F-117 Nighthawk

Flying Model Rocket Instructions
Designed by Dave Meyers

VEHICLE DATA SHEET

Physical Data

Parameter	Dimension
Length	23.25” (59.0 cm)
Wingspan	19.0” (48.3 cm)
Weight	12 oz (340 g)

Predicted Altitudes

Motor	Predicted Altitude
Aerotech E18-4	500 ft. (152 m) (Estimated)
Aerotech E20-4	500 ft. (152 m) (Estimated)
Aerotech E28-4	500 ft. (152 m) (Estimated)
Aerotech E30-4	500 ft. (152 m) (Estimated)

• Thank you for purchasing this North Coast Rocketry® model kit. We hope you have an enjoyable time constructing and flying this model rocket. Please read all of these instructions to become familiar with them before starting construction. The sequence is important. Check off each step as it is completed.
•This kit is recommended for adults (18 and older) only. Launch systems, model rocket motors, launch supplies, tools, and building materials are not included.
• Do not modify the design of the rocket! Changes to the design may affect the stability, and hence, the safety of the rocket.
• North Coast Rocketry certifies that it has exercised reasonable care in the design and manufacture of its products. However, as we cannot control the use of our products once sold, we cannot assume any responsibility or liability for product usage.
• North Coast rocketry shall not be held responsible for personal injury or property damage resulting from the use of our product. The buyer assumes all risks and liabilities arising from the use of our product and uses our product on these conditions.
• North Coast Rocketry makes no warranty regarding our products, except for defects in materials or workmanship for a period of one year after purchase.
• If any of these terms are unacceptable, please return the item to the point of purchase.

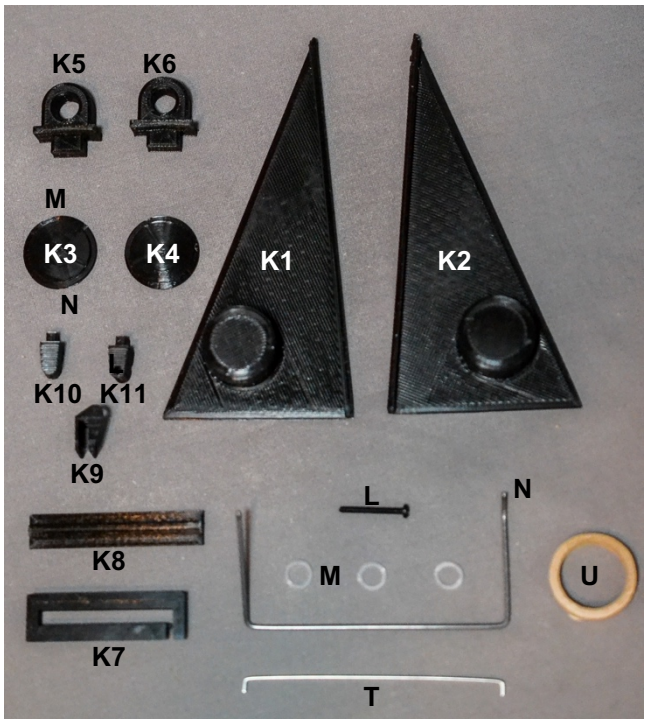
About the F-117 Nighthawk:

In 1996, Estes planned to release flying version of the F-117; it was even featured on the cover of the new products brochure that year. It never made it to market, but I always liked the design. A few years ago, I went back to the original designer, Dave Meyers, and asked him to update it for NCR. Three years of hard work later, here it is!

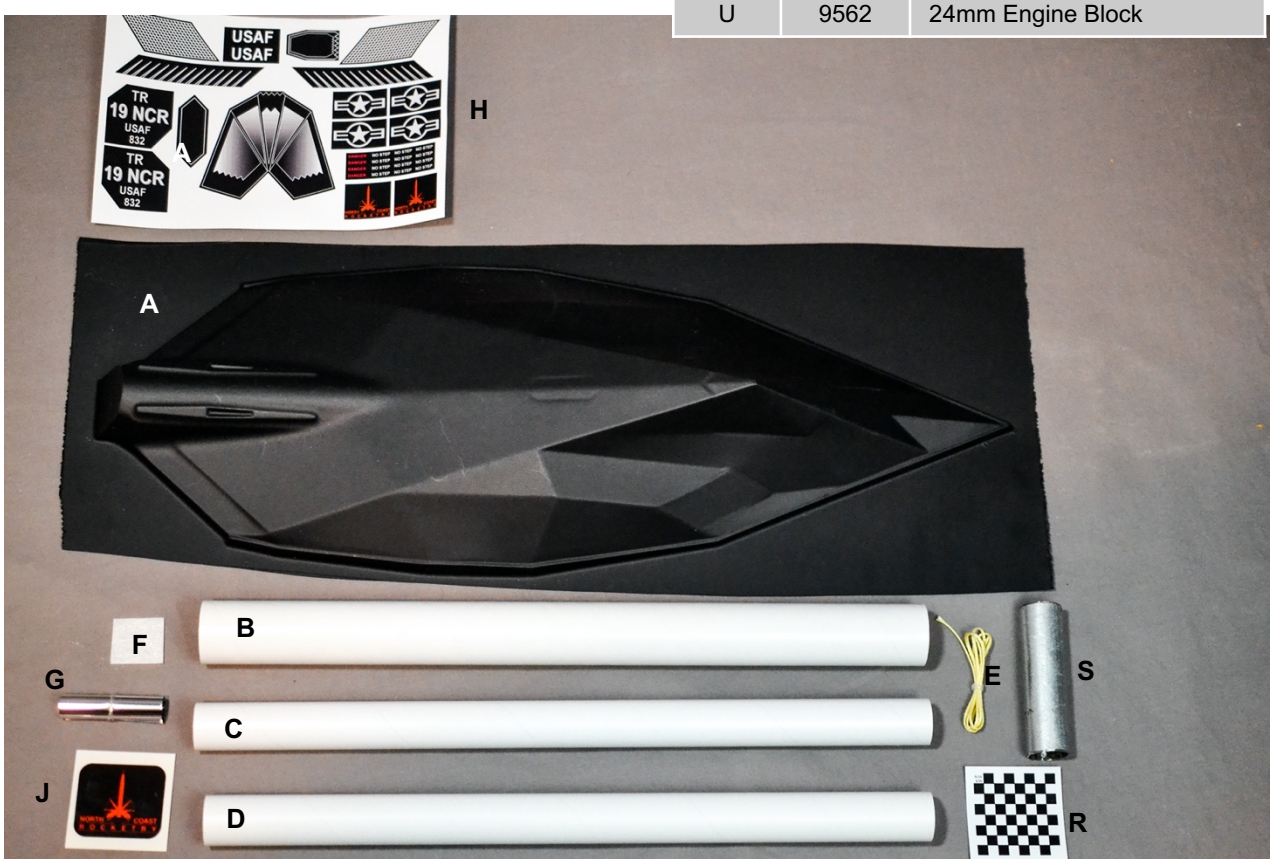
The following materials are necessary for construction:
Titebond II wood glue or similar; wax paper, 30 minute epoxy; thin cyanoacrylate adhesive (CA); ¾” wide masking tape; #60, #80, #120, #180, #220, #320 and #400 sandpaper; spray primer; matte black and bright orange spray paint, and 12 pennies (or 130 grams of lead weights). **Optional:** 12” x 24” sheet of smooth Melamine or similar, 0.125’ x 24” long rod

The following tools are required for construction:
Modeling knife or single edge razor blade; sanding block, sanding T-bar, pencil, pen or Sharpie, Pin Vise Hand Drill with 0.025” bit, small Phillips head screwdriver and an 18” long ruler. **Optional:** Dust mask, electric Mouse Sander, three 4” clamps, Dubro Kwik Hinge Slotter kit

Parts List

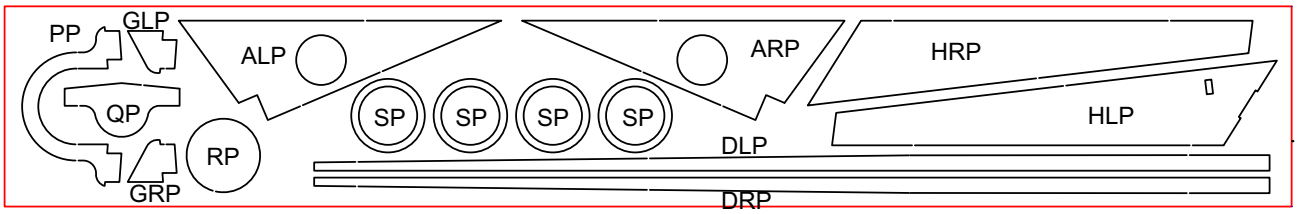


ID	Part #	Description
A	9563	F-117 Vac Formed Shell
B	1127	BT-55 Main Tube
C	1126	BT-52 Outer Pod Tube
D	1125	BT-50 Inner Pod Tube
E	9569	Kevlar Line
F	9570	Hinge Tape
G	9572	Mylar Streamer
H	8223	F-117 Decal Sheet
J	8200	NCR Decal
K	9564	Plastic Parts Set (11 pieces)
L	1127	Machine Screw
M	1126	Dental Bands (3)
N	1125	Aileron Torque Wire
R	9576	Streamer Attach Decal
S	9577	Nose Weight
T	9546	2.75” Engine Hook
U	9562	24mm Engine Block

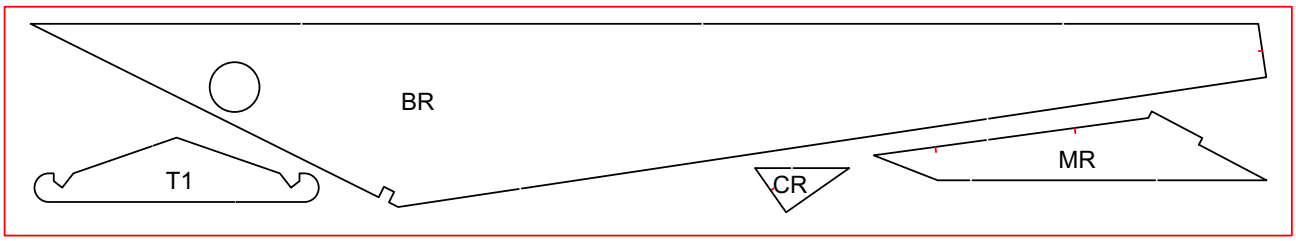


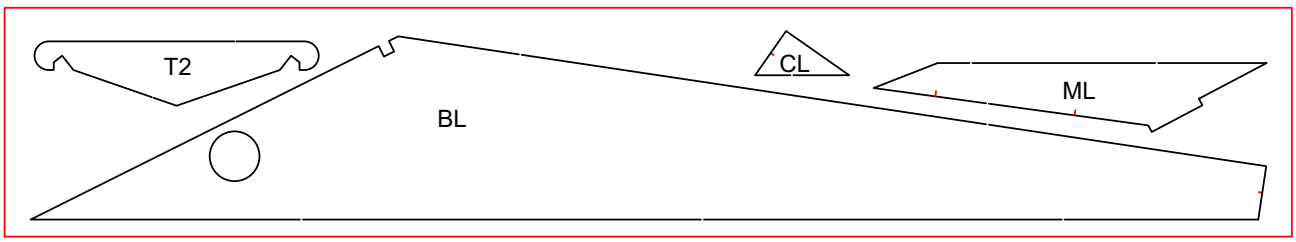
Laser Cut Parts Layout

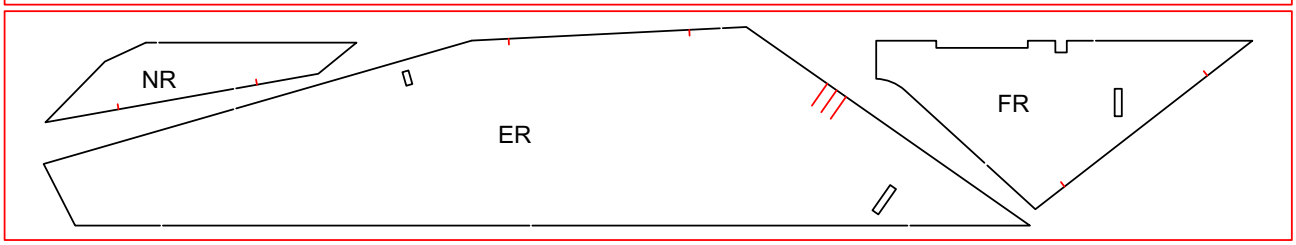
ID	Part #	Description
P	7218	Laser Cut Plywood Parts Sheet

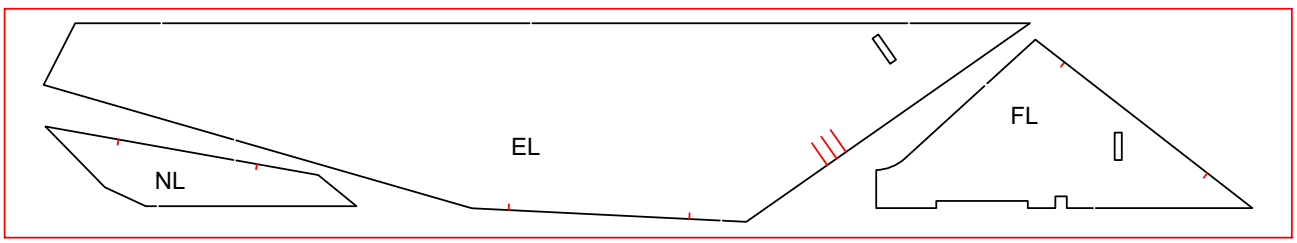


ID	Part #	Description
Q	7218	Laser Cut Parts Sheets (4)



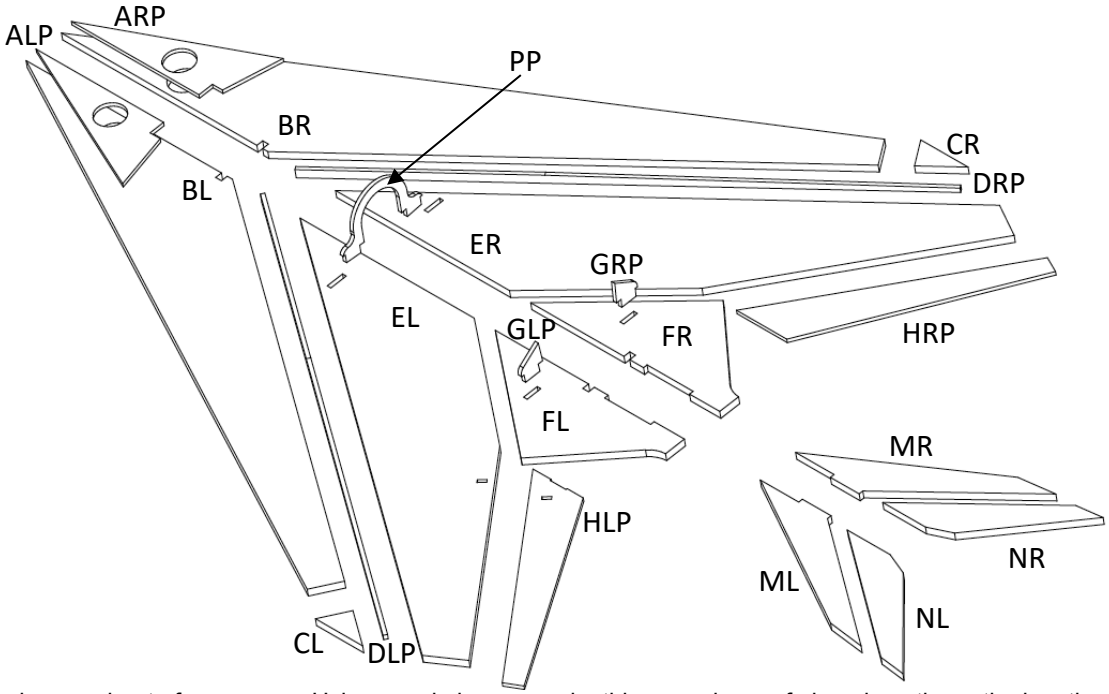






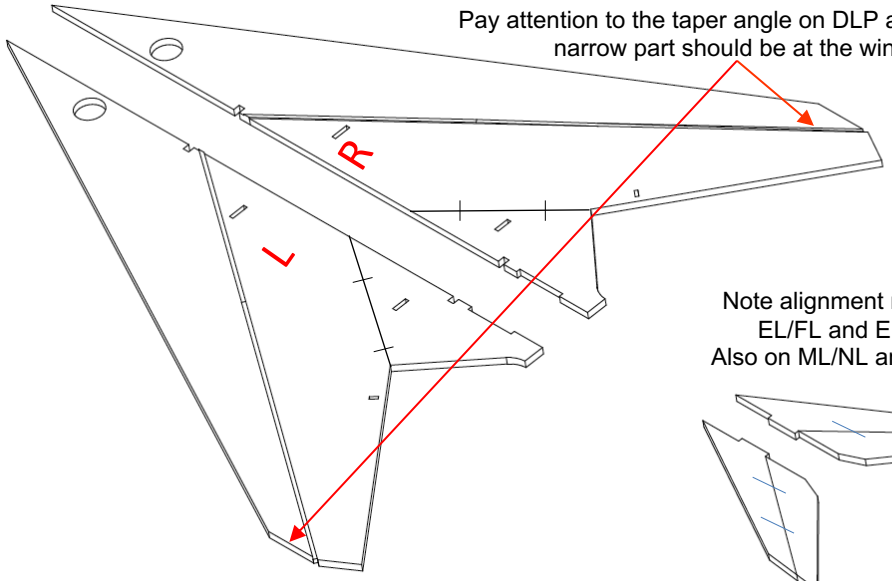
Assembly Instructions

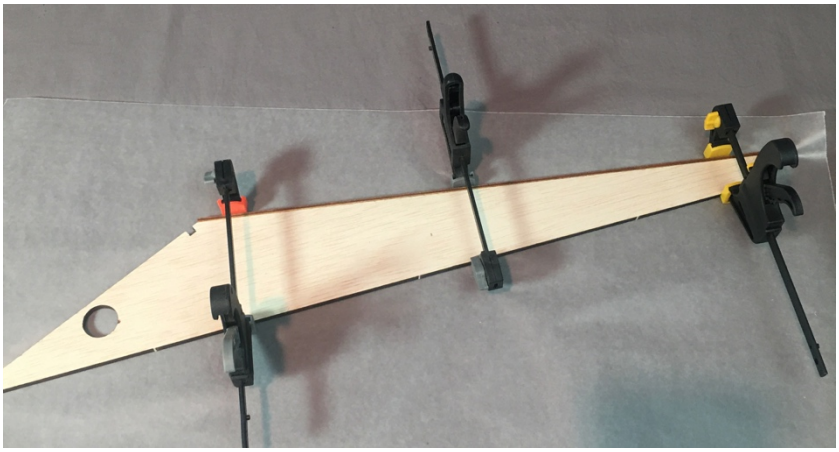
☐ Laser Cut Wood Parts Layout: L = Left Side (as shown on this illustration); R = Right Side; P indicates the part is cut from plywood, not balsa. Using a sharp knife, cut out all the balsa and plywood parts from their sheets. Sand all edges square to remove high points and char. Save the excess plywood – the long edge can be used as a marking guide later in construction.

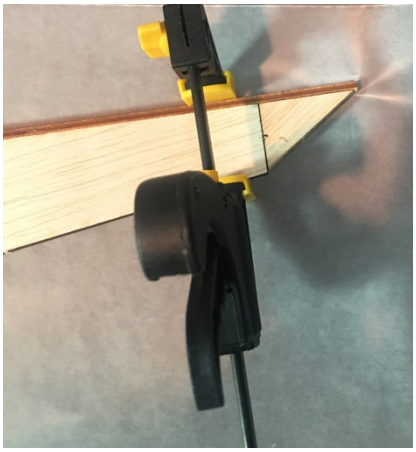


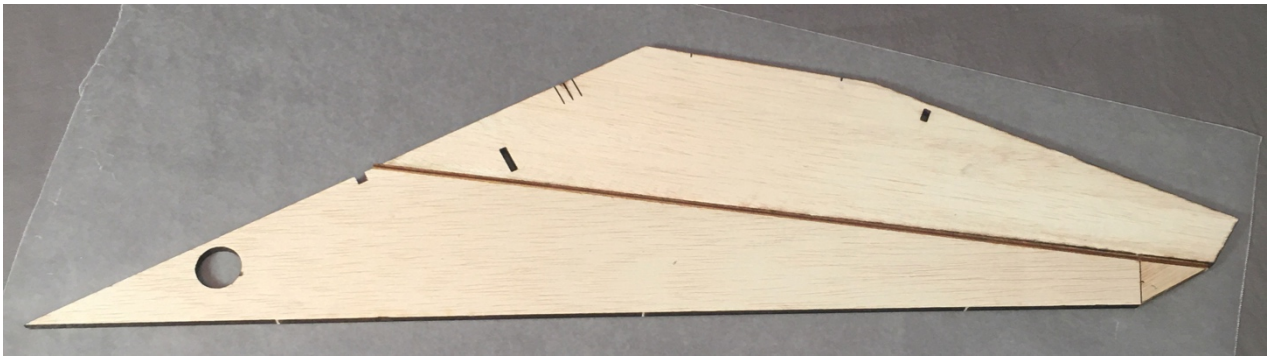
☐ Lay down a sheet of wax paper. Using wood glue, spread a thin, even layer of glue along the entire length of the surfaces to be bonded. Glue BL, CL and DLP together to form the forward wing assembly, paying attention to the taper angle on DLP and DRP; the narrow part should be at the wingtip. Two to three 4" clamps can be used to hold the parts together or place weights on top of the parts. Repeat with parts BR, CR, and DRP. When dry, glue EL and FL to the forward wing assembly to become the wing assembly. Repeat with ER and FR. Trim DLP/DRP as necessary at the root and the tip to be flush with the balsa surfaces. For easy reference, use a pen or Sharpie to mark the top left and right wings. See the next page for assembly photos.

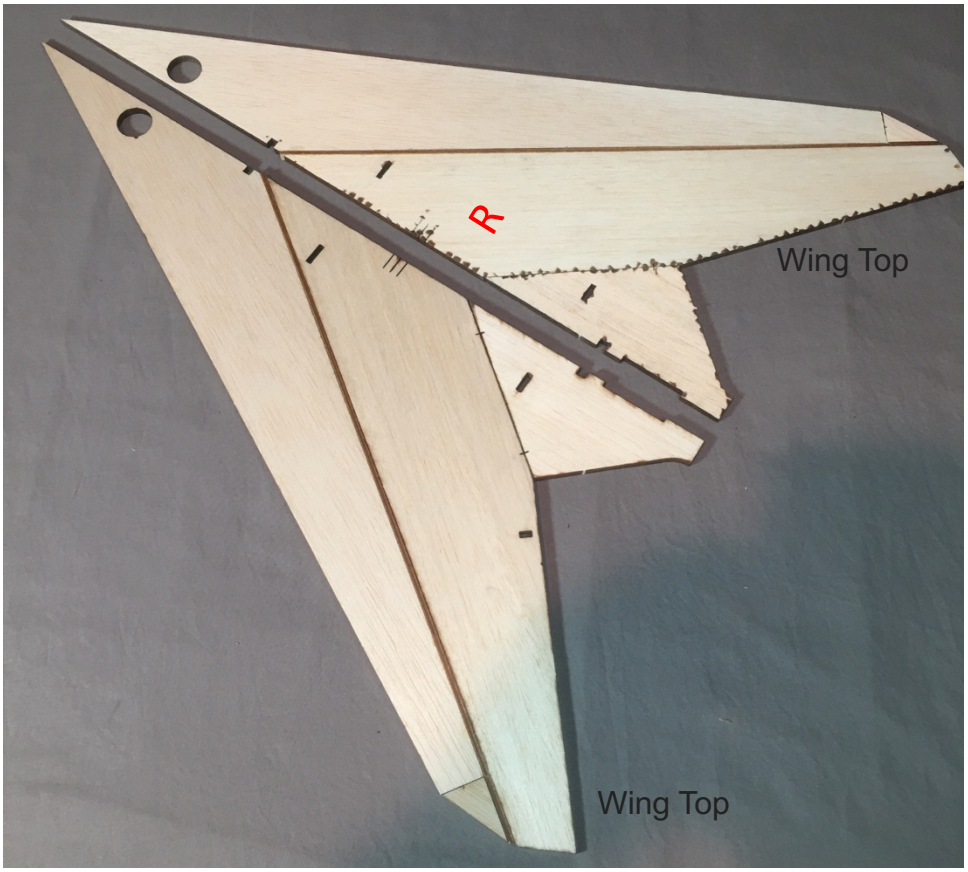
☐ Glue ML to NL, and MR to NR, and set aside to dry.



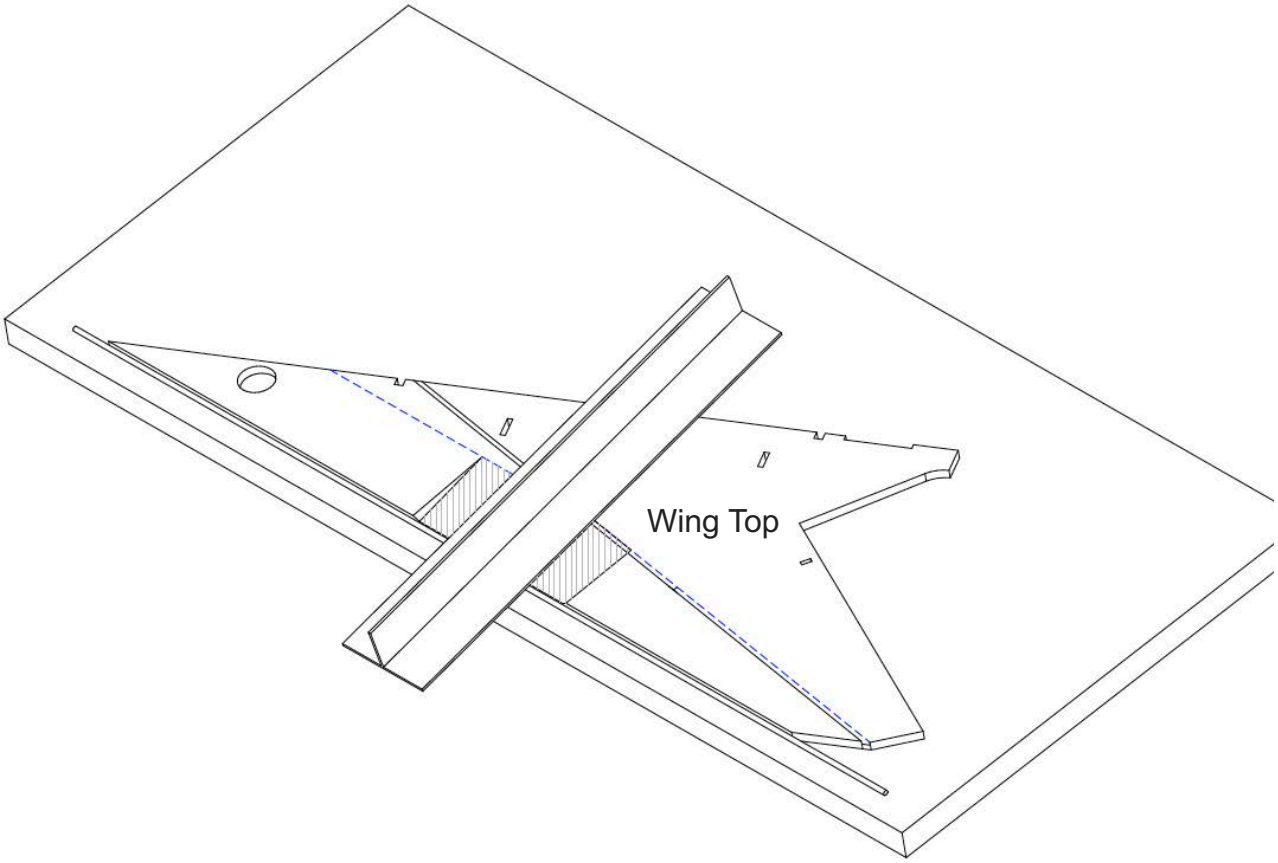


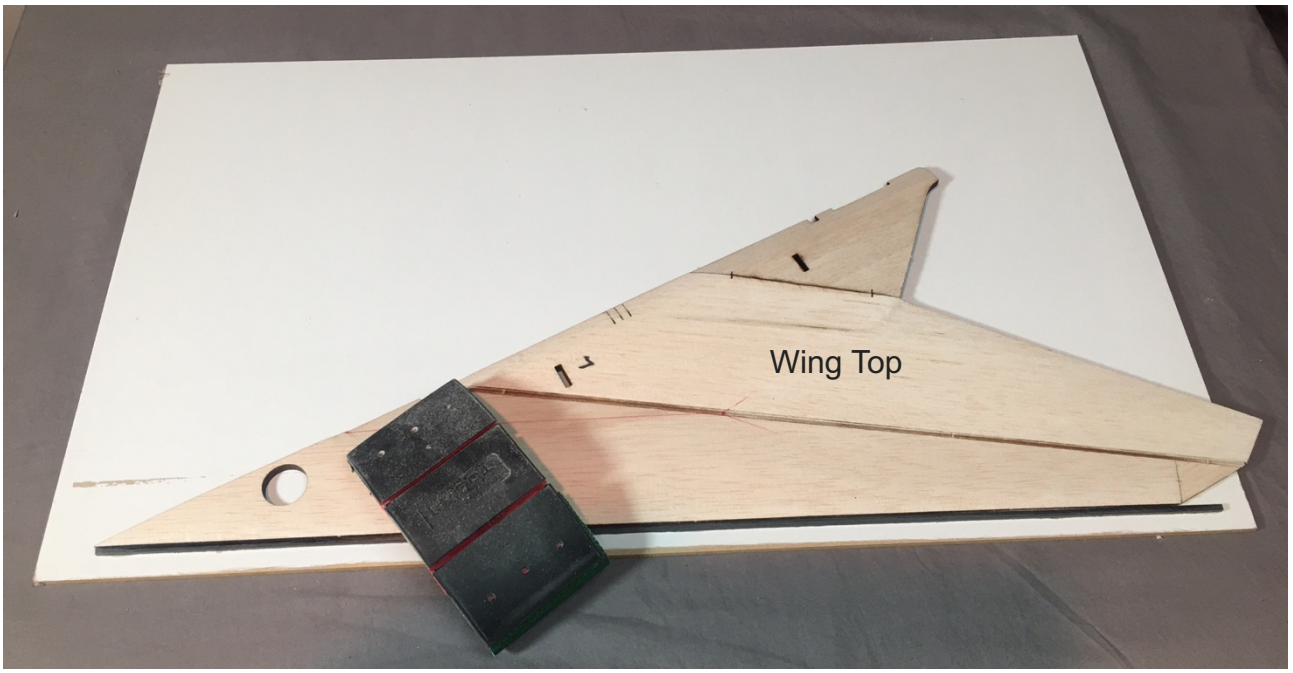






☐ To make a sanding jig that will provide consistent quality in sanding the balsa parts on this model, select a 12” x 24” sheet of smooth plywood, MDF or Melamine, and mark it 0.25” away from one edge. Using 30 minute epoxy, glue a length of 0.125” x 24” long round rod to the sheet on the 0.25”marks as shown below. This will serve as a depth guide when sanding the bevels and airfoil into the F-117 wings.

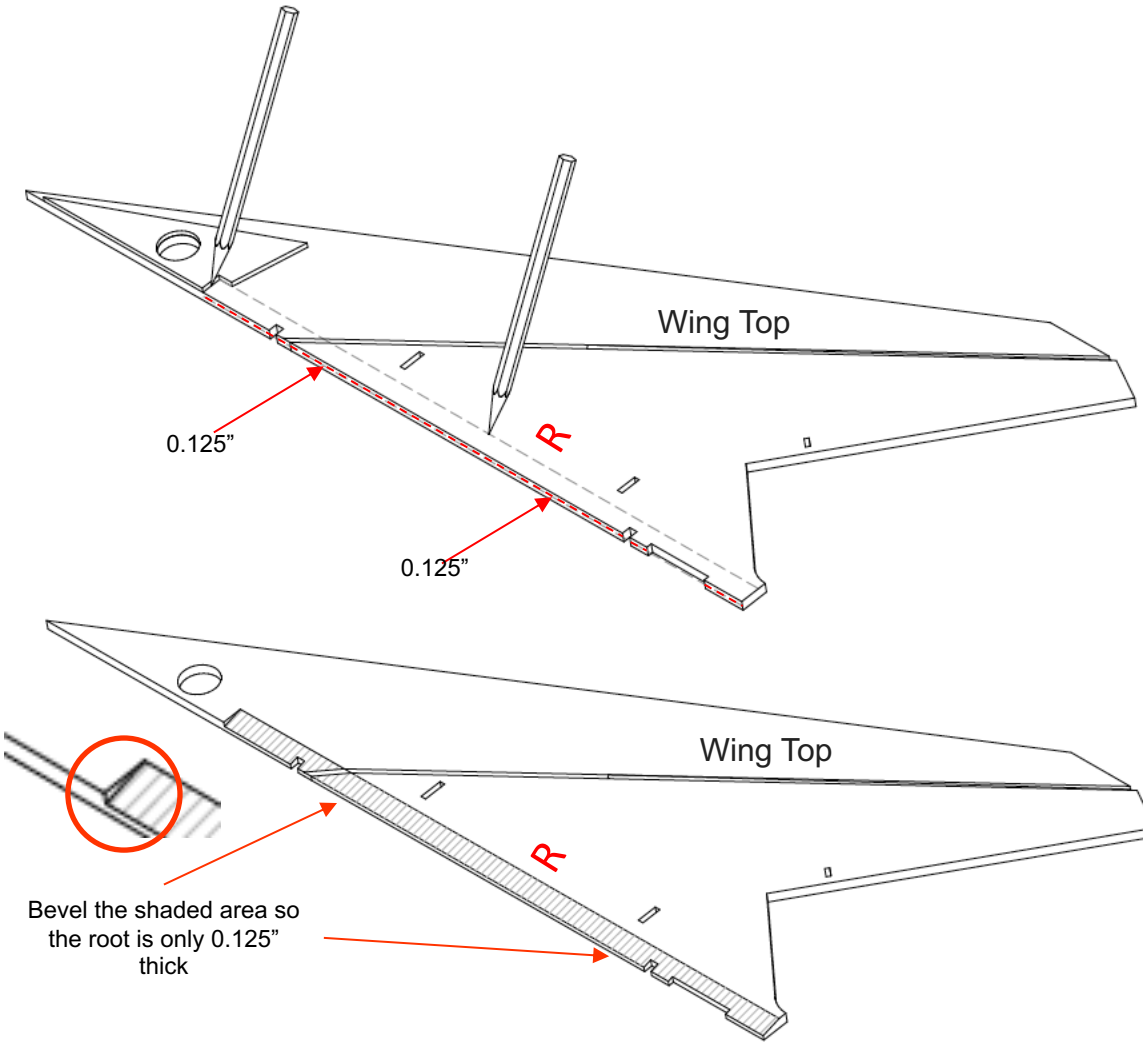




☐ Place (do not glue at this time!) the plywood plate ARP on top of the right wing assembly and mark on the wing the outline of the part. Remove the plywood part. Using a pencil, extend the line parallel to the wing root to the end of the wing assembly.

☐ Using a long scrap of the plywood, mark the root edge of the indicated area with a pencil so that it is approximately 1/8” (or half the thickness) from the bottom edge.

☐ Using #60, then #80 and then #120 grit sandpaper, bevel the area indicated so the root edge is only 0.125” thick. This is necessary to seat the outer engine tube and move the boost thrust line closer the the center of the model. Repeat for the left wing assembly using plywood part ALP.

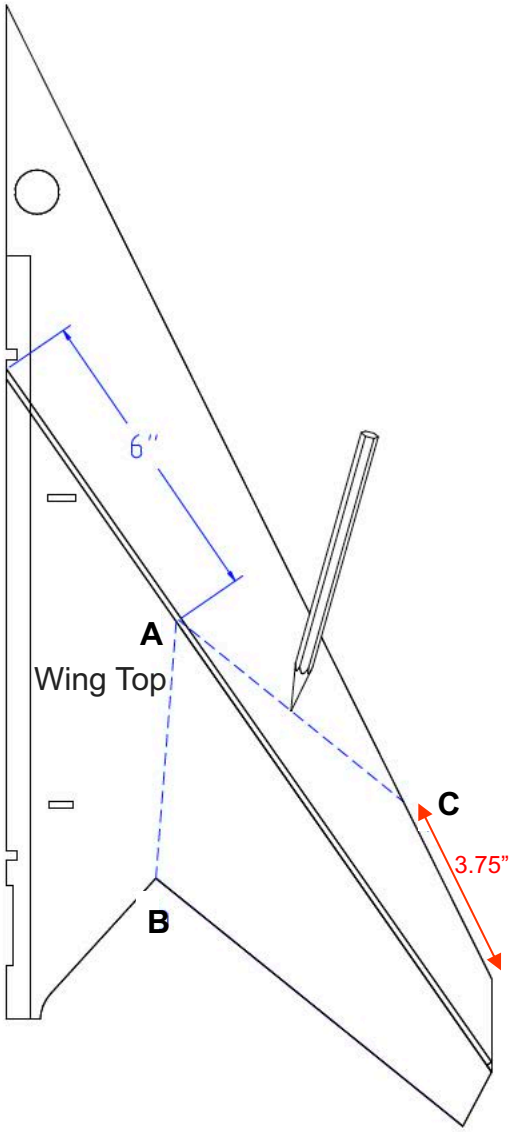


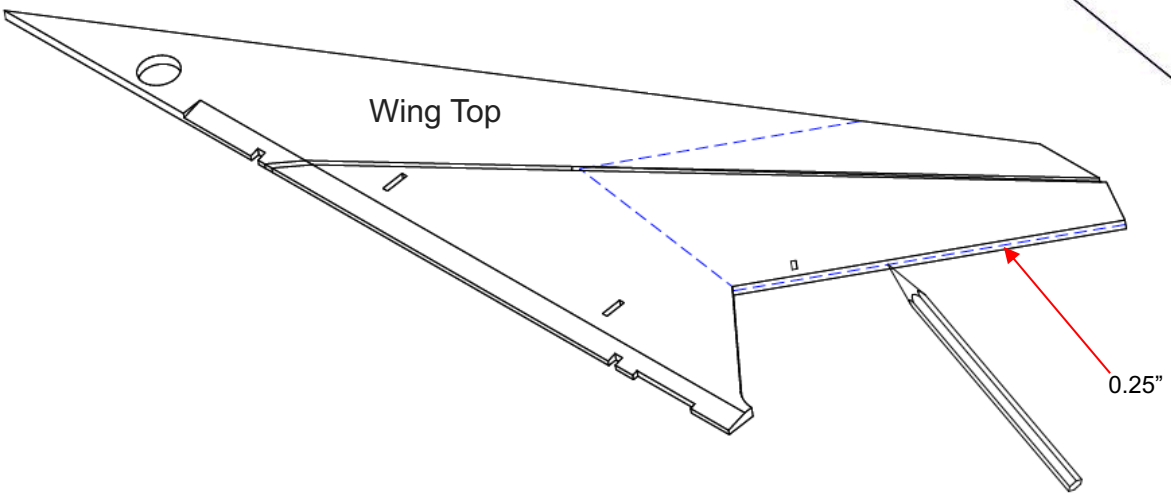
☐ Using a pencil, measure 6” from the root edge down the plywood spar, and mark point “A”.

☐ Mark a line from Point A to Point “B” which is the intersection of two balsa parts on the trailing edge.

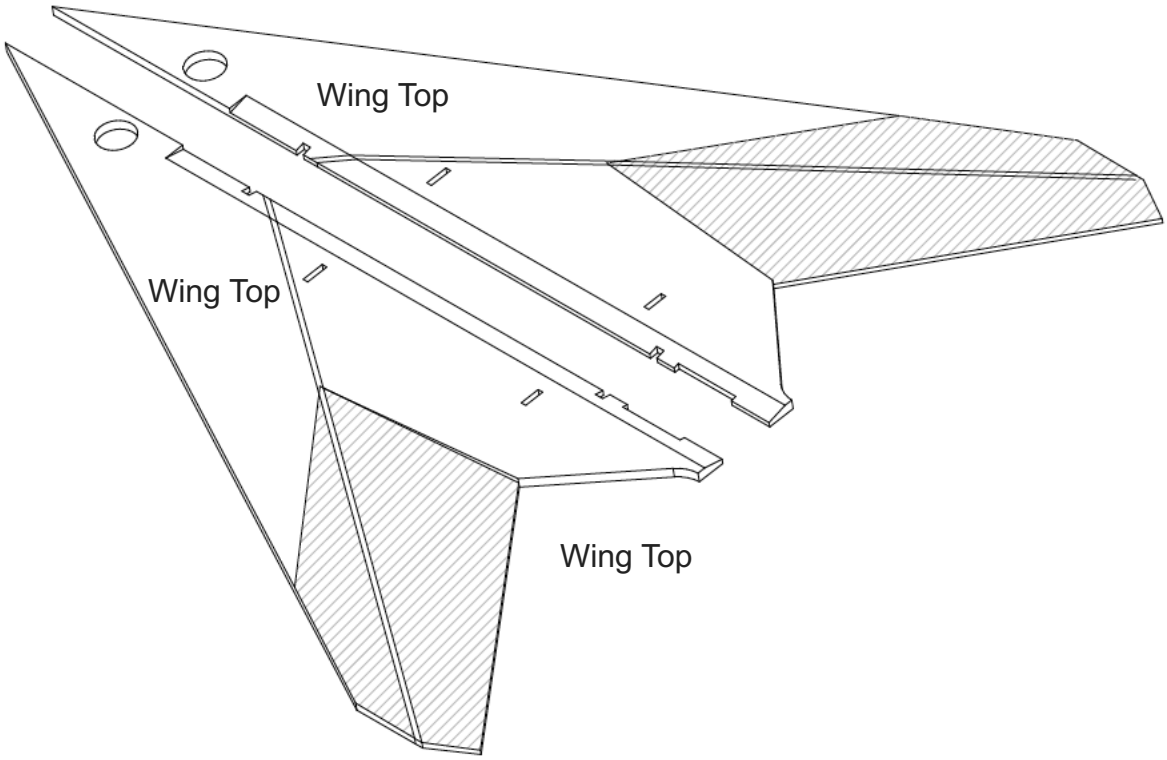
☐ Measure 3.75” from the tip of the leading edge forward, and mark as Point “C”. Mark a line from Point A to Point C. The line from A to C should end up PARALLEL to the trailing edge.

☐ Using a long scrap of the plywood, mark the trailing edge of the wing edge with a pencil so that it is approximately 1/8” from the bottom edge.

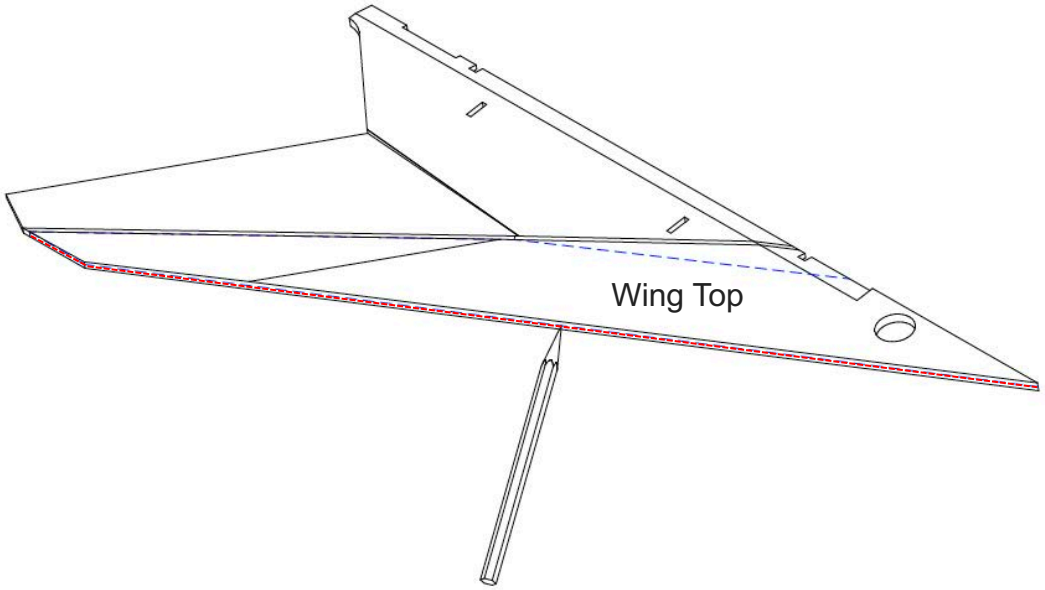




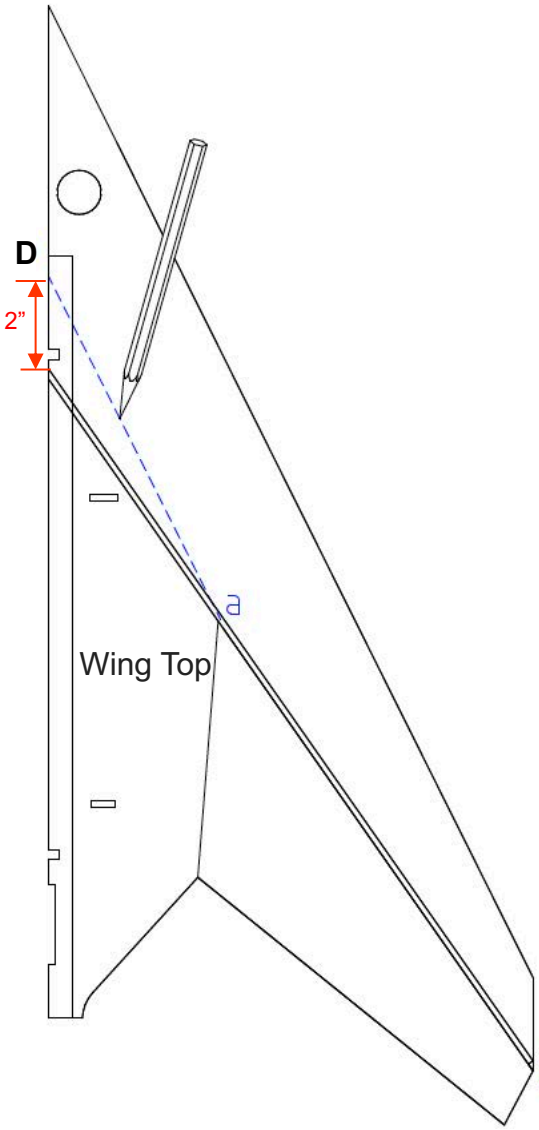
☐ Using #60, then #80 and then #120 grit sandpaper, sand the area indicated so the trailing edge is only 1/8” thick.



☐ Using a long scrap of the plywood, mark the leading edge of the wing edge with a pencil so that it is approximately 1/8” from the bottom edge.



☐ Using a pencil, measure 6” from the root edge down the plywood spar, and mark point “D”. Draw a line from D to A. This line D to A line is PARALLEL to the leading edge.



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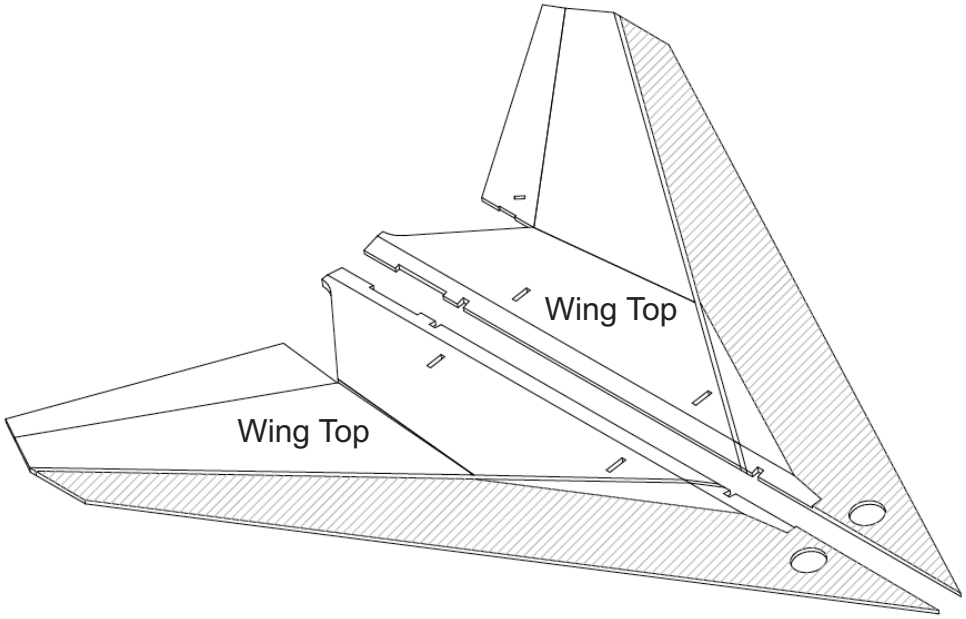
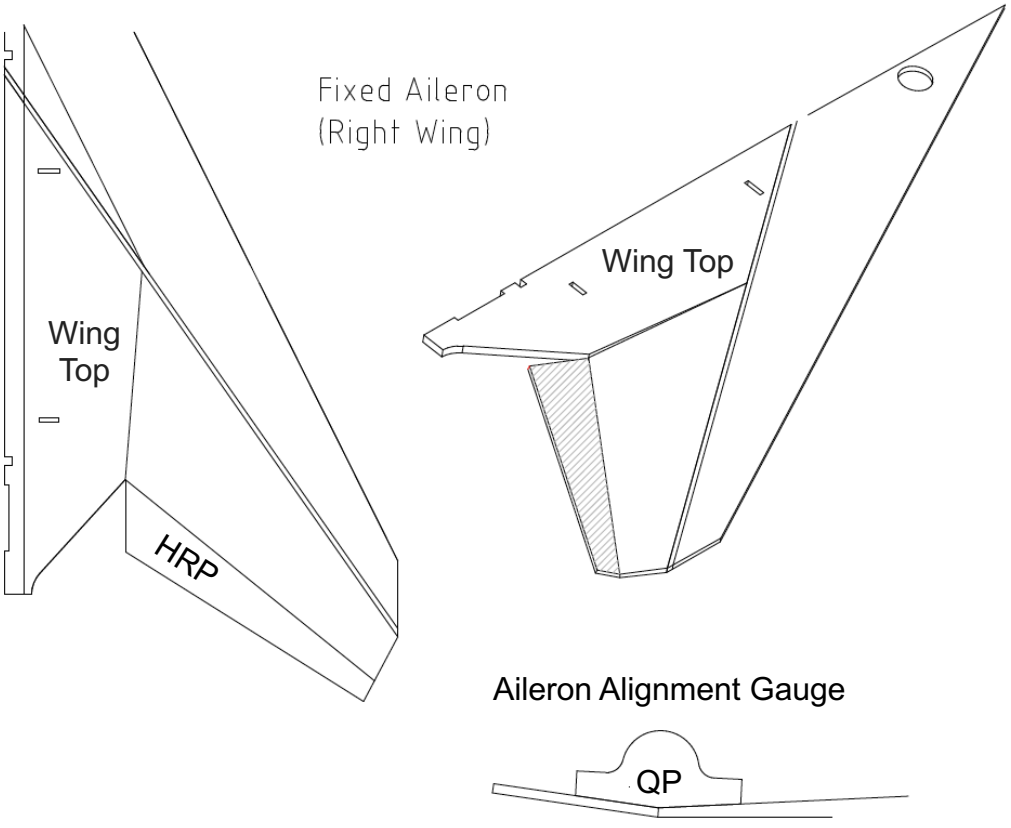
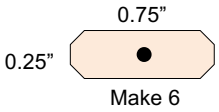
☐ Using #60, then #80 and then #120 grit sandpaper, sand the area indicated so the leading edges are only 1/8" thick.



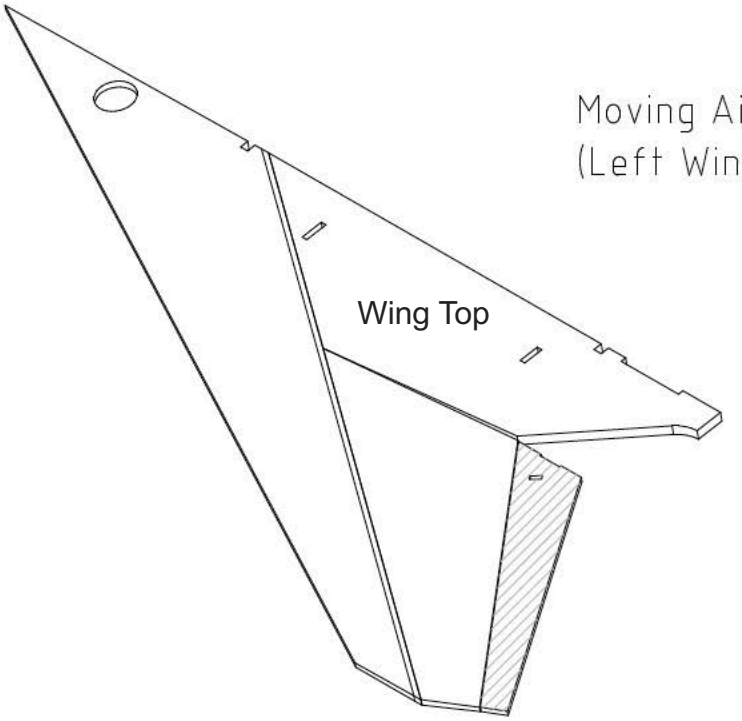
☐ Lay down a sheet of wax paper. Use the angle guide (QP) from the laser cut plywood sheet to set the angle correctly. and using wood glue, glue the wing fixed aileron on the right wing in place. Once dry, add a second coat of glue to fill in any gaps on the bottom of the joint.

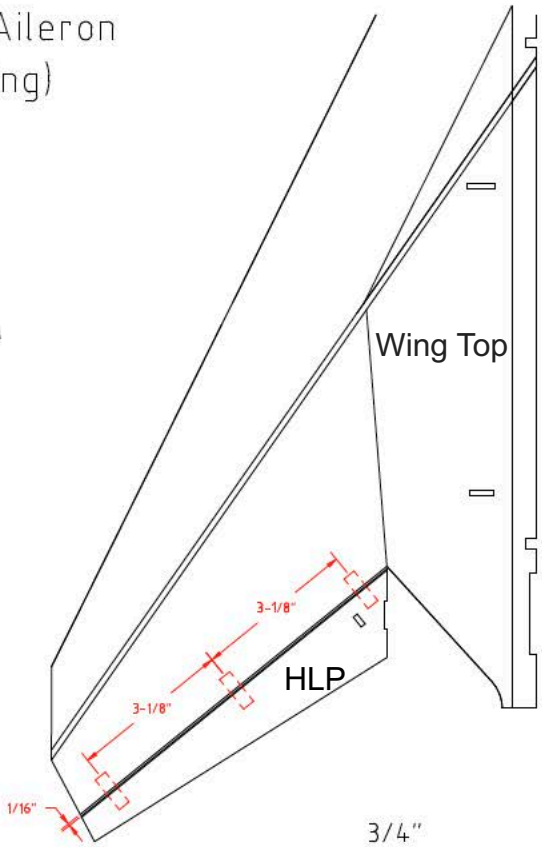


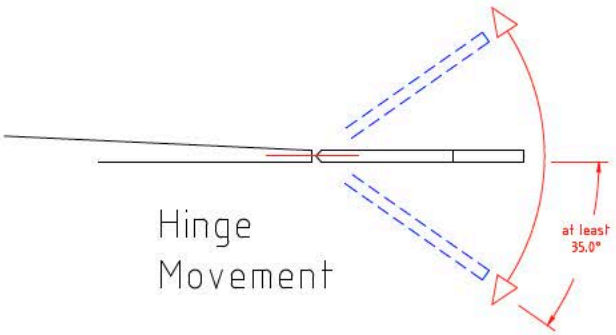
☐ Cut three hinges from the hinge material. Each hinge should be 0.25” wide x 0.75” long as shown on the right. Trim a little off each corner of each hinge. This makes it easier to install in the slots. Mark a dot in the middle of each hinge.

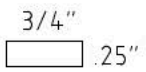


☐ Place the left wing and the left elevator (HLP) together, then place the hinges over the hinge line 3.125” apart as shown in the illustration. Mark the outside of each hinge with a pencil on the top of each surface. Extend the line to the thickness of the part. See below additional details.



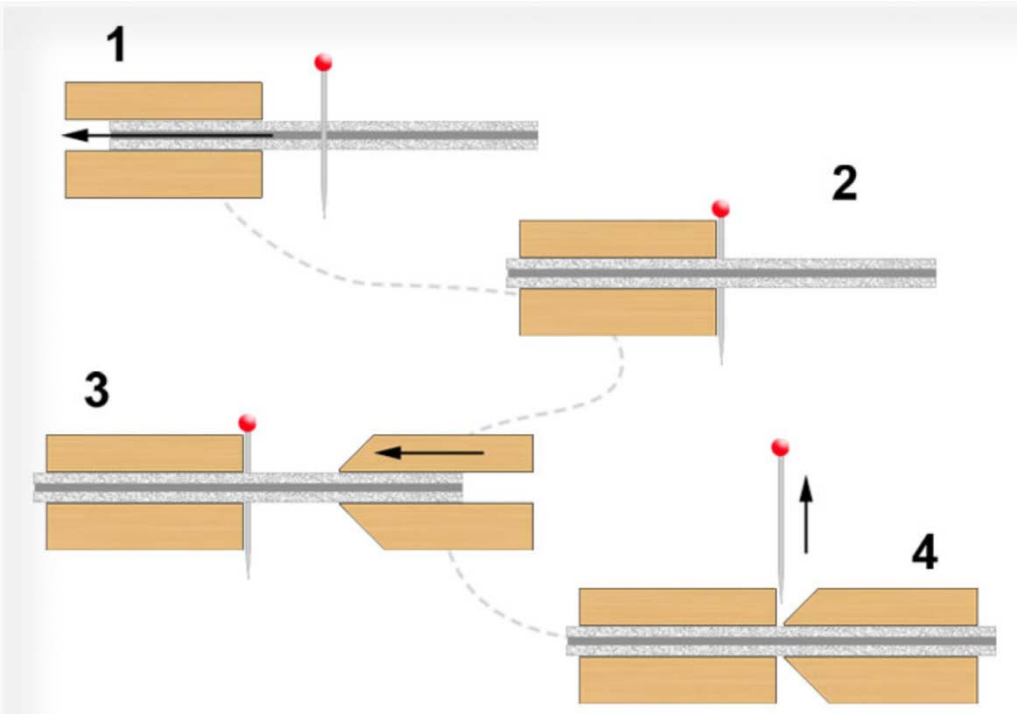






Hinge size

☐ Hinge installation overview – detailed instructions follow.



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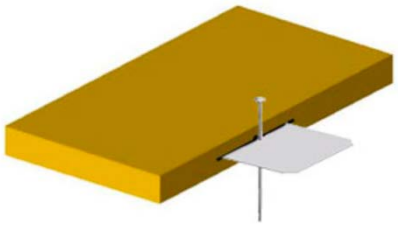
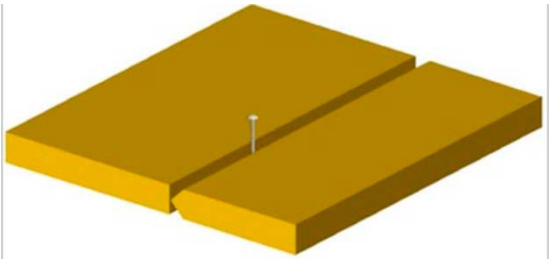
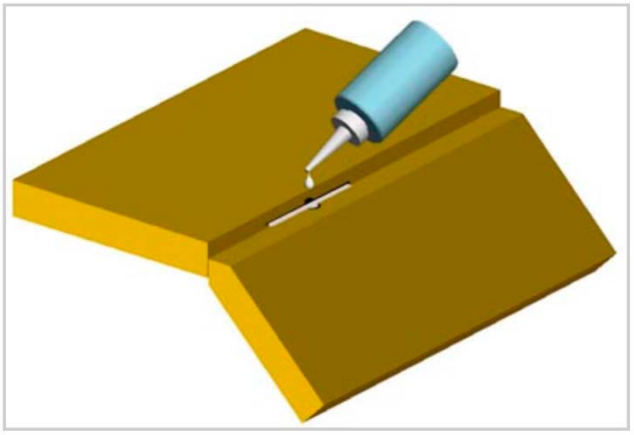
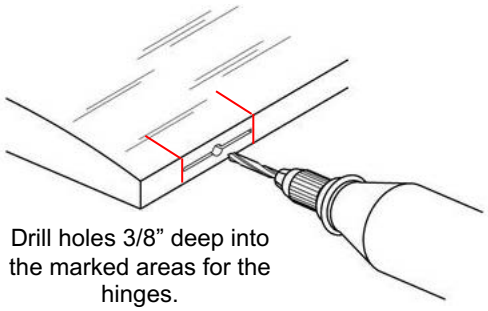


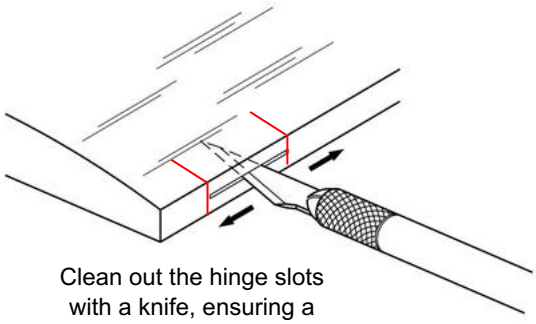




☐ Using a pin vise hand drill with a bit 0.025” (0.6-0.7mm) in diameter, drill a hole 3/8” deep into the leading edge of the left elevon just inside the location marks. Repeat the process, drilling multiple holes for the width of each mark. Using a knife, clean the holes out to give a good tight slot. Repeat the process for the slots in the wing.



Drill holes 3/8” deep into the marked areas for the hinges.

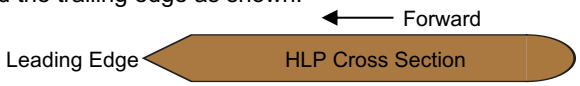


Clean out the hinge slots with a knife, ensuring a tight fit for the hinges

☐ Next, push a straight pin through the centers of of the hinges (where you marked the dot). Insert the hinges up to the pin to check the fit. Make sure that they go in all the way; if not, remove additional material until they do. Because thin CA has no gap-filling ability, the hinge slots need to be snug. They don’t need to be so tight that you have a difficult time getting the hinges in, but you should be able to feel some friction as you slide them in.

☐ Insert the hinges into the wing up to the pin to check the fit. Make sure that they go in all the way; if not, remove additional material until they do. If the slots are slightly off, simply cut the slots a little longer so that the hinges fit without binding.

☐ Remove the hinges. Carefully sand the leading edge of the the left elevon (HLP) the leading (forward) edge of the elevator to a point and round the trailing edge as shown.

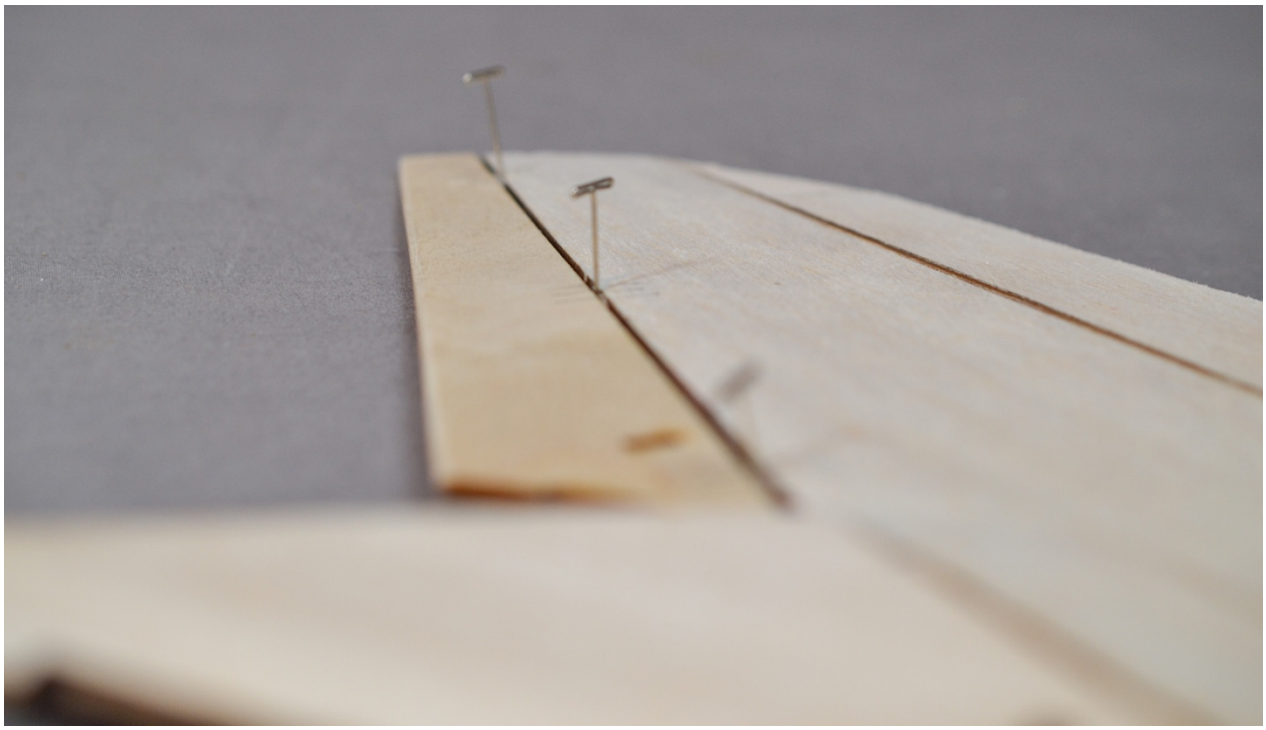


☐ Insert the hinges into the elevon and the wing. Flex the elevon 45º in both directions. Check the fit to make sure that no hinge has buckled. Sometimes if one hinge is too tight, or if its slot is not deep enough, it can buckle at the hinge line and the other hinges will hold it like that. If a hinge has buckled, remove the elevator and check that the slots are deep enough or not too tight.

☐ Remove the modelers pins, keeping the gap intact.

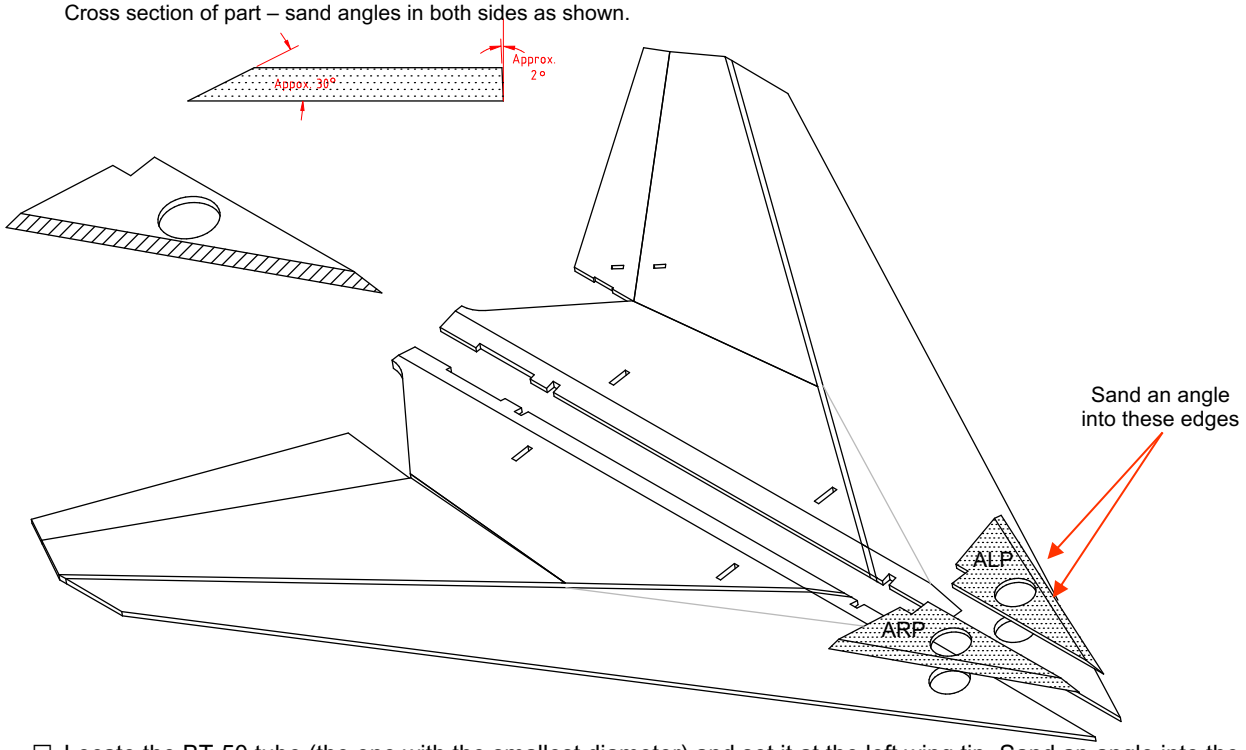
☐ Using a fine tip applicator, apply a couple drops of thin CA to each hinge across the top and then the bottom of the assembly. NOTE: Thin CA is the **only** adhesive designed to work with these hinges – do not substitute! Thin CA glue works on a “Capillary” principle, which relies on s the ability of a fluid (CA) to travel through a porous material (the hinge and the wood). Once the glue is added, it’s all over – there is no “undoing” a CA hinge and you only have one chance to get it right. Do not add anymore glue to the hinge after the initial application! Remove the modelers pins, keeping the gap intact. Set aside the assembly for fifteen minutes and then wiggle the elevon to loosen up the hinges.

☐ Elevon hinge installation details.

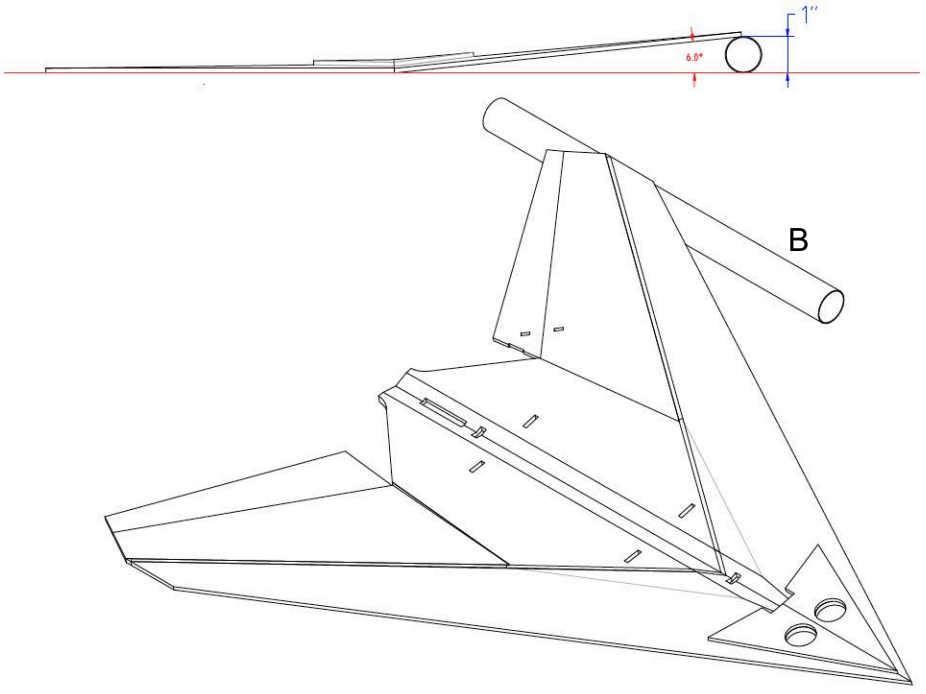


☐ Sand a 30º angle into both the leading edge and root edge of ALP and ARP. Test fit them on the wing assemblies to ensure the holes line up, then using wood glue, bond them in place.

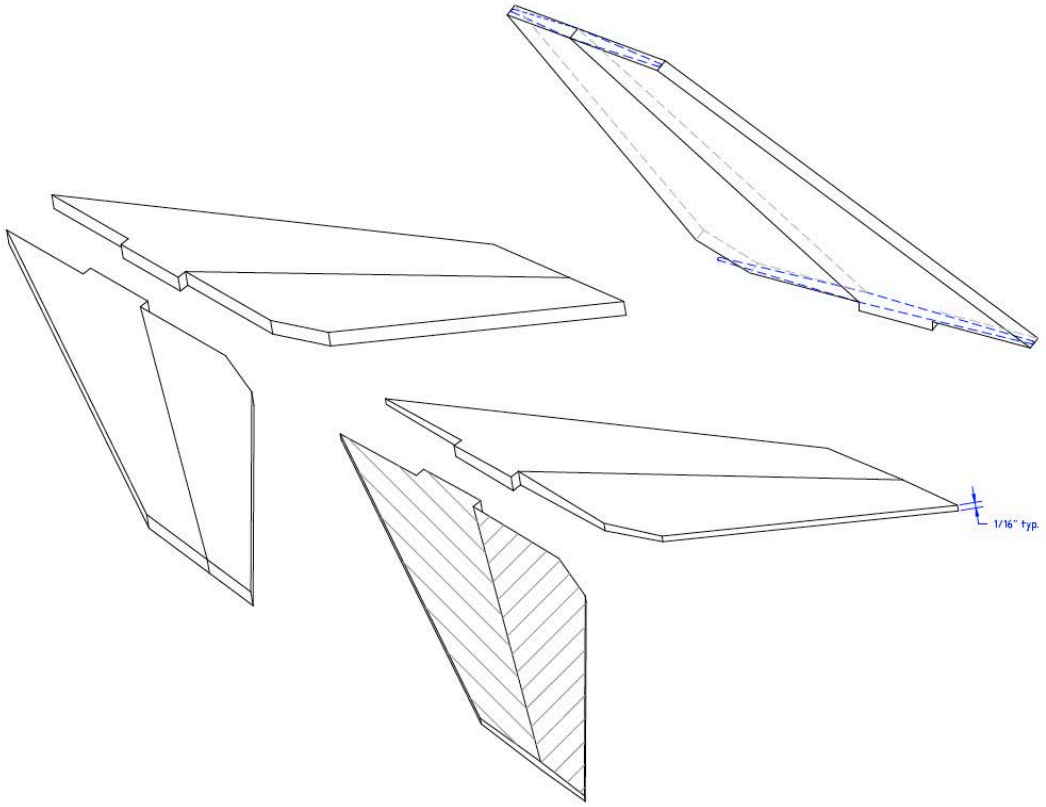
Cross section of part – sand angles in both sides as shown.



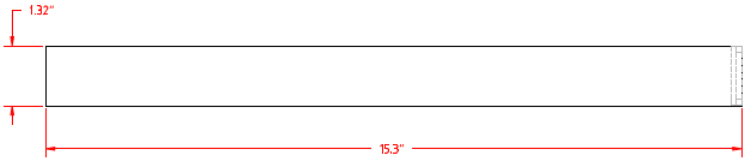
☐ Locate the BT-50 tube (the one with the smallest diameter) and set it at the left wing tip. Sand an angle into the left wing assembly, so that the part mates with the right wing assembly. Lay down a sheet of wax paper, and using wood glue, glue the wing halves together. Once dry, add a second coat of glue to fill in any gaps on the bottom of the joint. Fine sand the wing assembly with #220, #320, and #400 sandpaper.

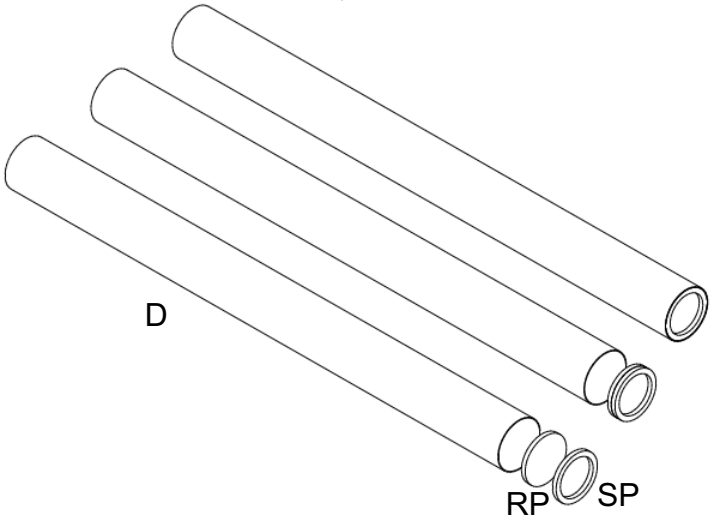


☐ Using #60, then #80, #120, $220, #320 and then #400 grit sandpaper, sand the rudders into a diamond shape as indicated in the illustration below, so the leading edges and trailing edges are only 1/8” thick.

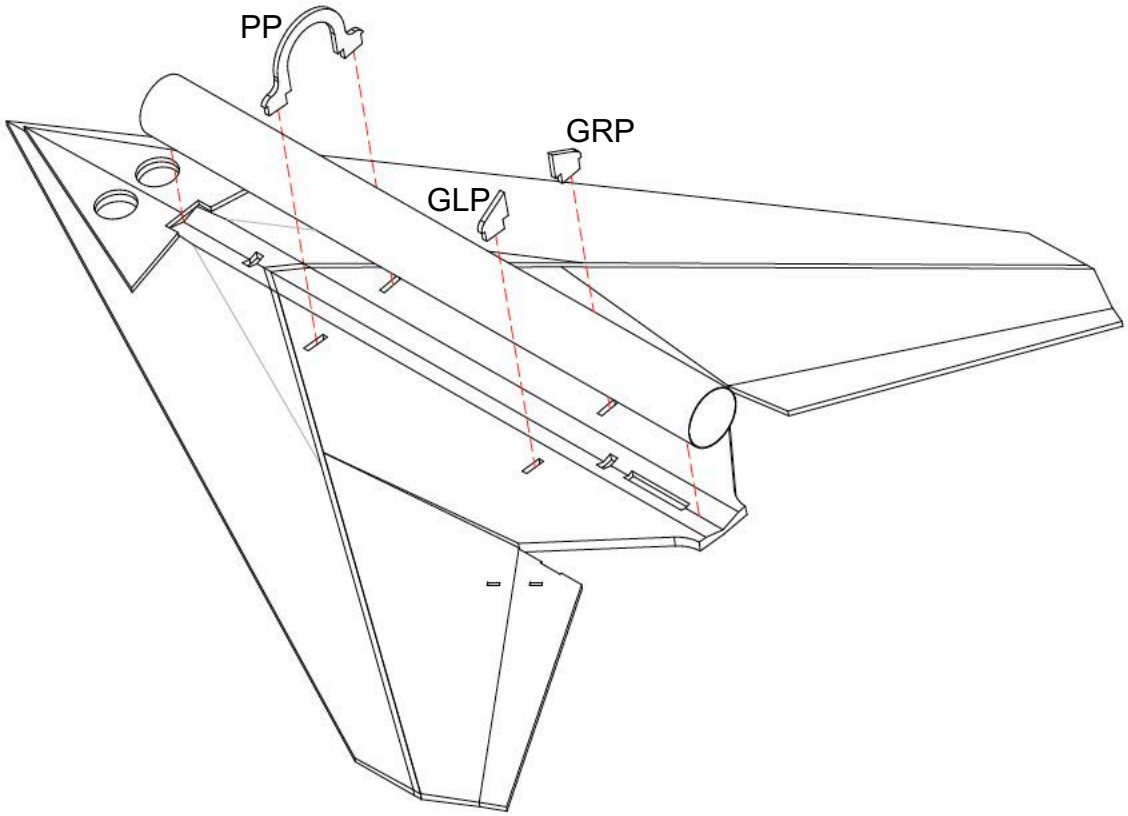


☐ Locate the BT-55 tube (the outer tube assembly). In one end, test fit the plywood bulkhead and one centering ring. Sand as necessary to get a good tight fit. Using epoxy, bond the bulkhead and centering ring in one end of the tube, with the centering ring flush with the end of the tube. Set aside to cure.





☐ Lay the outer tube assembly (the BT-55 tube) on the wing assembly, and glue with wood glue. Then, glue the positioning parts in place. After the glue has dried, add a fillet to each joint.



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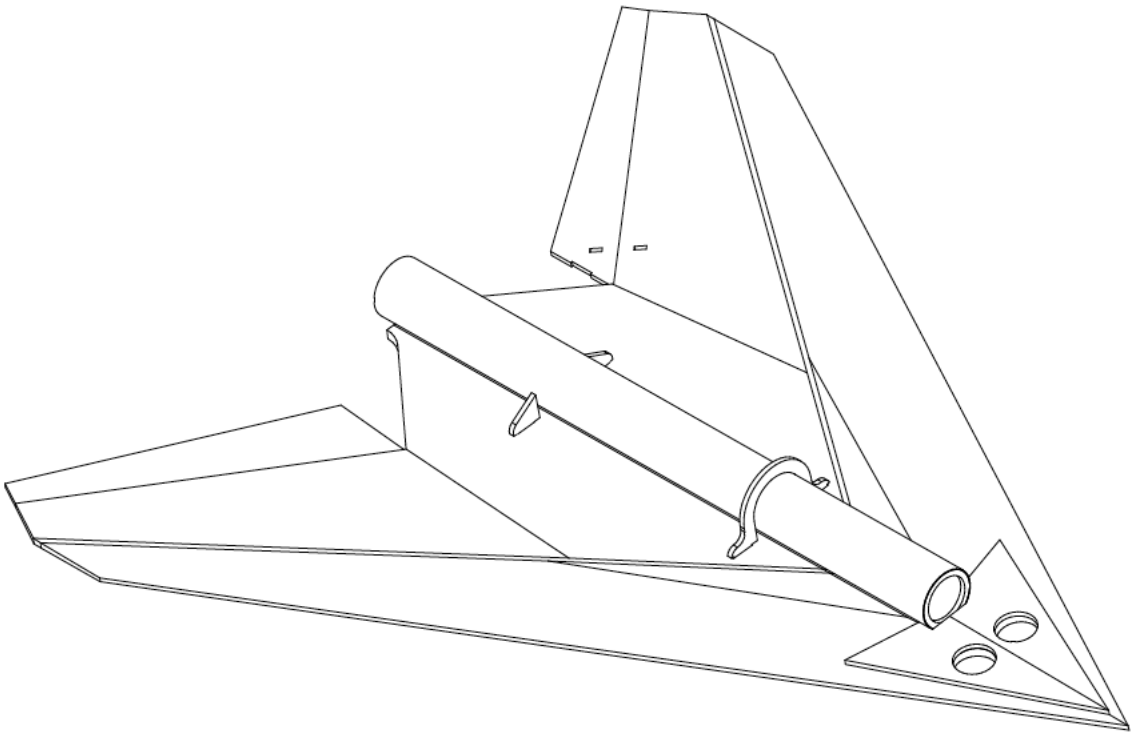
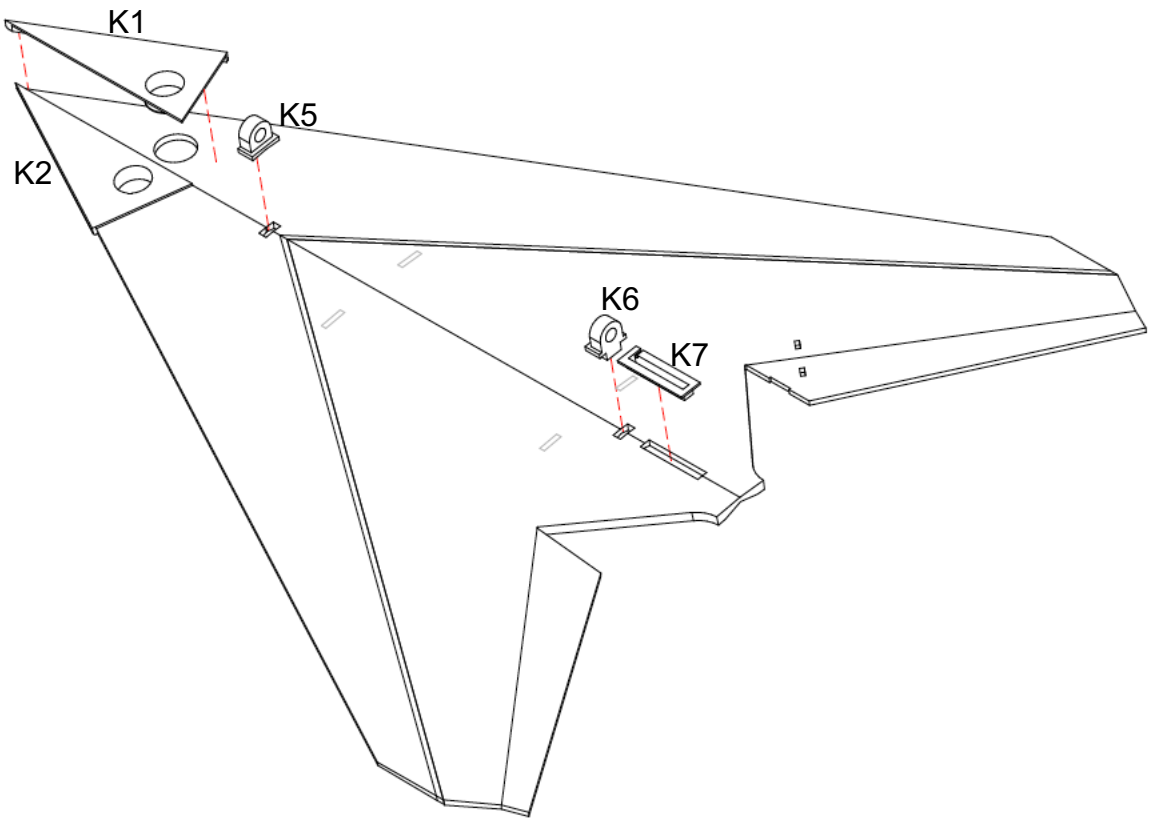


☐ Turn the wing assembly over so the bottom is facing up. Check fit the plastic parts into the slots; sand any balsa away to get a good tight fit. Using 30-minute epoxy, glue the pieces in place



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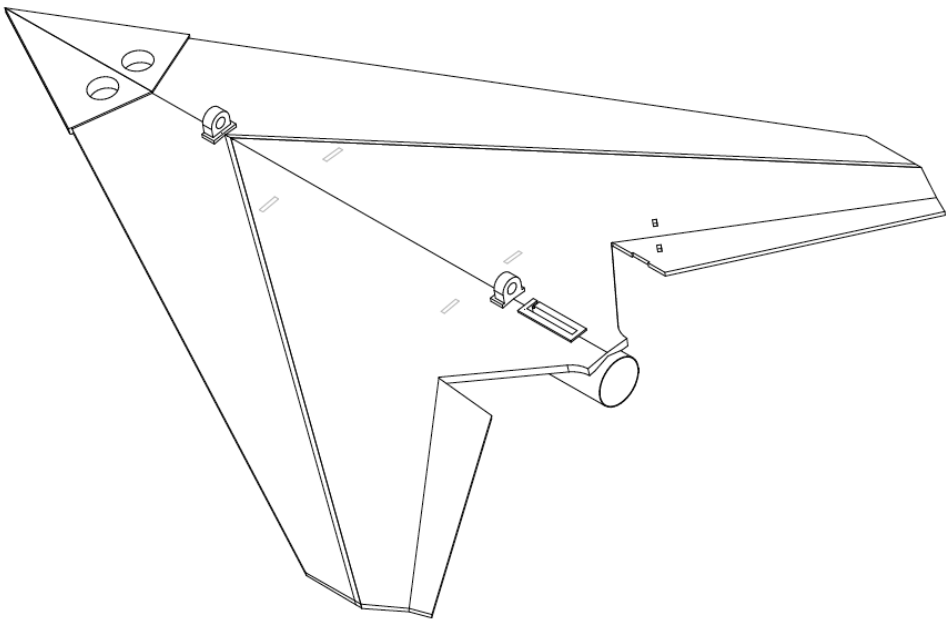
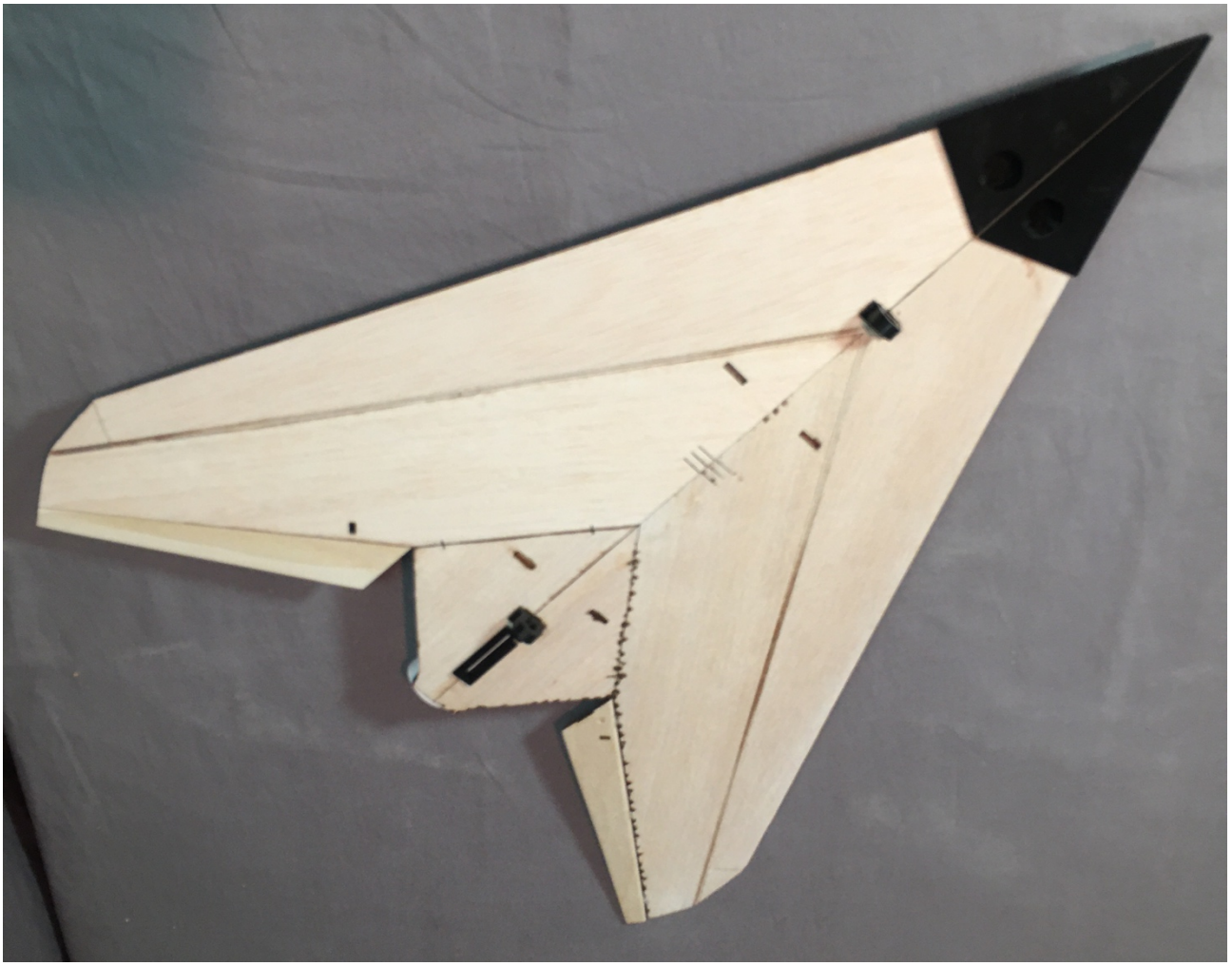
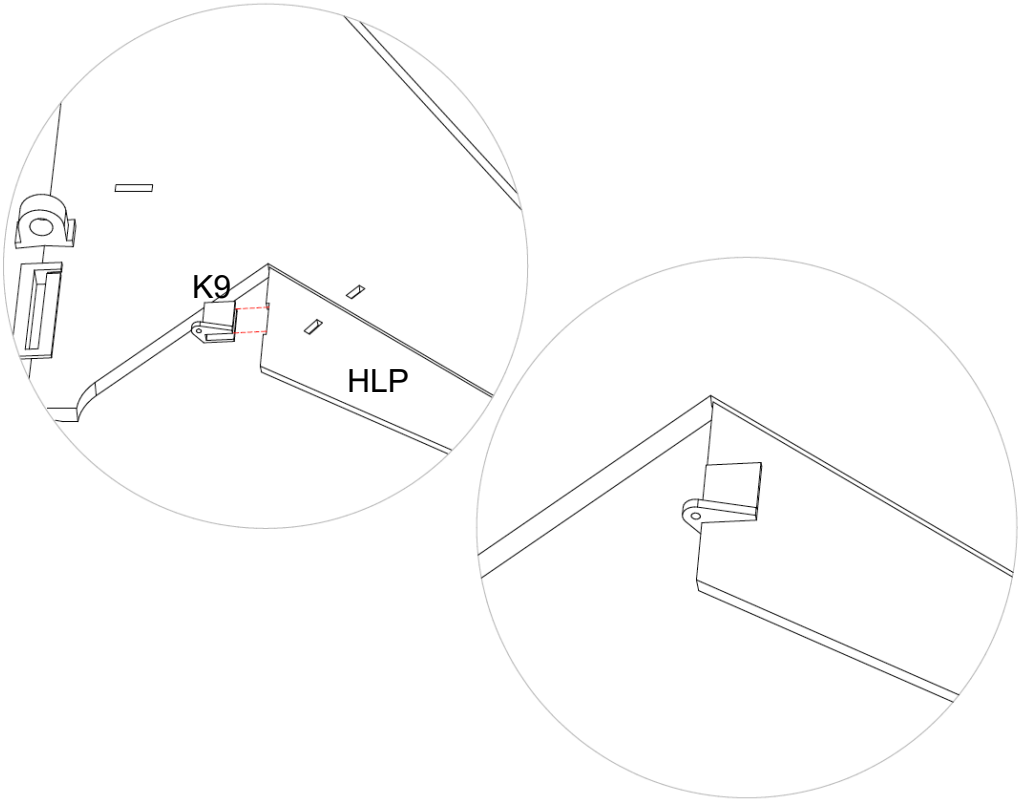


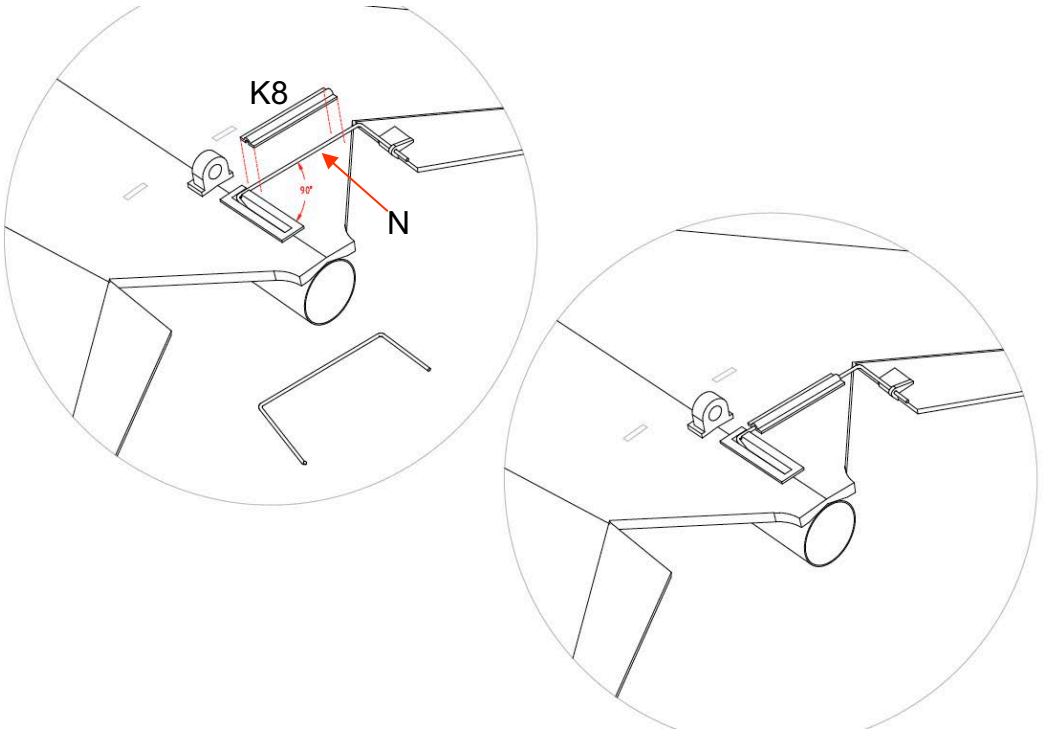


☐ Using a sharp knife, trim away the body tube inside part K7 to create a slot for the Aileron Activation Wire.

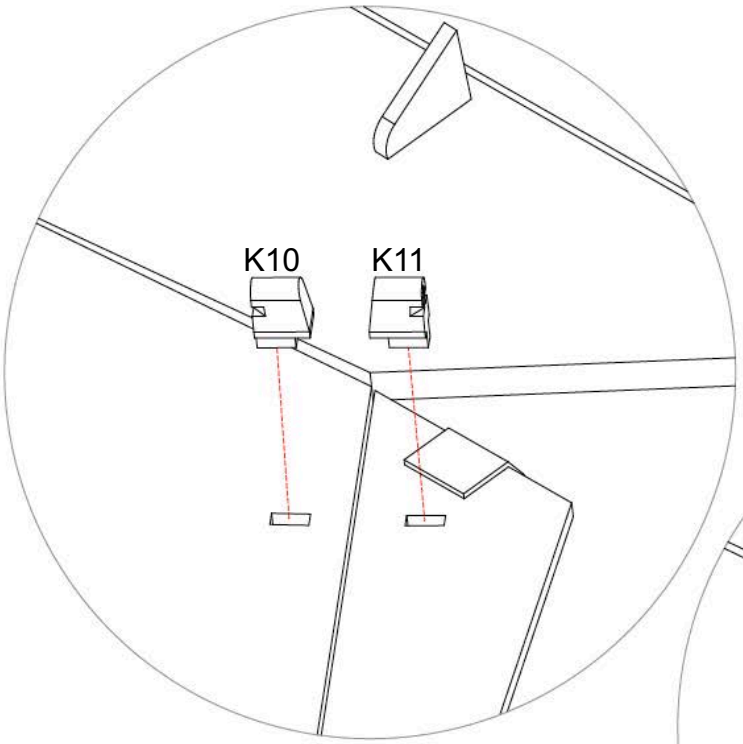
☐ Locate the Aileron Control Horn (K9) and test fit it into the slot on the moveable elevon. Remove, coat the inside of the part with 30-minute epoxy, and slide into place. Let cure.

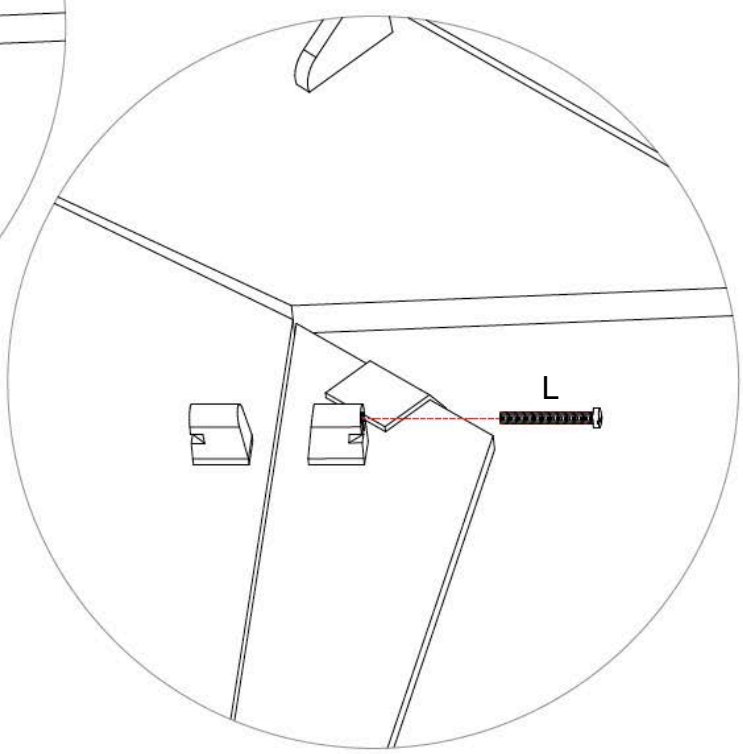


☐ Insert the straight end of the the Aileron Activation Wire (N) into the Aileron Control Horn, and the other end with a slight bend in the end into the slot of the main tube. Using 30-minute epoxy, glue the Aileron Activation Wire Cover (K8) over the wire as shown. The wire should slide in the Aileron Control Horn when the elevon is moved.

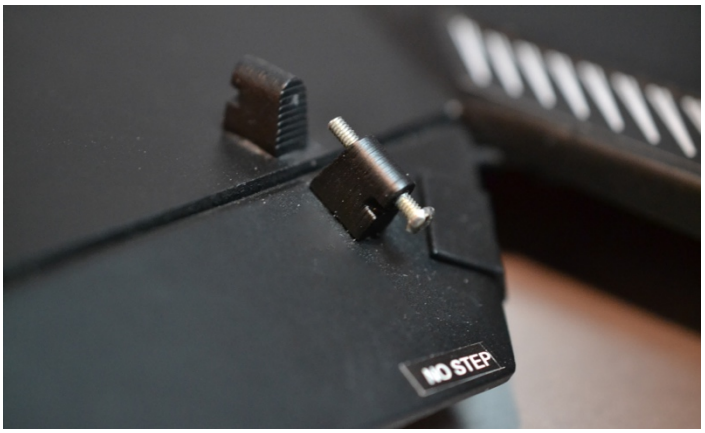


☐ Epoxy the Elevon Stop (K10) and the Elevon Adjustment Horn (K11) into the slots in the left wing and elevon, paying close attention to the direction of the rubber band slots on both parts. Set aside to cure.

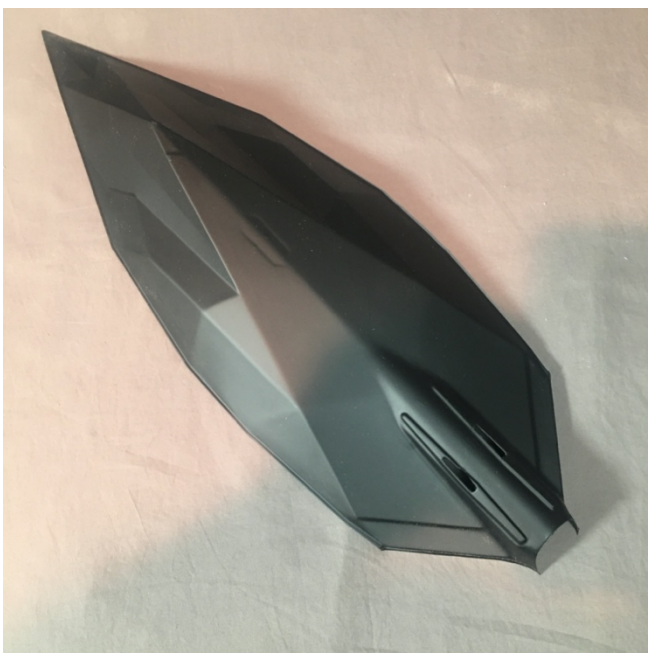




☐ When the epoxy has cured, thread the adjustment screw (L) into the Elevon Adjustment Horn until about 0.125” protrudes out the part.



☐ Locate the F-117 shell and flip it over so the bottom is facing up. Put a new knife blade in your knife, and carefully make a light score line on the inside of the vacform as shown. Repeat 2-3 times and separate the excess plastic sheet. Trim away the engine mount area using the same technique. Flip the shell over, and, on the aft end, trim away the plastic sheet. Sand the edges flat and square, using #60 or #80 sandpaper.

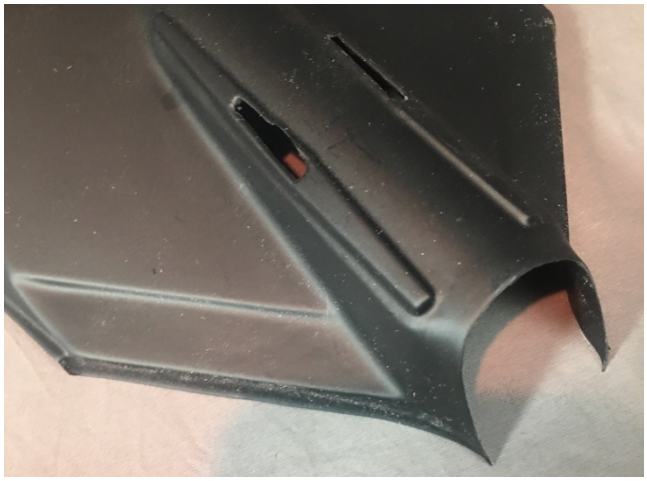


☐ Test fit the F-117 shell on the wing assembly, making sure that the shell fits square and true to the wing. Using 30-minute epoxy, apply a thin coat of epoxy to the “lip” on the shell, and a thin coat to the top of the tube on the wing assembly. Bond the shell onto the wing. Set aside to cure.

☐ Using 30-minute epoxy, fillet the shell to wing joint. Set aside to cure.

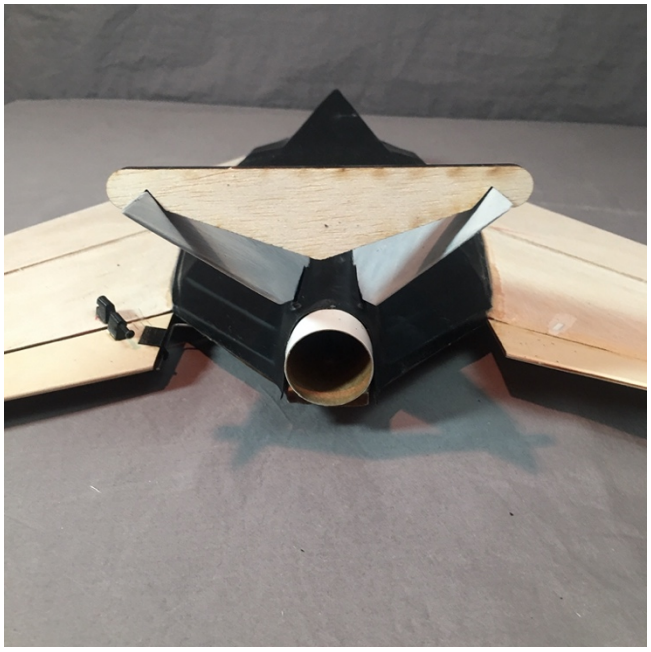
☐ Using #120, #220, and & #320 sandpaper, round the leading edges of the balsa wing

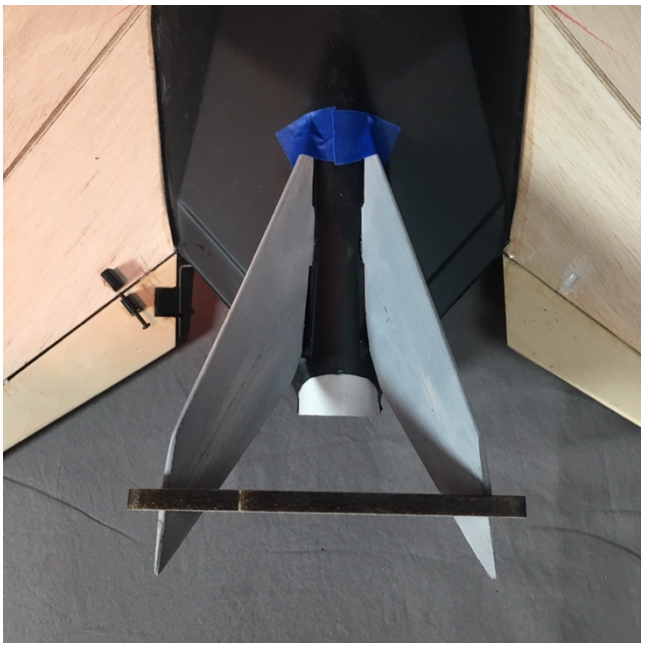
☐ Trim the plastic slots on the top of the shell. Test fit the rudders into the slots, trimming where necessary.



☐ It is easier to fill the rudders before they are bonded in place. To make them easy to prime and fill, insert a small diameter dowel or music wire in the root edge to hold the rudder. Apply 2-3 coats of primer filler, sand with #220, #320, and #400 sandpaper, and repeat.

☐ Using 30-minute epoxy, bond the rudders into the plastic slots and on to the outer tube. Using the rudder alignment tools (T1 or T2 – one is extra) to ensure proper alignment. The point of the tool should align with the centerline of the glider.

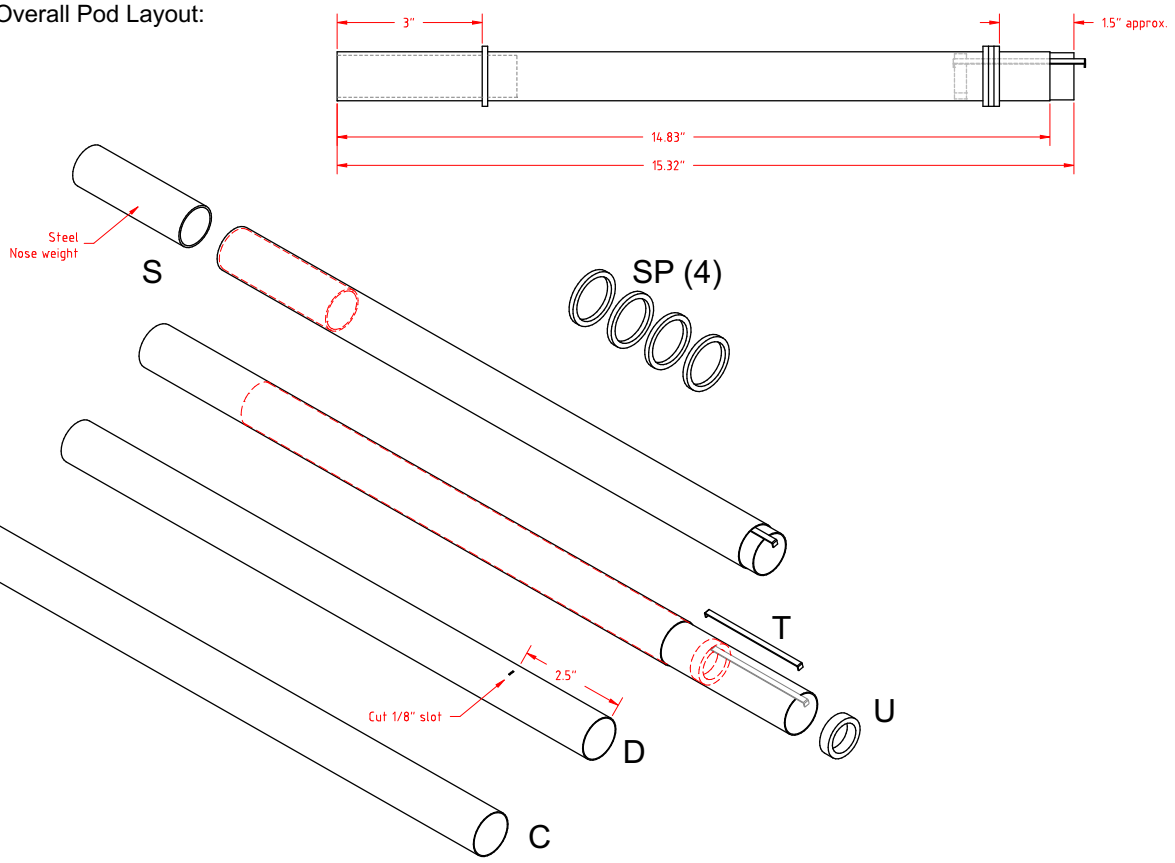




☐ Using 30-minute epoxy, fillet the rudder/shell joints.

☐ Mask off the shell (since there is no need to add primer and weight to that part. Apply 2-3 coats of primer filler to the balsa surfaces, sand with #220, #320, and #400 sandpaper, and repeat. Try and find a balance between a decent surface finish and light weight – each coat of primer adds a good deal of weight, that will affect both boost altitude and glide time.

☐ Overall Pod Layout:



☐ Locate the BT-50 tube (D) and make a mark 2.5” from one end. Cut a 0.125” wide slot at the mark. Insert the engine block (U) past the slot, and using 30-minute epoxy, bond the ring in place.

☐ Insert the engine hook (T) into the slot. Using 30-minute epoxy, glue the BT-52 tube (C) over the BT-50, making sure the the forward ends are flush.

☐ Mark the outer tube 3” from the forward end. Using wood glue, glue one centering ring (SP) on the 3” mark.

☐ Mark the outer tube 1.5” from the aft end of the BT-50 tube. Using wood glue, glue three (3) centering rings (SP) forward of the 1.5” mark. Set aside to cure.

☐ Test fit the pod assembly into the large tube in the F-117 glider assembly. Sand the plywood rings if the pod does not insert and retract smoothly.

☐ Locate the nose weight (S) and test fit it into the forward end of the pod assembly. Using 30-minute epoxy, glue the nose weight into BT-50, making sure the the forward ends are flush. Set aside to cure.

☐ Mask off the outer edges of the plywood rings. Paint the forward end of the pod a bright color like fluorescent orange. Paint the aft end of the pod flat black, similar to what you will use on the glider. Let dry.

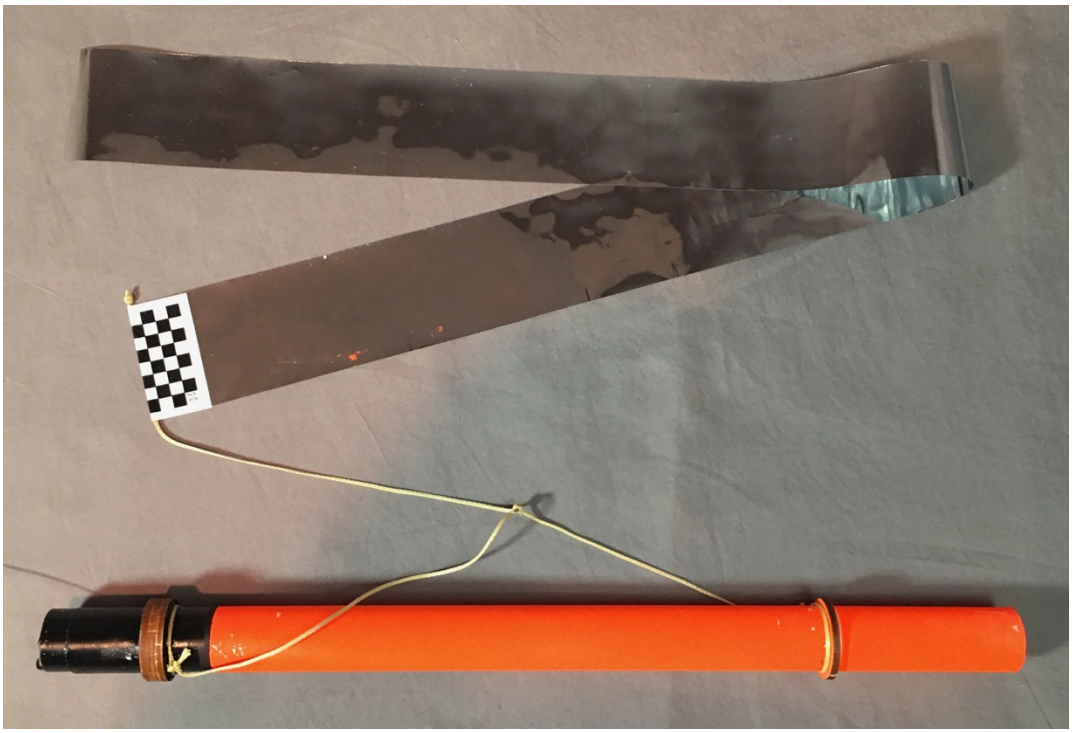
☐ Locate the Kevlar line. Cut a 24” length. Tie one end around the pod assembly tube about 2” from the aft end (snug against the aft centering ring), using a double knot. Be careful that the knot does not sit higher than the ring, or it will interfere with the pod fitting in the glider tube. Add a drop of thin CA to secure the knot.

☐ Loop the other end of the Kevlar line around the the pod assembly tube about 3.25” from the forward end (snug against the forward centering ring), using a double knot. Be careful that the knot does not sit higher than the ring, or it will interfere with the pod fitting in the glider tube. Add a drop of thin CA to secure the knot.

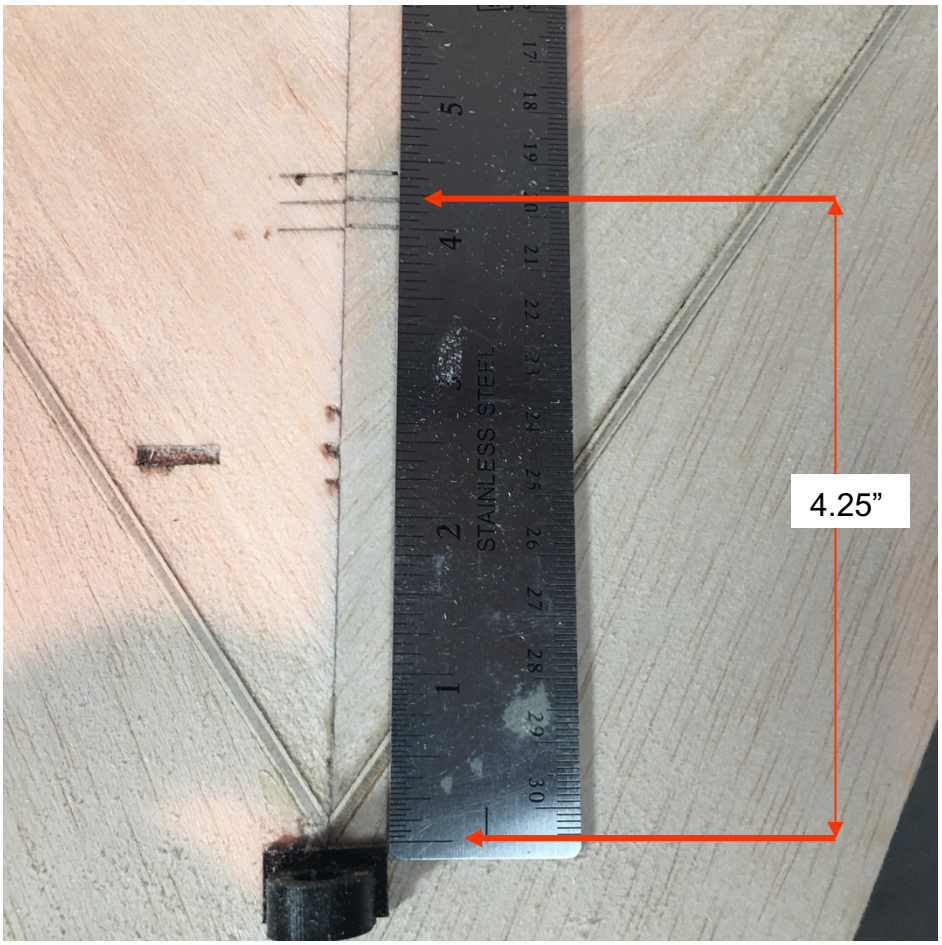
☐ Locate the streamer (G), and streamer attachment sticker (R). Peel off the sticker and attach the streamer about 0.5” down. Lay the Kevlar line at the end of the streamer, with the knot snug against the end of the streamer. Fold the sticker over to secure the line.

☐ Tape together 12 pennies and insert them into the end of the tube with the motor hook. This simulates the mass of the empty motor case. Pick up the pod assembly by the Kevlar line and mark the point where the pod hangs horizontal. Remove the pennies and set aside.

☐ Tie the free end of the Kevlar streamer line at that point, using a double knot. Add a drop of thin CA to secure the knot.



☐ On the underside of the glider (without the pod installed), make a mark 4.25” aft of aft surface of the forward launch lug. This is the target center of gravity (CG) location for the glider. Install as many pennies as necessary in each forward pocket to get the model to balance at the point.



☐ Check the balance of the glider without the pod.. Use your right and left index fingers to suspend the model from above. If the wing appears to hang level, the model is properly balanced. If the nose of the model hangs down, remove weight from the nose weight pockets; if the tail droops, add weight such as clay.

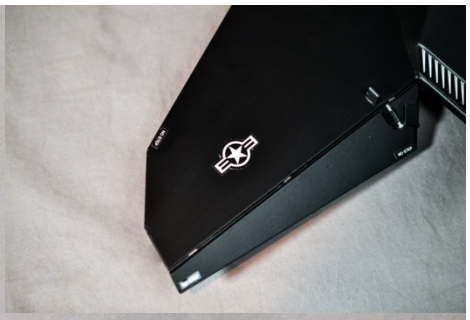
☐ When the proper CG is achieved, use a light coat of 30-minute epoxy to secure the pennies in the pocket. Set aside to cure.

☐ Use thin CA to glue nose weight covers (K3/K4) in place.

☐ Attach 1-2 of the rubber bands to the elevon stop. Using the elevon guide, adjust the set screw so to make the movable elevon angle match the fixed elevon angle.

☐ Gently toss the model in an area with a soft landing zone to test the glide. Make adjustments as necessary by turning the set screw or adding/subtracting nose weight to get a level glide with a gentle circle.

- ☐ Mask off the area on the wing bottom where the CG marks are located. Remove the elastic band from the elevon.
- ☐ Paint the entire glider assembly flat black.
- ☐ Apply the decals as shown in the photos below.



☐ Install 2 elastic rubber bands on the elevon stop.

☐ **Check to make sure the rubber bands are in place on the elevon stop!**

Flight Preparations

IMPORTANT!
READ BEFORE LAUNCHING!

☐ Install 2 elastic rubber bands on the elevon stop.

☐ **Check to make sure the rubber bands are place on the elevon stop!**

☐ Select one of the recommend motors shown on the first page. For an updated list of recommended motors, check the kit listing at NorthCoastRocketry.com.

☐ Install the recommended motor into the pod until the clip snaps in place. Ensure the motor is snug in the motor tube, and that it will not move forward or aft. Using ¾' wide masking tape, wrap the aft end of the motor and the motor tube to secure the motor in place. It is critical that the motor be firmly retained. If the motor is loose, it may blow out at ejection, causing the model to crash.

☐ Remove the pop pod. Check to ensure the Kevlar shock cord is securely mounted. Check for any damaged, burnt or frayed sections of the shock cord and replace if necessary.

☐ Carefully fold (do not roll!) the streamer and wrap the folded streamer around the motor pod tube.

☐ Insert the motor pod into the the tube, making sure the to push the left elevon to the "down" position as the pod passes by. Make sure it will easily slide out of the model when the ejection charge goes off.

☐ **Check to make sure the rubber bands are in place on the elevon stop!**

☐ Install the igniter per manufacturer's instructions.

☐ Perform a pre-launch check to ensure that:
• The fins and launch lugs are not broken, damaged, or loose in any way;
• The body tube and other components are not damaged or dented;
• The model slides freely on the launch rod or rail, with no binding, sticking or misalignment of the launch lugs or buttons.
• If any problems are detected, correct them before attempting to fly.

☐ **Check to make sure the rubber bands are in place on the elevon stop!**

Flight Instructions

☐ Fly your rocket from the largest field possible on a clear and calm day. **Flights of the F-117 are recommended for winds of 5 mph or less!**

☐ At a minimum, you need a field at least 1.5 times the expected altitude. For example, if you expect your model to fly to 500 ft (152m), then the field should be at least 750 ft (229m) on each side.

☐ Do not fly near trees, power lines, or tall buildings. Do not fly in the vicinity or low flying airplanes or airports.

☐ Be sure that the area is clear of dry weeds, grass, or other flammable materials that may be ignited by the rocket exhaust. Always use a large blast deflector.

☐ Use a launch pad with at least a 5 ft (1.5m) rod or rail. Fly from a minimum distance of 30 ft (9 m) for safety and a better view of the flight.

☐ Follow ALL Federal, State, and local regulations and ordinances when flying model rockets

☐ ALWAYS follow the NAR Safety Code when flying model rockets.

Flight Profile

Give a five second countdown to warn all others in the area of a launch.

When the launch button is pressed, an electrical current causes the igniter to heat up, igniting the propellant in the motor. This may take as long as one second.

The motor quickly builds up thrust and moves the rocket into the air. The F-117 will roll on the way up – this helps even out the drag imbalance of the model due to the unique "stealth" profile. When the motor's propellant is consumed, a delay grain generates tracking smoke.

When the delay grain is consumed near peak altitude, the motor's ejection charge fires. The pop pod will eject from the model, allowing the left elevon to transition from boost trim to glide trim. The pop pod should hang roughly horizontal under the streamer while descending,. The F-117 should go into a glide in large diameter circles.

Fly safely and have fun!

National Association of Rocketry
MODEL ROCKET SAFETY CODE

March 2009 Revision

ALWAYS FOLLOW THIS CODE WHEN USING NORTH COAST ROCKETRY® PRODUCTS!

Materials. I will use only lightweight, non-metal parts for the nose, body, and fins of my rocket.
Motors. I will use only certified, commercially-made model rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer.
Ignition System. I will launch my rockets with an electrical launch system and electrical motor igniters. My launch system will have a safety interlock in series with the launch switch, and will use a launch switch that returns to the "off" position when released.
Misfires. If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
Launch Safety. I will use a countdown before launch, and will ensure that everyone is paying attention and is a safe distance of at least 15 feet away when I launch rockets with D motors or smaller, and 30 feet when I launch larger rockets. If I am uncertain about the safety or stability of an untested rocket, I will check the stability before flight and will fly it only after warning spectators and clearing them away to a safe distance.
Launcher. I will launch my rocket from a launch rod, tower, or rail that is pointed to within 30 degrees of the vertical to ensure that the rocket flies nearly straight up, and I will use a blast deflector to prevent the motor's exhaust from hitting the ground. To prevent accidental eye injury, I will place launchers so that the end of the launch rod is above eye level or will cap the end of the rod when it is not in use.
Size. My model rocket will not weigh more than 1,500 grams (53 ounces) at liftoff and will not contain more than 125 grams (4.4 ounces) of propellant or 320 N-sec (71.9 pound-seconds) of total impulse.
Flight Safety. I will not launch my rocket at targets, into clouds, or near airplanes, and will not put any flammable or explosive payload in my rocket.
Launch Site. I will launch my rocket outdoors, in an open area at least as large as shown in the table below in safe weather conditions with wind speeds no greater than 20 miles per hour. I will ensure that there is no dry grass close to the launch pad, and that the launch site does not present risk of grass fires.
Recovery System. I will use a recovery system such as a streamer or parachute in my rocket so that it returns safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.
Recovery Safety. I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places.

Installed Total Impulse (N-sec)	Equivalent Motor Type	Minimum Site Dimensions (ft.)
0.00--1.25	1/4A, 1/2A	50
1.26--2.50	A	100
2.51--5.00	B	200
5.01--10.00	C	400
10.01--20.00	D	500
20.01--40.00	E	1,000
40.01--80.00	F	1,000
80.01--160.00	G	1,000
160.01--320.00	Two Gs	1,500

Join the National Association of Rocketry!
Visit www.nar.org for details!