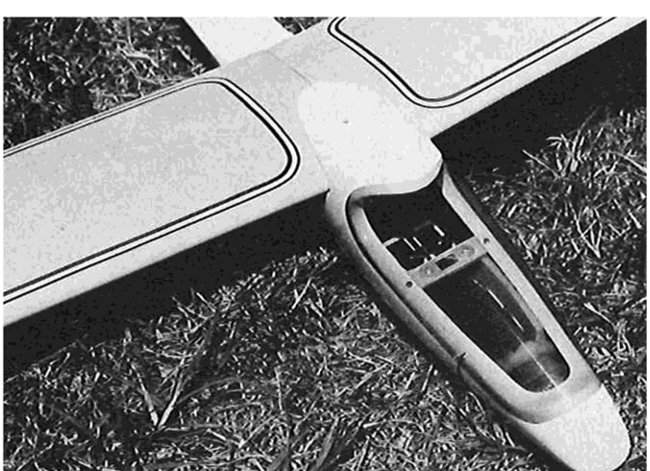

TOP ROW: (L) Underside of wing. Note 1/32" ply sheeting over center bay. (R) Thin, light cloth and glue used to reinforce dihedral breaks. 2ND ROW: (L) 1/32" ply inserts in trailing edge for wing hold-down bolts. (R) 4-40 blind mounting nuts in 1/8" plywood plate epoxied to underside of fuselage flange for nylon wing bolts. 3RD ROW: (L) Holes drilled in fuselage bottom for Airtronics tow hook, (R) empennage set-up. Notch in fin for stabilator pivot clearance. LEFT: RS Systems 3-channel installed in Centurion. Note internal location of switch to minimize drag.

The first requirement was that the fuselage should weigh no more than 6 oz. complete - - - a 2 oz. weight reduction from the original built-up balsa fuselage. The second requirement was to add an additional inch to the tail moment, a factor that we felt would be a definite improvement over the original design. A third criteria was to eliminate, as much as possible, the amount of drag created by the wing-fuselage junction. Thus, it was decided to fair the fuselage in smoothly over the top of the wing and to use no method of hold-down except a friction fit between the leading edge and the top of the wing and the fiberglass fuselage and two 4-40 nylon hold-down bolts at the trailing edge. This, I

felt, combined with a very streamlined fuselage, would reduce the overall drag factor to an absolute minimum. Another factor we wanted incorporated into the fuselage was one whereby absolutely no bulkheads of any kind had to be used in the fuselage for, as is characteristic of any fiberglass fuselage, the normal breaking point in the event of a crash is directly adjacent to the union of a bulkhead with the fiberglass fuselage. Thus the fuselage had to be light, strong, and completely free of any bulkheads or internal wood bracing. In addition, we wanted to allow enough room in the cockpit area to take any of the currently available proportional systems instead of limiting the design by a confined equipment area to the microminiature proportional sets, as seems to be the practice with many designs currently available.

The job of manufacturing the fuselage was given to P & M Fiberglass, P.O. Box 1020, Nipomo, California 93444. Several months later, several prototype fuselages were given to us, the heaviest of which weighed 5.95 oz. complete with canopy! All of the design criteria were incorporated in these prototype fuselages including a sturdy molded-in skid, a "rolled" wing seat and cockpit area, all double filled in areas where maximum strength was needed. This fuselage is one of the prime factors for the outstanding flight performance of the Centurion, and thus, if you want to build this high performance Standard Class sailplane, you will have to purchase a fuselage for $19.95 from P & M Fiberglass. No built-up fuselage is shown on the plans since we have proven to our own satisfaction that any attempt to duplicate this fuselage in balsa detracts immeasurably from the performance of the aircraft.

The wing has the same basic configuration as the original Gus insofar as the planform and overall area is concerned. However, here the similarity ends. The wing structure of the Gus was quite weak and suffered the most damage over long periods of flying. In addition, the excessive polyhedral that was employed on the Gus overshadowed the tight turning characteristics that can be gained from polyhedral by causing a severe rocking motion in normal flight attitudes. What we wanted to accomplish on the Centurion was the advantages to be offered by polyhedral without its disadvantages. This, coupled with an all flying stabilizer of generous area, would achieve the extremely tight turning radius we desired while the overall reduction in drag and the streamlined characteristics of the Centurion would give us the necessary penetration when moving from one thermal to another. One of the problems with the original Gus was that, while it had excellent ability to thermal in even the lightest air, it did not have a wide speed range and was unable to penetrate rapidly from one thermal to another when lift diminished in the area in which you were flying. These problems have been overcome by: (1) a reduction in degree of polyhedral, (2) streamlining of the entire aircraft, (3) the introduction of an all flying stabilizer, (4) increased vertical fin and rudder area, and (5) the location of the flying stab at an optimized point on the vertical fin.

Before you decide whether or not you want to invest $20.00 in a fuselage and begin building the Centurion, let's examine the flying characteristics of this sailplane. First of all, let's look at what the Centurion is **not**: To begin with, it is definitely **not** a model for the novice sailplane pilot. There are many suitable trainers on the market, but the Centurion is not one of them. Secondly, this sailplane is **not** an 80 mph speed merchant and it will **not** do the FAI Pattern on the slope, or anywhere else for that matter. Finally, while it is an extremely high performance sailplane for its size and designed for sport flying or for competition in the Standard Class, it will **not** beat a 12' high performance sailplane designed for all-out competition. In my own opinion, a good big sailplane will always beat a good small sailplane, all conditions being equal, although I, personally, prefer the smaller sized aircraft. It is for this reason that this sailplane is designed to compete in the 100" or under category. In that realm it will hold its own with virtually any of today's prominent designs. And, it will hold its own against many of the larger sailplanes which have been designed as "compromise" machines. For example, you need not hesitate to put this design up against a Cirrus in any thermal competition, be it precision or duration – given flyers of equal ability it will beat it 9 times out of 10. But, again, this is only my opinion based on previous experience and you will have to prove it to your own satisfaction. One final note before beginning construction - - - the Centurion is designed so that the two stabilizer halves and the wing panels are quickly removable and the entire aircraft can be stored in an average size kit box for easy transportation. This certainly eliminates banging up stabilizers and trying to find out what to do with long one piece wings!

CONSTRUCTION

WING:

The wingspan of the Centurion is 72" – 75" depending upon the size of wing tips that you use. This was purposely done in order that the Centurion might qualify for the new Formula 72 event which has been gaining in popularity in California. This event prescribes only two design parameters - - - the first being that the wingspan shall be 72" or under and that the wing loading of the sailplane will be no less than 8 oz. per square foot. Thus, the first design parameter has been met by keeping the balsa wing tips to a minimum so that your span will come out to 72" while the second requirement of an 8 oz. minimum wing loading can be easily achieved by using a slightly heavier radio and adding some ballast to the model, since the Centurion has a total wing loading of approximately 7 oz. per square foot.

The airfoil section used on the Centurion is a slightly modified 6409 undercambered foil which gives excellent lifting characteristics in calm air, such as normally found in the Eastern part of the United States, while retaining a relatively good degree of speed and penetration. Other design factors were included to compensate for the loss of penetration in speed range normally caused by the use of this particular airfoil. Thus, the good points of the airfoil were retained while its few drawbacks were compensated for in other design factors affecting this particular sailplane.

The construction of the wing, while fairly time consuming as is the case with most sailplane wings, is quite conventional in construction. You are cautioned to select your wood carefully with an eye towards light weight combined with maximum strength. The wing, in two panels, consists of 1/16" sheet balsa ribs, 1/8" x 1/4" spruce main spars with vertical grained 1/16" webbing on the front of the spars and running full length of the wing. The rear spar is a length of 3/16" x 3/16" spruce which ends at rib W5. The leading edge is made from 5/16" square balsa and pre-shaped with a razor plane prior to gluing in place. This is done to facilitate the gluing of the 1/16" leading edge sheeting down over the top of the leading edge itself, thus tying the entire structure together and adding a maximum of strength to this area of the wing. The first two bays of the wing are sheeted on top with 1/16" balsa while the first bay on the bottom of the wing is sheeted with 1/32" plywood when the wing is finished. The trailing edge consists of 3/16" x 3/4" trailing edge stock. Cap strips are 1/16" x 1/4" balsa. Be sure to check the rib section carefully and prop up the front of the trailing edge and the bottom main spar so that the proper rib profile is maintained throughout construction. 1/8" sheet balsa triangular gussets are used at the polyhedral break at the leading and trailing edge along with a 1/16" plywood dihedral brace on the rear spar and a 1/16" plywood dihedral brace between the two main spars. Be sure to build in 3/16" washout in the trailing edge of the wing tip. This is best accomplished by tapering a piece of 1/4" balsa sheet that is 11½" long and tapering from 1/4" at the tip down to a fine point at the other end. This long thin wedge can be placed under the trailing edge of the tip panel and the trailing edge stock held firmly in place so that the washout can be built into the wing. When the tip gusset and tip blocks have been added, you will find that the necessary washout is a permanent part of the wing.

The first three ribs in each half of the inboard panel are made from 1/16" plywood to carry the load of the 1/8" I.D. brass tubing for the 1/8" diameter wing rods. Be sure to epoxy these tubes firmly in place in the plywood ribs and to tilt the end rib in the appropriate amount to give the desired dihedral angle. I use Titebond glue throughout the construction of the wing. When construction is completed, be sure to allow the wing to dry for 24 hours before removing it from your building board. This will minimize any warps creeping into your wing due to an insufficient drying time for the adhesive.

Before sanding the wing, inlay the 1/32" thick plywood hold-down bolt braces at the trailing edge of the wing where the two panels join together. By inlaying these pieces into the wing, rather than surface mounting them, you will provide a neater surface on which to apply your finish as well as reducing any drag in this area.

Our wing was sanded down with progressively finer paper until the wing was completely smooth. It was then wiped clean with a tack cloth and covered with yellow Solarfilm. Pin striping was applied using DJ's Multi-Stripe, available from your local hobby dealer, or from DJ's Multi-Stripe, P.O. Box 41105, Los Angeles, California 90042. This striping tape is similar to that used on expensive automobiles for pin striping, and is a PVC material which will form around even the most severe compound curves. Do not stretch the tape when applying it but lay it on carefully and smoothly. Once in place to your satisfaction, simply set the wing in the sun for approximately two hours and the striping tape will be permanently bonded to your wing. It is not effected by any material with which you will clean your sailplane and cannot be removed once "baked" in place. In fact, you would have to chip the striping off as if it were actually painted on!

EMPENNAGE:

The first step in the construction of the empennage is to cut the vertical fin and rudder from 3/16" thick medium balsa. When the vertical fin has been cut to shape, glue the 3/16" x 1/2" balsa stab roots on each side of the vertical fin exactly as shown on the plans in order to maintain the proper incidence angle of the stabilizer in relationship to the wing. 5-Minute Epoxy can be used for this operation. The next step, while not difficult, must be extremely precise and accurate. This involves drilling a 1/8" hole through the stab roots and vertical fin into which is glued a length of inner NyRod which acts as a bearing for the stabilator pivot rod. Roughen up the length of inner NyRod with a piece of sandpaper and glue in place by lightly smearing the NyRod with epoxy. Be sure you do not get any epoxy into the inside of the NyRod. Once this step has been accomplished, the vertical fin can be glued in place on the fiberglass fuselage using Hobby-poxy Formula I glue. Make sure the vertical fin is perfectly aligned and exactly perpendicular to the platform on which it rests. Next, take two scrap pieces of 3/16" balsa and glue in place on either side of the fin to act as fillets. Fair these into the fuselage by sanding carefully until the proper contour is achieved. The rudder is cut from 3/16" medium balsa to which a strip of 3/16" x 3/8" pine is glued at the base of the rudder to act as a stiffener. The rudder is then sanded to airfoil shape.

The stabilator, or flying stab as it is commonly called, is built up of a 3/16" square balsa leading edge and tips with a 3/16" sheet center section and trailing edge. The Warren Truss ribs are 3/32" x 3/16" balsa strips. Again, a length of inner NyRod is imbedded into the 3/16" sheet intersections of the stabilator halves to act as the other bearing point for the pivot rod. These must be aligned exactly with the NyRod being used in the stabilator root ends which have been previously affixed to the vertical fin. After determining the proper position for these bearings, simply cut a 1/8" slot completely through the 3/16" balsa, then cut a thin strip of 1/32" balsa to fit in the base of the 1/8" slot. Roughen up two sections of inner NyRod cut to the proper length and epoxy them in place on top of the 1/32" strip. This will center the NyRod in the 3/16" balsa sheet. Use 5-Minute Epoxy to which has been added a sufficient quantity of micro-balloons to completely fill the void between the balsa and the NyRod, giving a flush and smooth surface. Another length of inner NyRod is roughed up with sandpaper and glued to the leading edge of each half of the flying stab. This acts as the front joiner for the stabilator. These lengths of NyRod are epoxied to the leading edge of the stabilator panels and then wrapped with a piece of fine silk and coated with glue. Sand them lightly and the entire stab can be covered with Solarfilm to match the wing. The pivot rods should be .070 or 1/16" music wire cut to the proper lengths.

FINISHING:

The final construction details for the Centurion include installing a tow hook of your choice. We would recommend the use of the Airtronics Adjustable Tow Hook available from Airtronics, 145½ Montecito Ave., Sierra Madre, California 91024. A piece of 1/4" plywood can be epoxied into the base of the fuselage and the tow hook mounted to this ply base.

A small piece of 1/8" plywood should be epoxied inside the fiberglass fuselage at the rear of the wing saddle to act as a bearing for the nylon wing hold-down bolts. Drill two holes through the fiberglass wing seat and the plywood underneath, and install two blind mounting nuts inside the fuselage using epoxy glue. The best method for doing this is to install the wing in place with the wing rods and then drill through the wing, the fiberglass fuselage, and the plywood plate so that the holes line up properly. Finally, install your blind mounting nuts and secure the wing in position with 4-40 nylon bolts and washers.

Before painting the fuselage, install your radio equipment, keeping the servos as far forward as possible. In order to further reduce drag, we simply mounted a small 1/8" plywood plate across the fuselage underneath the canopy lips and installed our switch in that plate, so that it would not be mounted externally. Before mounting the servos, epoxy a piece of 1/8" plywood in the base of the fuselage just ahead of the leading edge of the wing. We then used servo mounting tape between the two D & R servos and on the base of the servos and secured them to the plywood plate. Our RS Systems receiver and battery pack were placed as far forward as possible. You will find that there is more than adequate room in the Centurion for virtually any radio you want to use. One of the prototypes of the Centurion was flown with one of the old style early model Bonner proportional systems with the Transmite type servos – even then, there was more than adequate room in the cockpit area.

Our pushrods consisted of 3/16" dowels with 1/16" wire ends and Du-Bro Kwik Links. To further streamline the fuselage and reduce even the most minute amount of drag, we used IM pushrod exit guides at the rear of the fuselage as pushrod fairings. To protect the rudder, a piece of 1/16" aluminum was cut into the shape of a tail skid on our Dremel Moto-Shop and glued to the bottom rear of the fuselage with Sears Filled Epoxy.

The entire fuselage was lightly sanded with 400 paper as was the vertical fin and rudder. The latter, constructed of balsa, were given two coats of Quick Prep Resin from Hobbypoxy Products, sanding between each coat. A third coat may be necessary if you have not succeeded in filling all of the grain of the wood. Next, we used a sprayed on coat of K & B Super Poxy Primer over the entire fuselage and lightly sanded it until the fuselage and vertical fin and rudder were glass smooth. Two coats of Hobbypoxy White were then sprayed onto the fuselage using Hobbypoxy H-06 Quick-Spray Hardener. We allowed this to dry overnight and then lightly wet sanded the fuselage with 600 paper, used wet, and then rubbed the fuselage out with DuPont White Rubbing Compound. At this time the fuselage could be held up to the light evidencing a mirror-like finish with a minimum addition of weight.

We advise you, strongly, against fastening the canopy in place with any type of canopy floor, screws, or the like. This is due to the fact that a fiberglass fuselage, in order to retain its strength must be resilient in the case of a rough landing. If the canopy was firmly positioned in place, the forward portion of the fuselage would lose its flexibility, and thus we used a piece of double sided Scotch Tape on either side of the canopy where it contacts the fuselage. This holds it firmly in place and all that is necessary to gain access to the interior of the cockpit is to simply pull on one side of the canopy.

And that completes the construction of your Centurion. Make sure that the Center of Gravity is located where it is shown on the plans. The all-up weight of the Centurion should not exceed 25 oz. if you have built it properly. However, if it weighs up to 30 oz., it still will fly quite well since its wing loading is still within reason.

I sincerely hope that you will take the time and effort to build the Centurion for the next contest season. It will be a serious contender in the Standard Class contest circle in the hands of an experienced pilot. Again, if you are a novice to R/C sailplanes, we recommend that you begin with a more docile trainer than the Centurion. The all flying stabilizer is extremely sensitive and provides the contest pilot with the amount of control he needs for precision work in the thermal as well as for accurate spot landings. To the beginner this would be a definite hazard and he would find himself over-controlling the model from the very beginning. If you are an experienced sailplane pilot with no interest in competition whatsoever, try the Centurion for a high performance change of pace - - - you'll enjoy it! Drop us a line and a photograph of your model - - - we'd like to hear from you and of your experiences with this sailplane. □