

RQ-180 ISR

Earl J. Aune

The RQ-180 is the Air Force's newest top secret intelligence, surveillance and reconnaissance (ISR) aircraft that was unmasked in [Aviation Week & Space Technology](#) in a 9 December 2013 cover story following several months of research. The RQ-180 has been developed in secret by Northrop Grumman and is currently flying at Area 51 in the Nevada desert. It is scheduled to become operational sometime in 2015.



"The RQ-180 is a major step toward combining endurance and survivability in a high-end unmanned aerial vehicle. In addition to reconnaissance, it will . . . execute electronic attacks and penetrate well-defended areas where nonstealthy craft are problematic."

—Loren Thompson, military analyst at the Lexington Institute

While maintaining the “cranked kite” profile similar to the Navy’s X-47B but a much longer wingspan, perhaps as much as 130 feet, the Air Force may be planning for future capability.

The RQ-180 may also be responsible for the termination of the [Next-Generation Bomber](#) program that happened in 2009 which started the long range strike bomber (LRS-B) program which will operate with a "family of systems" including an advanced air-

launched cruise missile, conventional [prompt global strike](#) missiles, and electronic attack and ISR platforms; the RQ-180 would appear to fill the electronic attack and ISR roles. Reference: Wikipedia

I have always been fascinated by flying wings that seem to defy flight as we know it. Yet one only has to ponder the flight of birds that make flying seem effortless.

My first flying wing was a ME-163 powered by an AeroTech H-45P rocket motor which was quite spectacular. The first thing I learned was how critical the center of gravity (CG) is on these aircraft where as little as ½" could mean the difference between a wild roller coaster ride if tail heavy, or a lawn dart if too nose heavy.

I was looking for an airframe to use for First Person View (FPV) experiments that a friend of mine was advancing with and the advantages of a flying wing kept coming up. Then the January issue of Popular Science came in with a very interesting article on some of the latest unmanned reconnaissance aircraft. Some quick internet research on the RQ-180 revealed it has quite a history already and it is yet to be deployed (or so we are told).

As of this writing the RQ-180 has yet to be seen by civilians so the only documentation that can be found is a variety of artist conceptions or blurry photos from unidentified individuals hanging around area 51 😊

Therefore the RQ-180 outline I developed is derived from existing flying wing designs (B2, RQ-170) and several artist conceptions including the one on the cover of Aviation Week & Space Technology December 2013 issue.

The big question was would this profile actually fly? The answer didn't come easy as the first few attempts only revealed that the CG was off and that the air frame can really take a beating while performing cartwheels, nose plants, tail flops and many other scare-o-batics that it went through with surprisingly very little damage. Seventeen and ½" inches! That is the magic number finally found for the best location of the CG. The planes flight is now very stable and yet responsive and is a pure joy to fly. Since the drag coefficient is so low, it will glide around without power quite well but be careful with landings as it tends to float by in ground effect which uses up the entire runway 😊

Weighing in at just over 6 pounds with a 4500 mAh 6 cell Lipo, this 1/20th scale flying wing has a wingspan of 74" and is powered with a 90mm ducted fan. It can be hand launched at ½ power but retracts take the risk out of a bungled throw. The plane flies very much like a glider, even riding thermals with power off.

An SD7062 flying wing airfoil was used and with 4.2 degrees of leading edge droop and 3 degrees of up in the ailerons for pitch stability. The wing will fly without vertical yaw stabilizers however it is recommended to add a 3" (clear plastic) vertical stabilizer cheaters on each wing tip especially for the first few flights.

My latest bird has retracts and automatic drag rudders using a NAZE32 controller for yaw stability. Master builder and veteran Scale Masters flight judge Buz Hampton also built one as a prototype from the plans as they developed and true to form, his turned out much better looking than mine.



The author with his RQ-180 prototype



Buz Hampton with his refined RQ-180 (Photos by Brad Eaton)

Construction Guide

by Earl Aune

This project was designed to build fast and easy especially if the appropriate tools are available. While a hot wire foam cutter helps with precision it can be built by just belt sanding surfaces to shape. When working with foam always use a dust mask and have a shop vac handy as it can get quite messy in a hurry. Be mindful of tracking foam particles into the house as not everyone appreciates the masterpiece coming together as much you do 😊

Be sure and purchase the unscored insulation foam as the prescored foam weakens the structure.

You will need 15 minute and 5 minute epoxy, a belt sander, 2 rolls of EconoCote (black), razor saw and 3 carbon fiber arrow shafts for the spars. The airfoil SD-7062 and many of the profile shapes are available as DXF files from Model Airplane News online.

Also needed is a 90mm fan system with 4500 mAh 6s battery, servos ; 4 HS-81 servos (and 2 HS-55 servos if using drag rudders).



Photo by Brad Eaton



Photo by Dan Gillespie

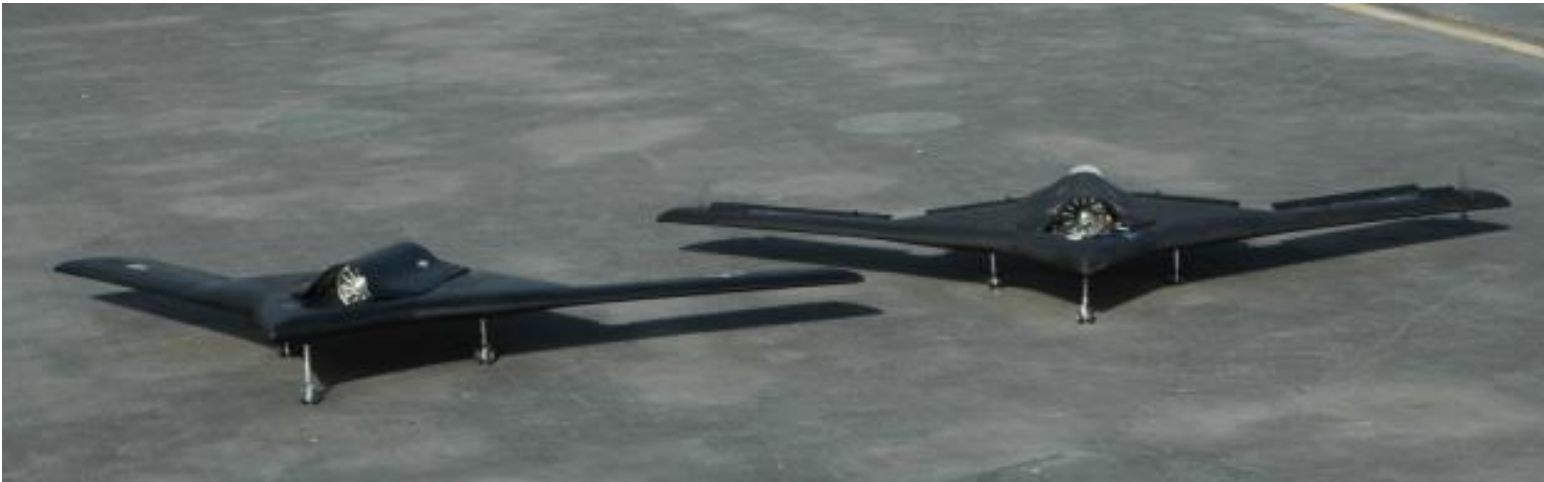


RQ-180 setting up for landing

Photo by Dan Gillespie



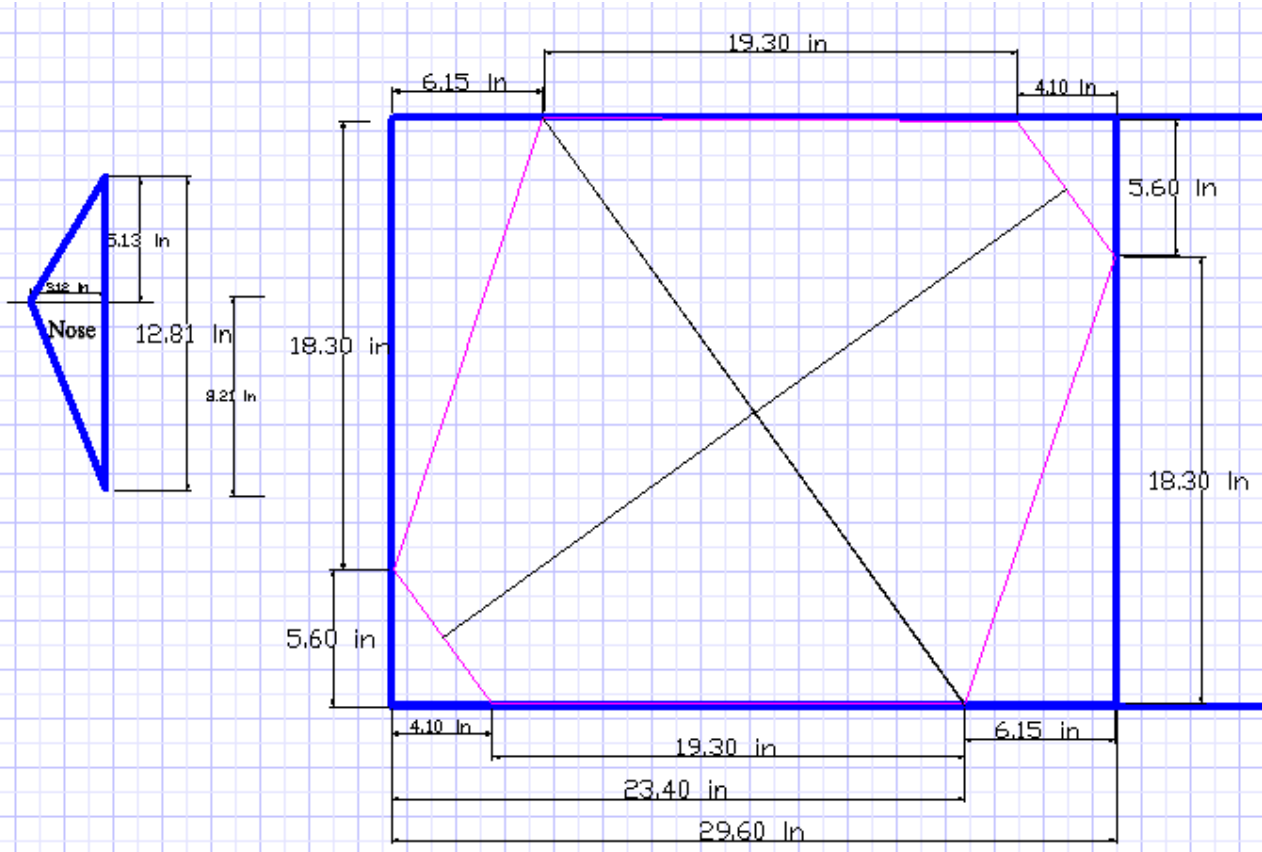
Photos by Dan Gillespie





Buz Hamptons RQ-180 ready to fly

RQ-180 Layout for cutting out of 2" thick blue insulation foam. Some stores offer 2' x 8' which is more than enough



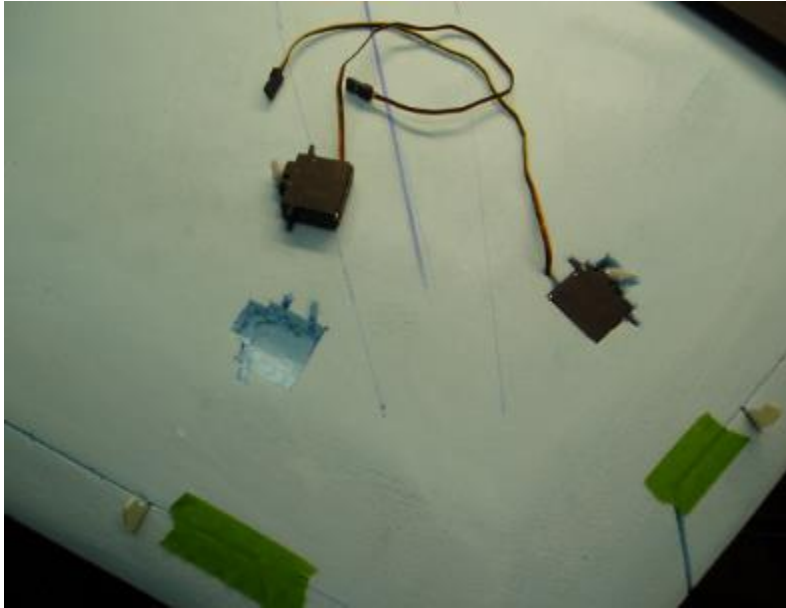
Center Section

1. Cut off one end at 29.6" which makes it easier to cut out the other parts using a band saw (cleaner cuts, less sanding)
2. Mark the board with a Sharpie pen per the above diagram. Be sure everything is square.
3. Cut out the center section. Use the corner scraps for the two nose pieces
4. Block sand all sides with 80 grit sandpaper to smooth all edges
5. Glue the two nose pieces onto the front with 5 minute epoxy using masking tape to hold together while curing
6. Using a 1" spacer (wood block, aluminum bar, etc.) mark a centerline of the foam sides all around the perimeter.

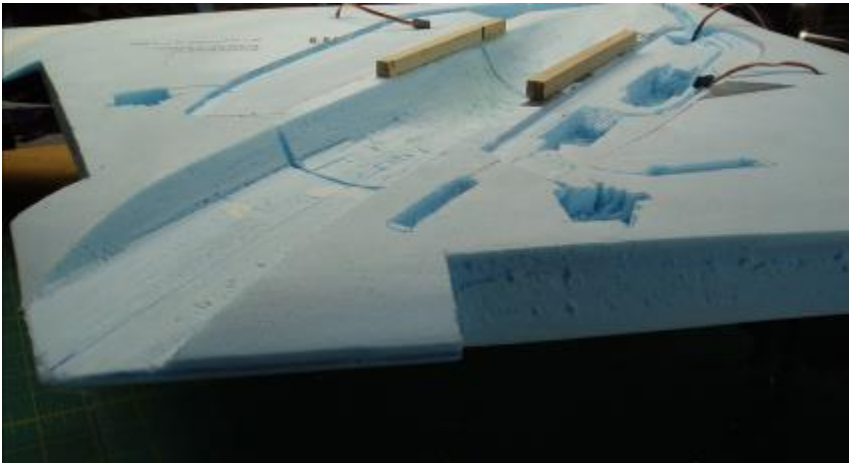
7. Mark the airfoil on each side and then sand the entire center section' leading and trailing edges to approximate the airfoil using a belt sander, first 60 grit sand paper then smooth with 80 grit. Be sure and wear a dusk mask, eye protection and even ear protection while machine sanding. Have a shop vacuum handy as you may look like a blue snowman after a bit ☺
8. Carve out the center 1" deep to rough out the center then sand a radius to match the fan unit of choice. I applied peel and stick 80 grit sand paper to a 4" diameter water bottle (full) and sanded the curve to fit.
9. Then cut the water bottle (drink the water first ☺) end off and attach at the fan unit with duct tape. Then cut the nozzle end at a 3" diameter (25% tube reduction)
10. Glue two hardwood rails along the sides to mount the fan as shown below (Dr. Mad's 90mm12 blade unit)



11. Bend a ¼" .032" brass strip to hold down the fan unit and drill each side for socket head servo screws.
12. Do the same for the exit only press down the tube to make it more of an oval. The rear of the tube needs to be angled upward about ¾" to vector the thrust keeping it flying level under power.
13. Mark and cutout the elevator servo pockets

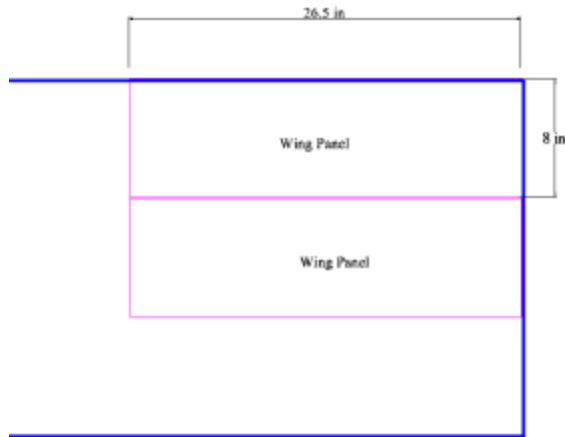


14. Cut out the elevators with a slight angle to allow some down throw but these will mostly be trimmed 3/8" up for level flight.

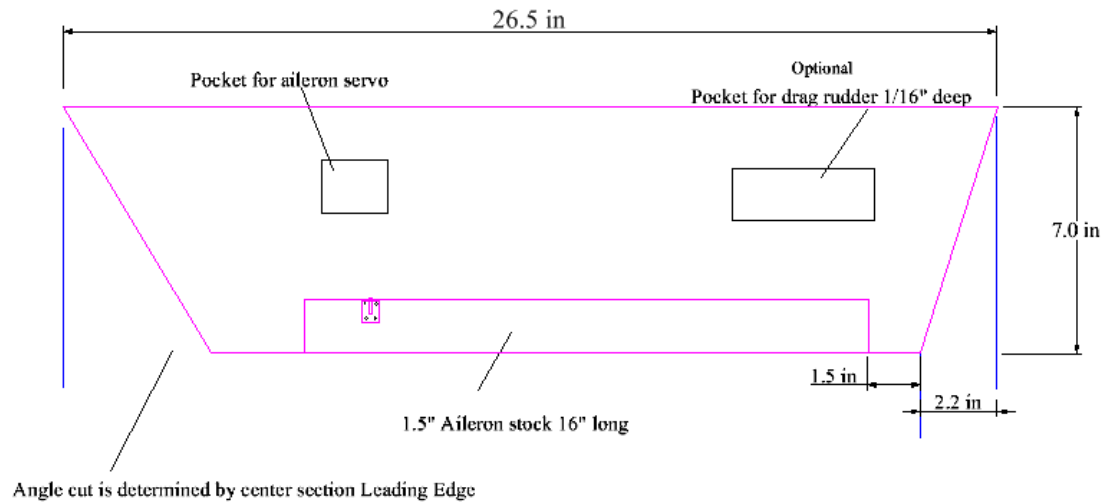


Wings

1. Cut out two blocks 26.5" x 8" for the wing panels and mark a line at the center of each end.

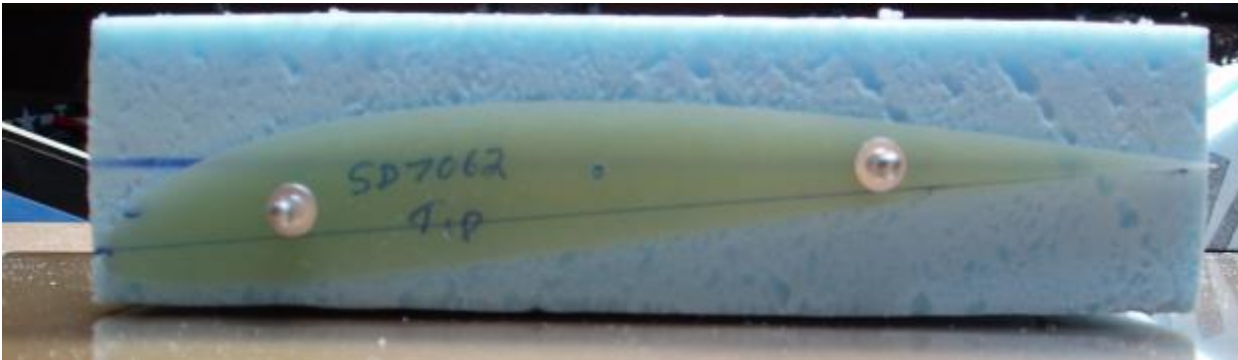


Right Wing Panel

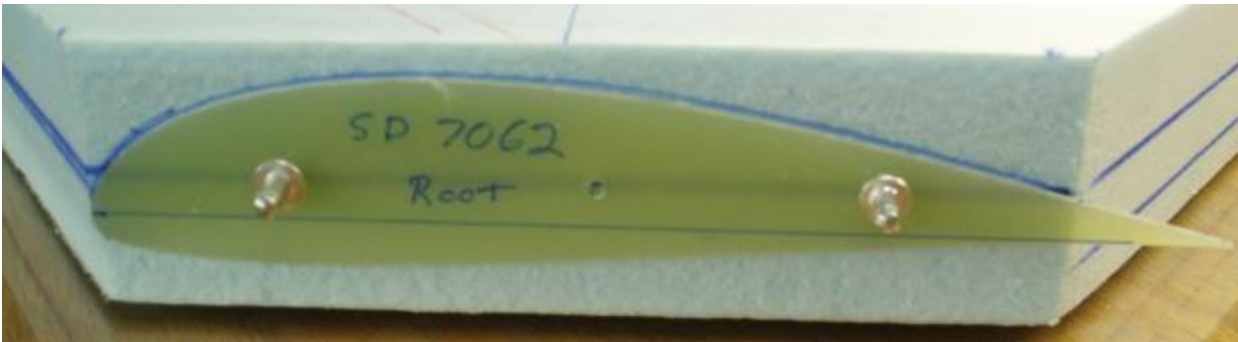


2. Pin the airfoil templates as follows:

- a. Tip airfoil, droop the LE 4.2 degrees (0.6") down from center to create the wingtip drag condition a flying wing needs



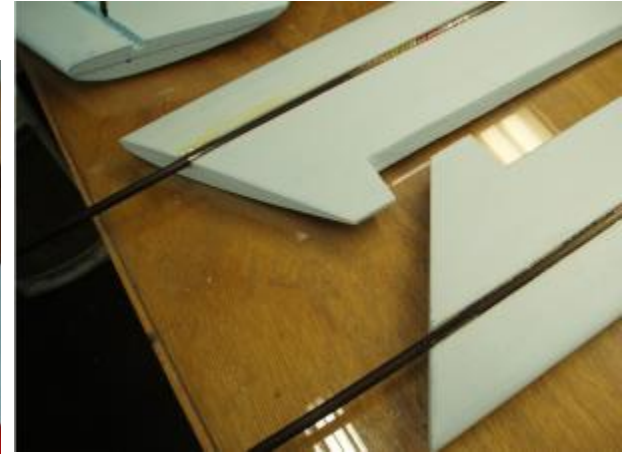
- b. Pin the root airfoil parallel (no angle), 1/4" below the center line as shown



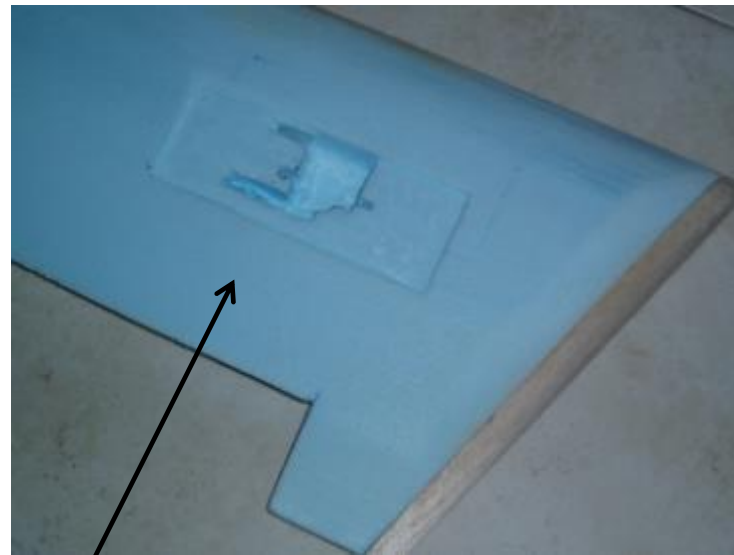
3. Hot wire the airfoils using a .016" guitar string on a wood dowel and an adjustable power supply (there are lots of DIY cutters to view on internet searches if needed)



4. Sand the fuzz off each wing with a block sander and 100 grit sandpaper. Fill in any dents or hot wire imperfections with lightweight filler.
5. Cut airfoil shape and glue a 3/8" balsa end cap on each wing tip with 5 minute epoxy. Use masking tape to hold in place while curing.
6. Shape each wing tip and leading edge with 80 grit sandpaper
7. Mark and cut out each aileron 16" x 1.5" using a razor saw angled about 60 degrees to the bottom. This creates an angled relief for the down aileron position.
8. Mark the spar center at 2.25" from LE and 6" from the tip on the bottom of each wing. Lay the carbon fiber arrow shaft on the mark and draw a line on each side of the shaft.
9. Using a razor saw cut at approximately 60 degrees toward the center of the mark on each line to form a V channel. Be careful not to cut too deep. Unplug the excess foam using pliers and use a large round file to ensure a snug fit.



10. Use a round rat tail file to deepen the channel such that the arrow shaft is slightly lower than the bottom of the wing so the servo leads that will lay on top of the arrow shaft are flush with the bottom of the wing.
11. Scuff up each arrow shaft with 80 grit sandpaper to provide maximum adhesion.
12. Mix up a generous batch of 15 or 30 minute epoxy and apply to the arrow shaft and foam channel. Press in to fit and wipe off any excess epoxy with a paper towel and isopropyl alcohol.
13. Install the aileron servo and linkage. Poke a hole through to the bottom for the servo lead which are laid on top of the spar then taped down with black electrical tape.
 - a. Lay the servo flat in position then draw an outline around it with a Sharpie pen.
 - b. Press an X-Acto knife blade into the foam following the lines.
 - c. “Unplug” the foam with pliers by grabbing a section and pulling it away
 - d. Smooth the bottom with a Dremel tool with a flat router bit. It should be deep enough so the HS-81 servo is flat with the surface of the wing.



14. Cut out a channel for the servo leads.
15. Cut out and install the drag rudder servo and leads (optional). The servo leads punch through to the bottom and are taped to the bottom of the carbon fiber arrow shaft before covering.
16. Cover the wing with black low temperature covering and scuff up with Scotchbrite® for painting

Fan Cover

This might be considered optional as the plane flies well without this part but it looks better with it on. It takes quite a bit of time to make this so I'll include the instructions and templates in case you would like to include this on your RQ-180

1. Download the DXF files and cut out the patterns for hot wire cutting the turtledeck. Or print and cut out from Appendix A. You will need 2 for the fan cover.
2. Cut out a block of blue foam 12" x 16"
3. Cut out another block for the top 4" x 16"
4. Mark the centers of each and glue together with 5 minute epoxy by laying a small bead down the centerline as you don't want to have the hot wire try and cut through epoxy.
5. Pin the template at each end ensuring the centerlines match up

6. Cut out with the hotwire going very slow (be sure and have a small fan running to blow the fumes away, this can give you a headache!)
7. Sand with 80 grit sandpaper to shape and smooth the curves and cutout the intake shape.
8. Fill in any imperfections with lightweight filler
9. Final sand then cover with low temperature covering, rough up with Scotchbrite and spray flat black
10. Set in place and press in an Exato blade at about a 30 degree angle to hold a popsicle stick
11. Press this into the main body and ensure a good fit.
12. Cut to length and glue into the top cover. This makes a font hold down that is strong and light.
13. Glue a length of Popsicle stick to the rear and fasten with a small screw to hold it down or use hook & loop tape.



Assembly

1. Glue the outer wing panels to the center section ensuring the wing tips are equal angles.
2. Final sand to shape and fill in any dents or imperfections with lightweight filler.
3. Install cutouts for the receiver, speed controller and BEC if separate. Important: the speed controller must have airflow over it during flight otherwise it will overheat and stop working (hence the separate BEC).
4. Cover entire frame with black low temperature covering
5. Scuff up the shiny covering with Scotchbrite® or 400 grit sandpaper (the paint needs something to stick to)
6. Spray paint flat black.
7. Apply decals and markings.
8. Install fan unit, speed controller and radio system
9. Adjust CG to 17.5" from the nose to start out with
10. Adjust aileron/elevators to 3/8" up
11. Install wingtip vertical yaw stabilizers (if optional drag rudder/gyro not installed)
12. Charge batteries and Fly it 😊





4 of these (top and bottom of each wing) 2 of these for the fan cover

Print 2 (one on each side of the cover)

Print out on clear label material such as Avery 18665 then spray 3 coats with clear acrylic protective spray

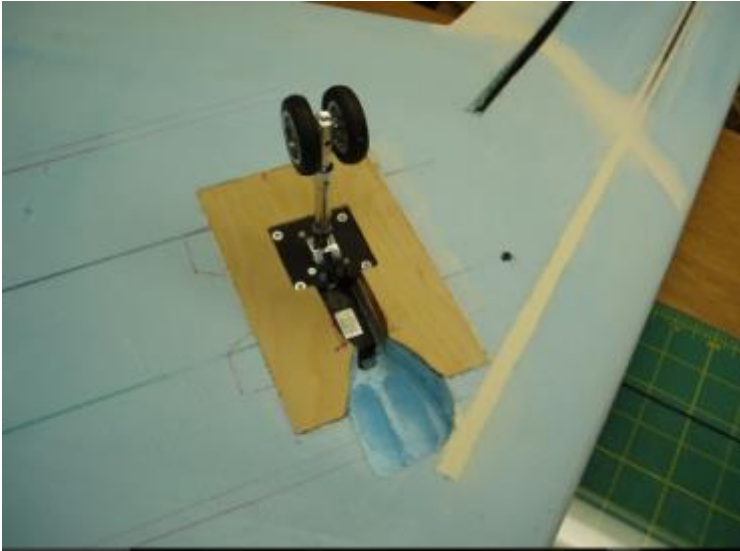
The Center of Gravity (CG) is critical. Locate the flight battery as far forward as possible to eliminate the dreaded lead in the nose 😊

There is about 1/2" of CG shift to use (as measured from the tip of the nose aft). You can experiment with your preference.

More stable flight use 17.25"

More maneuverability use 17.75"

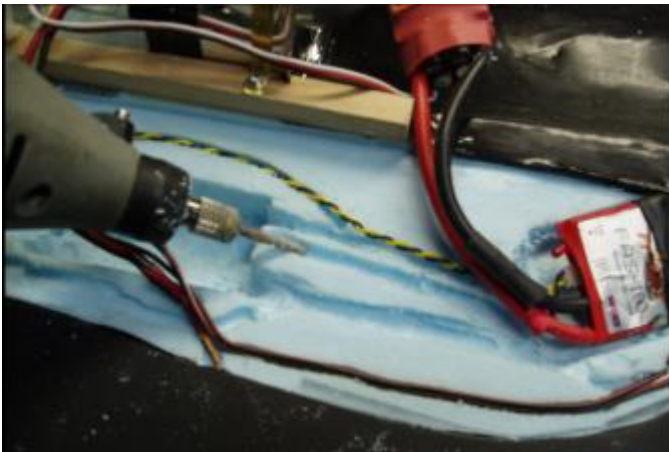


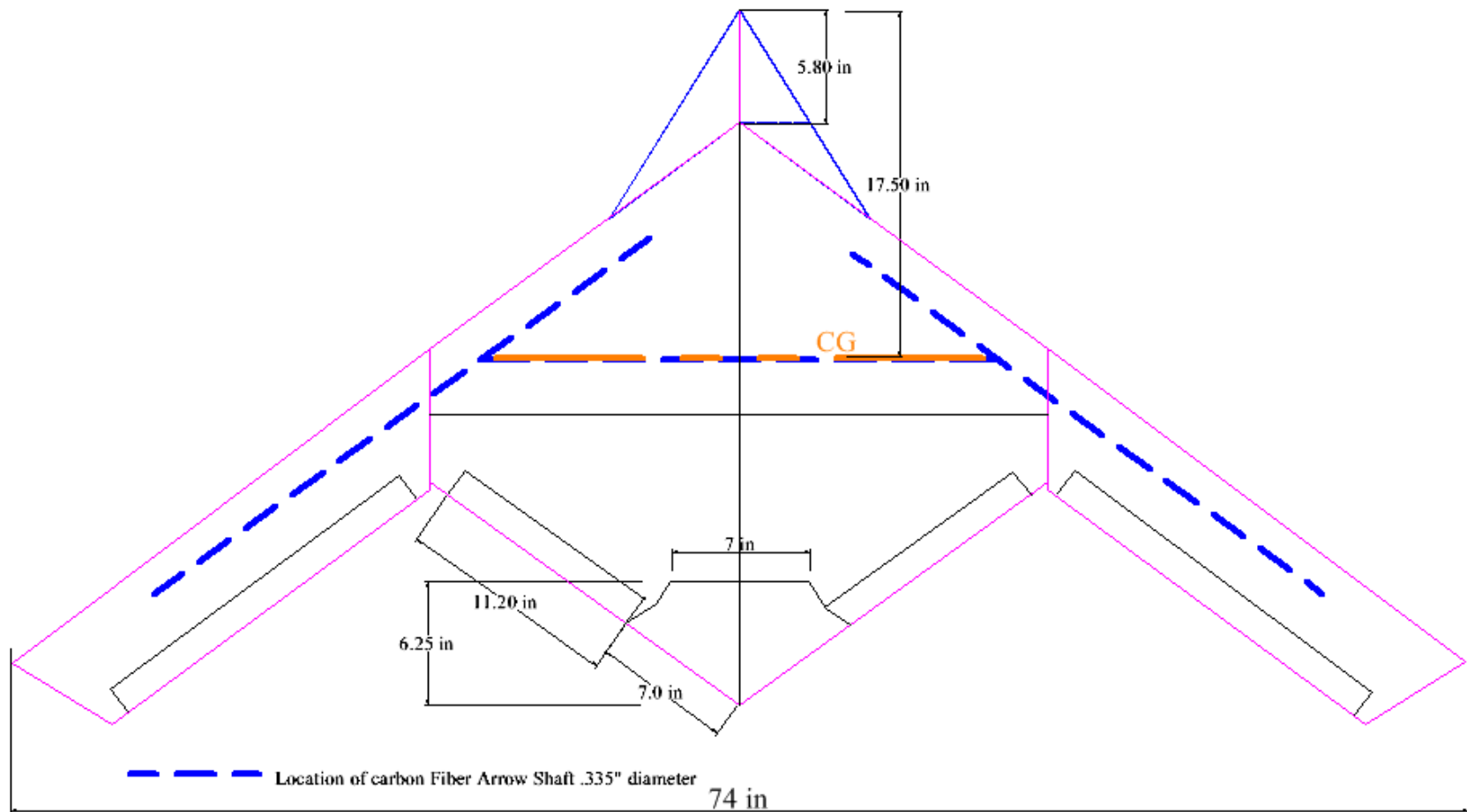


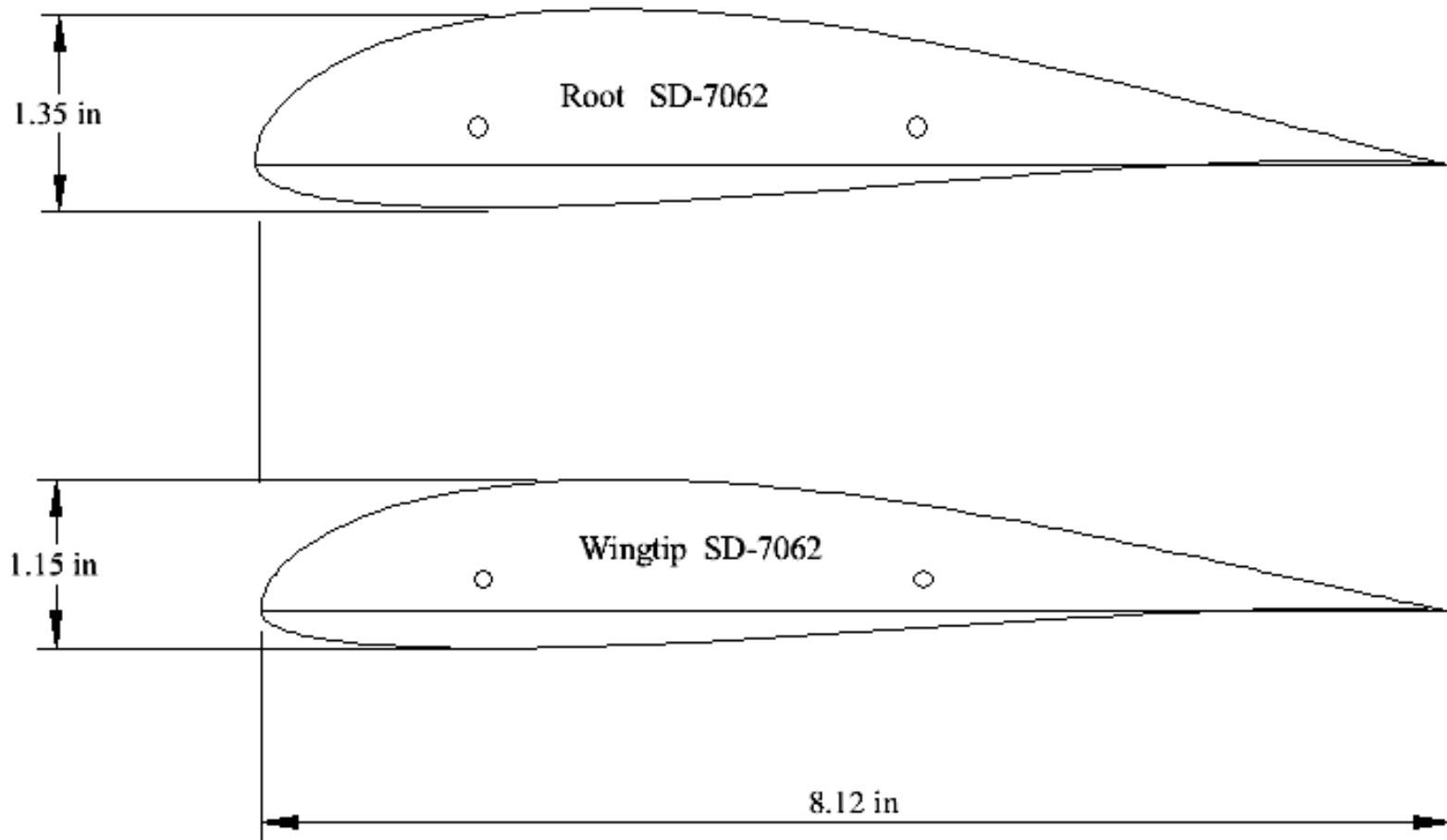
Right Main Gear installation. Note forward folding action. Also note the two carbon fiber spar locations

Ensure there is airflow over the top and bottom of the speed controller and battery to assist with cooling. The unit will draw 60 to 80 amps at full throttle!

Grind slots in the foam to act as airflow channels to allow cooling air to pass under the speed controller as shown

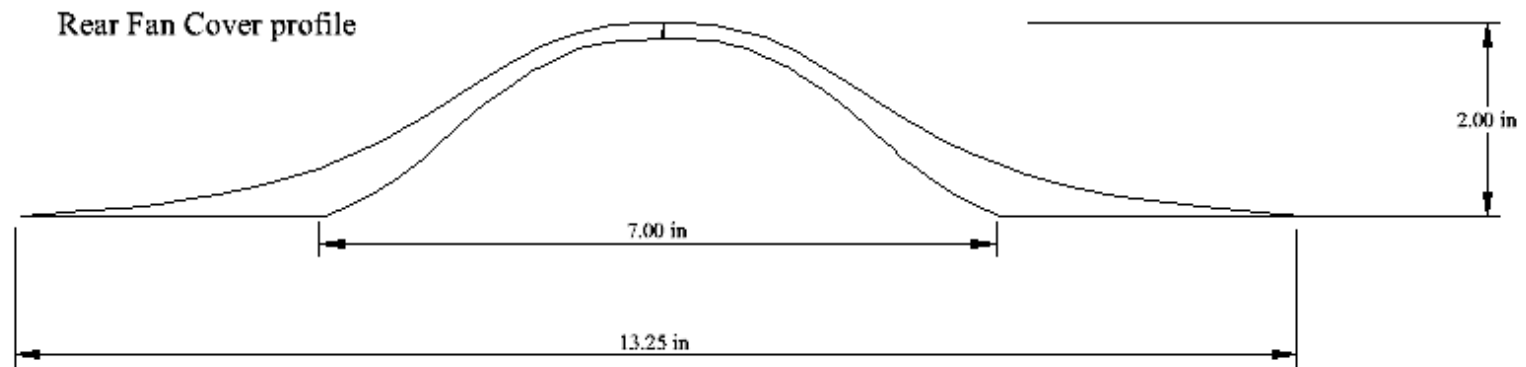
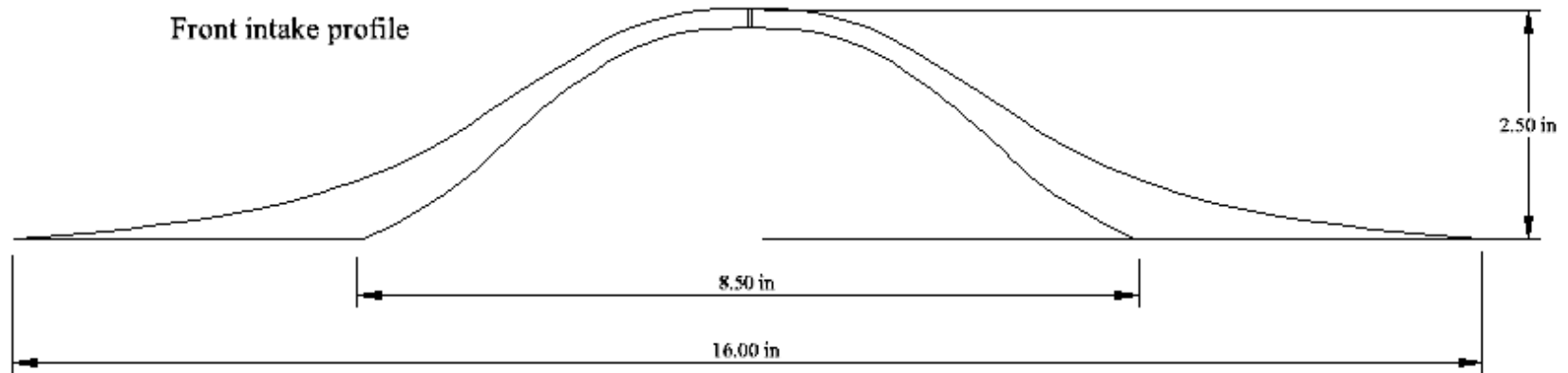




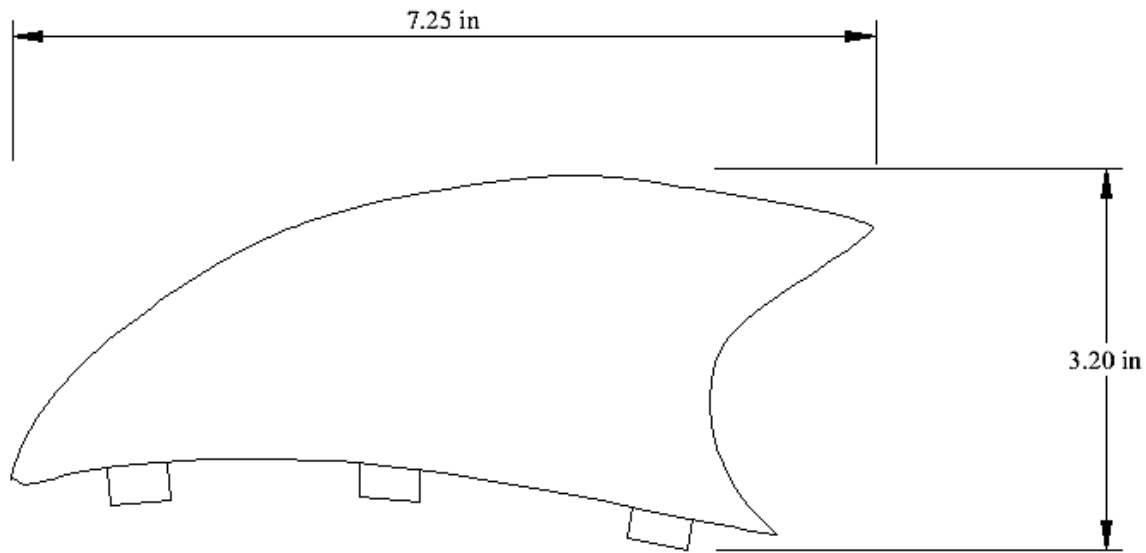


Fan cover templates

Front Intake profile (not to scale)



Yaw Stabilizer: Need 2



Wingtip yaw stabilizer .062" clear plastic