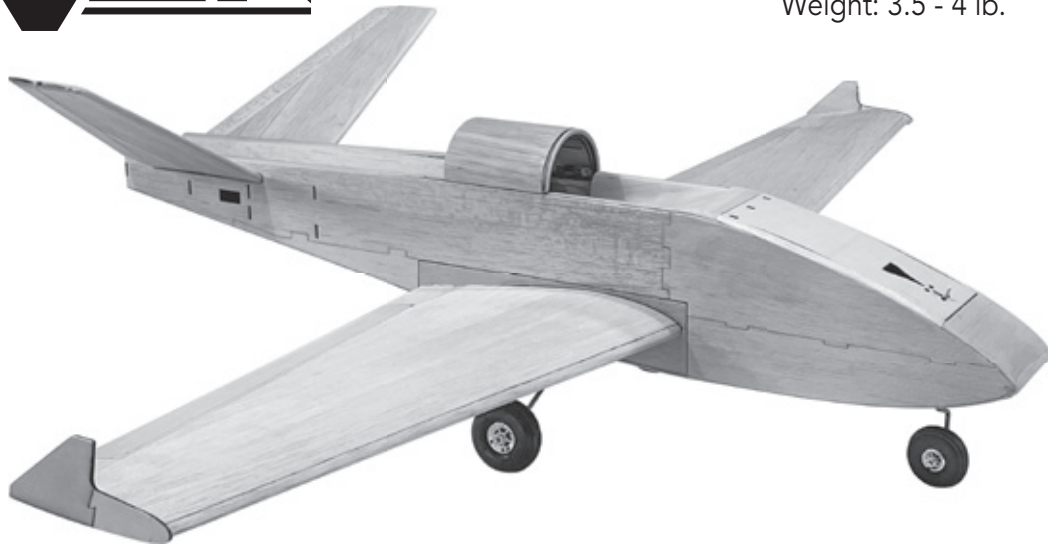


# RAVEN

**Specifications:**  
Wingspan: 47.25 in.  
Wing Area: 330 sq in.  
Airframe Length: 34.25 in.  
Weight: 3.5 - 4 lb.



## Using the Manual

Be sure to read each step thoroughly before you start the step. Test-fit the parts together to make sure they fit properly. If necessary trim to fit.

Beside each step you will notice a check box (or two). These are so you can keep track of your progress while building your kit. For steps that have two boxes, as in the construction of the left and right wing halves, these steps must be performed at two different times.

- Your **Old School Model Works** aircraft should not be considered a toy, but rather a sophisticated, working model that functions very much like a full-size airplane. Because of its performance capabilities, this model, if not assembled and operated correctly, could possibly cause injury to yourself or spectators, and damage to property.
- You must assemble this model according to the instructions. Do not alter or modify this model, as doing so may result in an unsafe or un-flyable model. In a few cases the instructions may differ slightly from the photos. In those instances the written instructions should be considered as correct.
- You must take time to build straight, true and strong.
- You must use an R/C radio system that is in first-class condition, a correctly sized power system and components (electronics, batteries, wheels, etc.) throughout the building process.
- You must correctly install all R/C and other components so that the model operates correctly on the ground and in the air. (Installation shown in the manual is a suggestion. You may have to adjust the mounting steps to accommodate the size of your radio equipment.)
- You must check the operation of the model before every flight to insure that all equipment is operating and that the model has remained structurally sound. Be sure to check clevises or other connectors often and replace them if they show any signs of wear or fatigue.



- If you are not an experienced pilot or have not flown this type of model before, we recommend that you get the assistance of an experienced pilot in your R/C club for your first flights. If you're not a member of a club, your local hobby shop has information about clubs in your area whose membership includes experienced pilots.
- While this kit has been flight tested to exceed normal use, if this model will be used for extremely high stress flying, such as racing, or if a power system larger than one in the recommended range is used, the modeler is responsible for taking steps to reinforce the high stress points and/or substituting hardware more suitable for the increased stress.

**Remember: Take your time and follow the instructions to end up with a well-built model that is straight and true.**



[www.oldschoolmodels.com](http://www.oldschoolmodels.com)

# WARNING

**READ THROUGH THIS MANUAL BEFORE STARTING CONSTRUCTION. IT CONTAINS IMPORTANT WARNINGS AND INSTRUCTIONS CONCERNING THE CONSTRUCTION AND USE OF THIS MODEL.**

**A Radio-Controlled aircraft is not a toy! If misused, it can cause serious bodily harm and damage to property. Fly only in open areas, preferably at AMA (Academy of Model Aeronautics) approved flying sites, following all instructions included with your radio, powerplant, electronics and batteries.**

- Inspect your model before every flight to ensure it is airworthy.
- Be aware of any other radio frequency user who may present an interference problem.
- Always be courteous and respectful of other users in your selected flight area.
- Choose an area clear of obstacles and large enough to safely accommodate your flying activity.
- Make sure this area is clear of friends and spectators prior to launching your aircraft.
- Be aware of other activities in the vicinity of your flight path that could cause potential conflict.
- Carefully plan your flight path prior to launch.
- Abide by any and all established AMA National Model Aircraft Safety Codes.

**IMPORTANT!!!** Two of the most important things you can do to preserve the radio controlled aircraft hobby are to avoid flying near full-scale aircraft and avoid flying near or over groups of people.



WARNING: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

## INCLUDED ITEMS

### Wood parts included in this kit:

- 2 LP1 - laser cut 1/8" x 5" x 24" lite ply
- 2 LP2 - laser cut 1/8" x 5" x 24" lite ply
- 1 LP3 - laser cut 1/8" x 4" x 24" lite ply
- 1 LP4 - laser cut 1/8" x 4" x 24" lite ply
- 1 LP5 - laser cut 1/8" x 4" x 24" lite ply
- 1 LP6 - laser cut 1/8" x 4" x 24" lite ply
  
- 2 BP1 - laser cut 1/8" x 4" x 12" balsa
- 2 BP2 - laser cut 1/8" x 4" x 12" balsa
- 2 BP3 - laser cut 3/32" x 4" x 24" balsa
- 2 BP4 - laser cut 3/32" x 4" x 24" balsa
- 2 BP5 - laser cut 3/32" x 4" x 24" balsa
- 2 BP6 - laser cut 3/32" x 4" x 12" balsa
- 4 BP7 - laser cut 1/16" x 4" x 12" balsa
- 2 BP8 - laser cut 1/16" x 4" x 12" balsa
  
- 3 1/8" x 4" x 12" balsa sheets
- 8 1/16" x 4" x 24" balsa sheets
- 2 1/16" x 4" x 12" balsa sheets
  
- 3 5/16" sq. x 36" balsa strips
- 2 1/4" sq. x 36" balsa strips
- 2 5/16" x 1-1/4" x 36" tapered balsa strips
- 2 3/16" x 3/8" x 36" basswood strips
- 1 1/8" x 1/4" x 36" basswood strip

### Hardware parts included in this kit:

- 12 2-56 x 3/4" self tapping screws
- 4 2-56 x 5/16" self tapping screws
- 8 2-56 x 1/2" machine screws
- 3 5/32" wheel collars
- 3 wheel collars set screws
- 4 control horns
- 2 plastic landing gear straps
- 2 1/4-20 x 2" wing bolts
- 2 pre-bent main gear legs

- 1 nose gear assembly
- 1 spring latch
- 8 magnets
- 12 CA hinges

### Other items included in this kit:

- 2 Rolled plans (fuselage and wing)
- 1 Construction Manual (the thing you're reading now)

## ITEMS NEEDED

### Hardware needed (not included in the kit)

For some of these items there is more than one option which will require a bit of decision making ahead of time. There isn't a right or a wrong choice, so choose the items that work best for you.

We strongly recommended supporting your local hobby shop.

- Powerplant: 64mm EDF power system (60+ amp ESC, 4s 2600+ mAh lipo)
- Transmitter - (4 channel minimum with V-tail mixing)
- Receiver - (4 channel minimum)
- Servos: 5 mini servos (Hitec HS5065MG or similar)
- Servo extensions: four 8-12 lengths
- "Y" harness (for nose gear servo)
- Pushrods - four 6" for ailerons and V-tail, 8" for nose gear
- Clevises for the pushrods
- Wheels: two 2" for mains, one 1.5-2" for nose (*Du-Bro Chromies look great - hint, hint*)
- Covering: If you're using simple scheme, two rolls should be enough. You'll need more if applying a more complicated livery.

### Additional Required Building Tools and Adhesives

- Drill & assorted drill bits
- Hobby knife and new blades
- Sandpaper: coarse (80 or 100 grit) & medium (150-200 grit)
- Pencil or pen
- Ruler

- T-Pins
- Waxed paper
- Building board
- 2-part epoxy (15 or 30 minute), brushes and mixing sticks
- Wood adhesives of your choice. We use medium viscosity CA (cyanoacrylate), but aliphatic resin and/or carpenter's glues (used correctly) will work just as well and give longer working time.
- Thin CA for attaching the included hinges
- A spray bottle of glass cleaner (with ammonia)

### We advise the following:

Closely inspect the supplied laser cut parts for damage. If you find any damaged or missing parts, contact us within 60 days from purchase.

When removing the laser cut parts from their sheets, you'll notice the parts are held in place by several small "tabs". These tabs are uncut pieces of wood and can sometimes make it difficult to remove a part. Rather than breaking and/or splintering the wood by forcing out the part, we recommend removing any laser cut parts from their sheets by using a hobby knife with a sharp blade. A quick cut of the tab will allow the piece to be removed with no damage. Sand any tab remainders flush with the part so there will be no problem aligning them later.

It's best to not remove parts from their sheets until they are needed. Refer to Appendix A of this manual as a reference to what all the laser cut parts look like and are called.

You'll notice a check box next to each step. Check these off as you go along so you don't miss a step. Some steps (building the wing) have two boxes - this means the step will be done twice - once now and once later (when told to repeat) for each wing half, for instance.

There could be a step or two which leaves you a bit puzzled. If this happens, step back and study the photo(s) for that step - both in this manual and online.

All photos shown in this manual are of different Raven prototypes. Several pieces may have changed slightly with improvements we've made so parts may look a little different in some steps.

### Online Supplementary Photos

We realize that the smaller black-and-white photos in this manual might not show some of the steps as clearly as you might want. So we've anticipated this and made these photos available on our website. You can either scan the QR code or type this address into your browser:



[www.oldschoolmodels.com/mpics/raven/](http://www.oldschoolmodels.com/mpics/raven/)

### InstaCaddy

Throughout this manual, you'll see photos with our InstaCaddy on the bench. This is a unique collection of Bob Smith C/A glues, accelerator, and pipettes. What makes this special is the box, as it has cutouts that make it the perfect tool to hold everything in one spot - **and the glue won't spill!** If you're needing C/A, consider our InstaCaddy!



## IF YOU READ NOTHING ELSE IN THIS MANUAL, PLEASE READ THESE FIVE POINTS.

**#1 - We've done everything we can to make the Raven a fun and easy to assemble kit. That being said, THIS IS NOT A BEGINNER KIT. If you've never built this type of balsa kit before, you will probably experience many challenges along the way. This manual is not written for beginners - it is assumed that the builder has the skills and techniques needed for these steps.**

**#2 - PLYWOOD HAS SLIGHT BOWS IN IT 93.48% OF THE TIME. We don't like it, but that's the way plywood is. Because of this, we engineered the Raven to eliminate these warps whenever possible - we'll make recommendations on how to overcome them as we go along.**

**#3 - Balsa has slight bows in it 81.53% of the time. We don't like it, but that's the way balsa is. We'll make recommendations on how to overcome them as we go along.**

**#4 - It is very important that you assemble the Raven in the order described. Skipping forward in the steps could leave you without the proper lengths of wood to finish the kit. We've included enough wood to easily complete this kit, but you must take care to properly measure and not waste wood when cutting.**

**5 - Save ALL of the scrap wood as you build - the ends of sticks, the left over sheets, etc. You will use some of this in assembly, and can maybe use pieces if you need repairs.**

**Remember, building is not a race. You are the craftsman here.**

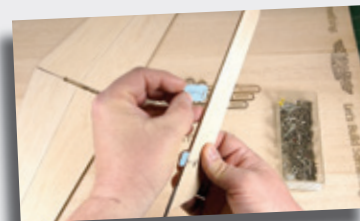
**If you take your time, take the time to understand steps, and make the effort to do good work, it will certainly show when the Raven's airframe is completed.**

Whether you're hinging, mounting, gluing, sanding, soldering or installing, chances are we've got a video tip to make the task easier.

OSMW has created a series of videos to help you not only build your aircraft, but build it better. These Bright Idea videos can come in handy for some of the following steps.

Check them out today - they're FREE and we're adding to them all the time!

Visit [oldschoolmodels.com/tips.htm](http://oldschoolmodels.com/tips.htm) or scan this QR code.



**Let's begin construction with something easy and warm up for the bigger assemblies.**

**Let's start with the tail surfaces of your Raven.**

**Prepare your work area**

Position the part of the fuselage plans with the V-tail on your flat building surface and tape it into position. Tear off a length of waxed paper long enough to cover that portion and tape it over the plan.



**Step 1 - V-Tail (EV1, EV2)**

Locate both EV1s from BP2 and four EV2s from BP8s. Glue one EV2 to each side of an EV1 as shown, being careful to line them up along the edges. Note that they only align correctly in one way.



When finished, do the same to complete the other elevator half and set these pieces aside.

**Step 2 - V-Tail (V1)**

Locate V1 from BP2. Pin this in place over the plans, forming the leading edge of this half of the V-Tail.



**Step 3 - V-Tail (V2, V3)**

Locate V2 and V3 from BP1. V2 is glued into the outer notch in V1 to form the outer edge of the tail. V3 is glued into the next slot, paying attention to its orientation.



Pin these in position to make sure they stay where they should.

**Step 4 - V-Tail (forward support)**

Locate the 1/8" x 1/4" x 36" basswood strip. Measure and cut the forward support to match the plans. Glue this piece in place, making sure it's firmly inserted into the V3's notch. It also needs to be glued to where it touches V1.



**Step 5 - V-Tail (V4, V5)**

Locate V4 and V5 from BP1. V4 is glued to the forward support you just installed, paying attention to the orientation of its cutout.

V5 is then glued in place to the support, forming the inner edge of the tail frame. Pin these in place so they don't wander off.



**Step 6 - V-Tail (rear support)**

Locate the 1/8" x 1/4" x 36" basswood strip you just used to make the forward support. Now you'll measure and cut the rear support to match the plans.



Glue this piece in place - firmly seated in the V4's notch and up against V5.

**Step 7 - V-Tail (V7)**

Locate V7 from BP1. Glue this short little guy in place, "elongating" the inner edge of the tail frame as shown here. Stab it with a pin too - just because you can.



**Step 8 - V-Tail (V6)**

Locate V6 from BP2. Lots of notches in this one that will help it form the trailing edge of the tail's frame.

Pay attention to V6's orientation and make sure all of frame's pieces are fully inserted when gluing V6 in place. Also make sure it's flat to the building surface along its entire length.



**Step 9 - V-Tail (V8)**

Remove the pins from the frame you've just assembled. You can leave it on the board, as it's probably tacked in place to the waxed paper.



Lightly sand this side of the framework to make sure it's completely flat. Then, locate one V8 from BP7 and glue the sheet to the framing as shown here. Apply pressure over the entire surface to keep it flat and bonded to the internal framing.

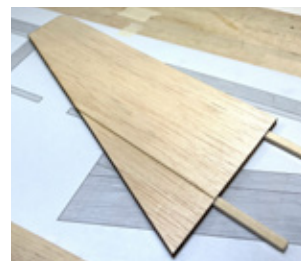
**Step 10 - V-Tail (V9)**

Locate one V9 from BP7 and glue the piece to the framing as shown here, to complete the surface.



**Step 11 - V-Tail (V8, V9)**

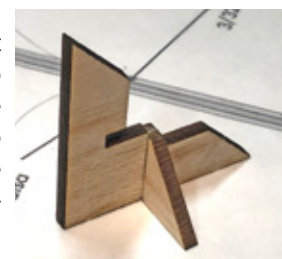
When the glue has cured, remove this assembly from the board, flip it over and lightly sand the exposed framing. Then locate another V8 and V9 from BP7. Glue these in place just as you just did, again making sure these pieces are perfectly aligned.



*This completes the assembly of the first half of the V-Tail. Set this piece aside. Now jump back to step 2 and repeat everything to make the other V-Tail half. When it's finished, you'll be back here again, and only then can move on to the next step.*

**Alignment triangles**

Pre-cut into LP4 is a triangle. Punch out the 90° triangle as it can be used to vertically align any of the parts in the construction of your Raven. LP4 also includes a "foot" piece that can be used with the triangle to hold it hands-free vertically.



Now we'll step things up a bit and start work on the Raven's starboard wing panel.

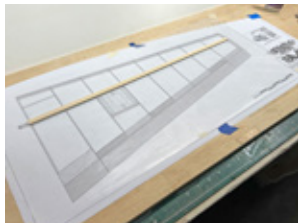
**Prepare your work area**

You'll need a flat building surface that is a minimum of 36" long. Position the starboard wing plan over the surface and tape into position. Tear off a length of waxed paper long enough to cover the plan and tape that into position, over the plan.

**Step 12 - Wing (lower spar)**

Locate one length of 3/16" x 3/8" basswood to use as the lower spar. Measure and cut it to length - making sure it extends beyond both R1 and R9 by roughly 1/8" to 3/16".

Using a few drops of medium CA glue, tack this spar in place as shown, making sure it is straight along its entire length.



**Step 13 - Wing (R9 rib)**

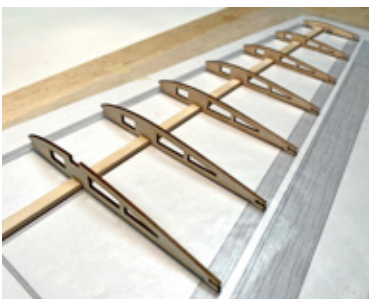
Starting with R9 from BP3, it's time to start gluing the ribs in place. To make sure R9 is perfectly aligned when gluing it to the bottom spar here's a couple of tips.



I like to put a small drop of medium CA on the bottom of the backside tab of each rib to help lock it in place to the waxed paper (or you can use pins if that's your thing - but be careful as pins can split the thin balsa). Also make sure to use the included 90° triangle that I mentioned just a few steps back. Using the triangle ensures that this rib, and all subsequent ribs are perfectly aligned at 90° to the building surface.

**Step 14 - Wing (R3-R8 ribs)**

Locate ribs R3-R8 from BP3, BP4 and BP5. Using the same techniques that you used on R9, glue each of these ribs in order as shown. Make sure each one is in the proper place and all are perfectly aligned at 90° to the building surface.



**Step 15 - Wing (SW3)**

Now locate two SW3s from LP1. These are glued between R3 and R2 (not yet installed). Note there is a small circle etched on SW3 which designates the top edges. These are glued in place as shown, butted-up against R3 and make sure that the tabs on both SW3's point towards R2. The SW3s should also be glued to the lower spar as shown here.



**Step 16 - Wing (R2, R2A)**

Locate one R2 from BP5 and two R2As from LP1. The R2A's are glued to each side of R2, to strengthen the area where the rear dihedral brace will be inserted later on. Working one side at a

time, line up the square cutout in R2A to the same cutout in R2. Pay attention to R2A's orientation when gluing it in place so it matches the wing's curvature. Once glued in place, flip R2 over and glue the other R2A in position.



**Step 17 - Wing (R2)**

Now glue R2 in place as shown, making sure the tabs from both SW3s are fully inserted. Also make sure that R2 is perfectly aligned at 90° to the building surface.



**Step 18 - Wing (TE)**

Locate one TE from BP5. This is the trailing edge of the wing and note the angle of its pre-cut slots. When properly installed, these slots will line up with each of the ribs installed so far.

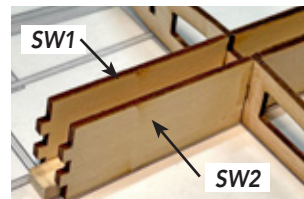
**BE CAREFUL AND TAKE YOUR TIME WHEN INSTALLING THIS PIECE.** Now is not the time to rush, as this piece, as well as the backs of each rib, are delicate.

A little at a time, work TE into the back of each rib. Once installed properly, TE will be flush with the back of each rib as shown here. Glue this in place to each rib.



**Step 19 - Wing (SW1, SW2)**

Locate one LP1, one SW1 and one SW2 from LP1. As before, there are circles etched into SW1 & SW2 to designate their top edges. Dry fit this next step first so you'll understand where I'm going here.



Slide the single tab on SW1 (fore) and SW2 (aft) into the holes on R2. Now, to get both to the proper height, use R1 (from LP1) as a guide by pushing it into place, with the twin tabs on the SWs sliding into the holes in R1. You'll see that R1 will hold the SWs at the proper height, and you can use this to your advantage when you glue the SWs in place. Now remove the SWs apply glue and attach them in place, making sure they are also glued to the lower spar **but do NOT GLUE R1 IN PLACE AT THIS TIME.**

**Step 20 - Wing (SW1B)**

Locate one SW1B from LP1. Note the circle - which designates what? That's right - the top edge. It is glued in place as shown, making sure its tabs are fully seated into the R2 and R1 tabs.

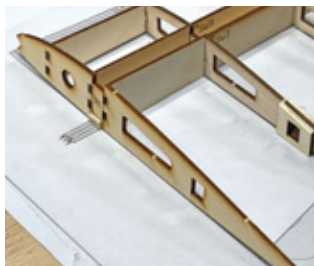


**Step 21 - Wing (R1)**

It's time to glue R1 in place. Cut into LP5 is a dihedral gauge that has its own "foot" inside it. Pop these out and use them to help align R1, as shown here. When R1 is properly installed (with the tabs in SW1



and SW1B fully inserted and TE inserted on the trailing edge), it should be perfectly flat and the same angle along its entire length.

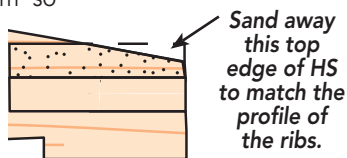


### Step 22 - Wing (HS)

Locate three HSs from BP5. These are glued in three spots on TE - between R2 & R3, between R4 & R5, and between R6 & R7.

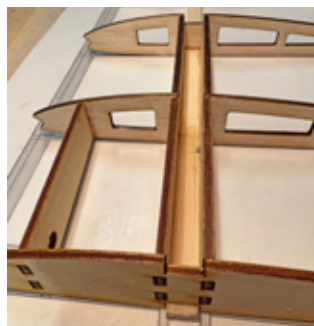
Once they're glued in place, you'll need to CAREFULLY sand them so their profiles match the profile of the ribs.

Refer to this drawing so you'll see the portion to lightly sand away. Do this for each HS.



### Step 23 - Wing (R2)

Carefully cut away the center of ONLY the R2 rib, leaving a box as shown in the photo. Carefully sand the inside of the box so the edges are smooth and flush. This forms three sides of the dihedral box and needs to be smooth and free from edges so the dihedral brace will slide in smoothly when joining the wing halves later.



### Step 24 - Wing (upper spar)

Measure and cut the upper spar from the left-over 3/16" x 3/8" basswood strip you used to make the lower spar, making it an extra 1/8" or so longer.

Apply glue to the sides of the spar, and to the top of the R1 and R3 ribs where they will contact the upper spar.

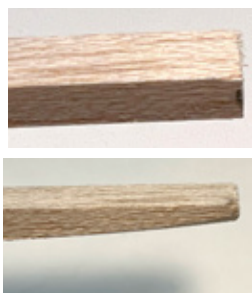


Starting at R3, carefully press the upper spar into position. This will be a tight fit and might require "wiggling" the spar from side to side to slip in-between the sheer webs. Be sure to press the spar completely into the slot in both ribs, making it flush.

Once the spar is in place, wick thin C/A along the spar-to-sheer web joints (front and back) along the length of the spar.

### Step 25 - Wing (leading edge)

Locate one of the 5/16" sq. x 36" balsa strips that will be used as the leading edge. This fits into the diamond-shaped cutouts in the front of each rib. Before cutting it to length, sand a bevel into one end of the strip as shown here. The bevel should be roughly 1" long and take the "point" off the strip. This section



will be positioned on the tip of the wing (R9) and this bevel helps it fit correctly and give clearance to your building surface. You may have to work on this with a little trial and error to get the proper fit.

When it's sanded, mark the length of the leading edge and cut it, leaving yourself about a 1/4" extra.

Glue this piece into each of the ribs as shown here.



### Step 26 - Wing (top sheeting, part 1)

Locate two of the uncut 1/16" x 4 x 24" balsa sheets. These will be used to create the wing's top sheeting.

**Now this needs to be measured carefully so you have enough sheeting to cover the top and bottom of the wings successfully** - and here's how we did it.

First, the leading edge piece of sheeting will need to bend along its entire length to match the curvature of the ribs. As the sheeting we get can vary in density, you might need to apply a bit of Windex® glass cleaner to loosen up the grain and allow it to bend without cracking. Soak the outer side of the wood to expand the fibers. Now hold it to the curvature needed, use a hair dryer or covering heat-gun to help "set" the balsa's bend as it dries. Once dry, and with the proper bend, it's much easier to make the following measurements.

### Step 27 - Wing (top sheeting, part 2)

Place this sheet you just formed up-against the leading edge of the wing, with the upper-left-hand corner just overlapping R1 by an 1/8" or so. Temporarily tape this in position.

Now, the second sheet will make up the back half of the sheeting, but needs to be cut on an angle to roughly match the trailing edge of the wing.

Position this sheet up against the first piece of sheeting, again with its upper-left corner just overlapping R1 by an 1/8" or so. Temporarily tape this sheet to the first piece of sheeting. Now you'll need to mark where to cut this second sheet, along the trailing edge of the wing, leaving yourself a 1/4" or so longer to play with. When done correctly, this diagonal mark should divide the sheet into two, roughly equal pieces when cut. (The cutoff piece of sheeting will be used when sheeting the underside of the wing later on.)

When satisfied with your measurements, it's time to cut the piece in preparation for the next step.

### Step 28 - Wing (top sheeting, part 3)

When edge gluing the sheeting pieces together, first make sure the edges are flat (give a quick, swipe or two with a sanding block). Then tape the two pieces together as shown here with some masking/painter's tape. As you lift the sheeting from the board you'll see that the tape will act as a hinge allowing you to put a small amount of adhesive in the joint. When the adhesive is applied, place the sheeting back down on the waxed paper, so that it's flat (as shown in the photo). Use pressure and weights if



necessary to hold it flat along the entire length of the joint. When cured, remove the tape and you'll now have a single, wider piece of sheeting.

**Step 29 - Wing (top sheeting, part 4)**

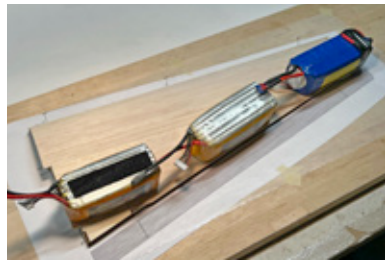
Glue the leading sheeting up against the leading edge first (medium CA works well for this). Once cured, bend the sheeting back over the wing and temporarily tape it in place (or weigh it down).



**Step 30 - Wing (top sheeting, part 5)**

Now apply a slower drying glue (aliphatic resin and/or carpenter's glue) to the upper framework of the wing (tops of the ribs, upper spar, trailing edge, etc.). Note that a paint or epoxy brush works great for this.

Then work your way rearwards, gluing a little at a time. Press the sheeting firmly against the ribs and weigh it down before gluing the next section of sheeting - slowly working your way back to the trailing edge, being careful not to put a bend (warp) in the wing.



**Step 31 - Wing (remove tabs)**

Once the glue has cured from the previous step, it is now time to remove the wing panel from the building surface. Flip the wing over and carefully remove all the underside tabs that helped hold the ribs in place. There's one on the back of each rib. When trimming these tabs, make sure you cut them away just enough so that the airfoil shape of each rib is not interrupted.

**Step 32 - Wing (HS)**

Locate three HSs from BP5. Just like you did on the top of the wing, now you'll glue these pieces in three spots on TE - between R2 & R3, between R4 & R5, and between R6 & R7.

Once they're glued in place, you'll need to CAREFULLY sand them so their profiles match the profile of the ribs.



**Step 33 - Wing (hatch rails)**

Locate the left-over 3/16" x 3/8" basswood strip used in the spars. Cut two 2-5/16" lengths.

Also cut one similarly sized piece of 1/16" from the scrap area of BP7 or BP8.

One basswood rail is glued to the outside of R3, and the inside of R4, using the following method.

Place a few drops of glue to the 3/16" (thinner) side of one of the



basswood rails. Place the 1/16" piece you cut on top of the rail, then press the rail in position - up against the lower spar, and making sure that the 1/16" piece is flush with the edge of rib. Be sure NOT to glue the 1/16" piece in place as it's just a spacer. When finished, you'll have two rails in place, set just below the surface of the ribs - 1/16" below.

**Step 34 - Wing (servo hatch frame)**

Locate left-over 5/16" sq. balsa strip, cut when creating the leading edge. Measure and cut a length to go between R3 and R4 as shown here. Make sure it is a snug fit and glue it in place, up against the hatch rails, you just installed, but flush with the bottom surface of the ribs.



**Step 35 - Wing (underside sheeting, part 1)**

Using the same techniques use when creating and installing the upper sheeting, it's now time to install the underside sheeting. Locate one of the uncut sheets of 1/16" balsa, and the leftover 1/16" piece you cut when making the top sheeting. Glue these together in the same way as before, then glue them to the leading edge.

**Step 36 - Wing (underside sheeting, part 2)**

Once cured, bend the sheeting back over the wing and temporarily tape it in place (or weigh it down). Again, using the same techniques you used on the top side, apply some slower curing glue to the frame - the rib's surfaces, lower spar and the balsa hatch-frame (not the rails). Then slowly attach the sheeting. Weigh it down and allow it to cure fully.



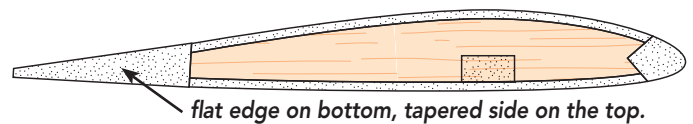
**Step 37 - Wing (shaped trailing edge)**

Locate one of the 5/16" x 1-1/4" x 36" tapered balsa strips.

This is cut to make the final trailing edge, as well as the aileron. These cuts are noted on the plans and need to be angled, so double-check everything before cutting.

Also, make sure that you are orienting the tapered balsa the correct way. Check the diagram below.

When you have the cuts made, glue the two shorter pieces in place as shown in the photo. Set the aileron aside.



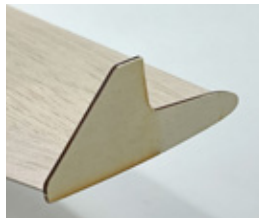
You can wick in some thin C/A into these short trailing edge pieces to help strengthen them if you'd like.

**Step 38 - Wing (sanding)**

Take a few moments to sand the wing panel smooth. Make sure to also sand the trailing edge, as well as the root (R1) and tip (R9) edges flat.

### □ □ Step 39 - Wing - (T1 - optional)

Locate T1 from LP2. This is an optional piece - just for looks (and it might add a little stability, but more for looks if I'm honest). And while I'm being honest, it's even optional whether or not you install them at this point.



I found it easier to install it now, rather than later. If you're going to do it, note its orientation first - the thinner "bullet-shaped" part is the front, leaving the taller, tapered edge to be the rear. Also, we found they look best when pointed upwards, but they could be flipped to point down if you'd like - your choice.

Regardless of the orientation you choose, T1 should be roughly centered on the wing's tip. Test fit it into place first, then make a few pencil marks to help align it. Now glue this in place making sure it's aligned to the marks you made.

### □ □ Step 40 - Wing (R1)

Now it's time to cut a square hole out of the root rib (R1).

This will be between the pre-cut slots for the sheer webs and between the upper and lower spars, as shown here. Carefully using a rotary tool to do most of the work is best, then clean up everything with a hobby knife. Do not cut into the sheer webs as you will weaken them.



### □ □ Step 41 - Wing (aileron hatch cutout)

In the back of this manual is Appendix B which is a full-size template that you should use to locate and cut out the aileron pockets.

Remove that page, cutout the template and place it as shown here, on the bottom of the starboard wing panel.



The rectangular cutout is pretty close to the size, but I advise lightly cutting inside it by 1/8" or so - using just enough pressure to cut through the outer sheeting. You should now have a hole that reveals the hatch rails, similar to what's shown here (except hopefully a bit neater than my example).



An easy way to find the sides of the box is to take a piece of scrap 3/16" x 3/8" and place it directly over one of the servo rails, mark, then cut this outer edge. Do the same to find the outer edge of the other rail.



Then carefully cut away the fore and aft edges of the box so the sheeting is flush with the lower spar and the rear frame of the aileron box.

Test fit one of the servo hatches (SH, from LP2). Lightly sand the opening to allow the hatch to comfortably fit in the opening.

### □ □ Step 42 - Wing (sanding)

Grab your sanding block and sand the inside (root) face of R1 and the trailing edge piece you installed so it's all flat and smooth.

**Set the starboard wing half aside and begin work on the port wing half. Tape the port wing plan and fresh wax paper on your board. Then follow steps 12 through 42 to complete the port wing half. Once finished, then move on to step 43.**

**Note that when building the port half that many of the parts will need to be glued to the opposite side (the sheer webs, for instance). Always refer to the plans to make sure you're gluing the parts together in the correct way.**

### □ Step 43 - Center section (FS7, FS9)

Locate both FS9s from LP2 and both FS7s from BP6. Before any glue makes it out of the bottle, do a test run. The result is that you'll need two sub-assemblies, mirror images of each other, and perfectly aligned along the top, front and rear edges - but NOT the bottom. Also, FS7 has a temporary spacer that will need to be cutout before it's glued in place.

Once, and only once you're sure on how these pieces should go together, glue them in place. They should be perfectly aligned, mirror images and flat along their entire lengths - just as in this picture.



### □ Step 44 - Center section (1/4" strips)

Locate one of the 1/4" x 36" strips of balsa. Then flip the FS7/9 assemblies over. Note the lip on the bottom of each piece - where the ply is 1/4" short of the balsa sheeting. That's where this 1/4" strip will go.

You'll cut two pieces for each sheet. One that runs from the front edge to the landing gear support cutout. The other from the rear edge to the landing gear support cutout.

Glue these pieces in place up-against the lite-ply and note that you'll have to use a little force to make them curve to match the shape of the sheeting..



### □ Step 45 - Center section, (TR3)

Locate TR3 from LP5.

**Now orientation is key here - please pay attention!!!!**

Place the STARBOARD side on the plans as shown, then glue TR3 in place, noting where the u-shaped and circle cutouts should be. Please refer to his picture.

TR3 should be perpendicular to the starboard side and you can use the 90° angle we referenced earlier.



### □ Step 46 - Center section (F6A)

Locate F6A from LP4. This is glued to the rear of the starboard side, with it's tabs fully inserted into the cutouts in the side sheeting and TR3 you just installed.





#### Step 47 - Center section (F3A)

Locate F3A from LP5. This is glued to the front of the starboard side, with it's tabs fully inserted into the cutouts in the side sheeting and TR3 you just installed.



#### Step 48 - Center section (port sheeting)

Now it's time to attach the port side to the center section. Make sure all the tabs are completely inserted into the notches, and the section as a whole is flat. Positioning it like we have shown here will help make it flat.



#### Step 49 - Center section (LG2)

Locate five LG2s from LP2 - yup, I know there are six, but you only need five.

These are glued into the main gear cutout in the bottom of the center section. Glue these in one at a time, and epoxy is recommended here.



#### Step 50 - Center section (LG1, WH1)

Locate LG1 from LP6 and both WH1s from LP2. You'll need to designate an inner side of LG1 - as this is the side where both WH1s will be glued.

Both WH1s are glued cross-ways on to LG1, with WH1's pre-cut circles perfectly centered on the pre-cut circles on LG1. Shown here is an example that was shot after more pieces were assembled, but it will give you the idea of how the WH1s are positioned - fitting between the 1/4" strips already installed.



#### Step 51 - Center section (LG1)

Now glue the LG1 assembly to the bottom of the center section, noting the orientation of the pre-cut landing gear cutout - which should be over the LG2s you installed.

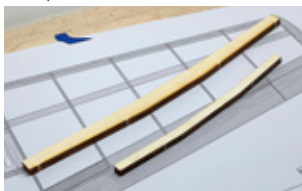
LG1 should be perfectly aligned over all four edges of the box, and you'll need to use a little force to make it match the curvature of the side panels (a clamp or four). Once this is glued in place, flip the center section over and run a bead of glue along the inner edges to make a stronger box.



#### Step 52 - Center section (DH1, DH2)

Locate three DH1s and three DH2s from LP2. These are glued together to make the thicker front and rear, dihedral braces.

Note there are etched lines on each of these parts. Make sure that one of



the outside parts for these braces has these lines showing.

Using epoxy, glue the three DH1s together for the front brace, and then the three DH2s to form the rear brace.

Make sure that the pieces are perfectly aligned and flat along their entire lengths. Use clamps and/or weights to hold everything in place while the epoxy cures.

#### Step 53 - Center section (dihedral braces)

Once the glue has cured it's time to test fit the dihedral braces into the center section.

Because each piece of lite-ply is not necessarily uniform thickness (unfortunately), there's a possibility that you'll have to lightly sand the surfaces so they will easily fit slop-free into the center section's cutouts.

So take some time test fitting and sanding as necessary to get a good fit for both braces. Get a good fit that doesn't require a lot of force.

When you're satisfied with the fit, mix up a little more epoxy and attach these braces in place - making sure they are aligned with the pre-etched marks on the braces. These marks will help you get them perfectly centered on the center section.



#### Step 54 - Center section (fitting the dihedral braces)

After the epoxy has cured, it's time to test fit the wing panels to the center section.

Take some time test fitting and sanding as necessary to get a good fit in both wing halves for both braces. Don't take off too much, too fast. Carefully sand as necessary to make sure everything fits properly. Take your time and get a good fit that doesn't require a lot of force.

Remember you may have to file inside the boxes built into each wing half. Make sure they're smooth and the brace doesn't catch on any extra glue or remnants of R2.

#### Step 55 - Center section

After test fitting, join the wing halves to the center section with 30 minute epoxy. Working one panel at a time, apply a good coating of epoxy into the pocket in the half and also coat the faces of each root rib. Then slide the wing half in place. Squeeze it to the center section, wipe off any excess epoxy with some denatured alcohol and use long strips of masking tape to hold the wing half firmly together.

After the epoxy has fully cured (give it several hours), remove the tape and use the same technique to attach the other wing panel.

Remember, any twist in the alignment of the panels cannot be fixed after the epoxy cures and will lead to a poor flying model.

**This completes assembly of the wing.**

**Set the wing aside for now, as it's time to start work the Raven's fuselage.**

#### Prepare your work area

The fuselage plans are used more for reference, than actually building on, but if you want to have the side view on your work surface, now's the time. Whether you do or don't, you will need to

tape down a fuselage length (36") of waxed paper on your work surface so you'll have something to protect it when building the fuselage.

#### □ Step 56 - Fuselage (FS5, FS6)

Locate both FS5s and FS6s from LP1. One FS5 and one FS6 are glued together to form a fuselage side frame. Take care of the orientation of these pieces and make sure the tabs in FS5 are fully inserted into FS6's slots - and that both pieces are flat along the entire joint. Right now, the sides are identical so don't worry about mixing them up - that will come later. Set these frames aside for the moment.



#### □ Step 57 - Fuselage (FS1, FS2)

Locate both FS1s and FS2s from BP4. One FS1 and one FS2 are glued together to form the forward, outer fuselage skin.



Take care of the orientation of these pieces and make sure the tabs in FS2 are fully inserted into FS1's slots - and that both pieces are flat along the entire joint. Right now, the sides are identical so don't worry about mixing them up - that also will come later.

#### □ Step 58 - Fuselage (FS3)

Locate both FS3s from BP3. One FS3 is glued to the rear of each FS2.



Take care of the orientation of these pieces and make sure the tabs in FS2 are fully inserted into FS3's slots - and that both pieces are flat along the entire joint. Still no worries about which side is which.

#### □ Step 59 - Fuselage (FS4)

Locate both FS4s from BP4. One FS4 is glued to the bottom of each FS3.



Take care of the orientation of these pieces and make sure the tabs in FS4 are fully inserted into FS3's slots - and that both pieces are flat along the entire joint. Still no worries about which side is which.

#### □ Step 60 - Fuselage (sanding)

Take a few moments to lightly sand the fuselage sides and the fuselage frames you have just created. Specifically you're wanting the joints to be smooth and flat on both sides of each assembly.

#### □ Step 61 - Fuselage (frames)

*Read through this step completely before even thinking of applying glue - you've been warned!*

Now you'll form the port and starboard fuselage sides. Shown in this picture is the starboard side, and obviously the port side should be a mirror of this.



To create this, you'll glue one of the lite-ply frames to the

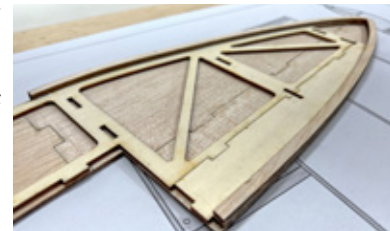
outer skin. Although there aren't tabs to do this, it's easy to align using three edges of the wing-saddle area. In the saddle, the balsa and ply should be aligned perfectly on each edge. When done properly, there will also be a consistent 1/4" ledge of balsa sheeting surrounding the lite-ply frame, around the nose of the assembly.

*Again, you need to make mirror images in the step, NOT two identical pieces.*

When you're satisfied with how these pieces are aligned, then, and only then is it time to apply glue to the lite-ply framing and attach it to the balsa sheeting. Take care to keep glue out of all of the pre-cut notches in the framing.

#### □ Step 62 - Fuselage (FS8, FS9)

Locate four FS8s and four FS9s from BP1. These will form the 1/4" internal edging around the nose of the fuselage.



Glue one FS8 on the bottom and it should be aligned up against the bottom of the fuse frame and match the sheeting's bottom edge. Then another FS8 on top of the FS8 you just installed.

The FS9's install similarly, just along the top edge of the fuse frame.

#### □ Step 63 - Fuselage (rear frames)

Locate the two 1/4" sq. x 36" balsa strips. Using one strip, measure and cut pieces for the rear frames (top and bottom) - running from F6 back to F10.



Glue these pieces in place along the top and bottom edges of the fuselage sheeting, up against the lite ply framing and matching the sheeting's edges all the way back to the rear of the side.

Then do the same for the other fuse side, using the other 1/4" strip.

#### □ Step 64 - Fuselage (F2, F3, TR1)

Locate F3 from LP3 and F2 and TR1 from LP4.

A couple of orientation notes here. F2 has an etched circle which designates its top. Also TR1 has a "bulbous protrusion" (*big scoring words Scrabble there!*). This is at the rear of TR1.



There are two parts to this step.

First slide TR1 into the center of F2. TR1's middle notches will allow it to slide down the sides of F2 and rest on the bottom of the cutout. Then insert "bulbous protrusion" of TR1 into the slot cut into the bottom of F3. Now test fit this loose assembly into the port fuselage side, as shown in this photo.

See how all of the tabs should fit into the pre-cut slots in the fuselage framing. Sand, file, and fit as necessary so these pieces will all fit properly and completely into the frame.

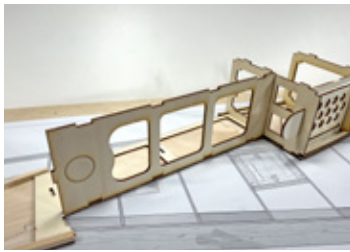
When you're satisfied, remove the pieces, then glue them all together, and into the fuselage side. Take your time as there's a few things to juggle, but when finished, each piece will hold the other at the perfect angle.

### □ Step 65 - Fuselage (TR2)

Locate TR2 from LP3. This makes the top of the wing saddle area - and note the etched circle. It should be towards the rear and visible through the wing saddle when TR2 is mounted.

Test fit first, as all the cutouts should push into the tabs on the fuse side. It should also fit into the cutout in F3.

Once satisfied with the fit, remove it, apply glue and attach it to the fuse side.



### □ Step 66 - Fuselage (F6)

Locate F6 from LP3. This is attached to the rear of TR2. Test fit first, as the tabs should push into the cutouts on the fuse side. It should also fit into the tab on the rear of TR2.

Once satisfied with the fit, remove it, apply glue and attach it in place.



### □ Step 67 - Fuselage (F5)

Locate F5 from LP5. Test fit first, as its tab should push into the cutouts on the fuse sheeting. Glue it in place making sure it is perpendicular to the sheeting, as shown here.



### □ Step 68 - Fuselage (F7)

Locate F7 from LP6. Test fit first, as its tabs should push into the cutouts on the fuse sheeting. Glue it in place making sure it is perpendicular to the sheeting, as shown here.



### □ Step 69 - Fuselage (F8)

Locate F8 from LP5. Test fit first, as its tabs should push into the cutouts on the fuse sheeting. Glue it in place making sure it is perpendicular to the sheeting, as shown here.



### □ Step 70 - Fuselage (F9)

Locate F9 from LP4. Test fit first, as its tab should push into the cutouts on the fuse sheeting. Glue it in place making sure it is perpendicular to the sheeting, as shown here.



### □ Step 71 - Fuselage (F10)

Locate F10 from LP4. Test fit first, as its tab should push into the cutouts on the fuse sheeting. Glue it in place making sure it is perpendicular to the sheeting, as shown here.



### □ Step 72 - Fuselage (F4)

**CAREFULLY** locate F4 from BP4. *I say carefully as it will break very easily until you complete this step.*

Remember way back at the beginning when I told you to keep

all the scrap for use later? Well if you remember, in TR1 there were some long strips of ply that were punched out - you'll need one of those here. Glue it across the bottom of F4 as shown here - centered side to side.

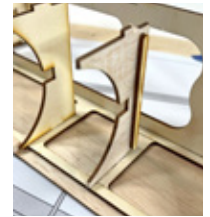
If you pitched the scrap, *all hope is lost. There's no way you can complete the kit now. Oh, the humanity!!!! Just kidding!* Cut a similar piece from one of the unused sections of the lite-ply sheets.



### □ Step 73 - Fuselage (F4)

Now it's time to install the strengthened F4.

Test fit first, as its tab should push into the cutouts on the fuse sheeting. Glue it in place making sure it is perpendicular to the sheeting, as shown here.



### □ Step 74 - Fuselage (F1, F1B)

Locate F1 from LP3 and F1B from LP5. Glue F1B to F1 as shown here - on the side of F1 with the etching.

Take care not to get glue into the small precut holes on F1 or F1B.



### □ Step 75 - Fuselage (F1, F1A)

Locate F1A from LP4.

Flip F1 over and use epoxy to glue F1A into place as shown here - etched lines visible. It should line up side-to-side, as well on the bottom corner cutouts on the bottom of each edge.

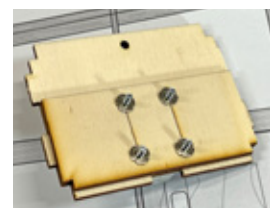


### □ Step 76 - Fuselage (nose gear block mounting)

Now might seem like a strange time to install the nose gear block, but actually it's the perfect time. Things are gonna be very tight, or even inaccessible if you wait until later, so why not take the extra time to make things easy, eh?

Locate the nose-gear assembly bag from the hardware bag. You'll need the mount the 4 mounting screws, the 4 washers, 4 lock washers, and the 4 t-nuts. *Forget about the gear wire and the other parts for now. We'll worry about them later on in the build.*

On the bottom of the firewall are two etched lines. These are to aid in the location of mounting the nose gear block. Position the block so it's about an 1/8" above the bottom of the firewall, and so the mounting holes are lined up with the lines etched on the firewall. Mark the position of these 4 holes and drill through the firewall. Mount the block to the **F1B** of the firewall using the 4 mounting screws, t-nuts and washers from the nose gear bag.



### □ Step 77 - Fuselage (F1)

Now it's time to attach F1 into the fuselage. Test fit first, as its tabs should push into the cutouts on the fuse sheeting, as well as the

center cutout in TR1.

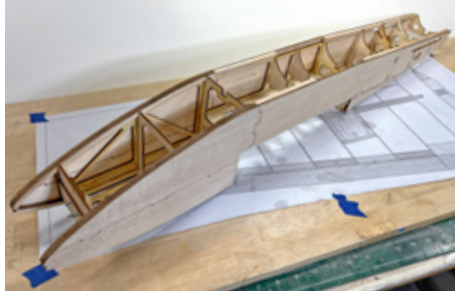
Epoxy F1 in place making sure all the slots are filled up with the tabs, as shown here.



### □ Step 78 - Fuselage (starboard fuse side)

Now it's time for one of the bigger steps in the Raven construction - attaching the starboard fuselage side to all of the formers you've just installed. This is going to take some time - and we recommend a slower curing glue here, because of the amount of surfaces that have to be attached.

So... first, let's test fit everything. There's a lot of tabs and slots that all have to work in unison for this to happen, so take your time to move and caress as needed - *and make sure nothing snaps off!*



When you're satisfied on how all this goes together, you'll need to use a combination of glues to make this work. Up-front around the F1 former you'll need to use epoxy. Then for the rest of it you can use your regular glue of choice.

I found it best to epoxy the firewall section first and let that cure. Then come back and slowly work back to the trays, through the formers, all the way to the rear - one former at a time, clamping and making sure everything is straight along the way. You don't want to introduce any twists or banana shapes in here - just two perfectly aligned fuselage sides with a lot of formers in between.

### □ Step 79 - Fuselage (front spine)

Time to use up another piece of scrap - this time some 5/16" square balsa strip that was used in the wing panels. Measure and cut a piece that will lay diagonally in the cutouts of F3 and F4, creating the front spine.



Glue this in place, fully inserted into both former's cutouts, then sand the outer edges of the balsa strip flush with the formers they're mounted to.

### □ Step 80 - Fuselage (rear spine)

You should have one more length of 5/16" square balsa that can be used for this step. Measure and cut a piece to form the rear spine that runs from the cutout in F5 to the cutout in F10.



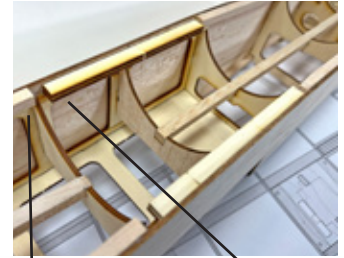
Glue this in place, fully inserted into each former's cutout, then sand the front of the balsa strip flush with F5 - don't worry about the aft end just yet.

### □ Step 81 - Fuselage (P1)

Locate four P1s from LP1. These are the EDF Mounting rails. Make two thicker rails by gluing two P1's together, stacked on top of each other.

Then these rails will be glued to the top of the fuselage frames, up against the side sheeting as shown. (Between F4 and F6.)

Make sure that both rails are pushed up against F6, so there's a gap between the forward end of the rails and F4 - that's where part of your EDF unit will slide into later.



### □ Step 82 - Fuselage (P3)

Locate P3 from LP4. This is glued to the top of the rails you just installed. Make sure it is oriented with the large notches towards the nose of the plane and the cutout circles towards the rear.

Again, this should be back

against F6, maintaining the gap for the EDF unit.

Be sure to keep glue out of the cutouts as things will go in those holes later, so those spaces need to be clean.



### □ Step 83 - Fuselage (fan inlet sheeting)

*I won't kid you - for most of you this is going to be the single hardest step. It involves getting the sheeting to conform to the inlet for the EDF unit.*

Locate one of the uncut 1/16" x 4" x 24" sheets. You'll need to make two cuts - one lengthwise (2-1/2" width), and then cut that piece at 15" (leaving you with 15" and 9" pieces that are 2-1/2" wide).

The 9" piece will form half of the inlet, so set the rest of the sheeting aside as it will be used on the rear.

Now using a liberal amount of patience and Windex®, you'll begin to form the 9" piece to the curve needed.



Just as you did for the wing sheeting, coat one side of the sheeting with the cleaner, *liberally* - this will be the outer portion of the bend, inside the fuselage. Give things a little time to loosen up the fibers, then offer the piece into the top of the fuselage - on top of F4 and F5.

Slowly use a little force and hold the sheeting in place while the cleaner evaporates. To start, concentrate on the rear curvature more than the front edge. You might have to re-apply the cleaner a couple times to get it to finally conform to the curve.

*Also note that because of the curve, the rear of the sheeting will*

have to extend past F4 slightly to completely cover it when glued into place. That's OK, as you'll trim it later.

When it is finally curved as needed, wait until the piece is dry, then glue the inner edge half-way on the center 5/16" spine, and around the curve of F4 - **NOTHING ELSE YET.**

With the sheeting glued in place you'll now work little by little along the fuselage edge to form the gradual change from a curve, back to straight. **TAKE YOUR TIME** - and you'll probably need to use more cleaner to help this along. You'll also need to trim the sheeting as you work your way forward, to relieve the stresses on the wood.

When finished you should have half of the sheeting formed to match the photo. Now go back to the start of this step and repeat it to form the other half of the inlet sheeting.

#### Step 84 - Fuselage (fan inlet sheeting)

With the hard part done, take a little time to sand the sheeting where extends past F4, F3, and along the top of the fuselage.

#### Step 85 - Fuselage (fan exhaust sheeting)

Locate those 15" x 2-1/2" sheets you cut a couple steps back, as they'll now be used to form the exhaust sheeting. Compared to the inlet, these will be much easier as the bends are constant.



Using the same techniques, you'll use the cleaner to help bend the outer curve (inside the fuselage when mounted) for each sheeting half.

You'll also note in this photo that this prototype had a forward and rear section of this sheeting - cut at the back of the EDF mounting rails. You can do this if you think this will be easier.

In either case, do one side first, then come back and do the other.

#### Step 86 - Fuselage (fan exhaust sheeting)

Now take some time to trim any extra exhaust sheeting. It should be flush with F5 and along the top of the fuselage sides. Don't worry about getting the rear perfect just yet, but you could trim off any large amount of sheeting, just to avoid hangar rash.

#### Step 87 - Fuselage (3/32" trim sheeting)

In the BP3 and BP6 sheets, you'll find pre-cut lengths of 3/32" sheeting that are now used to form the top "trim" to dress up the top of the fuselage - starting from the rear of the EDF rails, to the rear of the fuse, on both sides.

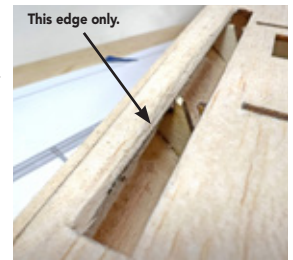


These strips can be pieced together, end to end as needed. They're slightly wider than needed so center them along the fuse sides. Do the same to trim the fuselage along both sides of the inlet sheeting.

#### Step 88 - Fuselage (V-tail slot)

Before you can install the V-tail, you'll need to file a small bevel to the top of the slots in the fuselage side frame. As the laser can't cut anything but 90° angles, you'll need to lightly sand a relief angle

into the top of the V-tail cutouts, along its entire length. Technically the V is a 30° angle, so you'll need a similar angle here.



#### Step 89 - Fuselage (V-tail)

Now it's time to install the V-tail halves you made way, way, way back.

Before attempting to install them, it's easier to round their leading edges now, so take a minute to put a nice radius on them.



Test fit them into the slots. Note that the basswood supports will slide into the notches in F8 and F9. These pre-cut notches will also hold both halves at the correct angle, so no measuring needed - pretty slick, eh?

Trim the supports as needed so each half can slide fully against the fuselage sides and slightly into the cutout. When you're happy with how these fit, then glue them in place. You also have access to inside of the fuse from underneath, so add glue as needed along the halves and where each of the supports are held by the formers.



#### Step 90 - Fuselage (servo rails)

Now is a good time to test fit the servos you'll be using for the V-tail. There are cutouts sized for the Hitec servos we used on our prototypes (HS-5065MG), but you might need to trim a bit to fit your servos. When you have a good fit, then locate the eight SRs from LP2. Two SRs are glued on top of each other to form four servo rails. From the inside of the fuselage, glue one rail to the front and one to the rear of the servo cutouts on each side of the fuselage. Test fit your servos again, and trim/file/sand as necessary so they slide in nicely.



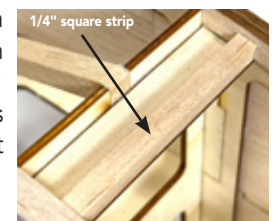
#### Step 91 - Fuselage (H3)

Locate H3 from LP5. This is glued against the underside of the FS9 pieces and up against F3, as shown here.



#### Step 92 - Fuselage (1/4" scrap)

Locate a piece of the 1/4" sq. balsa scrap. Measure and cut a length to span between the FS9 pieces (roughly 3-1/4" long). Sand as necessary, then glue this to the top of H3, aligned along its front edge as shown here.



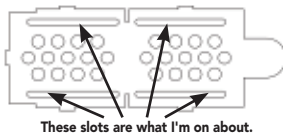
### Step 93 - Fuselage (nose strip)

Locate a piece of the 5/16" sq. balsa scrap. Measure and cut a length to span the width of the fuselage to form the tip of the nose. Glue this in place.



### Step 94 - Fuselage (hook and loop?)

Sheeting is coming next, but before this happens, you might want to think about installing any hook and loop you might use to hold in the battery. TR1 has long cutouts that allow straps to pass through and around it. It's going to be MUCH, MUCH easier to install this now, rather than waiting until after the sheeting is in place - TRUST ME! So take a few minutes to now install and/or glue-in whatever form of battery hold/grab/fasten/sticky/goo/secure system you use.



### Step 95 - Fuselage (rear, underside sheeting)

There are some uncut 1/8" balsa sheets in your Raven that you'll now use to form the sheeting for the rear of the fuselage, on the underside - *cross sheeted, that is.*



Start at the rear of the wing saddle (F6), and work your way rearward to the back of the fuselage - a piece at a time. Hold the sheeting against the fuselage, making sure the grain is cross-ways. Mark, cut and glue the first section of sheeting in position. Using this same technique, work your way rearward, one piece at a time, until you get close to F10. Then you'll have to trim a piece to fit the remaining distance. Be careful to waste as little of the sheeting as possible.

### Step 96 - Fuselage (front, underside sheeting)

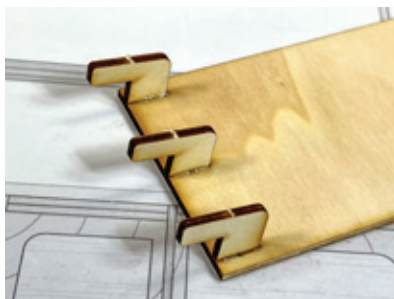
Using more of the 1/8" balsa sheets, now attach the underside, front sheeting starting from the 5/16" nose strip, rearward to F3. Use the same techniques as you just used.

### Step 97 - Fuselage (H1, H2)

Place the fuselage aside for a moment, as it's time to assemble the hatch - as you'll need it to use as a reference in the upcoming steps.

Locate H1 from LP6 and three H2s from LP1.

Now, before gluing these in place, take a look at H1 for a moment. It probably has a natural bow in it - so use this bow to help match the slight bow of the fuselage. Glue the H2s in place as shown, all to the side which bows in, not out.



### Step 98 - Fuselage (latch)

Locate the spring latch and four of the 2-56 x 5/16" self tapping screws. We will temporarily mount this latch to test fit and adjust F1 as necessary. The latch mechanism should be



mounted in H1's pre-cut holes, and on the same side of the hatch as the H2s.

### Step 99 - Fuselage Assembly (hatch fitting)

Now you can test fit the hatch to the fuselage. The H2s will face rearward and "hook" under H3 that was installed earlier. H1 will now curve around F2 and meet up with F1.

Because lasers only cut straight, and the hole that the spring latch fits into needs to be at an angle, you'll need to do a little work to the pre-cut holes in F1B and F1. Use a drill or file to carefully work on this hole until the latch's rod can pop into the hole and securely hold the front of the hatch in place.

H1 will appear to be "above" the fuse sides but that's OK. We'll fix that in the next step.

### Step 100 - Fuselage Assembly (front sheeting)

Time to add the fuselage front sheeting which will form a frame around the hatch. With the hatch in place, you'll need to cut and attach 4 pieces of 1/8" sheeting. The first is to cover up the nose - from the 5/16" nose strip to the front of the hatch.



The second is a piece from the rear of the hatch and just capping the front of the inlet sheeting. The third and fourth pieces are strips that are attached to the fuselage sides, butting up against the hatch (can be made from smaller pieces if needed).

Make sure none of these pieces are glued to the hatch itself, or interfere with the latch.

### Step 101 - Fuselage (WH2)

Locate the four WH2s from LP1. These are glued one top of the other - perfectly aligned. Sand the edges to remove all roughness.



Then the assembly is glued **UNDERNEATH** the aforementioned "bulbous protrusion" that extends into the wing saddle area.

Wick in some thin CA along the edges to really strengthen the lite-ply as this will be the forward wing-hold point.



### Step 102 - Fuselage (WH3)

Locate **five** of the WH3s from LP1.

These are glued one top of the other - perfectly aligned. Sand the edges to remove all roughness - maybe even a bit more than you just did with the WH2s. And it's recommended to wick in some thin CA along the edges to really strengthen the lite-ply as this will be the aft wing-hold point.



Now this assembly is glued inside the pre-etched circle showing on TR2 - *finally answering that question you've had for a while now about why that circle was there - another of life's mysteries solved!*

### Step 103 - Fuselage (fitting center section)

It's time to offer up the wing's center section into the wing saddle of the fuselage. If all goes as it should, it should fit with very little

effort, but as things don't always go as they should, you might need to do a little sanding. Make sure the areas where the center section and wing saddle touch are the only areas you work on - sanding a little here and a little there until you get a good, snug fit.

#### Step 104 - Fuselage (drill wing bolt holes)

With the wing properly fitted into the fuse, it's time to drill two 3/16" holes for the wing bolts, using the pre-cut holes in WH1 as a guide. Before powering up the drill, position the bit down through the hole and only then turn on the power to drill down through WH2 in the front and WH3 in the rear of the wing saddle.

Use caution to make sure the wing does not move until both holes are drilled.

When drilling, take your time and make sure the drill is held so the bit is in the center of the bolt holes. This will guarantee that the holes drilled in WH2 & WH3 will be perpendicular with the wing's sheeting.

This will make it so the wing bolt goes in at an angle, but the screw's head will be flat on the wing surface. Remove the drill, remove the wing and clean up around the new holes you drilled.

Run a 1/4x20 tap through the WH2 and WH3 pieces so that the wing bolts will thread into these blocks. A few drops of thin CA will help strengthen and secure the threads you've cut. We've found this to be a very secure way of holding the wing in place for all of our prototypes, but... if you don't want to go this way, you can also use 1/4x20 t-nuts (not included). If you go that route, you may also need slightly longer bolts, but that's something you'll have to find out for yourself.

#### Step 105 - Sanding

Now is the time to get quite familiar with the sanding tools of your choice. Take the time to perform a good sanding, rounding the wing's leading edge and wing tips. Go over the entire wing, making sure the sheeting is smooth and the trailing edges are blended into the sheeting, continuing the curvature of the wing.

Smooth out the edges of the fuselage and sand the rear flat with the F10. Because of the sheeting and the 1/4" balsa supports installed around the fuselage's perimeter, you can be a little more aggressive in rounding the corners. Take the time to smooth out the top side caps and blend them into the inlet/exhaust sheeting. Also it's time to cut out the three supports in P2 as they won't be needed anymore.

The V-tail should already be sanded and formed by now, but check it again and go over any problem areas to be sure. Sand bevels into the leading edge of both V-tail halves and the ailerons.

The idea is to spend some time caressing this awesome airframe you've created, smoothing the rough edges until it's something so slippery that it will cut through the air like a knife through melted butter.

What you should end up with will be thing of beauty - something that looks pretty darn close to this (but without the EDF cover and landing gear which I haven't told you how to install yet.)



**This completes the Raven's airframe assembly. Set it aside let's begin work on the EDF cover.**

#### Step 106 - EDF cover (P2, P4)

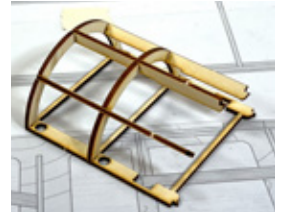
Locate P2 from LP5 and two P4s from LP2. Both P4s are glued to P2 as shown, perpendicular to surface of P2.

Leave the P2's cross braces in place until after the cover is finished and covered. to help hold it's shape. Cut them away only after covering.



#### Step 107 - EDF cover (P6)

Locate **three** P6s from LP1. These are glued into the pre-cut notches of both P4s. Make sure they are fully inserted into each of the notches in each P4.



#### Step 108 - EDF cover (P5)

Locate both P5s from LP2. These are glued on to the front end of P2 and the P6 pieces, as shown. Glue one P5 on first, then second one should be glued to the first - nicely and properly aligned.



#### Step 109 - EDF cover (sheeting)

Locate the two pieces of uncut 1/16" x 4" x 12" balsa sheeting. Using a straight-edge as a guide, cut one 3" wide sheet from each of these sheets. Then cut two 4" pieces from each of these sheets - so you'll have four 3" x 4" sheets when finished.

Edge join two pieces together along their 4" length. Then it's time to attach the first piece of sheeting to the framework, positioning the framework dead-center on the sheeting, using the sheeting's center joint as a guide. With the center glued in place,



you can carefully wrap the sheeting on both sides, making sure it's glued to the framing everywhere it touches. *You shouldn't need the Windex® trick here, but use it if necessary.*

When that sheet is installed, do exactly the same thing and cover the applied sheeting with **another** layer of 1/16th. Not only does it add strength, but is MUCH easier to do it this way than to work with a single, thicker balsa sheet.

When both layers are applied, sand the ends and the bottom of the sheeting flush with the framework.

#### Step 110 - EDF cover (P7)

Locate four P7s from BP5. Two are glued to each end, capping off the framework as shown. These P7s, can then be rounded to allow a more aerodynamic flow for the EDF.



#### Step 111 - EDF cover (magnets)

Locate the eight magnets from the hardware bag. Four of these are glued into the cover you just made - in the circular cutouts of P3. They should be pushed completely in - making them flat with P3's surface.

The other 4 magnets are installed into the top of the fuselage into P2 which was installed earlier. As with all magnets, we want these to attract, not repel, so pay attention to their direction when attaching them so the EDF cover will easily and positively "snap" in place.



### □ Step 112 - EDF cover (optional)

This is an optional thing, but makes since to do.

Cut a piece of paper to fit into the back half of the cover, as shown here. The thought is to keep the airflow as smooth as possible when exiting the EDF, and give less opportunity for the air to grab the framework - popping the cover off in flight. Applying a little glue onto the framework to hold this in place worked well for the prototypes.



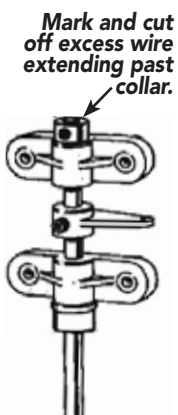
***This completes assembly of the Raven airframe. These next few steps can be done in most any order - up until it's time to cover.***

### □ Nose Gear assembly.

Everything you need to assemble the nose gear is in one package. Push the nose gear wire partially into the block you've already mounted in the fuselage. Slip the steering arm in place, then push the nose gear wire all the way through the block and the arm.

With the nose gear positioned so the steering arm at a 10-15° angle, tighten the set-screw in the steering arm just tight enough so it should make a mark on the nose gear wire. Also, mark where the wire should be trimmed off, above the top collar.

Loosen the screw and remove the wire. Grind a small flat on the nose gear where the screw made a mark, and trim the excess top wire as needed, then re-attach. Use a touch of thread-locking compound on the screw to make sure it doesn't vibrate loose later on down the road (or more to the point - down the runway).



### □ Main Gear mounting

Locate the two main gear wires, two plastic landing gear straps and four of the 2-56 x 3/4" self tapping screws. You'll need to drill two 5/32" holes into the LG blocks of the center section.

**Drill these two places.** → 

Then push the main gear into the wing until it's fully seated in the slot on the underside of the wing. Then place the two plastic mounting straps over the gear wires, as shown in this photo. Use the four screws to mount the gear in place.



### □ EDF Installation

As you should know by now, I designed the Raven around a readily available 64mm EDF unit. Obviously, I don't have the capabilities and resources to know if every 64mm fan will fit, but hopefully your's has the same dimensions - if not, you might need to sand and/or modify as needed for a good fit.

To mount the EDF is pretty simple. The unit's mounting ears drop into the cutouts on the top of the Raven. Then you can use the mounting hardware that came with the EDF to bolt it in place - of course you're need to drill a couple of holes first.

I cut a small hole in the exhaust sheeting to allow the EDF's wires to enter the fuselage.



### □ ESC installation

I chose to install the ESC just above the wing saddle in our prototypes. It seemed a good place to keep the wire length to a minimum and it had a decent amount airflow through the fuselage at this point. I fashioned a simple tray from scrap wood, supported by the bottom of F4 and the fuselage framing. Also I added a short "leg" to support the other corner.



### □ Servo & Pushrod installation

Although you can install the servos and control hardware after covering your Raven, I find it easier to temporarily mount everything in place before covering.

Take a bit of time to plan things out, including where you'll mount the nose gear servo and run the steering pushrod.

When mounting the aileron servos to the both SHs (in LP2) you'll need to cut eight 3/4" lengths of the 3/16" x 3/8" square basswood scrap. Make four thicker mounting posts by laminating two pieces together then sand the ends flat.

Position your servo on the inside of the hatch so the servo arm output shaft is centered in the opening.

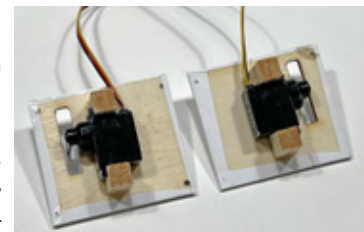
On the inside of each aileron hatch, glue one post on each side of the servo as shown in the photo.

Note that the left hatch is a mirror image of the right hatch. Now fit the servo hatches into position on the bottom of the wing, running the servo wires through the ribs and out into the wing's center section.

Using the pre-cut holes as a guide, drill four 1/16" mounting holes into the basswood mounting rails you installed earlier. Harden the wood with a bit of thin CA and you can use the supplied 2-56 x 3/4" self tapping screws to secure the hatches in place.

Finish the layout of your radio gear by adding the receiver and nose gear servo. We mounted the receiver to the side of the fuselage by using a bit of self-adhesive hook-and-loop (not included).

I chose to mount the nose gear servo inside the battery compartment, on the side of the fuse, running the pushrod along the side of the



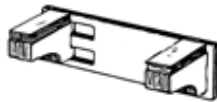


compartment to the nose gear arm. This photo is of one of the prototype setups, before I designed the servo mount system into the ply frames.



For your kit, there's pre-cut slots on each side of the fuse - so choose which side works best for your steering setup.

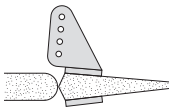
Then the servo mounting NG1 arms (LP1) can be glued in place. Two NG1s are glued together to form each arm. The rear arm position is fixed. You can slide the arm in the forward slot to match your servo's length, then glue the arm in place. Top both arms by gluing on an NG2, then you can drill and mount the servo.



### Control Horn installation

Now it's time to mount all of the control horns - one for each control surface. A control horn consists of the horn, it's plastic backer plate and two 2-56 machine screws - You'll find all of that in the hardware bag.

Each aileron control horn should be mounted so it's in-line with the pushrod opening and the holes in the control horn should be in-line with the hinge, as shown in this diagram.



As for the pushrods, we're not going to go in-depth on how they work, as that's covered in their included instructions. Basically you'll measure and cut the pushrods to length, taking into account the length of any clevises on the end of the pushrods.

We typically have one end of the pushrod with an adjustable clevis, and the other end with a simple z-bend that attaches into the servo horn. Doing it this way allows fine adjustment at the field without having to get inside the plane, taking things apart.



Note that we made a small "Z" bend in the V-tail's pushrods, as the clevises can't be installed directly in line. But that's ok. This small bend proved to be slop free.



### Covering

When it's time to cover the Raven, remove the EDF, main gear, nose gear wire, pushrods, and any other hardware that would get in the way of applying the covering.

Double check that all surfaces are smooth and ready to cover. Sand as necessary, then cover the entire airframe with the covering/finish of your choice. **Be sure to seal those hinge gaps!**

When the covering is complete, re-attach all the components you removed earlier in this step.

### Logos, Numbers, etc.

If you want to use graphics similar to the ones we used, Old School Model Works has teamed up with Callie Graphics as a supplier

for pre-cut vinyl. They are a very well known provider of custom graphics for R/C models.

We have supplied them with the artwork needed to cut the correct size logos. You can order straight from them, choosing the colors that work for you.

Contact Callie Graphics at this link: <https://callie-graphics.com> or scan the QR code.



*Note that Callie Graphics is not affiliated with Old School Model Works, nor does Old School Model Works generate any income from this partnership.*

### Attach the Control Surfaces

Now is the time to attach all the control surfaces to the airframe, by gluing the hinges in position with thin C/A. We've noted suggested hinge locations for each of the control surfaces on the plans.

When using the CA hinges, first push a pin through one side, at the center of the hinge as shown here. This will keep the hinge centered as it's pushed into the surfaces. When you've got all the hinges for a surface in place, then remove the pins and glue the hinges.



### Attach Wheels

Use the included 5/32" i.d. wheel collars to hold your wheels (not included) on the axles. For a maintenance free installation, file a small flat on the axle where the set screw of the wheel collar touches. Also use a touch of thread-locking compound to keep the screw from loosening over time.



### EDF Cover

Although we've supplied magnets to hold the EDF cover in place, we also recommend using a couple pieces of clear tape (or iron-on covering) to hold the cover in place. We've never had one blow off in flight, but as you should never have to access the fan unit, after it's installed, having the cover more permanently attached can't hurt.

### Recommended Control Throws:

I like my airplanes more responsive than most pilots I've come across. So bear with me on the throw setup, as I don't use rates. Instead, I set my models so I always have the full, recommended throw, at my command, and smooth it with some exponential.

The Raven's ailerons are very effective, so these throws are quite a bit less than I typically recommend for other kits. The response from the V-tail is closer to normal, so it has a bit more throw for normal flight. However if you go this route I do recommend more than usual expo on the ailerons - something to help smooth out the controls around neutral. I also use it for the V-tail (elevator and rudder), but more of a traditional percentage.

**Ailerons: 1/2" from neutral (30% expo)**

**V-tail: 5/8" from neutral  
(20% expo elevator, 15% rudder)**

Again, your mileage may vary.

(Expert tip: Once the control throws have been set, cut a few pieces of medium silicone fuel tubing (or heat shrink tubing) to go around each of the clevises. This will keep them from opening during flight.)

#### Flaperons:

I also experimented with changing the ailerons to flaperons through a mix in my radio. I found it quite nice and allowed the Raven to fly at somewhat slower speeds and still have good control. It can help with landings on shorter strips, but I highly recommend testing the feel for yourself with the Raven several mistakes high. If using flaperons you'll also need to hold (or mix in) some elevator trim to help offset the slight pitch change.

I have flaperons set to a 3 position switch on my transmitter - off, half and full-throw. At full throw, my setting was about 1/4" of throw.

**Please, please, please! Check the direction that each control surface moves.**

**Then double check the directions.**

**Walk away for a while, then come back and check the directions again.**

**The number one cause of a crash of any brand new airplane on its maiden flight is having the wrong throw for one (or more) of the control surfaces.**

**This completes the assembly of the Raven. Now you'll need to adjust the control throws and check for balance.**

#### Recommended C.G. setting:

An important part of preparing the aircraft for flight is properly balancing the model. This is especially important because of the various motor/battery combinations that can be used.

### **CAUTION! DO NOT SKIP THIS STEP!**

The Raven's recommended starting position for the Center of Gravity (CG) is 2.8" from the leading edge of the wing, as measured where the wing contacts the fuselage, and you'll see this marked on the fuselage plan with this symbol.

C.G. BALANCE POINT



If necessary, move the battery, receiver, and/or add weight to either the nose or the tail until the correct balance is achieved. Stick-on weights are available at your local hobby store and work well for this purpose.

#### Preflight:

Charge both the transmitter and receiver pack for your airplane. Use the recommended charger supplied with your particular radio system, following the instructions provided with the radio. In most cases, the radio should be charged the night before going out flying.

Check the radio installation and make sure all the control surfaces are moving correctly (i.e. the correct direction and with the recommended throws). Test run the engine and make sure it transitions smoothly from idle to full throttle and back. Also ensure the engine is tuned according to the manufacturer's instructions, and it will run consistently and constantly at full throttle when

adjusted.

Check all the control horns, servo horns and clevises to make sure they are secure and in good condition. Replace any items that would be considered questionable. Failure of any of these components in flight would mean the loss of your aircraft.

#### Range check your radio before flying

Before each flying session, range check your radio. This is accomplished by turning on your transmitter with the antenna collapsed. Turn on the radio in your airplane, but do not attach the arming switch.

With your airplane on the ground, you should be able to walk 30 paces away from your airplane and still have complete control of all functions.

If not, don't attempt to fly! Have your radio equipment checked out by the manufacturer.

#### **Warranty Information**

**Old School Model Works** guarantees this kit to be free from defects in both material and workmanship at the date of purchase. This warranty does not cover any parts damage by use or modification. In no case shall **Old School Model Works'** liability exceed the original cost of the purchased kit.

If you find any damaged or missing parts, contact us within 60 days from purchase to receive replacement(s).

Further, **Old School Model Works** reserves the right to change or modify this warranty without notice.

In that **Old School Model Works** has no control over the final assembly or material used for the final assembly, no liability shall be assumed nor accepted for any damage of the final user-assembled product. By the act of using the product, the user accepts all resulting liability.

#### **Limit of Liability**

In the use of this product, our only obligation shall be to replace such quantity of the product proven to be defective. The user shall determine the suitability of the product for his or her intended use and shall assume all risk and liability in connection therewith.

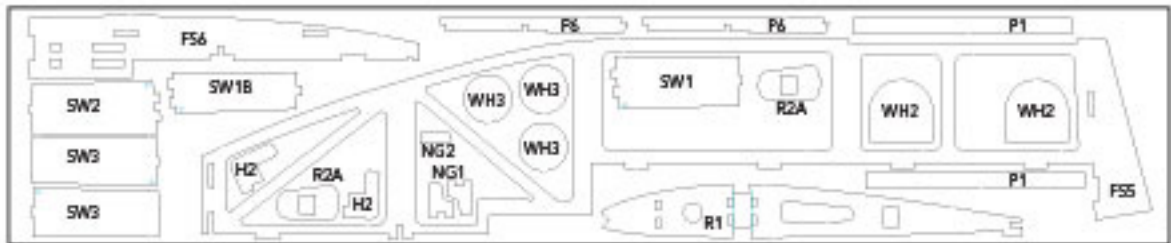
If the buyer is not prepared to accept the liability associated with the use of this product, the buyer is advised to return this kit immediately in new and unopened condition.

As of this printing, you are required to register with the FAA if you own this product.

For up-to-date information on how to register with the FAA, visit: <https://registermyuas.faa.gov>.

For additional assistance on regulations and guidance of UAS usage, visit: <http://www.knowbeforeyoufly.org>.

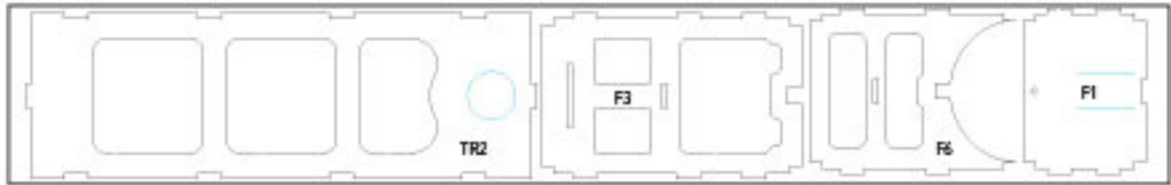
**LP1**  
1/8" Lite Ply



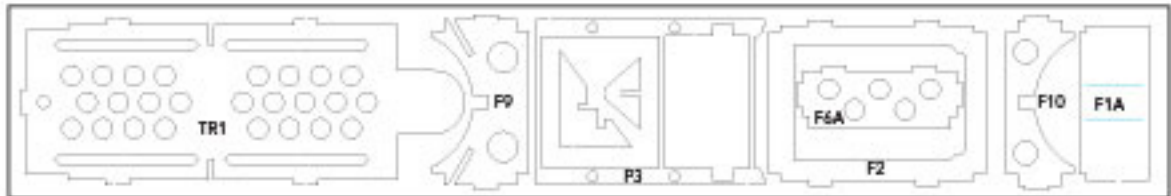
**LP2**  
1/8" Lite Ply



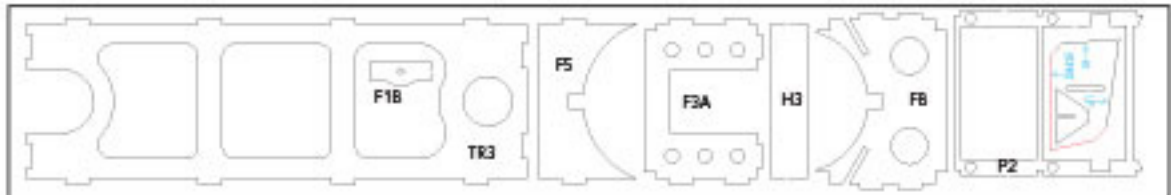
**LP3**  
1/8" Lite Ply



**LP4**  
1/8" Lite Ply



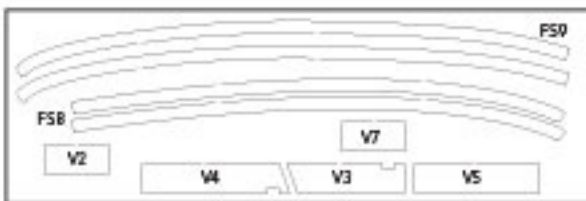
**LP5**  
1/8" Lite Ply



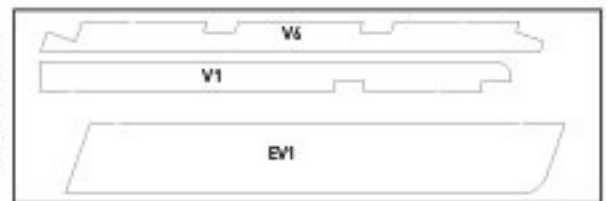
**LP6**  
1/8" Lite Ply



**BP1**  
1/8" Balsa



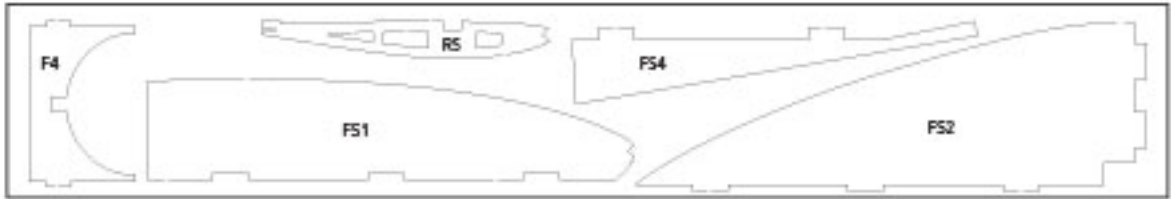
**BP2**  
1/8" Balsa



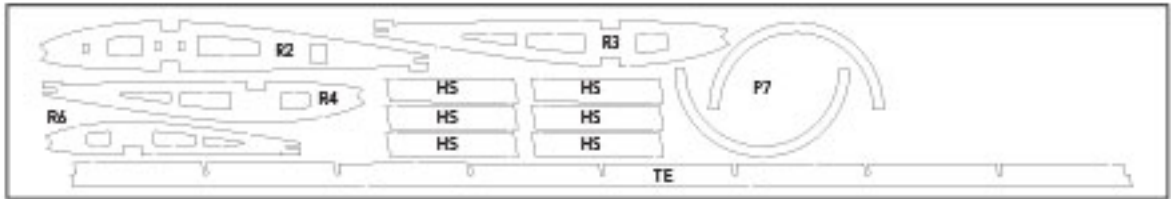
**BP3**  
3/32" Balsa



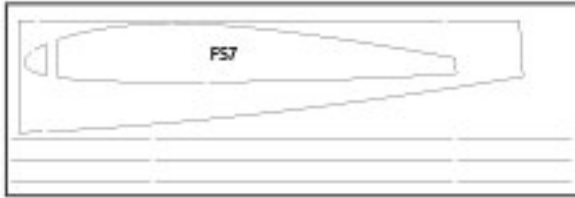
**BP4**  
3/32" Balsa



**BP5**  
3/32" Balsa



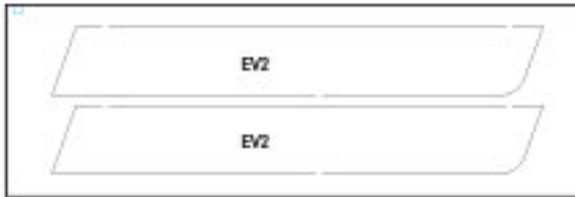
**BP6**  
3/32" Balsa



**BP7**  
1/16" Balsa



**BP8**  
1/16" Balsa



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# Raven Aileron Hatch template

