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PLAN #1335

ARROW

.35-.60 Powered Amphibious Delta Sport Flier

In 1986, the plans for an amphibian model that I designed called the North Star, were published in the pages of this magazine. To my amazement, after nearly two decades have passed, this model is still being constructed in many parts of the world and Balsa USA continues to produce kits for the North Star to this day. Since the inception of this model, various delta wing model designs seem to dance around in my head. The Arrow presented here is a simplified version of the North Star.

This model is amphibious as was the North Star. Characteristic of deltas with a light wing loading is that it has a great speed range. The Arrow can burn up the sky while performing high speed passes, but it can also be slowed to almost a crawl during landing. Any glow engine from .35 to .60 cu. in. can be used to power this model. Alternatively, electric power enthusiasts can achieve good performance by using the appropriate brushless motor. The wing halves plug into the fuselage, which makes transportation of the model a simple task even in the smallest of "aircraft carriers." No fiberglass was used in the construction of the Arrow. If you decide to build this model, and are seeking solid performance, then build it as shown on the plans. I am aware from past experience, that some of you will modify the design. In this case, be certain to keep the wing planform, C.G., and location of the engine elements consistent with those indicated on the plans.

The prototype was constructed by using instant glues exclusively, following the building sequence described below.

CONSTRUCTION

The wing is built first. As mentioned earlier, the wing halves plug into the fuselage. Two 3/8" o.d. carbon fiber tubes with 1/16" wall thickness protrude from each wing half. These tubes plug into square plywood box receptacles inside the fuselage. Construct these tube boxes from 1/8" birch plywood. Cut out strips for the box sides as shown on the plan. Wrap the carbon fiber tubes using one layer of clear (food wrap) plastic. Glue the plywood strips around the carbon tubes to create a square box. Once the glue has cured, pull the tubes out and set them aside.

Cut out all of the ribs. Ribs W1 and W3 are cut from lite ply while all other ribs are cut from balsa sheet. Be certain to mark the location of holes for the carbon fiber tubes very accurately since this is critical to alignment.

Cover the plan with clear plastic. Directly over the plan, pin the leading and trailing edge sheeting to the building board. Mark each rib's location line on this sheeting so that it will be easier to position the ribs. Glue the wing's root and tip sheeting

between the leading and trailing edge sheeting. Glue in all capstrips between the leading and trailing edge. Glue the bottom main spar and the trailing edge spar to the sheeting. Position and glue all the ribs to the bottom capstrips and to the trailing edge sheeting. NOTE: it is important to align rib W1 square to the building board. Insert and glue in the top main spar. The leading edge sub-spar is cut from 3/16" balsa sheet. Sand this spar on angle so it will follow the contour of the ribs, then glue this leading edge sub-spar to the ribs. Pull up the bottom leading edge sheeting and glue it to the bottom of the ribs and to the leading edge sub-spar. Next, glue the four balsa blocks to the trailing edge sheeting that are used to attach the elevon hinges. Cut four carbon fiber tubes to the indicated lengths. Use balsa scrap pieces to plug the tubes at both ends. This is done so that water cannot enter the wing when operating from water. Insert and glue the carbon fiber tubes to the ribs.

Glue on the top main spar, then the top trailing edge and leading edge sheeting. Glue a hardwood block to rib W1 as shown on the plan. This block is used to secure the screw for the "L" shape metal bracket, which is employed to hold the wing to the fuselage. Glue on the sheeting between the leading and trailing edge over ribs W1 and W2 and W6 and W7. Glue on all top capstrips and the leading edge capstrip. Sand the wing.

Build the other half of the wing using the same process.

The engine nacelle, pylon, and fin are built next. Cut out the four nacelle side pieces. The balsa grain of the rear section of the nacelle side is horizontal. Front section is vertical to make bending easier. Cut out the firewall (F12) and the front plywood ring (F13). Drill holes in the firewall for the engine mount, the fuel lines, and for the throttle's NyRod tube. Glue 1/2" triangular stock to the nacelle sides. Use a razor saw to make a series of cuts into the triangular stock approximately 7/16" deep and 1/2" apart. This will make bending of the sides in the front much easier when gluing the plywood ring in place. Glue the firewall between the nacelle sides. Glue on the top and bottom sheeting. Glue the plywood ring to the front of the nacelle and sand the nacelle to shape. Cut out a square hole for the spruce post in the bottom of the nacelle as indicated on the plans.

The pylon is made in two halves, left and right, to be glued together in a later step. First make the post for each half of the fin. Use two 1/4" x 1/4" spruce sticks glued together to create a 1/4" x 1/2" post. Cut the post to length and pin it to the building board. Glue the bottom rib F11 and top rib F10 to this post directly over the plan. Make certain that both ribs accurately line up with the drawing. Glue the leading edge and the trailing edge of the fin to the ribs and then glue on the sheeting.

Carefully trace the pylon plan onto light paper. Turn the paper over and make sure you can see your traced lines through it. Pin the light paper to the board and build the second side of the pylon over it. Glue the two pylon sides together and run the NyRod throttle tubing through the notches in the top and bottom ribs. Glue on leading edge capstrip, then sand the pylon.

At the bottom of the nacelle, cut a slot for NyRod throttle tubing. Feed the NyRod into this hole and the hole in the firewall so that the tube protrudes into the engine compartment. Glue the nacelle to the pylon rib F11 and the fin's post to the back of the firewall. Glue the fin to the top of the nacelle.

Now for the fuselage: Glue two 1/8" thick and 3" wide balsa sheets together to create one 6" wide sheet. On this sheet, transfer the outline for the fuselage sides, centerline and positions of all the formers, and the square holes for plywood boxes. Cut out the sides. In the fuselage sides, cut out the two square holes for the plywood boxes. On the inside of each fuselage side, glue the plywood doubler that is used to hold the landing gear block. Again, on the inside of the fuselage sides, glue in the 1/2" triangular balsa stock and the 1/4" x 1/4" balsa longerons.

In the radio compartment area, glue in the short 1/4" x 1/4" balsa sticks that will give support to the radio compartment walls. Pin one fuselage side to the building board and position formers F3 to F9 in their indicated location. Using a square for align-ment, glue these formers to the fuselage side. Note: Former F3 must have 5/32" i.d. brass tubing attached using epoxy and thread. This tubing will accept the nose gear wire. (An accessory nose gear mount could also be used.) You will need to cut a hole in the bottom sheeting to install the nosewheel strut. Be sure to cover this hole with packaging tape before flying from water. Next, align and glue the other fuselage side to these formers. Re-position and pin the fuselage over the fuselage centerline as indicated on the drawing and glue in formers F1 and F2. Next, the square plywood boxes are inserted into their holes and both wing halves plugged into them. Check alignment and then glue the boxes to the fuselage side and to the formers F7 and F9. Unplug the wings and feed the NyRod tubes used for rudder and elevons and the tube for the receiver antenna through the holes in the formers.

Designed by:
Laddie Mikulasko

TYPE AIRCRAFT
Amphibious Delta

WINGSPAN
44-1/2 Inches

WING CHORD
30 Inches

TOTAL WING AREA
801 Sq. In.

WING LOCATION
Mid Wing

AIRFOIL
Symmetrical

WING PLANFORM
Delta

DIHEDRAL, EACH TIP
0

OVERALL FUSELAGE LENGTH
52 Inches

RADIO COMPARTMENT SIZE
9" (L) x 5" (W) x 5" (H)

VERTICAL FIN HEIGHT
13 Inches

VERTICAL FIN WIDTH (inc. rud.)
11-1/2 Inches

REC. ENGINE SIZE
.35-.60 2-Stroke

FUEL TANK SIZE
10 Oz.

OPTIONAL LANDING GEAR
Tricycle

REC. NO. OF CHANNELS
4

CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.

C.G. (from L.E.)
10-1/2 Inches

ELEVATOR THROWS
5/8" Up – 5/8" Down

AILERON THROWS
3/8" Up – 3/8" Down

RUDDER THROWS
1" Left – 1" Right

SIDETHRUST
–

DOWNTHRUST/UPTHRUST
–

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Balsa, Ply & Spruce
Empennage	Balsa
Wt. Ready To Fly	88 Oz. (5 Lbs. 8 Oz.)
Wing Loading	16 Oz./Sq. Ft.

Glue on the top fuselage sheeting and draw the centerline on this sheeting. Cut a square hole in this sheeting for the pylon's post and the holes for the Nyrod tubes for the throttle and antenna. On the inside of the fuselage, glue a small plywood block to the top sheeting behind F5 for the screw holding the radio compartment hatch in place. Slide the throttle NyRod into the hole in this sheeting and into the holes in the fuselage formers, then slide the fin's post into the square hole. Be certain to check for proper alignment and, once satisfied, glue the fin to the top fuselage sheeting and to the former F9. At the bottom of the fuselage, glue in the landing gear blocks. Inside the fuselage between formers F7 and F8, glue in small hardwood blocks to hold the "L" shape metal bracket that holds the wing halves to the fuselage. Drill vertical holes for the 5/32" landing gear piano wire.

Glue on the bottom fuselage sheeting. At the fuselage step, glue a 1/8" x 1/2" plywood strip to strengthen the step's edge. Glue on the nose cone block.

Sand the fuselage, then cut out the radio compartment hatch. At the rear of the hatch, glue in a plywood block. Two screws will hold a metal landing gear clip to secure the hatch in place. A 1/8" dowel is glued into the front former of the hatch. On the bottom of the fuselage, glue on the sub-fin.

Cut the rudder out of 1/4" balsa sheet. To match the thickness of the rudder and the thickness of the pylon, glue 3/8" balsa sheets on both sides of the rudder above the wing. The lower portion of the rudder below the wing remains 1/4" thick to match the thickness of the sub-fin under the fuselage. Sand the rudder to a taper.

For aesthetics I added leading edge extensions (lex) to the wing's halves. This is optional, but if you wish to add them, cut out all the pieces for the leading edge extensions. Plug the wing into the fuselage with food wrap in-between to protect the fuselage. Glue the lex ribs to the wing, followed by the lex spine and then the top and bottom lex sheeting. When done, remove the wings.

Cut out the elevons from 3/8" thick balsa sheet and sand them as shown on the fuselage drawing.

The model is now ready for covering. I covered the prototype using iron-on plastic film. To make certain that water does not soak the raw balsa, I brushed on one coat of Balsarite adhesive. After the adhesive is dry, sand the model using 150-grit sandpaper and cover the model. Take care to be sure that there are no openings at seams that allow water to get between the covering material and the balsa. When you are finished covering, install the elevons. The slots for these hinges must be made where the balsa blocks were glued to the trailing edge. Install the rudder, then install and connect all pushrods. Install the engine. Mount the servos inside the radio compartment in a location that will help make the model balance within the C.G. range shown on the drawing. C.G. balancing is done with the fuel tank empty. If the model is tail heavy, the receiver battery can go all the way to the nose.

Check all the controls. The deflections of the control surfaces are such that when moving the elevator stick, the elevons move 5/8" up and down (measured at the root of the wing). When moving the ailerons stick, the elevons move 3/8" up and down from the same reference point. The rudder should move 1" left and right. To secure the wing to the fuse-lage, make two "L" shape brackets. Be certain that this bracket is made from 1/32" thick aluminum or steel. Bend these strips to a 90 degree angle as indicated on the plans and drill two holes. These brackets will hold the wing to the fuselage using two screws. One screw will hold the bracket to the fuselage and the other to the wing.

Flying

The model is easy to fly. Just point it into the wind and apply power. On your first flight, let the model pick up extra speed before rotating. Gain altitude while keeping your eye on the model at all times. If you are not used to flying a delta wing model, please be aware that because of its un-conventional shape, inattention may cause disorientation in your early flights. The model will roll, loop, fly inverted, and can be flown in very tight circles. Landings are as straightforward as those of a well-behaved conventional model. The extreme slow speed qualities of the Arrow can be explored by following this procedure. At a safe altitude, slowly reduce the power. At the same time, start raising the nose using elevator input. At some point, the model will begin to sink (mush) straight down. By increasing the power slightly, the model will travel forward at very low speed. I enjoy using this flight mode while conducting my approach to landing. For flying from a firm surface, install landing gear. The model can be flown without the landing gear when flown from grass, and you must remove the landing gear when flying from the water.

This is a unique, versatile, and compact model that I hope you will enjoy.

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