SEAGULL SPORT FLYING BOAT
BY IVAN PETTIGREW
CONSTRUCTION NOTES

The Seagull came into being in 1994. Often when camping at a peaceful lake I thought it would be nice to have a quiet electric glider in order to do some relaxed flying. The idea came to mind of building the fuselage of a glider with the bottom shaped into a hull, putting an electric motor on a pylon, and using some existing 2 metre glider wings. Articles by Andy Lennon about flying boat design helped in coming up with the hull design, and also the “Thurston” type wing floats. At first the motor was direct drive to a small 8x4 prop in tractor configuration, and the model flew reasonably well, gave long flights, and landed well. But taking off from water was something else. The glider wing had dihedral, and no ailerons. If the model was not kept precisely into wind on take off, the wing on the up wind side got more lift than the other one, and the tip float on the down wind side dug into the water and turned the model out of wind. Often it was necessary to resort to hand launches when wind conditions did not line up with the direction of take off available. It seemed that a long high aspect ratio wing was not suitable for a flying boat, since during take off and landing it was more difficult to keep the wing floats out of the water than it would have been with a shorter wing of lower aspect ratio. From that experience, three lessons were learned. A flying boat should have little dihedral, not have a terribly high aspect wing, and be equipped with ailerons to keep the wings level during take off and landing.

About this time, plans came out for “Die Schwinge” (The Wing), an electric glider designed by Hal DeBolt. It had an interesting looking wing with a relatively low aspect ratio for a glider. It was decided to built a wing along the lines of the “Die Schwinge”, adding ailerons and reducing the dihedral. The construction of the wing was different too. It turned out to be very strong and light. Since then a similar method for building wings has been adopted for most of my models. The wing spar is full depth, cut from sheet balsa. The ribs are cut in two where they meet up with the spar, then glued to the front and rear surfaces of the wing spar. Sheet balsa is then applied to the top and bottom of the wing from the leading edge to the main spar. This makes a very light “D” tube that is extremely strong and resistant to twisting.

It was soon learned from flying other models that a geared drive with a larger prop gave a much better take off and climb performance. Using a larger prop on the Seagull meant that it was necessary to increase the height of the motor mount. The higher thrust line combined with the added thrust of the geared drive resulted in the model wanting to pitch down considerably when power was added, but this was corrected by using up thrust when the motor was in the tractor configuration. On the plans it is shown as down thrust in the pusher version. This has a correcting tendency to the problem of pitching down under power. With the larger propeller of the gear drive, it is desirable to use a folder, but this is difficult with the tractor version without extending the motor a long way forward on the mount. The folded blades hit the uprights of the pylon. Hence the pusher version was adopted since it makes it easier to fold the prop. Going from the original Speed 600 type can motor (Mabuchi 550) to a 22 turn car motor with nine cells was a great leap forward in terms of performance and makes the model very aerobatic for those who want a change from peaceful soaring.

At some time in the future I still want to experiment with the motor as a tractor instead of a pusher. I don't think it will change the performance, but may make it easier to get the C of G location correct. With the motor in the present position as a pusher, the battery has to be pushed well forward so the model is not tail heavy. I try to avoid a battery hatch forward of the wing because of the difficulty in keeping the spray out. If the pylon uprights are angled forward and the motor extended forward enough, it should be possible to use a folding prop. It would mean that the battery could move back a little and be easier to locate under the wing. The wing is always removed for changing the battery, but it is just held in place by one wing bolt. With a tractor mounting as outlined above, it should be possible to reduce the height of the pylon if the canopy was shortened and the prop blade came down in front of the wind shield. Having a shorter pylon would reduce the "pitch down" tendency that was mentioned earlier.

Watch the weight during construction. The beam (width of hull) of a flying boat is matched to the weight of the plane, so if the model is built overweight, it will sink deeper into the water than it should. This will make for problems getting up on the step during take off, as well as result in both of the wing floats being in the water when only one should touch at a time. The model is capable of flying at a heavier weight, but in such a case should be built with a wider beam to give added buoyancy.

FUSELAGE CONSTRUCTION

This is of traditional box type construction. All wood is balsa unless otherwise shown. Two sides are built over the shaded sticks shown in the plan. Join the sides together with balsa sticks to make the basic “box.” Note that the fuselage is wider at the bottom than the top. This reduces the amount of spray from the bow wave, and keeps it from going over the wing into the propeller blades during take off. Next the upper and lower bulkheads are glued in place, then the top and bottom surfaces are sheeted. Notice there are triangular shaped strips along each side of the forward part of the hull. These reduce spray and add lift during the take off run. The sides of the fuselage can be sheeted forward of the wing, but it is best to leave the sides of the rear section until final assembly has been done and the control pushrods for the tail surfaces have been installed.

TAILPLANE

Notice that the tailplane has a symmetrical airfoil section. This results in a deeper spar which is stronger than it would be if a flat surface was built. It also means that the tail surfaces can be built lighter, and the resulting tail section is less prone to warping. Make the spars first and hinge carefully to get good alignment before proceeding with building the tail surfaces in the usual manner. Waterproof glue is not necessary in all of the tail, but it should be used for the lower part of the rudder which serves as a water rudder. This area should also be waterproofed with something like nitrate dope before covering.

WING. Start construction by cutting out the wing spar from 3/32” balsa. Assemble the full length spar over the plan so that the correct dihedral angle is built in. Next attach the hardwood spars that run part way out the wing. These may be bass or spruce. To start assembly of the wing, pin one half of the spar to the building board with the other half propped up to the correct dihedral angle. Glue the rear part of each rib to the rear surface of the spar, and attach the trailing edge and aileron spar. Because of the curved leading edge towards the tip, it is best to glue the lower tip sheeting to the rear of the spar before gluing the last few ribs in place.

The front parts of the ribs are next attached. Notice that the leading edge consists of two strips of balsa. At this stage, just glue the first (inner) strip to the nose of each rib. When one wing has been assembled to this point, the opposite one can be built by propping up the completed section to the correct dihedral angle. Pin the spar of the second panel to the building board and complete the construction similar to the first one. When completed, the sheeting is applied to the lower surface of the wing from the leading edge to the main spar. Notice that the wing is still not torsionally strong, meaning that it can be twisted quite easily. Some people call this “Ivan’s Spaghetti.” Don’t be fooled by this. It will become very rigid when the sheeting is applied to the upper surface. Hence it is very important to have the wing set in the correct position while applying the top sheeting. This is done by weighting the wing panel down on a perfectly flat surface. There is 3/16” washout at the tip, but washout should only start at the aileron break. Hence the wing should be weighted down flat from the root to the point where the aileron starts. From there to the tip there is the slight twist that gives the correct washout. With the wing firmly weighted down correctly, glue the upper sheeting in place from the leading edge to the main spar. When this has been done, the remaining outer strip of the leading edge is added and shaped to the correct contour. Many modelers wait until a wing is covered before they check for undesirable warps, or wrong washout. Then they heat the covering to twist the wing to correct the problem. This is very difficult to do with a wing built in this manner. It is just too strong and resistant to twisting. If the wing is not true at this point, dampen the sheet balsa covering and weight it down overnight in the correct position. Make sure that opposite panels match so that one wing does not have any more angle of attack than the other. Often an error creeps in at the centre section, and the model will never fly right with this problem. The ailerons are next built. One way to get an accurate fit is to hinge the aileron spar in place first, and then build the aileron with the wing weighted down over the plan. Attention to getting the ailerons to fit flush with the wing surfaces pays off in reducing drag.

COVERING AND FINISHING

It has been found over the years that film covering on a hull does not stand up to repeated use in water. The hull and tip floats are best covered with light tissue (lightest available silkspan) applied with nitrate dope. The silkspan should be applied to the hull and at least the lower half of fuselage. Be sure to prime the fuselage and tip floats by applying two coats of clear nitrate dope before covering. While doing this, waterproof the inside of the hull by also giving it two coats of clear nitrate dope. To apply the tissue, first spray it lightly with water and rub the tissue on to the surface of the hull while damp. Smooth out any wrinkles then brush a coat of dope on to the outer surface of the tissue. It will bleed through the tissue and cement itself to the primed surface below. After it has dried, apply at least two more coats of clear dope. The fuselage 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-can paint is known to be one of the lightest and most suitable for models of this type, but any lacquer spray paint should be suitable. Check for compatibility with the nitrate dope. The good thing about electric models is that the paint does not have to be fuel proof. The wings and tail surfaces are best covered with low temperature film. Mica film used for the lower surface of the wing saves weight and adds strength. It doesn’t look as good as film, but under the wing is not so noticeable. Use high temperature films with caution. Apart from being heavy, the shrinkage can warp lightweight airframes. Water seepage into the tail surfaces can be a problem with models flown a lot off water. Water will get into a tail surface through the slightest opening, and if the surface is covered with film, the lack of breathing results in eventual water damage to the structure. It has been found best to use a covering like litespan or coverlite on the rudder and lower surface of the stab and elevator. It seems to breathe, and avoids the problem of moisture trapped inside.

The CG shown on the plan is the absolute rear limit. Glide will be at its best with the CG where shown, but the elevator will be very sensitive. It is best to start the initial flights with the CG right at the main spar and gradually work it back if necessary. It the model has a tendency to balloon when flaring for touch down, it is an indication that the CG is too far back. For some reason, the Seagull needs very little elevator throw, so this could be reduced as well if the model is too sensitive in the pitching movement.

CONTROL THROWS
Elevator ½" max up and down. Rudder 1½". Aileron ¾" up and ½" or less down. A flying boat needs plenty of aileron differential. Read the notes on Ivan's web page about the design of flying boats. Without aileron differential it may not be possible to keep the wings level and the model straight during the early stage of the take off run.

EMERGENCY FLOTATION
Because of the weight of the battery and motor in an electric model, there is not enough flotation to keep the plane on the surface of the water in the event of a bad crash. Hence it is recommended that blocks of foam board be placed in the fuselage. The small air sacks used as packing are another option. When asked why the model of the Seagull is so light, the writer often points out the little air sacks in the fuselage and says that they are filled with helium. Several model flying boats have flown with foam blocks in recent years, and fortunately this flotation has never been put to the test. But in earlier years the first Seagull was lost following a crash due to radio failure. On arriving in the rescue boat at the crash scene, all that was floating was the wing and horizontal tailsurfaces which had torn lose. The fuselage, complete with radio gear, speed control, motor and battery, was at the bottom of the lake. Had it been a multi motor flying boat, the wing could have possibly 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.

As with all flying boats, full power is necessary to get the model on the step, but the power should be applied slowly with elevator full up, at the same time using 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. As soon as the model becomes airborne, reduce the amount of up elevator so that a safe climbing speed is attained.

One of the peculiarities of the high thrust line is a tendency for the model to pitch skyward at the top of a loop if the airspeed gets too low. To enter a loop, dive to gain plenty of speed, pull up very slowly to make the loop large and graceful, and reduce power at the top of the loop if the model does not follow over naturally into the downward part. Because of having very little dihedral, the Seagull is not as directionally stable in the air as a trainer with lots of dihedral. Anyone who has flown with ailerons will not have trouble. The shape of the tips is rather unusual, but the result is that the model is very resistant to tip stall. In fact, if the elevator throw is not excessive, the model cannot be forced into a spin. It is very safe in this regard, and can be flown safely in a small pond surrounded by trees where it is necessary to do tight gliding turns on approach to land.

The airfoil of the Seagull is quite thin. This gives it a good glide ratio if the speed is kept up. With the prop folded, the Seagull is a great glider. However it is best to keep the speed up until into the flare for landing. When this is done it will float for quite a while, and as with all flying boats, it should not be allowed to touch down until it has slowed down and the model is in a slightly nose up attitude. After touch down hold the stick back to keep the elevator up, and the model will plane on the water for quite a distance before settling. If the model skips on touch down, it is because the landing speed is too high and has not been slowed down to the point where the nose is slightly raised.

Enjoy building and flying your Seagull.

SUMMARY
Seagull, (1994) Non scale flying boat. Span 60 ins. Wing area 550 sq ins. Length 48 ins. Weight with nine N-1900 SCR nicads, 55ozs. Wing loading 14.5 oz/sq.ft. Motor, Outlaw Stock 22T (Predecessor of Magnetic Mayhem) 2 1/2:1 Master gearbox with 12 x 8 Master folding prop clipped to 10 1/2 ins. Static thrust 25 ozs at 7,000 RPM, drawing 20 amps. Selig 3021 airfoil gives glider like performance. Is capable of doing 15 minute flights with 25 to 30 "Splash and Go" circuits. Flights should be longer with NiMH or 3S LiPo cells.

April 2005 update
The present motor of choice is the 22 turn Magnetic Mayhem. It is more efficient than the standard racing car motors because of the armature being a little longer. When running off nine cells the efficiency approaches that of brushless motors. Because it has advanced timing, the Magnetic Mayhem is available for either normal rotation, or reverse. Use the normal rotation if using a single stage gear drive in pusher configuration, but if using in tractor arrangement, the reverse rotation motor should be used. Great Planes now offers a very good reduction drive, the GD-600. An advantage of this gear drive is that it is very easy to change ratios by simply changing the pinion which is held in place with a set screw instead of being pressed on as is the case with other gearboxes. The Magnetic Mayhem can be run off as many as ten nicads or NiMH cells, or 3S LiPo cells. Further to these upgrades, APC now have a very efficient folding propeller. It is necessary to order the hub separate from the blades. The hubs come in two lengths, 45mm and 35mm. The longer 45mm hub seems to be the normal one and gives the diameter that is specified for the blades. The shorter hub reduces the diameter by half an inch. For the Seagull a good combination will be the 35mm hub with a pair of 11x8 blades. This gives a diameter of 10 1/2 inches. Tests on the Magnetic Mayhem with the 10½” x8” combination driven through a 2.5:1 gearbox by a nine cell pack of 1900 nicads gave a static thrust of 32 oz at a current draw of 23 amps. The prop was turning 7,800 RPM. This should make for a sparkling performance.

The Seagull has been a long time favourite for relaxed float flying. On most flights a good part of the time is spent doing “touch and go’s on the water. It is real fun with this model. A typical flight would have about 15 of these, so at the time of writing, with over 300 flights logged off water, this model has probably done well over 4,000 water landings. Let me know when yours has done more. ……..Ivan

May 2007

Total flights is now over 400. It is best to have the CG at the main spar, a little ahead of the place indicated on the plan. Elevator throw should be kept at a minimum to help in making smooth landings, and flight performance is greatly enhanced with using a 3S LiPobattery. The LiPo cells are much lighter than those used previously, so need to be well forward of the location shown on the plan. A hatch has been made so that the area of the canopy can be removed for access to the new battery location.

October 2010

Total flights are now 600. My all time favorite flying boat for fun at the pond. Performance is much enhanced now with an Astro Flight 020 brushless motor and 3S LiPo battery. Because of the lighter weight, the battery needs to be right up in the nose, and the canopy area has been made into a removable hatch for battery access. There is no problem with water getting in up there. It is ahead of the wake line. The battery needs to be at least 2500 mAh to give enough ballast weight. The model has enough power and duration on a smaller size 3S LiPo, but there may not be enough weight for balance. It is better to carry a larger battery than add ballast. The model seems to fly forever on a larger battery.

July 2014

The Astro .020 geared inrunner that had been given to me in a very used and abused condition finally died. The replacement is an E-Flight Park 450 which gives a very healthy performance with a 9x6 folding prop. A Turnigy Park 450 outrunner should also do well. These can be propped for about 15 amps.

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