GRUMMAN ALBATROSS
BY IVAN PETTIGREW
CONSTRUCTION NOTES

The Grumman Albatross started life in 1947 as the G-64 and had a wing span of 80 ft. Different models were used by the US Air Force, US Navy and US Coast Guard. Hence many designations are found such as SA-16A and B, G-111, HU-16B and C, and UF-1. Some of the later models such as the G-111, SA-16B and HU-16B were slightly longer and had a wing span of 96 feet 8 inches. This increased the range to an impressive 3,465 miles. It also improved single engine performance. If the builder of this model is a purist and wants it to be a true1/12 scale, the tips of each wing should be clipped by two inches, and the model will then conform to the G-64, SA-16A and UF-1. Some models were designated as “triphibians”, being capable of operating from land, water and ice. Two UF-1L triphibians were used by the US Navy in its first attempt to fly to Antarctica from New Zealand in 1955.

Like the Sealand project, this model was designed to take advantage of the great efficiency obtained when two Magnetic Mayhem motors are run in parallel from a nine cell battery pack. The battery should be an SCR of 1700 mAH capacity or greater. The 22 turn Magnetic Mayhems are not considered to be powerful motors, but when run from nine cells at less than 20 amps, they are extremely efficient. This is because the armature is a little longer than that used in standard racing car motors. With 3:1 gearbox reduction, the motors should turn the 11x7 APC-E props at 6,000 RPM static with each motor drawing 16 amps, making for a total current of 32 amps from the battery. If using the single reduction gearbox like that available from Great Planes (or Master Airscrew) it is important to use the version of the Magnetic Mayhem motor that is available with timing for “reverse rotation.” Another advantage to using these motors at low power is the long motor life that is obtained.

FUSELAGE
The fuselage is a simple framed up box with bulkheads added to the top and bottom. First build the two sides of the fuselage over the plan, and join together. At this point it is easiest to join the two sides with 3/16 x 3/16 inch sticks, and add the bulkheads to these later. The sides of the fuselage aft of bulkheads #11 are in two sections. The upper sections come together at the tail, while the lower ones come together at the point of the second step.

The lower semi circular bulkheads from 11B to the tail should then be added to the bottom of the upper section of the fuselage. Before proceeding to cover these, read through all of the instructions and get the complete picture in your mind. While the shape of the outer skin on the section of the hull from bulkhead 12b to 14b is the most challenging part of the fuselage construction, it is not as difficult as it might seem. My problem is not in doing it, but in explaining it in words that make it easy to follow. The 1/16” balsa sheeting is applied to the semi circular bulkheads from #12b to the tail, with a triangular strip at the top edge extending forward from 12b to station 11. An e-mail picture of this is available from Ivan on request. Next the remaining lower bulkheads 8c to13c are added to the area of the secondary step and covered with 1/16” sheet.

The sides of the fuselage are just sheeted from the bottom outside edge up to a point an inch or two above the water line. This sheeting is straightforward from the nose back to bulkhead 11. To sheet the sides of the secondary step, cut a fairing from a single piece of 1/16” balsa approximately 13” x 3”. It is glued to the side (lower section) of the secondary step. The top curls out to meet the sheeting that was earlier applied between bulkheads 13b and the tail. It is much easier than it sounds, especially if this 3” wide fairing is dampened before applying. Most modellers attempting a project like this have built a low wing scale model like a Spitfire that has a fillet and fairing where the trailing edge meets the fuselage. One way to visualise this part of the hull is to lay the fuselage on its side, and think of the 3/32” fillet at the end of the secondary step as being the fillet where the trailing edge of a Spitfire meets the fuselage.

The section of the hull forward of the main step is covered in stages, starting from the outside. The outer strips are glued to the crosspieces of the fuselage as if the hull was going to have a flat bottom. Then the triangular formers from 1b to 8b are glued in place. Next the 1/8” x 3/16” keel is glued in place and the sheeting applied. The plan indicates 3/32” hard balsa for covering this section of the hull, but 1/32” ply may also be used. The concave shape of the hull that is thus formed really helps in reducing spray and getting the model on the step promptly. This model will take off easily with about 75% power. Use of reduced power during take off adds much to realism by lengthening the take off run.

Add bulkheads and sheeting to the curved upper surface of the fuselage, building wing mounts and cockpit area as shown in the plan. The battery platform can be left until the model is completed and checked for C of G location. If the model is built with the tail too heavy, the battery platform may have to be moved slightly forward. If it is planned to use lighter Li-Poly cells, the battery platform will have to be moved forward quite a bit to get the correct C of G location at the main spar.

TAIL SECTIONS

Before starting to assemble the tail surfaces, the main spars should be made and hinged so as to get a smooth fit. Notice that the stabiliser has a small amount of dihedral. The spar should be built over the plan so as to get the correct angle. Because of this dihedral, the purist may prefer to use independent pushrods to the elevators. This is always done when there is more dihedral to a stab, but with the small amount of dihedral on this model, the wire connector between the elevators was found to be satisfactory, especially since the elevator throw is only ¾ inch. Otherwise the tail surfaces are of conventional construction, but the fin may be built in place by starting with the spar being glued to the rear of the fuselage. Notice that the spar (post) for the fin goes right down to the bottom of the fuselage. The lower part of this post acts like a bulkhead at station 16. In constructing the fin, notice that F2 acts like a platform for the stabiliser to sit on, so it should be well secured with gussets. Rib F3 further secures the stab. Do not glue F3 in place when building the fin, or it may not be possible to slide the stab through the slot. The problem comes with the wire that joins the elevators. Glue F3 in place only after the stab has been attached to F2. The area from F1 to F2 should be covered with 1/16” sheet, the grain running vertically, then the 1/16” sheet fairing is added to the dorsal fin area and extending to the tail. Flaring the lower edge of this fairing out a little will add strength to the fin mounting, and also provide space for the elevator nyrod to run inside the fairing to one side of the fin leading edge.

After doing the fairing on one side, install the nyrod for the elevator before covering the other side. To avoid the sight of an ugly external antenna, it can be run down the inside of the fuselage and up to the tip of the fin. If doing this, the antenna should be installed before completing this fairing.

WING CONSTRUCTION

The wing is built in one piece. If this is too large for local transportation, the wing could be built in sections. Joining the wing at the centre is NOT the way to go because of the stress at the centre section of the wing, and complexity of the motor wiring etc. Wing joiners could be built in the usual manner at the point where the ailerons start. There is not so much stress out there and it is easier to hook up the ailerons by placing the bell cranks just inboard of the break and putting the aileron control horn right at the inboard end. This builder prefers to build a wing of this size in one piece because of simplicity, weight saving and strength. The basic airfoil is a Selig 7055, but outboard of the aileron break it uses a NASA leading edge cuff to reduce tip stall tendencies. A full depth 3/32" sheet balsa spar is continuous throughout the wing The ribs are cut where they meet the main spar, and are butted to the front and rear surfaces of the spar. Cut the main spar from 3/32" sheet balsa and splice the pieces together over the plan. Notice that the top surface of the spar is a straight line, the only dihedral being that of the upward sweep on the lower edge. Now glue the 1/8" x 3/16" hardwood strips to the top and bottom surfaces of the spar as indicated. These strips should be bass (basswood) or spruce. Notice that they do not go all the way to the tip. Likewise, in other locations where bass is stipulated, spruce or other hard woods may be used.

Cut all the ribs in two at the point where they join the spar. Build one wing panel first by pinning the spar on its edge over the plan, the spar for the other half of the wing being raised slightly because of the dihedral. It is easiest to start by gluing the rear part of each rib in place first, then attaching the trailing edge. Next add the second spar on the lower surface of the wing. Now glue the front part of each rib in place and then the first "inner" strip of balsa which forms part of the leading edge. The outer strip of sheet that completes the leading edge is not added until the sheeting has been applied to the top and bottom surfaces of the wing from the leading edge back to the main spar. When one section of the wing has been assembled, it is propped up a little so that the lower edge spar for the other wing is flat on the work bench. The second section of the wing is then built in the same manner as the first, making provision of course for the ailerons. At this point the wing will still be very floppy. Some call it "Ivan's spaghetti." Be patient, and please resist the temptation to add wood.

Sheeting is now applied to the lower surface of the wing from the leading edge to the main spar. It should be done in two sections, one inboard of the leading edge break, and the other outboard. At this point the wiring may be installed for the motors, but it is possibly better to leave the wiring until later since it makes it easier to sheet the upper surface without the wire in place. At least the holes for the motor wiring should be drilled at this point in the nose ribs between the fuselage and motor bay. This wiring should be twisted to reduce the risk of electrical interference with the radio. It will be noted that the wing is still not torsionally strong, meaning that it can easily be twisted. In other words it is still "spaghetti." After the sheeting is applied to the upper surface of the wing it will be extremely rigid and difficult to twist. Hence it is very important, when applying the sheeting to the upper surface, to weight that section of the wing down on a surface that is perfectly flat. There should be no washout from the wing root to the start of the aileron (leading edge break), but from that point to the tip there should be 1/4" washout. So the inboard top surfaces of the wing from the root to the leading edge break should be sheeted first with the wing weighted down on a perfectly flat surface. Note that the flat bottom section of the inboard ribs is that part from the spar to the trailing edge. Next apply the sheeting to the top of the outboard section with the rib at the leading edge break weighed down flat, but the trailing edge of the tip rib propped up ¼" to give the correct wash out. If you really want to be able to do tip stalls and spins, don't put in any washout. As set up in the plans with regard to washout, C of G location and elevator throw, this model will NOT tip stall or spin. The best it will do is a lazy spiral. The remaining balsa strips that form the leading edge are now glued to the ones in place and contoured to shape. Finally sheeting is added to the part of the centre section aft of the main spar. If the motor wiring was not installed before sheeting the wing, it is easily accomplished now by cutting out a narrow strip of the lower covering where the wires are to be located. If the cut is angled a little, wider at the top, it is very easy to glue the same strips back in place after the wiring is installed. The second spar and ailerons are installed as shown on the plan. For accuracy in building the ailerons, the 1/8" leading edge of the aileron can be hinged to the wing first, then the ailerons built while attached to the wing. It pays to really work at getting the ailerons to flush fit with the wing so that drag is at a minimum. That is the advantage of fitting the aileron leading edge to the wing first and trimming it to the exact size before building the rest of the aileron.

A small amount of the lower sheet covering has to be removed where the engine nacelles are to be located. The nacelles are built by first gluing 2 inch long triangular strips to the rear face of leading edge and front face of the spar at the location shown, then attaching the hardwood motor mounts. At this point it is best to make up bulkheads N-1 and C-2 as a matching pair. Notice the small plywood plates that are glued to these for holding the wood screws that secure the cowlings. Drill the holes at this point and thread the screws into the rear securing plates. Now the nacelle bulkheads are glued in place, and the nacelles planked with 1/16" sheet balsa.

Cut out the covering for the cowlings to the pattern shown, then wrap the cowling around to form a sleeve and glue the edges together. The nose ring (C-1) of the cowling is like a doughnut, and can be shaped from one piece of thick balsa, or laminations. Slide the nose ring into place in the cowling "sleeve." Next the bulkhead C-2 is slid into place also. If the sleeve is too loose, a narrow strip may have to be removed, or on the other hand added if the fit was too tight. Provision should be made for cooling air to exit from the motors. This is done by leaving a section of the engine nacelle open under the wing. A triangular piece is left open on the inboard side of the lower nacelle from N-3 to the rear, about ¾" wide at N-3, tapering to a point at the rear.

The tip floats are built up and covered with 1/16" sheet balsa. Construction is fairly basic, especially for anyone who has built a set of floats. Cut out the centre strips, top and bottom, and assemble them with the bulkheads, not forgetting to put the offset centreboard in place. This serves to attach the mounting struts. Attach the side pieces then cover the bottom and top surfaces. The strips that form the leading and trailing edge of the mounting struts should be glued to the centreboard before the covering is completed on the top of the floats. It is very rare for a float to be knocked off in regular flying, so the small screws that attach the struts to the wing are sufficient. It is hoped that they will pull out in the event of a float strike. This is more likely to happen when going through the workshop door than when flying. If you feel the float mounting should be stonger, go ahead and do it, but when you hit the float on the workshop door, be prepared to do a major repair job inside the wing instead of putting the screws back in place with the help of a little glue in the screw holes.

CONTROL THROWS

Control throws are shown on the plan. Because of the angle of the control rod to the elevator chord line, the position of the elevator horn is critical. If it is too far forward the elevator will go down more than it goes up and vice versa. The ailerons should travel at least 1 1/4” up, and no more than 1/2” down. Importance must be given to this amount of differential in the ailerons, and it can be achieved if the control arm on the aileron servo is made as shown, but the location of the aileron control horn is important too. If the horn is too far forward it will reduce the differential. Likewise, the differential is increased by placing this horn further aft. At the start of the take off run in a flying boat, one of the tip floats will be in the water. It is necessary to lift this float out of the water using ailerons, or the model will want to turn in the direction of this float that is dragging in the water. Poor aileron design aggravates this problem in many models because of the adverse yaw that is inherent at larger angles of attack, such as while getting on the step. Two things are done in the design of the Albatross to overcome this problem. Frise ailerons are used, and a substantial amount of differential is used in the aileron linkage. At the start of the take off run, while holding up elevator to get on the step, advance the throttle just a small amount at first until the wings are levelled with both tip floats out of the water. When this is under control, advance the throttle further and relax on the up elevator as the model accelerates on the step. With practice this becomes one smooth continuous movement. A very slight amount of up elevator may be necessary at the point of lift off, especially if operating off glassy water.

In multi motor electric models, there is an increased risk of problems with radio interference from motor brush noise and also the increased length of wiring used for the motors. While it is always recommended to put a Schotky diode across the terminals of each motor when they are wired in series, it is not so critical in this application where the motors are wired parallel. The normal capacitors should of course be used across the motor terminals, whether or not Schotky diodes are used. The wires carrying current to the motor should be kept touching each other, and twisted about one turn to the inch. Wire of at least 16 gauge should be used from the motor to the point where it joins the wire from the opposite side since it is only carrying 16 amps. But from the junction point of the wires to the output of the speed control there will be 32 amps, so heavier wire of at least 13 gauge should be used. Keep the length of wire from the junction point to the motors the same for each side. If they are uneven, the motor with the shorter wire will get a higher voltage and run slightly faster. The radio and servos should be kept as far as possible from the motors and motor wiring, but this is taken care of with the layout shown in the plans. Servo leads must be kept short. Do not use outboard servos for the ailerons. These would require long leads running along the wing parallel to the motor wiring, and they would be very prone to picking up interference. At the low airspeed of this model, one standard servo is ample to operate the ailerons.

COVERING AND FINISHING

Most of the airframe on the prototype is covered with low temperature film. It has been found over the years that film does not stand up to repeated use in water, so the hull and tip floats are best covered with light tissue (silkspan) applied with nitrate dope. This should be done before covering the upper part of the fuselage with film. The silkspan should be applied to the entire hull, and up to the top edge of the sheeting on the sides, this point being a few inches above the water line. Be sure to prime the hull and tip floats by applying two coats of clear nitrate dope before covering. When applying the tissue, first spray it lightly with water and rub it on to the surface while damp. Next brush a coat of dope on to the tissue. It will bleed through and cement itself to the primed surface below. After it has dried, apply at least two more coats of clear dope. The hull should be sanded after each coat of dope is applied, and when a smooth surface has been obtained, the colour should be applied. Krylon spray paint is known to be one of the lightest and most suitable for models of this type. When painting is completed, cover the remaining section of the fuselage. Allow about an inch overlap where the film joins the top edge of sheeting on the lower part of the fuselage sides. It should not be continued to a point below the water line.

EMERGENCY FLOTATION

With an electric powered model, because of the weight of the batteries and motors, there is not enough flotation to keep the plane on the surface of the water in the event of a crash, or the hull being punctured. Hence it is recommended that blocks of foam board be placed in the fuselage, or even some of the wing bays. The small air sacks that are often used as packing are another option. When asked why the model of the Albatross is so light, I point out the little air bags and say that they are filled with helium. In the case of several multi motor flying boats that I have flown for several years now, I have fortunately never had to put these flotation devices to the test. But in earlier years I lost a flying boat with a single pylon motor following a crash due to radio failure. When I got to the crash scene, all that was floating was the wing and tail section that had torn lose from the fuselage. The weight of the battery and motor had taken the rest to the bottom of the lake. Had it been a multi motor flying boat, the wing would have probably gone down as well because of the weight of the motors. Flotation is like insurance. You will only need it if you don’t have it.

Enjoy building and flying your Albatross. There is not much that can be said about the flying that does not apply to other flying boats. Apply the power SLOWLY on take off with the elevator UP until the model is on the step. At the same time use the ailerons to keep the wings level. As soon the model is on the step it will accelerate and back pressure on the stick should be reduced until the elevator is only slightly up. In glassy water conditions without any wind, it may be necessary to use a little more up elevator to lift off the surface when flying speed is achieved. As soon as the model becomes airborne, reduce the amount of up elevator so that a safe climbing speed is attained.

The Albatross was never intended for aerobatics, but as part of Ivan’s test routine, the prototype model has been looped and rolled just to prove to the critics that it has plenty of strength. When it comes to landing, if the model skips on touch down, it is because the landing speed is too high.

The most impressive landings are achieved when the final part of the approach is done with a small amount of power which is kept on right through the flare. Back pressure should be applied on the elevator until speed is diminished and a slightly nose high attitude is attained. The point of the main step should touch the water first. If this is done, the model will not skip or bounce. Because the step is behind the C of G, the model will pitch down slightly at the point of contact. This reduces the lift on the wing just as when landing a tricycle gear plane on the mains, and there is no danger of a bounce. If the model is allowed to touch down at a higher speed, it will be flying at less angle of attack. Therefore the forward part of the hull will hit the water first and the model will pitch up and balloon. In this type of landing, the nose is pushed upwards, increasing the angle of attack of the wing, and the result is an ugly bounce or a series of porpoises. If landed in the right attitude with the nose slightly up at a slow speed, the Albatross will not skip. If the model balloons in the last stage of the flare as if the elevator is too sensitive, it is likely because the C of G is too far back. Be sure to check that the elevator throw is correct. At just ¾ inch it is not very much, but makes for smooth flying and is ample control for all aspects of normal flying. After touch down, the elevator should be kept up, as in a three point landing with a tail dragger. The landing run after touch down is more impressive if extended by leaving on the small amount of power that was used for the approach.

Have fun flying your Albatross, and if you still want to do tip stalls and spins, increase the elevator throw and move the C of G backwards. But don't ask me why the model is suddenly harder to land.

SUMMARY

Grumman Albatross. December 2004. Scale 1/12. Span 84 in. Wing area: 945 sq. in. Length 62 in. Airfoil: Selig 7055. Can fly on eight to ten cells. Weight with nine N1900 SCR nicads, 93 ounces. Wing loading 14.2 oz/sq.ft. Motors are two Magnetic Mayhem reverse with Great Planes "GD-600" 3:1 reduction, driving 11 x 7 APC electric props. Motors are wired parallel. Static current with nine cells is 32 amps at battery, 16 amps to each motor. Static thrust 52 ounces at 6,000 RPM. Fuselage is stick construction, sheeted below water line and on top. Covering below the water line is silkspan applied with nitrate dope and painted with lacquer. Upper fuselage, tail surfaces and wing are covered with film. Because the Albatross is slightly larger in size than the Sealand, it has a lower wing loading and flies slightly slower.

Sept 20, 2005. Any model listed as suitable for nine cells can be upgraded to the use of Li-Poly battery packs with "three series" combinations. The weight saving will enhance the performance of the model considerably.

With the price of brushless motors and controllers coming down all the time, it is getting more reasonable to think of using these in Multi motor models, but remember that a separate controller should be used for each motor. Try to use the same size props as used in the model previously, and choose a motor/gearbox combination that will turn the props at about the same speed as when used with the brushed motors. Some of the cheaper brushless motors are not that much more efficient than brushed motors that are used with the right loading, so don't expect wonders. My personal feeling is that for the dollar spent, the biggest improvement in performance is achieved by first going with Li-Poly batteries.

Because of the Magnetic Mayhem motors no longer being available, the Albatross was used to test a pair of Multiplex Permax 7.2 volt Speed 480 motors, flying on eight or nine cells. It can fly and land considerably slower because of the weight saving. 12 x 8 APC electric props were used with 4.1:1 ratio gearboxes. With a nine cell pack of CP-1700 SCR nicads the flying weight is 81 ounces for a wing loading of 12.2 ounces/sq.ft. On an eight cell 3,000 NiMH battery the flight time is 28 minutes.

June 2006. The landing characteristics of the Albatross have been improved by reducing the elevator throw to 3/8 inch which is half of what was originally used. Control is much smoother and is still adequate. With full up elevator at the original maximum throw, the model was rather nose high and there was lot of drag in the water once the model touched down. With the reduced throw, the model touches down smoother in just a slightly nose up attitude and planes on the step for a distance while it slows down, especially if a little power is left on after touch down. This looks much nicer than the “plop” of the full stall landing which was more akin to a “belly flop” if the model was held off too long. To reduce the throw to 3/8 inch it may be necessary to use a long control horn on the elevator.