SHORT SEALAND 600
BY IVAN PETTIGREW
CONSTRUCTION NOTES

This model of the Sealand was designed to be an exercise in efficiency, using two Magnetic Mayhem motors in parallel, running off 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 and can are a little longer than those used in standard car motors. With 3:1 gearbox reduction, they 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 Master Airscrew, it is important to use the version of the Magnetic Mayhem motor that is timed for reverse rotation.

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. Take note that the sides slope inwards slightly towards the top, the width of the fuselage at the top being less than at the bottom. The sides of the fuselage aft of bulkheads #9 top and bottom 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.

Add bulkheads and sheeting to the curved upper surface of the fuselage. The lower semi circular bulkheads from 9B to the tail should then be added to the bottom of the upper section of the fuselage. In the case of bulkhead 10b, only the semi circular part of the bulkhead should be fixed in place at this time. The remaining part between the upper and lower sections of the fuselage will be added after these semi circular bulkheads are covered with 1/16” sheet. 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 10b to 12b 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 bottom semi circular bulkheads from #10b to the tail. The lower part of bulkhead #10b is glued to this sheet covering later. .

The sides of the fuselage are just sheeted from the bottom up to a point an inch or two above the water line. This sheeting is straightforward from the nose back to bulkhead 8b. After doing this, the lower section of #10b is glued to the sheeting that was applied earlier. To sheet the lower section of the sides from bulkhead 8b to the end of the second step, including the 1/8” balsa fillet attached to the keel bulkhead between 10b and 11b, use a single piece of 1/16” balsa 13” x 3”. It can be glued to the side (lower section) of the secondary step. The top curls out to meet the sheeting that was earlier applied between bulkheads 10b and 11b. It is much easier than it sounds, especially if this 3" wide piece of sheet is dampened before applying. Most modelers attempting a project like this have built a low wing scale model like a Spitfire that has a gusset where the trailing edge meets the fuselage. One way to visualize this is to lay the fuselage on its side, and think of the 1/8" gusset at the end of the secondary step as being the gusset where the trailing edge of a Spitfire meets the fuselage.

Add the remaining lower bulkheads to the hull section and cover as indicated. The triangular balsa strips added under the outer edge of the planing section of the hull make it a concave contour. This shape 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.

TAIL SECTIONS

These are of conventional construction. The only challenging part is in the mounting of the stabilizer. 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 12. In constructing the fin, there are two ribs, F2. The lower one acts like a platform for the stabilizer to sit on, and the upper F2 further secures it. Do not glue the upper F2 in place when building the fin, or it may not be possible to slide the stab through the slot. Glue the upper F2 in place only after the stab has been attached to the lower F2. The angle braces are important for adding strength to the mounting platform for the stab, and further to this, 1/16" sheet covering is added to the side of the fin between the top of the fuselage and the stabilizer mount.

WING CONSTRUCTION

The wing is built in one piece. The basic airfoil is an Eppler 205, 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. First join the two sheets together that show the plan of the wing. The top surface of the wing spar should be a straight line from tip to tip, so use this as a guide when taping the sheets together. Cut the main spar from 3/32" sheet balsa and splice the pieces together over the plan. Notice that the only dihedral is that of the upward sweep on the lower edge of the outer section. This is due to the taper on the spar of the outboard section of the wing. Now glue the 1/8" x 3/32" hardwood strips to the top and bottom surfaces of the spar as indicated. These strips should be bass or spruce.

Cut all the ribs in two at the point where they join the spar. Assemble just the rectangular (non tapered) section of the wing first. Pin the spar on its edge over the plan. It is easiest to start by gluing the rear part of each rib in place first, then attaching the trailing edge. Next glue the front part of each rib in place and then the first inner strip of 1/8" balsa which forms part of the leading edge. The outer strip of 3/16" 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 the rectangular section of the wing has been assembled, one end is propped up a little so that the lower edge of the outboard section of the spar at the other end is flat on the work bench. That section of the wing (the tapered part) is now built in the same manner as the rectangular part, making provision of course for the aileron. When complete, the procedure is repeated to build the tapered outboard section at the other end.

Sheeting is now applied to the lower surface of the wing from the leading edge to the main spar. At this point the wiring should be installed for the motors. It will be noted that the wing is still not torsionally strong, meaning that it can easily be twisted. After the sheeting is applied to the upper surface of the same area, the wing will be very 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, but from that point to the tip there should be 3/16" washout. The remaining strip of 3/16" sheet balsa that forms the leading edge is now glued to the one in place and contoured to shape. Finally sheeting is added to the centre section, and cap strips where indicated.

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.

.

The engine nacelles are built by first gluing the hardwood motor mounts in place, securing them firmly to the leading edge of the wing and bottom surface of the main spar. Next the nacelle bulkheads are glued in place, and the nacelles planked with 1/16" sheet balsa.

The engine cowlings are built in place with the motors installed. Before starting the construction of the cowling, "banana" shaped pieces are cut from 3/16" sheet bass and glued to the front surface of N-2, one at each side. These are for locating the #2 wood screws that hold the cowlings in place. Other "banana" shaped pieces are cut from 1/8 balsa and glued to the front surface of N-2 at the top and bottom. These are to hold the shape of the cowling when it is fitted.

Next the nose blocks are made, but the hole for the propeller shaft should at this point be made just large enough for the nose block to be a snug fit over it. This will hold the nose block in place while the cowlings are built, and later the hole for the propeller shaft can be enlarged. With the nose block held in place by the propeller shaft, start making the cowls by cutting out the inner and outer side panels. These are attached to the 'banana" shaped bass strips with screws, and glued at the front to the nose block. Next apply the top and bottom parts of the cowling, gluing these to the nose block and adjacent side panel sections, but not of course to the pieces attached to N-2. When the glue is dry, take out the screws and remove the cowlings. Now the hole in the nose block for the propeller shaft can be enlarged to give adequate clearance. Before covering the cowlings, small washers should be made from 1/64 ply and placed under the heads of the #2 screws that hold the cowlings in place.

CONTROL THROWS

Control travel for the elevators is 1” up and down. For the rudder it is 1 3/4” each way. The ailerons should travel 1 1/2” up, and no more than 3/4” down. Importance must be given to this amount of differential in the ailerons, and it will be achieved if the control arm on the aileron servo is made as shown. 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 Sealand 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 leveled 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. 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 one more coat 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 Sealand 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 loose. 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. This model was not intended to be a pattern plane, but it is surprisingly aerobatic. With tapered wings, it has an excellent roll rate. It handles loops, rolls and Cuban eights with ease. Be sure to secure the battery well before trying inverted flight or eight point rolls.

Enjoy building and flying your Sealand
Ivan Pettigrew

Summary - Short Sealand

August 2002. Scale 1:9.5 Span 75 ins, Wing area 830 sq.ins. Airfoil, Eppler 205M with leading edge cuff on outboard sections. Length 58.5 ins. Weight with nine RC1700 nicads, 90 ounces. Wing loading 15.6 oz/sq.ft. Motors are two Magnetic Mayhem "reverse" with Master Airscrew 3:1 gearboxes, driving 11x7 APC electric props. Motors are wired parallel, static current, 32 amps from the battery, 16 amps to each motor. Static thrust is 52 ounces at 6,000 RPM. Plug in wheels are optional for flying from land. Very aerobatic. Can fly for over 10 minutes on 1700 cells with conservative use of power, and will fly longer on larger cells.

For further details on flying boats, read the page about “Flying Boat Design’ on www.ivansplans.com

September 2005 update As of mid 2005, the Kyosho Magnetic Mayhem motors are no longer available in most countries. Other racing car or buggy motors of 23 turns give an almost similar performance. The Peak Racing 23 turn Jaguar is a possibility. It has ball bearings and adjustable timing, so can be timed for reverse rotation. If motors of less winds are used, the gear ratio will have to be increased or the prop size decreased. Both of these changes have their disadvantages since gearboxes of higher ratios are more expensive and smaller props are less efficient.

In the Multi motor models that use the Magnetic Mayhem motors in parallel, it has been found that the Jamara Pro 480 HS BB and Permax 7.2 volt Speed 480 motors can give the same performance as when using the Magnetic Mayhem motors. The weight saving with these motors is considerable, and reduces the landing speed quite a bit. These Speed 480 motors are sometimes referred to as “long can speed 400” motors, and are not to be confused with the Graupner series of Speed 480 motors which have a different configuration and thicker shaft, apart from being quite a bit more expensive.

Late in September I changed the motors in my Albatross flying boat from Magnetic Mayhems to the (long can) 7.2 volt Multiplex Permax 480 volt motors and used a 4.1 MP-Jet reduction drive to a 12x8 APC electric prop. Because of the weight saving with these motors, it flies on much less power and the flight time with an eight cell 3,000 NiMH battery increased from about 17 minutes to 28 minutes. The same set up could be used in the Sealand, since it is a little smaller and lighter than the Albatross. The other option with the Sealand is to go with the Jamara Pro 480 HS BB motor and use the MP Jet 4.1:1 ratio gearbox with 10x 7 props.

Because the diameter of the motor can and the shaft thickness of the Jamara 480 and Permax 480 motors are the same as for Speed 400 motors, they use a Speed 400 gearbox. It is claimed by some that these Speed 480 motors can be run up to 170 watts input. In the applications given for the Sealand 480 and Albatross, the input is closer to 125 watts which is a conservative figure that results in better efficiency and longer motor life. The Permax motor has more turns than the Jamara, but of thinner wire. Hence if maximizing the performance, the Permax could be run on more cells than the Jamara, but the Jamara with its winding of thicker wire can take more amps. The efficiency of the Jamara motor is higher than that of the Permax. If a higher ratio gear box is available, the Jamara performance could be improved by using a larger prop, up to 12x8 in size. The Jamara motors are available from John Swain (in England) of www.fanfare.f9.co.uk at Eight Pound each. He sends overseas orders by airmail at a reasonable cost, and can supply the MP-Jet gearboxes and 3mm “long shaft” prop adaptors that are necessary with these gearboxes. Multiplex Permax 7.2 volt Speed 480 motors are available in the USA from Tower Hobbies for $9.50.

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.