PLEASE READ THIS FIRST

Many thanks for buying the MOTH !

To ensure a great maiden flight, there are several things we really, really want to emphasize before you begin building the kit, and before your first launch.

(a) **NAIL THE CG!!!** Plank wings are very CG-sensitive. If you are as little as 1/32" off of the recommended location, performance can suffer. Also, please make sure to follow the "Finding the Sweet Spot" procedure on page 18 of the manual… you will be glad you did!

(b) **DO NOT EXCEED THE RECOMMENDED ELEVATOR THROWS!**
As a result of being CG-sensitive, plank-style ships need very little up / down elevator travel. Use the Dual Rates and/or End-Point Adjustments on your transmitter to dial-down your elevator to the recommended throws listed in this manual.

(c) **TRY TO BUILD THE MOTH TO MANUAL SPECS.** We have built and extensively tested different Moth prototypes and have combined the strongest points of each for this kit. Remember, ANY excess weight that accumulates behind the CG may ultimately need up to twice that amount in balance weight in the nose to rebalance the ship. If you add in the original excess weight, the ship's all-up-weight has just increased significantly! Try to avoid a ton of extra strapping tape, excess unnecessary glue, etc., and build this kit exactly to the methods we describe within the manual. This will produce a ship that's strong, aerodynamically clean, has a versatile speed range, ample strength, and is very fast.

As you flip through the manual, you will see that we have gone to great lengths and used many paragraphs to cover certain procedures in great detail, though that entire procedure may only take 2 minutes to complete. For example, if you were to describe, word by word, the entire process of "Microwaving and Eating a Frozen Burrito" from opening the wrapper to swallowing the last bite, it would probably take several pages. Yet, that entire process only takes a few minutes (when you're really hungry, anyway). So, we felt it necessary to describe each procedure, adequately and in-depth. A few extra minutes of building time can mean the difference between a rock solid, durable aircraft, and something that comes apart on the first impact. As an added benefit, you will be able to use some of the techniques you're about to learn here in building other airplanes as well. So?.... Don't rush it… Build it solid and clean.

We are always learning, modifying, adjusting and improving our aircraft. Consequently, we continually update our website with the latest findings. The "Latest News" and FAQ sections can be checked for reference, and we also have several links to photo-builds that may be of great help during the building process.

We would love your feedback, both on the building process and flight characteristics. Feel free to email us at flight@northcountyflyingmachines.com.

THANKS!!

NCFM ☺

Span: 48″
Weight: 14-22 Oz.
Wing Area: 336 Sq.In.
Core Material: EPP Foam
Wing Loading: 6–9 Oz/SF

The Moth

High Performance

48″ EPP Aerobatic Slope Racer

North County Flying Machines

Note: There is also a "Frequently Asked Questions" (FAQ) section on our website that may provide useful tips and up-to-date information.

www.northcountyflyingmachines.com

(858) 485-1137

03/09/2017

ASSEMBLY INSTRUCTIONS:

Kit Includes:

2 Wing Cores (CNC machined,1.3lb Density EPP)
1 Fuselage Blank (CNC machined,1.9lb Density EPP)

2 Wing Spars (22.5" carbon tubes)
1 Secondary Rear Spar (10" long carbon tube)
1 Longeron (19" fiberglass tube)
2 Drag Spars (1/4"x1/8" x24.5" basswood)
2 Spar Cap Filler Strips (1/4"x1/4"x24" balsa)
2 Elevons (Weight-matched triang. section balsa)

1 Spar Joiner (Aluminum tube)
1 Drag Spar Joiner (Triangular shaped basswood)
2 Elevon Control Horn Sets
4 Machine Screws
4 Nylon Clevises
2 Threaded Control Rods
1 Foam Dowel
1 Fin (two 1/8"x 3"x 6" balsa sheets)

Materials Needed:

Epoxy (5 Minute & 20 or 30 Minute)
"Goop" Glue (Marine Goop w/ UV Protect is best)
"Goop" Thinner (Toluene, Xylene, etc.)
Gap Filling Cyanoacrylate Glue(Thick C.A.)
1" Strapping Tape
Masking Tape
3M77 Spray Adhesive (or similar)
Drywall Screen and/or Misc Sandpaper
Ultracote® covering or Similar
Sharp X-acto knife and No.11 blades
T-pins (buy at hobby or office supply store)

Recommended Servos: (2) Hitec HS85-MG
Recommended Receiver:(1) Castle Creations Berg 4L
Recommended Battery: (1) 350 mAh NiMH Flat Pack

Transmitter requirements:
Please be advised that to operate this model the transmitter should have the following capabilities:

1. Elevon Mixing
2. End-Point Adjustments and/or Dual Rates

C O N T E N T S :

BUILDING THE WING

Joining the Wing Halves, Gluing in the Spar and Shaping the Tips:

1. On a flat, straight surface, tape the bottom wing beds together. Glue the wing halves together with 5 min. epoxy and set the wing into the beds to cure using a piece of wax paper or plastic grocery bag, between the wing/beds, to prevent sticking.

2. Run two strips of masking tape on each side of the spar groove from wingtip to wingtip. Without using glue yet, position the two Carbon Spars fully into the Aluminum Spar Joiner and center this assembly on top of the spar groove. The Spar Joiner is wider than the spar groove so use a pen to mark the outline of the Spar Joiner on top of the wing. Also mark the ends of the Carbon Spars near the wing tips on the masking tape (approx. 2" in from tip). Now remove the Spar Assembly from the groove and using a sharp X-acto knife cut along the outline you made and remove the excess foam to make room for the Spar Joiner to fit in the spar channel. Now cut two small pieces of foam from the end of a wing bed to fit the tip area of the spar groove (from your mark to the very tip of the wing). Glue these into the tips of the groove (using Goop will allow flexibility for both shaping and impacts). Let the glue set-up (It doesn't have to cure completely. Just long enough so the foam fillers won't "re-position" during the following procedure). Next cut the two provided **¼" x ¼" x 24" balsa** Filler Cap Strips to match the exact length of the Spar Assembly (when inserted into the Spar Joiner and installed in the spar channel) Sand the underside of these strips where they fit over the Aluminum Spar Joiner at the center of the wing so the fit snugly without rocking. Set these aside for the end of Step 3.

3. It's time to glue in the spars. But first a word about the glue:
   We recommend using Polyurethane glues ("Gorilla Glue" or "Elmer's Ultimate Glue") instead of epoxy, for the main spars and fuselage longeron. In our experience it fills gaps better and is far stronger for these applications. If you decide to use Polyurethane glue (PU), we ABSOLUTELY recommend that you read the directions on the bottle first and run tests on a scrap piece of foam! It will foam-up considerably and, if you are not prepared, things can get out of hand very quickly. This is not to discourage you from using PU. On the contrary we want you to use it, but gain some experience before you start

   A word of caution when using PU glue in this step: …Make sure you protect the bottom of the wing to avoid the PU from oozing through the cores and gluing them permanently to the beds! … One method is to lay down strapping tape on the beds, from the root to the tip, where the spar channel would lay on top. PU glue doesn't like to stick to the smooth side of the strapping tape!

   These instructions will be providing directions for applying two-part epoxy glue since it is the easier process. For directions on how to apply polyurethane glue refer to the instructions elsewhere on this DVD.

   Now then, let's start: First, rough sand both Carbon Spars for a better bond.
   Mix up a generous amount of slow epoxy* (no faster than 20 min) and distribute it along the entire length inside of the spar groove (now with glued-in foam dams at either end). Spread the epoxy along the sides of the groove with a small piece of wood, making sure that the groove is wetted all the way to the top and out to the tips (the masking tape will prevent overflow from getting on the wing). Remove excess epoxy—leave just enough so the entire spar groove is wet. Quickly, (since the glue is now "on the clock") epoxy the two Carbon Spars fully into the Spar Joiner and press the entire

spar assembly in the spar groove. Dribble a little excess epoxy on top of the spar and add the balsa Filler Cap Strips. Make sure the wing is properly seated in the bottom wing beds and position some small weights along the span of the wing to keep everything flat until the epoxy cures (remove the masking tape while the epoxy is still wet). When the epoxy has cured, carefully sand the balsa Filler Cap Strips and foam tip fillers flush with the airfoil.

4. Using the provided Tip Pattern (see Diagram C), cut the tips to shape—make the cut slightly oversize, then do the final shaping/rounding with 120 grit drywall screen or sandpaper.

Installing the Drag Spar:

This is the most important joint on the plane… MAKE IT STRONG!

1. Apply slow epoxy to one side of one the **1/8" X 1/4" x 24" basswood** Drag Spars. **Do not apply epoxy to the first 2-1/2" of this basswood Drag Spar.**

2. Position the Drag Spar on the trailing edge of the foam wings so that the end that's missing epoxy is at the center of the wing.

3. Repeat the process for the other Drag Spar. **Do not forget to leave off the epoxy from the first 2-1/2" of the side to be positioned at the center of the wing.** But do put a small dab of epoxy on the very end of this Drag Spar where it butts the first one. The idea is to glue the two Drag Spars together and to the trailing edge, but not to the area of foam in the middle 5" of the wing.

4. Once positioned correctly (Refer to Diagram 1), the Drag Spar should be taped to the wing with short pieces of masking tape; while the epoxy is still wet, place the wing back in the bottom beds (use wax paper to prevent unwanted gluing!) and weight it down to assure that everything remains straight and flat. Make sure that the ends of the Drag Spars are butting each other and align perfectly.

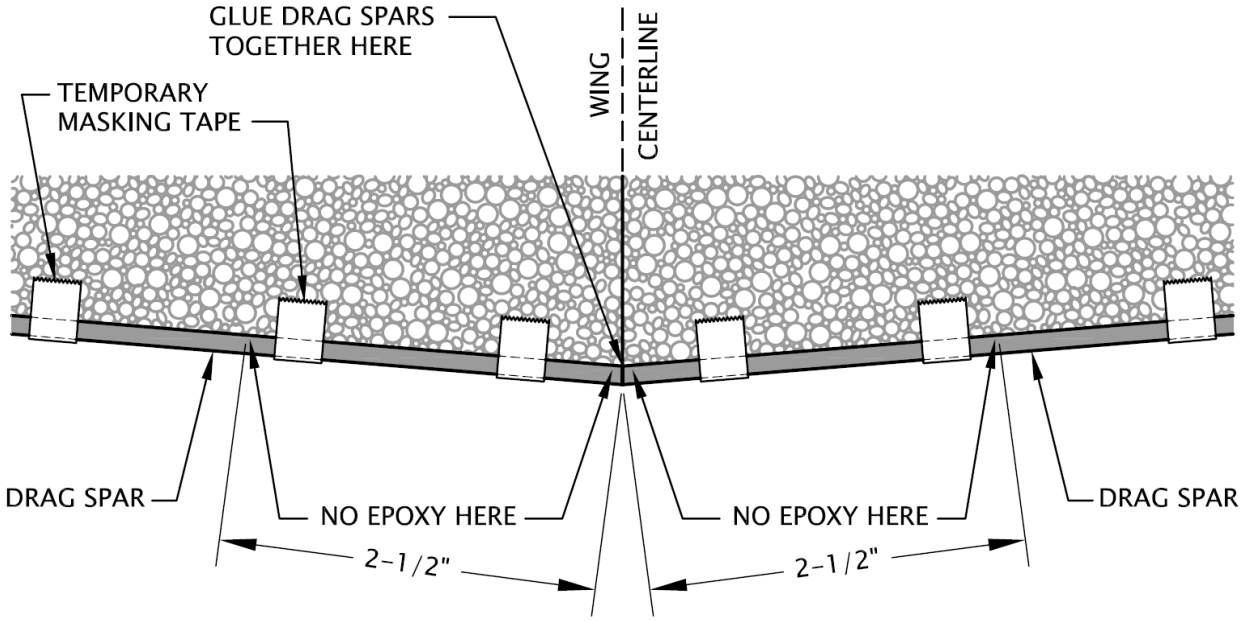


DIAGRAM 1
INSTALLING THE DRAG SPAR

5. When the epoxy is cured, position the supplied triangle shaped basswood Drag Spar Joiner on top of the wing at the trailing edge and align the two equal sides with the inside face of each Drag Spar (this is the side that's adjacent to the foam wing). Using a felt tip pen, draw a line along the long side of the Joiner, on the foam wing. (Refer to Diagram 2).

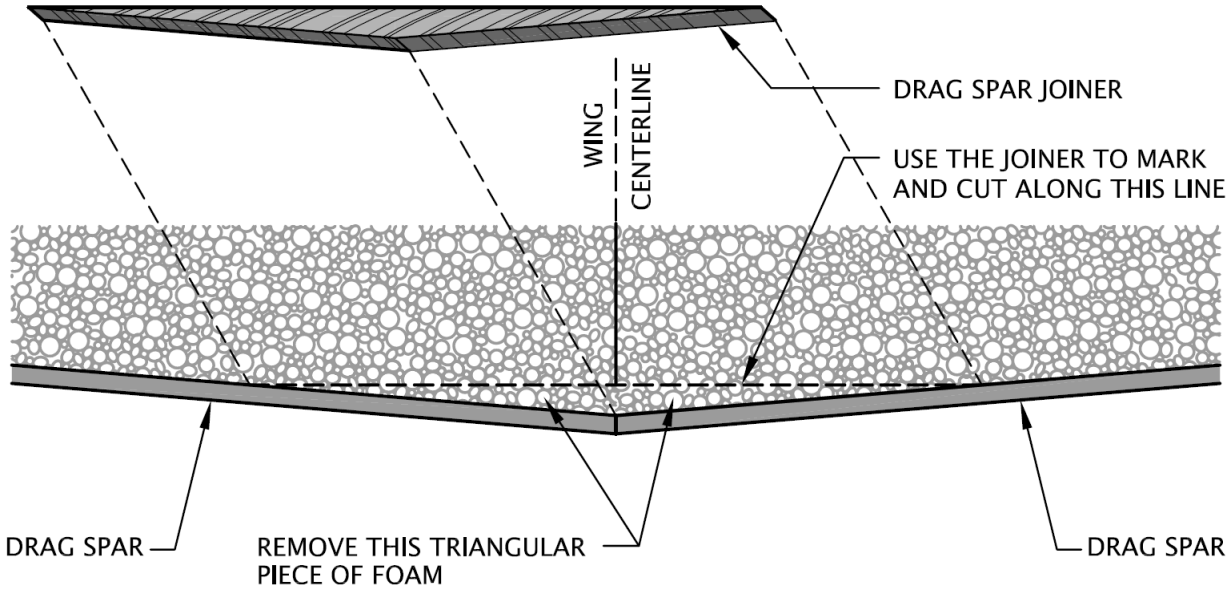


DIAGRAM 2
MARKING THE JOINER LOCATION

6. The triangular piece of foam between the line you just drew and the unglued edges of the Drag Spars, needs to be removed. Once removed, you can glue in the basswood joiner in its place. Remove this triangular piece of foam by making a single cut along the line you drew on the foam. The triangular piece of foam should fall out. If epoxy ooze has glued the triangular piece to the Drag Spars, using your knife, cut the foam free of the Drag Spars.

7. Test fit the Drag Spar Joiner in the triangular hole you have just created. **The joiner should fit as tight as possible to the Drag Spars.** If the joint is not tight remove the joiner and sand or smooth the offending edge and retest for a tight fit. The fit between the joiner and the foam wing is not as critical. It will be filled with glue shortly.

8. Once you're happy with the fit of the Drag Spar Joiner, mix some 5-minute epoxy and glue it in place. Make sure you have positive contact between the Drag Spars and the joiner and enough glue to fill the gap between the foam and the joiner. (Refer to Diagram 3)

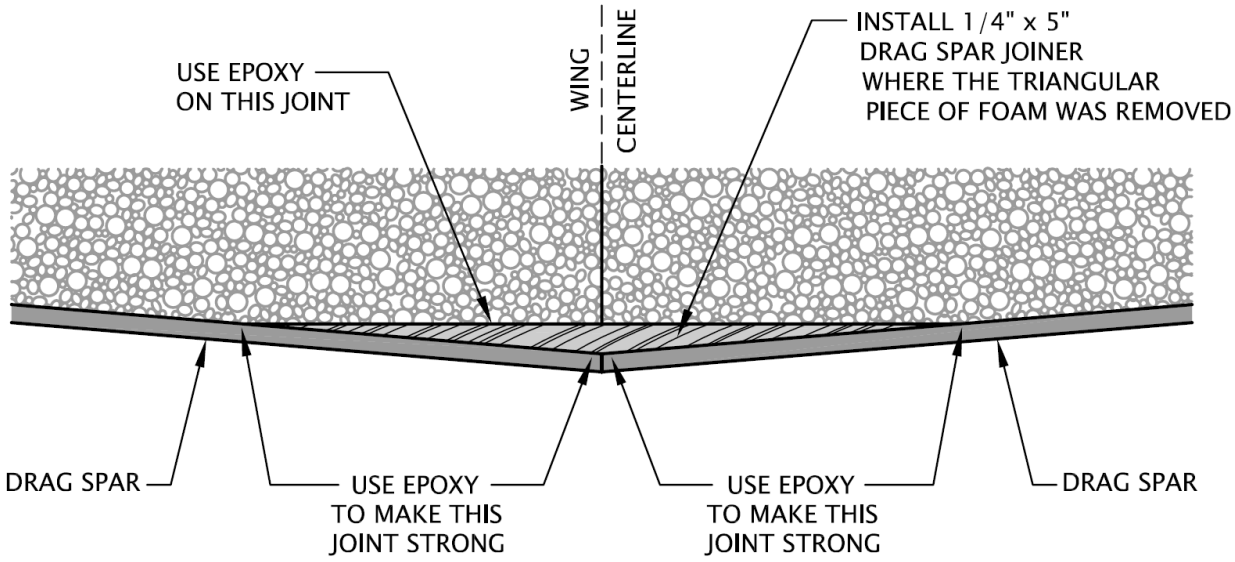


DIAGRAM 3
INSTALLING THE JOINER

9. After the epoxy has cured, sand the top and bottom of the Drag Spar Joiner flush with the Drag Spars and the foam wing. If there are low spots fill them with light weight spackle before you apply the covering.

10. Gently round off the tips of each Drag Spar to match the wing tip.

<u>Installing the Secondary 10" Carbon Spar:</u>

Included in the kit is a 10" x .187" diameter carbon tube. For anything other than ultra-light, thermal flying, we do recommend the installation of this 2nd spar for maximum strength.

<u>Installation:</u> The 2nd spar is located 3" behind the main spar, centered in the wing (span wise). Using a Dremel, or other method of choice, rout or cut out a 10" long by 3/16" wide groove for the spar, about ¼" deep. Glue the spar into place using Epoxy or Goop. Fill any gaps above the spar with scrap balsa, glue, etc., flush with the airfoil.

Installing the Servos: (See Diagrams A and B at the end of this manual)

The Moth was designed to use Hitec HS-85MG Servos, but any "Mini Servo" of similar size will do, with one provision: The servo leads must be long enough to provide at least a couple of inches beyond the leading edge so that the servo can be plugged into the receiver after the wing and fuselage have been joined together and the receiver is still outside the fuselage.

1. Position the servos on the bottom side of the wing, close to, but not into the area where the fuselage will be (if the servos are covered by the fuselage, you won't be able to remove them if it is ever necessary to change a gear, etc.). It is recommended that the servo flanges be cut-off so the servos can be mounted firmly against the carbon spar. Trace around the servos with a pen and cut out just enough foam so that the servos fit flush inside the wing (make sure you have cut out enough space for the servo arms to go through their full range of motion—see diagram A).

2. *"Potting the Servos":* Since the Moth has the ability to see extreme speeds, and the necessary elevon throw distances are very little, you won't want ANY wiggle in the servos themselves. EPP has very little compressive strength, so we strongly recommend "potting" the servos.

   Procedure: (do one servo at a time)

   (a) When you are finished with Step 1 above, wrap the servo in a poly sandwich bag, or piece of a black trash bag.
   (b) Mix a batch of 5-Minute Epoxy and apply it to the walls and bottom of the servo well in the wing (just enough on the bottom to cover the foam, and try to avoid the area where the servo drive arm is located).
   (c) Press the *wrapped* servo into the cavity while the epoxy is still wet, making sure it is perfectly positioned, and either slightly below, or flush with the airfoil (not sticking up above the surface of the wing).
   (d) When the glue has cured, remove the servo, then peel the plastic bag away from the epoxy and discard. You should now have a perfect mold of your servo shape, allowing the servo to "snap in", with near zero movement.

3. *Routing the wires:* Still on the bottom of the wing, make a shallow cut from the servos to the leading edge and bury the leads in the foam (refer to both the wing and fuselage diagrams). The leads should exit a little to the left of center, on the topside of the leading edge. (Remove servo control arms prior to covering… this makes gluing the wing into the fuselage much easier).

Covering the Wing:

1. *Taping the leading Edge: (**Do not sand the leading edge** - the strapping tape and Ultracote, when shrunk, will round the LE appropriately).* Temporarily cover the servos and exposed ends of the servo leads with masking tape for protection. Spray a 1" wide strip along the entire leading edge, both top and bottom, with adhesive spray (3M-77, etc.). Allow this to dry for ½ hour and then, lengthwise, apply the 1" wide strapping tape, first on the top surface of the LE, and then on the bottom. Tighten these strips with a hot iron and then add one more strip which wraps around the LE ½" on both top and bottom.

2. *Covering the Wing:* The wing may be covered with either Ultracote or packing tape. Using MonoKote is not recommended as the gasses released when heating can cause bubbles on the surface. Whichever covering material you use, first spray the entire bottom surface of the wing with adhesive spray and let dry ½ hour before applying the covering. If using packing tape, start at the trailing edge and work toward the leading edge, with about a ¼" overlap between each strip of tape. If using Ultracote, etc., the bottom surface of the wing can be covered in one piece. After covering, iron the edges flat before repeating the process on the top surface. When the wing is completely covered, shrink the covering with a hot iron (practice on a scrap piece first, to establish correct temperature). Leave the servos covered until after the wing has been glued into the fuselage. When the covering is tight, return the wing to the bottom beds and insure that there are no warps or twists (which can be straightened out with a hot iron).

Elevons: (This procedure should be completed after the Wing and Fuselage have been joined).

1. Cut the elevon stock to length, leaving 1/8" gap between the elevons and the fuselage. Using a sanding block, finish beveling both elevons to 30 degrees (see diagram A). There is always a slight variance in elevon stock thickness from the manufacturer. If yours are thicker than ¼", make sure to sand them to ¼" or slightly less, to avoid serious drag near the trailing edge of the airfoil.

2. Cover the elevons with packing tape or Ultracote (adhesive spray is not necessary on balsa wood). Attach them to the wing with full-length strips of tape (a tape thickness of 3 mil. or greater is recommended, and a width of 1" is typical); make sure the elevons can move through their full travel without binding.

Next: Building the Fuselage

BUILDING THE FUSELAGE

The fuselage is supplied in multiple parts. These parts need to be assembled in the proper order and the entire assembly shaped and covered before the wing and fuselage can be joined. Consult Diagram 4 below, for a visual explanation of the assembly process. Diagram "B", at the end of this manual, shows the completed fuselage and its components.

Start by preparing the parts:

1. Rough-sand the exterior of the fiberglass Longeron for a good glue bond. Use 150 grit sandpaper and put some serious scratches on the Longeron until it's not shiny. Use a wet paper towel to remove all the sanding dust.

2. Squeeze generous amounts of polyurethane glue (Gorilla Glue or similar) or epoxy (no faster then 30 Minutes) into the groove of the Fuselage Bottom. Make sure the glue is evenly distributed along the groove.

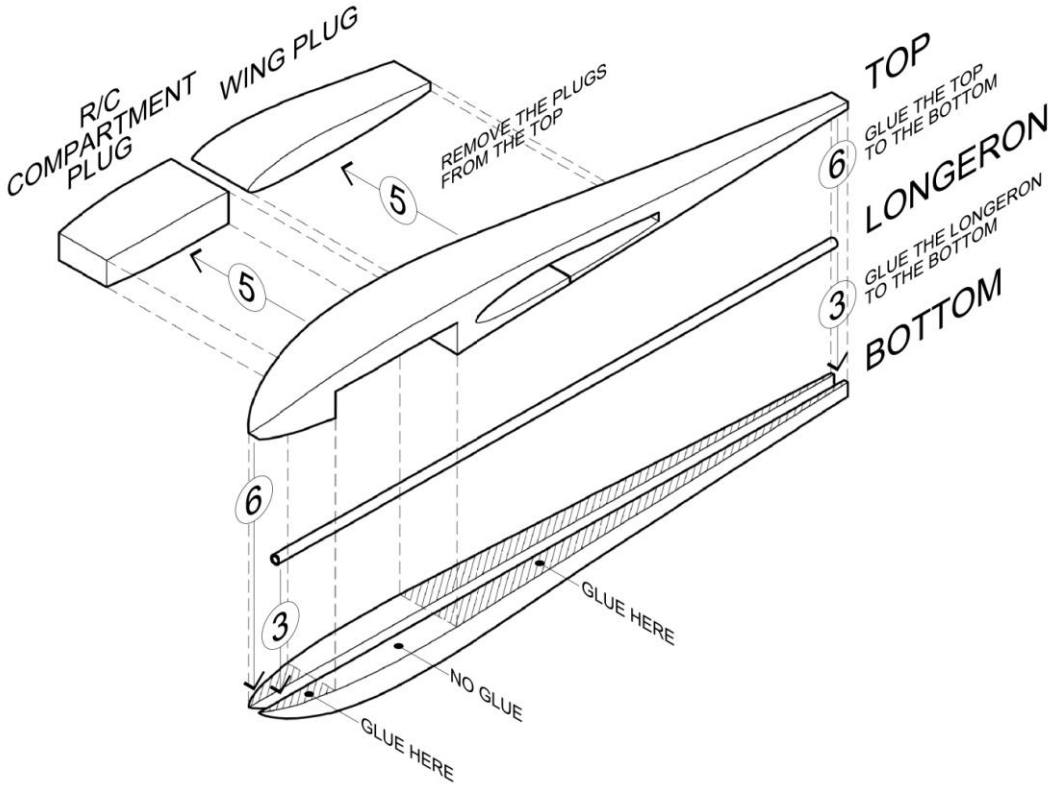


DIAGRAM 4 - FUSELAGE ASSEMBLY

3. Place the Longeron into the groove and make sure that its back end is flush with the rear of the Fuselage Bottom. As you push the Longeron down in the groove, glue should ooze up and cover the top of the Longeron. If this doesn't happen (you were not generous with the glue!) squeeze some more glue on top of the Longeron and make it completely wet with glue. Don't allow glue to stand proud of the top of the groove as you would have to sand it off later. Also make sure the Longeron is completely in the groove and no part of it sticks out. Allow the glue to cure completely.

4. After the glue has cured, sand off any excess glue that is sticking out of the groove. The top of the Fuselage Bottom needs to be perfectly flat so you can glue it to the Fuselage Top.

5. Remove the R/C Compartment Plug and Wing Plugs form the Fuselage Top and save them. They will be put back later when you are shaping the fuselage, but you don't want them to be permanently glued in the next step.

NOTE: If you are planning on installing a charge jack (combination charging receptacle and on-off switch) on top of the fuselage, this is a good time to make preparations for it. Once the top and bottom of the fuselage are joined, access to the roof of the R/C Compartment will be limited. Consult the instructions for the charge jack for requirements.

6. Glue the Fuselage Top to the Fuselage Bottom. Use glue only in the areas where they come in contact (see shaded areas in Diagram 4). You can use Epoxy Glue or Polyurethane Glue, but in either case don't use too much; It will make the shaping operation difficult in the next step. The best way to keep the two parts properly aligned and pressed together is to use pins. Straight pins work fine but T-pins work better as the head will lock the pieces together. Lastly, glue the foam dowel into the hole in the front of the Longeron. Allow the glue to cure completely.

Next you will be shaping the Fuselage. A torpedo shaped fuselage will offer less resistance to air (drag) and will result in faster speeds. However, the more foam you remove from the fuselage, the weaker it will become. This manual illustrates the minimum amount of foam you should remove from the fuselage. Shaping the fuselage is best accomplished in two steps. First you will remove foam from the four sharp edges of the four-sided fuselage. This will result in an eight-sided fuselage. Then you will be sanding the ridges between these eight sides to produce a rounded, smooth and torpedo shaped fuselage.

7. ***Shaping the Fuselage:***

Preparation: Return the R/C Compartment Plug and Wing Plugs to their respective cavities. The R/C Compartment plug needs to be shaped along with the rest of the fuselage. Replacing the Wing Plug will make the job of shaping the area around the wing saddle easier. The Wing Plug itself will be discarded later. If the two plugs are too loose and won't stay in place, you can use small dabs of glue to temporarily hold them in place. Don't use excessive glue as it will make removal difficult.
Shaping: Using a razor blade or very sharp knife trim the edges of the fuselage. At the thickest point of the fuse, trim off at least 5/16" from each corner (see cross-section on Diagram B). As you move toward the nose and tail, decrease the depth of the cuts uniformly.

8. ***Sanding the Fuselage:*** Finish rounding the fuse with a sanding block. Remove the ridges between the sides using medium pressure. In our experience 120 grit drywall screen works best, since it will cut EPP foam rapidly without tearing chunks out of it. But 150 grit sandpaper works just as well.

Once you are happy with the shape of the fuselage, it's time to finish the R/C Compartment

9. ***Install the R/C Compartment Walls and Hatch:*** Remove the R/C Compartment Plug and slice off 3/16" from each of its sides (see Diagram 5 below). Discard the middle part. The two thin slices will be used to form the walls and hatch of the R/C Compartment.
Glue the Right Side Wall back into the right side of the R/C Compartment with 5 min. epoxy. Next, make a vertical cut 1-1/2" away from the left side of the Left Side Wall. This will split the Left Side Wall in two pieces. (dotted line on Diagram B) The shorter piece (the one that's 1-1/2" long) should be glued in using Epoxy to form the Front Wall of the left side of the R/C Compartment. The R/C compartment should now have a full wall on the right side and a partial wall on the left. This partial wall (Front Wall) will hold the battery in place and the opening in the back will allow the insertion and removal of the Rx, battery and balance weight. The remaining portion of the Left Side Wall, will be the R/C Compartment Hatch that you will secure with tape before each flight.

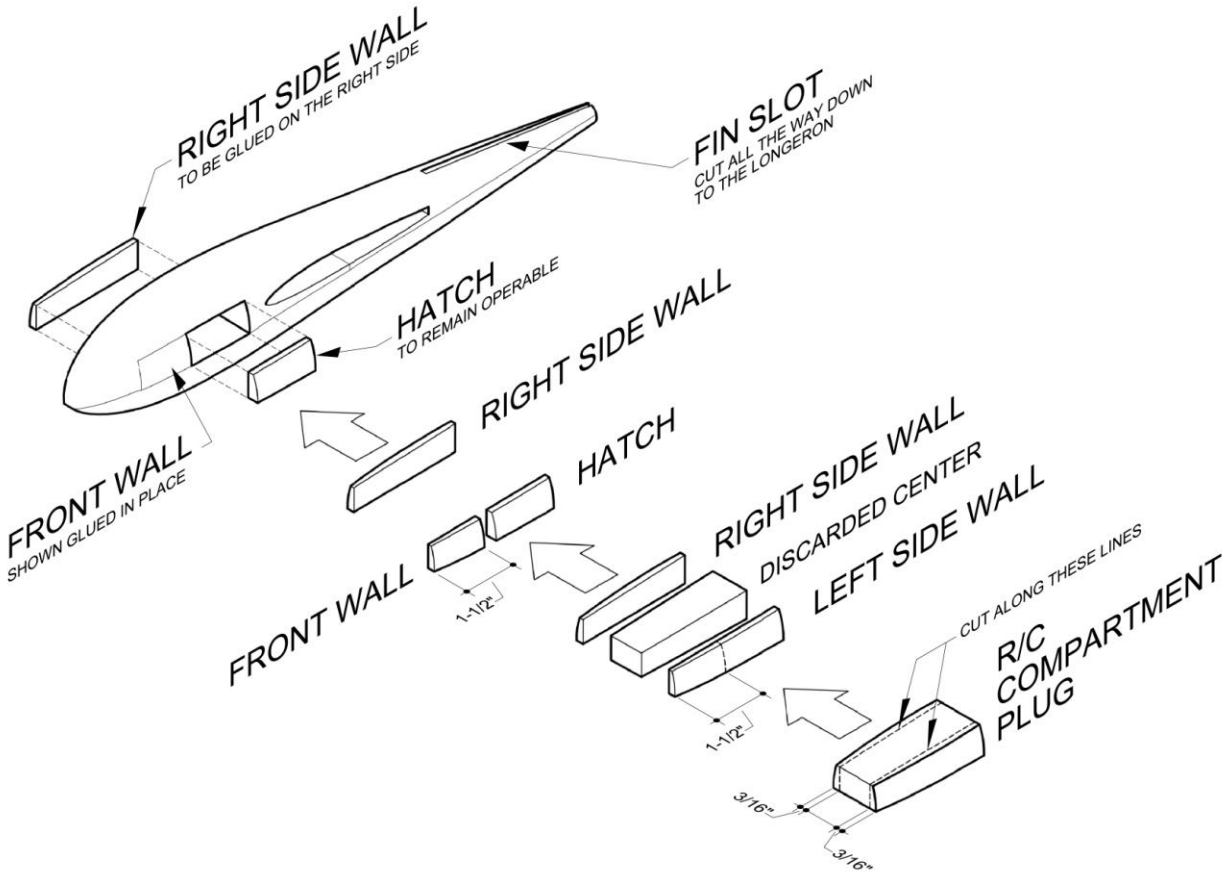


DIAGRAM 5 – Hatch and Walls

10. ***Installing a Charge Jack:*** To install a charge jack (like the NCFM BlackJack) follow the instructions that are provided with the part. The charge jack is commonly installed on top of the fuselage and directly above the rear portion of the R/C Compartment where the receiver resides. This is a good time to temporarily install and test the charge jack. Remove it for the next step if you have to.

11. ***Covering the Fuselage:*** There are many different techniques for covering an EPP fuselage. They all have their weak and strong points. On these pages, we offer several techniques as a guide, but they are by no means mandatory.

Method 1: "Gooping" is a popular covering method for a foam fuselage. When applied correctly, it can provide a beautiful, hard-shell finish with a decent amount of impact protection. The process involves "painting" the foam fuselage with successive layers of rubbery adhesive /sealants such as "Goop" (hence the name of the method) manufactured by Eclectic Products.
The "Goop" brand is not the only material suited for this application but it is often the most readily available in the United States. (*NOTE: If you reside outside of the U.S., "Goop" may be unavailable… you can try "Shoe Goo" or E6000 which are very similar, thick, clear, gel glue).* Another adhesive which is suitable (albeit a little more difficult to source) with a faster cure time and harder shell is "Welder" manufactured by Homax Products.

The weak points of "Gooping" are:

1. If applied hastily or with too few coats, it will not build up enough strength to protect the foam.

2. If not allowed to cure properly the final surface will remain "gummy" and attract dust and debris.

3. If subjected to repeated hard impacts, the nose may wrinkle a bit. Removing the wrinkles is a bit tedious.

4. If applied in a space without adequate ventilation, the resulting fumes can range from annoying to hazardous. Always exercise good judgment when using products such as "Goop" and follow all manufacturers' recommendations.

Prep: Once the fuselage is shaped and smooth sanded, apply some "Lightweight Spackle" over the entire fuselage, to fill all of the voids. Once dry, very lightly sand the surface smooth, without pitting any of the spackle. If desired, this is a good time to spray paint the fuse any color you like (standard Krylon works well and will not desolve EPP foam).
Application: Although standard "Household Goop" will work fine, we prefer the "Marine Goop" variety (green tube), since it has a UV inhibitor. The Goop must be thinned to about the consistency of thin maple syrup. The best thinning agent in Goop is "Toluene", which is usually available at industrial paint supply outlets (Sherwin Williams, etc.). "Xylene" will also work as a thinner, but not as well as Toluene. You can mix the Goop and its thinner in an empty glass "Relish Jar", so it can be sealed between uses. Once you are finished, the sealed jar will avoid evaporation and air curing of the mixture until next time.
Once the Goop has been thinned, apply it to the fuselage in long, smooth strokes using a medium sized brush, until both the outside of the fuse and inside of the airfoil cutout are completely covered. Try not to go over the same area too many times with the wet brush, or the Goop will begin to bead up. Coats can be applied 1/2 to 1 hour apart, depending on ambient temperature and humidity. Usually anywhere between 10 and 15 coats of thin goop are required for optimum protection. If possible, and for added protection against nose wrinkles and stress lines, it helps to let the finished fuse cure in the sun, or a hot shed, etc., for several days or more (weeks is even better). The Goop finish will become even harder and more resistant to damage with curing. For additional strength, it is advisable to use the same method on the wingtips, prior to covering.

Method 2: "Taping" is another popular covering method for the foam fuselage that is a good substitute for "Gooping" when superior impact protection is desired. It involves covering the foam fuselage with overlapping bands of filament-reinforced strapping tape. Successive layers of strapping tape can build strength quickly and produce an exceptionally smooth finish provided you can avoid the dreaded "wrinkled finish". Several brand of uni-directional and bi-directional strapping tape, such as those manufactured by 3M, are available through office supply stores and hardware stores.

The weak points of "Taping" are:

1. It requires a thought-out application plan and superior technique.

2. If applied hastily wrinkles can develop resulting in a less-than-appealing finish.

3. If subjected to repeated hard impacts, the nose may wrinkle a bit and removing the wrinkles is a bit tedious.

4. A final Goop or heat shrink finish may be needed as strapping tape alone cannot be effectively painted.

PREP: Before taping, it is a good idea to use a felt-tip pen to outline the (a) Access Hatch to the R/C Compartment; (b) the foam Wing Plug; With these marked, you should be able to see their outline, and know where to make your cut through the covering. Next, spray the fuse with 3M77 adhesive and let it dry for 30 minutes before applying the strapping tape.
Application: Whether you apply the tape diagonally and/or lengthwise, use plenty of overlap; It adds strength. You may have to make several relief cuts in the tape where wrinkles can develop when negotiating the curves around the nose area. When finished taping, use a hot iron to shrink the tape, help smooth out any wrinkles and insure a good bond to the foam.
Referencing your ink marks, cut through the strapping tape around the Wing Plug and remove the plug and discard it. Cut the tape and remove the R/C Compartment Access Hatch; this piece should be re-attached to the fuselage with strapping tape that act as a hinge (allowing access to the receiver compartment as the need arises). Make sure the tape overhangs both the Hatch and the fuselage by about ½" on both the "hinge" and "latch" side. Once complete, you can use heat shrink covering such as Solartex or Ultracote, as final color layer for the fuselage. (Practice on scrap pieces of foam and covering to establish the correct iron temperature—the inside surface of the top wing beds will work well for this, since you won't be using them anyway).

Method 3: "The Works" If you like to give the fuselage a greater measure of protection from impact, you might prefer to combine the above methods. If so, after shaping, seal the fuselage with a coat or two of thinned Goop, then wrap the fuselage with strapping tape as in Method 2 above. You can keep adding Goop and strapping tape in alternating layers to build up strength. But be advised that this builds up weight quickly. You need to gauge how much strength you really need in the fuselage versus how light you need to keep it for your flying sites conditions. In any case your last layer will most likely be Goop or some type of heat shrink covering such as Ultracote.

Next: Joining The Wing and The Fuselage

JOINING THE WING AND FUSELAGE

1. Since "Goop" does not give an ideal bond to most of the standard covering materials, it is first necessary to *slightly* rough-sand the covering on the top and bottom of the wing, where the fuselage will be glued (150 Grit is optimum). You **MUST** also spread another thin coating of goop on the *Inside* portion of the wing cutout in the fuselage, top and bottom of the airfoil—this will seal the foam and further improve the bond between the Goop and the wing covering; let goop dry.

2. Before putting the wing in the fuse, it is necessary to cut a slice in the foam bulkhead (see diagram B), between the wing cutout and the receiver location, so that the antenna and servo leads can slide into place, through the left side of the fuse, as the wing is moved into its final positioning. After making the cut, slide in the wing and center it.

Since the wing is glued to the fuselage with "Goop" (which can be a "messy" operation, at best), the following procedure will be helpful in keeping the wing and fuse surfaces clean and "Goop-free". When using "Goop", no amount of protection is too much! Keep paper towels handy or risk marring your covering with gooey fingerprints.

3. ***Carefully center the wing:*** Place a long strip of masking tape on top of the wing, LE to TE, running alongside the fuselage, with no gap between it and the fuse. Repeat this process so that the wing is completely masked off, top and bottom, just next to the fuselage. These four pieces of tape will keep the Goop off of the wing when adding the glue, and are now also your line-up points. (Make sure the edges of the tape are pressed firmly to the wing so they don't curl or hang on the fuse when sliding in/out).

4. ***Gluing/Gooping:*** Slide the wing so that the inside edge of the masking tape is about 3/8" from the fuselage on one side and apply a liberal coating of Goop to the wing, top and bottom. Then slide the wing the other direction and repeat the Gooping process on the other side. (Work quickly because Goop will surface-dry rather rapidly). Re-center the wing and remove the masking tape.

The actual distance you can move the wing depends on the width of your masking tape; ¾" is good, 1" is better. The connection is cleaner if masking tape is also applied to the sides of the fuse, but if your fuse is goop covered, make sure it is fully cured, or the tape might peel up the coating.

Let the Goop applied in the above procedure fully cure.

Next: Final Assembly

FINAL ASSEMBLY

1. Cut around the perimeter of the servos (on bottom of wing) and remove the covering material from them. Attach the servo control arms. Install the control horns on the elevons (over the covering material), making sure they are in-line with the servos. Referring to the bottom of Diagram A, use a piece of masking tape to hold the elevon in the correct flight position. Cut or file the threaded push rod to the correct length and twist on the nylon clevises. Repeat for the other servo and install both push rods

2. Install the battery, receiver and plug the antenna connections together. Turn on the gear and center all trims (both mechanical and programmable).

3. When the elevons are functioning as **Ailerons**, the **total** movement of the trailing edge should be about **7/8 of an inch**.

   The **Elevator function** requires less movement, a **total** of about **1/4 of an inch**, (1/8" up, 1/8" down). Once the plane has been trimmed and flown, you can increase or decrease the servo travel distances for more or less sensitivity.

   In most cases, as you get more comfortable with flying your Moth you want to ***adjust the Center of Gravity*** *during the test flights* ***and move it back.*** *As you do so you must also* ***reduce the amount of elevator travel usually to around 1/16" !!***

4. The elevons should be centered so that they appear as in the attached diagram A. When you are satisfied with the throws, secure the servos in wing with tape, covering or other method of choice.

MAKING THE FIN:

5. Join the two **3" x 6" x 1/8"** pieces of balsa fin material with *thick* C.A., to create a single 6" x 6" piece of balsa. Print Diagram "C", at the end of this manual, on 8-1/2" x 11" paper. Make sure the printer is set to print at 100% scale (otherwise referred to in the printer driver as "Full scale" or "Page Scaling : None") Once the print is ready, measure the width and height of the Fin Pattern to make sure they agree with the dimensions listed. If your measurements do not agree with the dimensions, your printed copy is not Full Scale or 100%! With the wood grain running vertically, use the Fin Pattern you printed to cut out your fin. Sand the edges round and cover the fin with packing tape or Ultracote (again, it is not necessary to use adhesive spray on balsa).

6. ***Fin Channel:*** Cut a fin-width groove in the rear of the fuselage, extending down to the longeron tube (see Diagrams 5 & B); ensure that it is centered not only vertically, but also at a perfect right angle to the leading edge of the wing.

7. ***"Potting" the Fin:*** Rather than permanently gluing in the fin, we recommend the same procedure as used when mounting the servos. Wrap the fin in a poly sandwich bag and glue it in with epoxy. When the glue has cured, you can remove the fin and bag, allowing the fin to fit snugly back in the slot—it is now easily replaceable in case of a doink. (We wrapped one layer of 3 mil. poly tape around the base of the fin (over the already fully taped fin), after removing from the sandwich bag, for a very snug fit—works beautifully, and also allows the fin to pop-out in a mid-air or impact!). A small piece of poly tape on the TE base of the fin also works well to hold it in place.

Next: Balancing, Trimming & Flying

BALANCING, TRIMMING & FLYING

BALANCING THE PLANE:

A good *starting* Center of Gravity (CG) on the Moth is 1-3/8" (35 mm) back from the leading edge of the wing (LE)

The optimal CG location is usually a tick behind 1-1/2".

By optimal we mean it will not hyper-stall, be more agile and better bounce off of the turns.

The Moth's CG usually falls somewhere between 1-3/8" to 1-5/8" back from the LE. This is a "range", due to the variances in flying styles and experience. The location of the CG influences the way the plane flies and behaves while flying. The optimal location varies from plane to plane and from pilot to pilot.

Also be reminded that there is a strong correlation between the **CG location** and the amount of **elevator travel** required. The further back from the leading edge the CG is, the more sensitive the plane will be to elevator input (what we call "pitch sensitive") Therefore, as you **move the CG back** you need to **reduce the elevator travel**. Conversely, a "forward" CG location requires more elevator travel to "hold the nose up".

The CG is critical. Since the plane will not fly properly if the CG is as little as 1/16" off, "fingertip" balancing is not recommended. Balancing a plane to within 1/16" sounds daunting, but with a little preparation and patience it is actually easily achieved.

Preparation: You need two relatively sharp points to balance the plane on.
Sharp #2 pencils work well. Sharp X-acto blades are better! To prevent the points from puncturing the underside of the wing, you need to reinforce the covering at the intended CG point. Small strips of masking tape work well for #2 pencils.
For X-acto blades. you will need thin pieces of aluminum taped at the CG (one penny per side also works well in a pinch).
Place the small strips of tape (or tape the pennies) over the location of the CG, under the wing, and mark the desired CG position on them with a permanent marker by measuring back from the leading edge (1-3/8" is a good start).

Balancing: Position the plane on top of the vertically mounted pencil tips or similar pointed objects. Hold the plane in a horizontal attitude and let go. Observe if the plane falls to the front or to the back. Your goal is to arrest this fall by placing counter-weights on the plane in the appropriate locations. For a tail-heavy condition (most common with new planes) place lead weights (preferably stick-on strips) on the top of the fuselage, above the area where they will ultimately be positioned inside (see diagram B), until the proper balance is achieved. Keep adding weights, a little at a time, until the plane does not fall as quickly.
When the plane momentarily sits still on top of the points before falling, the plane is balanced at that particular point. When balanced, the plane will fall randomly to the front or the back. Now that the necessary amount of balancing weight has been determined, remove the receiver and battery from the R/C Compartment, make room for the weights inside, and then put them back in, along with the weights.
Once you have moved the weights to the inside and repacked the electronics, place the plane on top of the sharp point and double check the balance one last time before attempting the test flight.

Remember that in case of a hard landing or arrival via the nose (!) the contents of the compartment can and will move around. This can result in a shift in the CG. Always re-balance the plane after a hard landing or (God forbid) crash.

TEST FLIGHTS, TRIMMING AND FINDING "THE SWEET SPOT":

With the plane now built, balanced and charged, you are ready to launch! For the first toss, it is a good idea to "transmitter-trim" about 1/16" of up-elevator—just in case, and give it a firm and level toss…not too wimpy, not too hard!

THE FOLLOWING PROCEDURE IS CRITICAL TO "OPTIMUM PERFORMANCE"!!!
You may THINK your Moth is flying beautifully, but very often we help pilots trim out their planes, and 99% are nose heavy! We usually end up adding at least ¼ ounce of stick-on lead temporarily placed near the front of the fin to achieve optimum balance and minimize or eliminate hyper-stall.

After flying the Moth at the above-listed CG, it's time to find the "Sweet Spot".

So….. do this:

1. Place a ¼ oz stick-on lead weight on top of the fuselage, behind the CG.
2. Keep moving the weight back a little, after each short flight, until the plane becomes un-flyable.
3. Now, move the weight just forward enough so the plane flies comfortably (usually by moving the little weight forward about ¼" or so)—*this balance point will allow the Moth to fly at optimum performance.* It should snap turns, fly light, fly inverted effortlessly, and have considerably more speed. Once you've found this point, DO NOT REMOVE THE LITTLE WEIGHT! At least not yet.
4. Back in the laboratory, determine and mark the location of your new CG, then remove the stick-on weight, and re-balance the plane internally, to the new CG location.

What happens if the plane is not properly balanced?

If the CG is too far forward, the plane will bob its nose up and down in quick succession ("hyper-stall"), feel sluggish and slow (especially in turns) and appear to fly "heavy".

If the CG is too far back, it will slam the turns and feel agile, but the pitch control may seem a little sketchy over long distances (100 feet or more)--this is completely different than a hyper-stall. The plane will be difficult to control as if it has a mind of its own.

All in all, we have found that most pilots prefer a CG of approximately 1-1/2" back from the LE, which is optimum for most conditions.

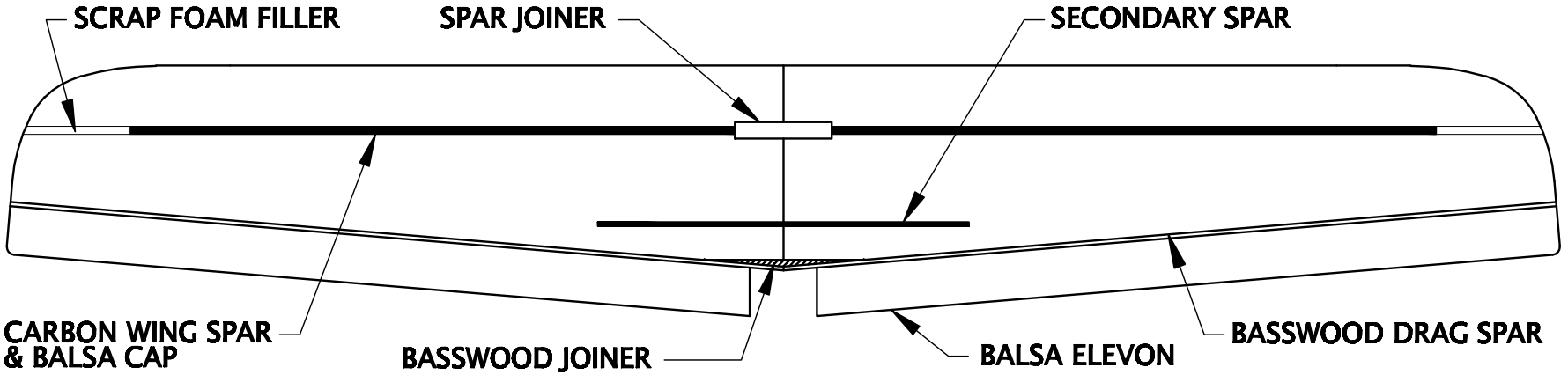
And one last thing to remember:

It is worth repeating that, as stated above: ….When you move the CG back, your Moth **will** become more sensitive in pitch (nose-up/nose-down). Anytime you push the CG back you **must** reduce the elevator travel incrementally, otherwise your Moth will be too sensitive and difficult to control! If you have to move the CG forward at any point, go ahead and add back a little bit of elevator travel.

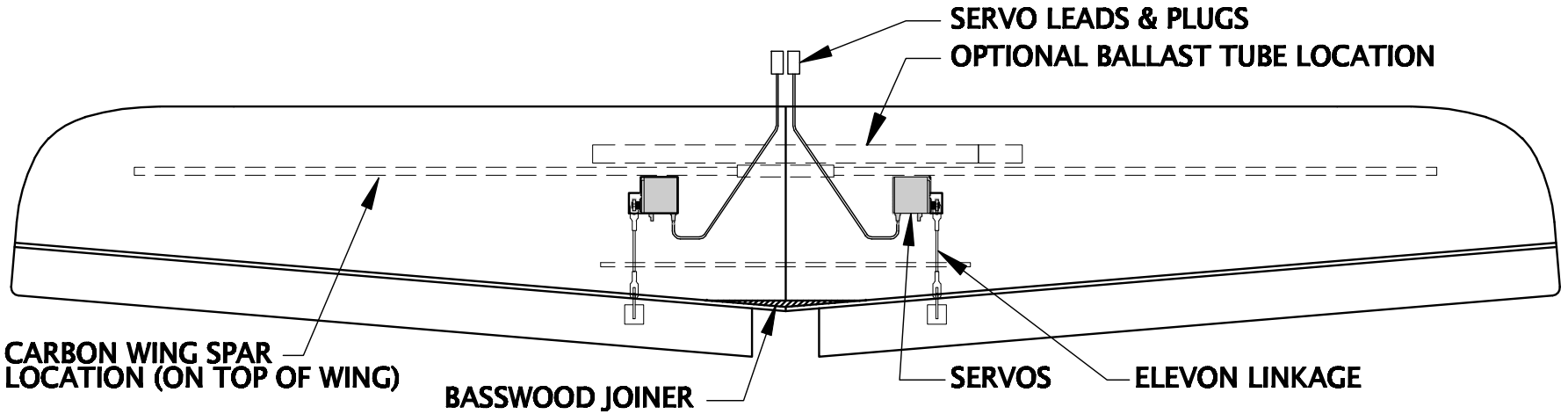
Thanks for following these instructions and we hope you get hours of enjoyment from flying your new Moth!
☺

DIAGRAM "A"

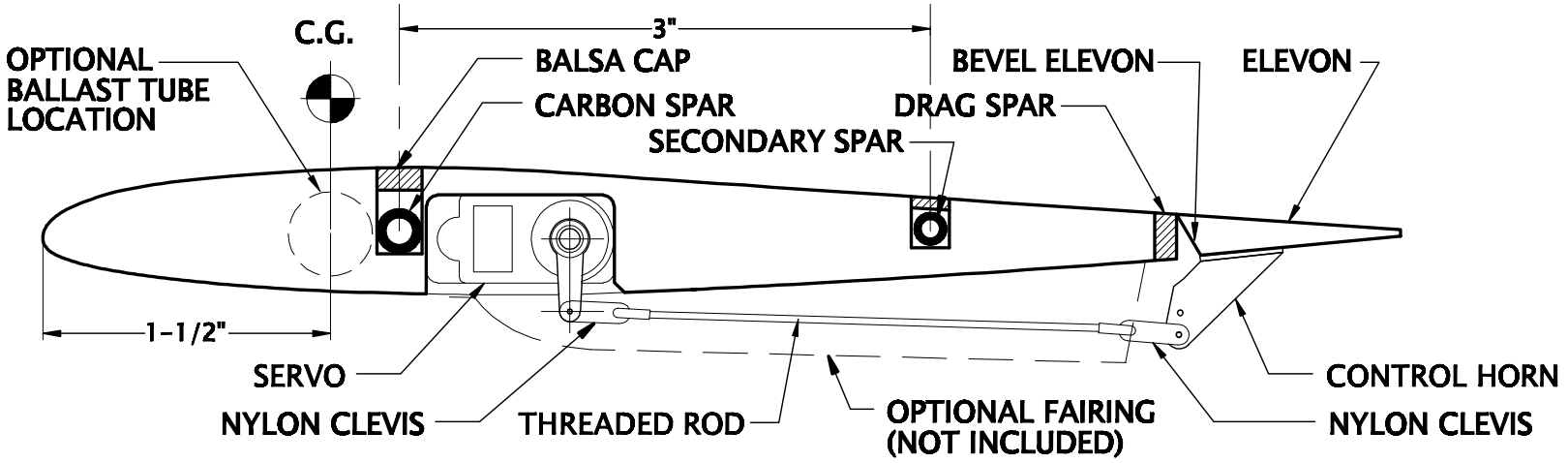
WING TOP VIEW

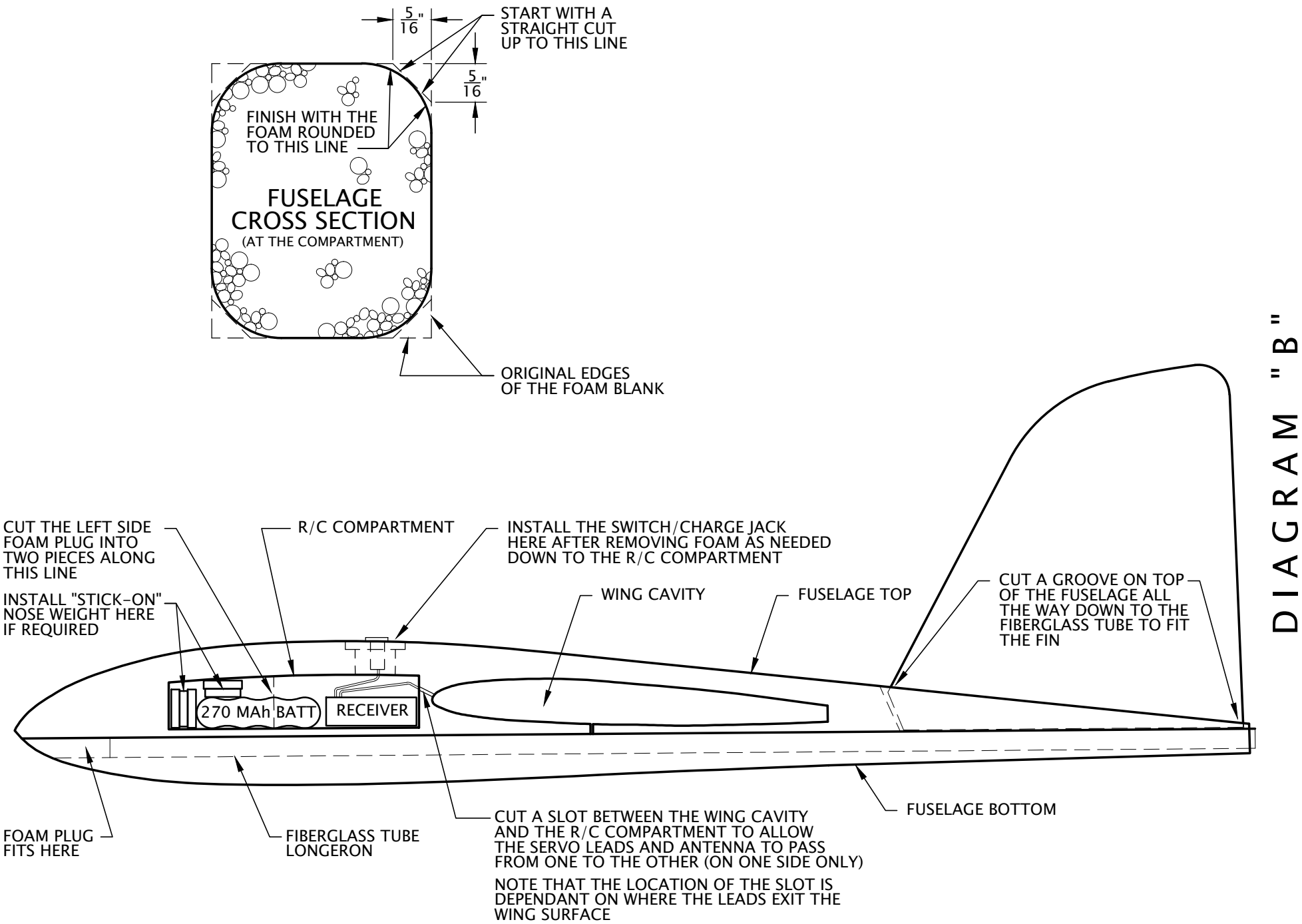


WING BOTTOM VIEW



WING CROSS SECTION




5/16"
5/16"
START WITH A STRAIGHT CUT UP TO THIS LINE
FINISH WITH THE FOAM ROUNDED TO THIS LINE
FUSELAGE CROSS SECTION
(AT THE COMPARTMENT)
ORIGINAL EDGES OF THE FOAM BLANK
DIAGRAM "B"
CUT THE LEFT SIDE FOAM PLUG INTO TWO PIECES ALONG THIS LINE
INSTALL "STICK-ON" NOSE WEIGHT HERE IF REQUIRED
R/C COMPARTMENT
INSTALL THE SWITCH/CHARGE JACK HERE AFTER REMOVING FOAM AS NEEDED DOWN TO THE R/C COMPARTMENT
WING CAVITY
FUSELAGE TOP
CUT A GROOVE ON TOP OF THE FUSELAGE ALL THE WAY DOWN TO THE FIBERGLASS TUBE TO FIT THE FIN
270 MAh BATT
RECEIVER
FOAM PLUG FITS HERE
FIBERGLASS TUBE LONGERON
CUT A SLOT BETWEEN THE WING CAVITY AND THE R/C COMPARTMENT TO ALLOW THE SERVO LEADS AND ANTENNA TO PASS FROM ONE TO THE OTHER (ON ONE SIDE ONLY)
NOTE THAT THE LOCATION OF THE SLOT IS DEPENDANT ON WHERE THE LEADS EXIT THE WING SURFACE
FUSELAGE BOTTOM

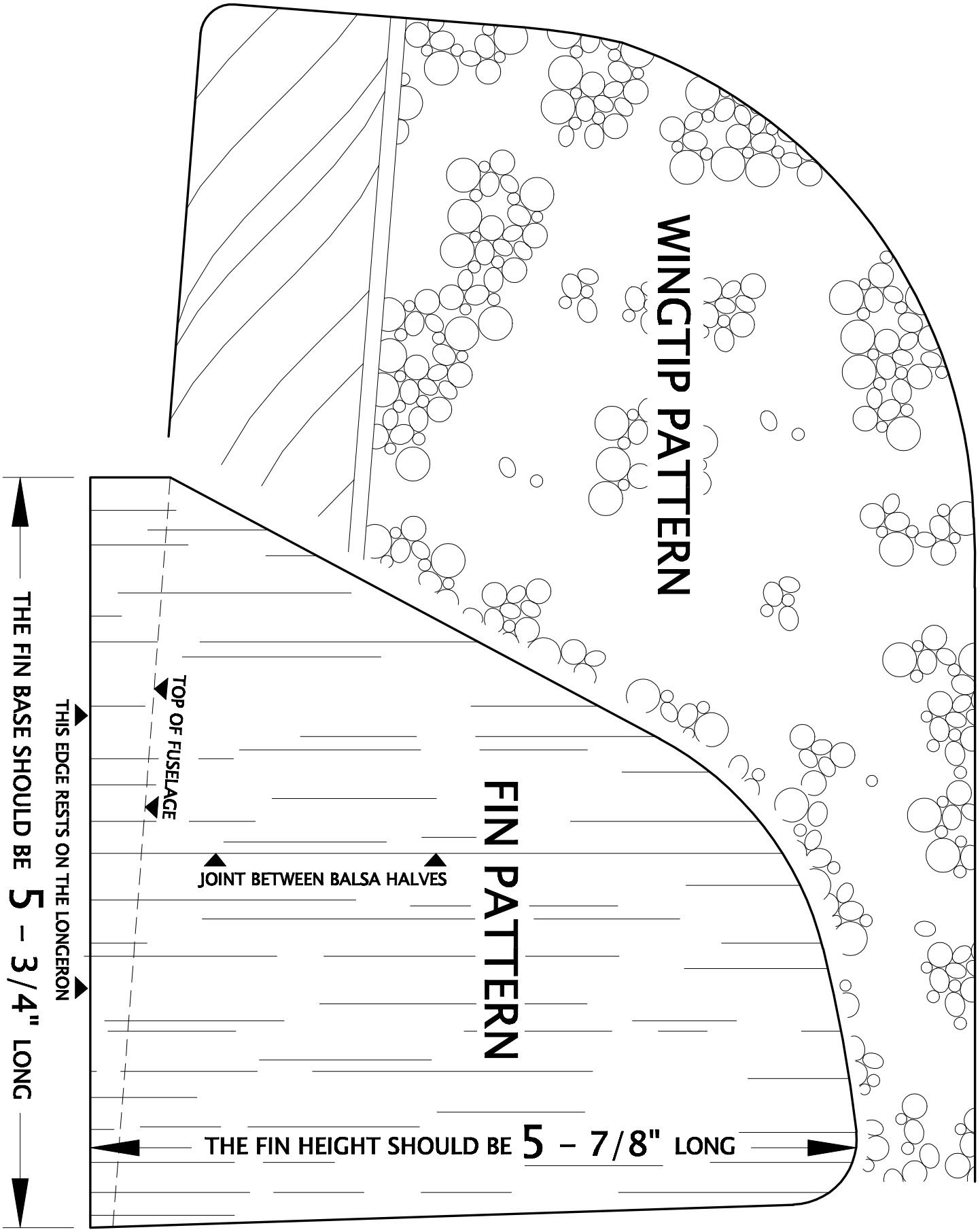


DIAGRAM "C"

AFTER PRINTING THIS PAGE
MAKE SURE THIS SYMBOL
MEASURES 2" LONG

0" 1" 2"