TurboRaven

85" 50-61cc

Build Guide

EXTREME FLIGHT

Please read the following paragraphs before beginning assembly of your aircraft!

THIS IS NOT A TOY! Serious injury, destruction of property, or even death may result from the misuse of this product. Extreme Flight RC is providing you, the consumer with a very high quality model aircraft component kit, from which you, the consumer, will assemble a flying model. It is beyond our control to monitor the finished aircraft you produce. Extreme Flight RC will in no way accept or assume responsibility or liability for damages resulting from the use of this user assembled product. This aircraft should be flown in accordance to the AMA safety code. It is highly recommended that you join the Academy of Model Aeronautics in order to be properly insured, and to operate your model at AMA sanctioned flying fields only. If you are not willing to accept ALL liability for the use of this product, please return it to the place of purchase immediately.

Extreme Flight RC guarantees this kit to be free of defects in materials and workmanship for a period of 30 DAYS from the date of purchase. All warranty claims must be accompanied by the original dated receipt. This warranty is extended to the original purchaser of the aircraft kit only.

Extreme Flight RC in no way warranties its aircraft against flutter. We have put these aircraft through the most grueling flight tests imaginable and have not experienced any control surface flutter. Proper servo selection and linkage set-up is absolutely essential. Inadequate servos or improper linkage set up may result in flutter and possibly the complete destruction of your aircraft. If you are not experienced in this type of linkage set-up or have questions regarding servo choices, please contact us at info@extremeflightrc.com or 770-887-1794. It is your responsibility to ensure the airworthiness of your model.

We recommend that you read this build guide entirely before beginning your assembly, to familiarize yourself with the tools needed and materials used.

The Turbo Raven series of aircraft were designed for Extreme Flight by Cody Wojcik and are intended to be extreme performance, no compromises aircraft. As such, some items in assembly may be slightly different than you are used to.

The Raven has a wingspan of 85" without its optional wingtips, and 88" with these tips installed.

The Raven is intended for either electric power using the XPWR60cc outrunner motor on 12S 5000mah lipo, or single-cylinder 50-61cc gas power.

If you elect to use gas power, be aware that because the Raven is a very narrow airframe, fitting the exhaust to the cowl will be different than a typical airframe. We have included detailed photos of a stock muffler istallation and a header installation. If you wish to use a Pitts style muffler, be aware that space is tight, and you will need a small-can style Pitts. A standard or large can "quiet" Pitts will likely interfere with the motor box.

The Raven has extremely large control surfaces. For this reason, it requires extremely powerful servos to prevent flutter. For our builds, we chose Savox 1280 and Savox 2290 servos.

Note that the Raven has an option for mounting the rudder servo in front or back, and there are two different mounting locations for the rudder control horn.

Your aircraft has been on a journey around the world since it left our factory. Although the covering material was perfectly smooth when it was boxed up, changes in weather and humidity may have wrinkled the covering material. For certain, wrinkles will appear in the covering once you have unpacked your aircraft and it adjusts to the atmospheric conditions in your region. Learning to remove wrinkles from covering is a necessary skill to maintain your wood aircraft.

Your Extreme-Flight produced aircraft is covered in Ultracote covering material (US market name), also called Oracover in global markets. If you need replacement covering to repair damage, Ultracote/Oracover is widely available from retail hobby suppliers. Also, each roll of Ultracote/Oracover includes excellent instructions which are also available online. Please refer to them for details about working with and/or repairing your covering.

The basic tools are a covering iron and a hobby heat gun. Start by using the iron at 220F (104C) to seal all of the edges on the covering scheme. This is CRITICAL on the leading edges of wings and stabilizers. Then use the iron at 300F (149C) or a heat gun to shrink out any wrinkles in the covering. Remove the plastic canopy from the aircraft when using a heat gun to protect it from heat damage. GO SLOWLY AND CAREFULLY to avoid over-shrinking or burning the covering. This is a skill which takes a bit of practice. There are many tutorial videos online demonstrating shrinking wrinkles from Ultracote.

Periodically repeat the sealing and shrinking process to keep your aircraft in good condition.

If you need additional covering material to repair your Raven, the color codes are:

Blue/Yellow Scheme	
Oracover colors	Ultracote colors
Blue #50	Deep blue #HANU873
Dark Blue #52	Midnight Blue #HANU885
Cub Yellow #30	Cub Yellow #HANU884
White #10	White #HANU870

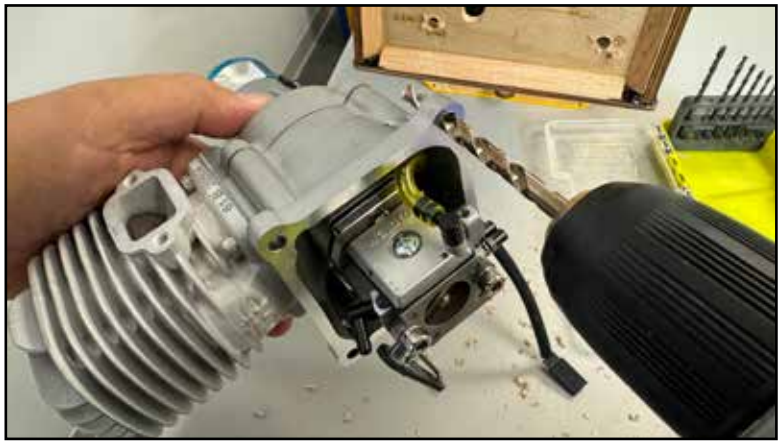
Red/White Scheme	
Oracover colors	Ultracote colors
White #10	White #HANU870
Ferrari Red #23	True Red #HANU 866
Dark Blue #52	Midnight Blue #HANU885
Cub Yellow #30	Cub Yellow #HANU884

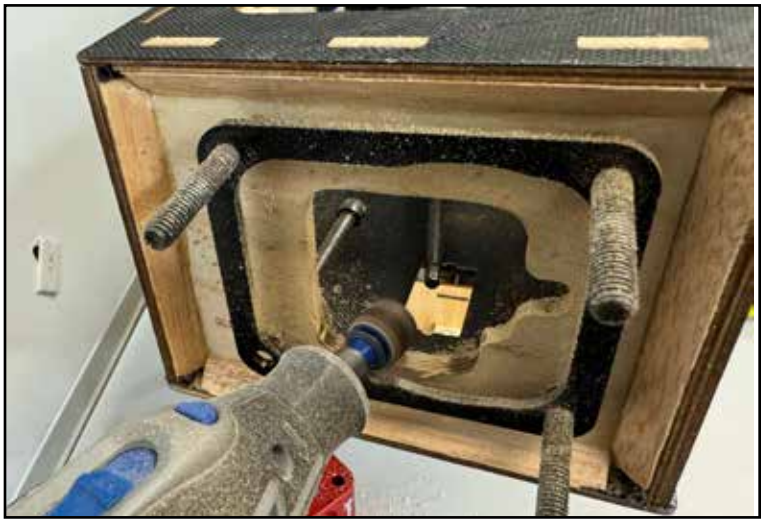
1.

In this installation, we are using a GP-61 engine, but other brands and types of single cylinder engines install very similarly. We are also using our Blazing Star DA60/GP61 one-piece aluminum engine mount, which has the correct spacing for this aircraft. We begin by drilling the appropriate, marked holes in the firewall. Start with a small bit, such as 2mm or 1/16", and go up to the final size bit afterwards.

It is personal preference, but we like to use 6mm engine mounting bolts and this requires drilling the mounting pads on the GP engine out to 6mm. The firewall has a basic cutout as delivered, but you may need to modify this cutout to fit the linkage on your particular engine. We use a dremel-type rotary tool for this.

Install the throttle linkage pushrod onto your engine carburetor arm as shown.

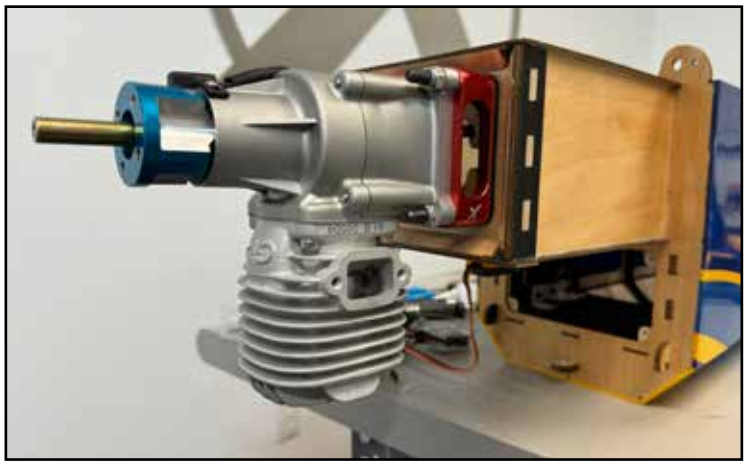


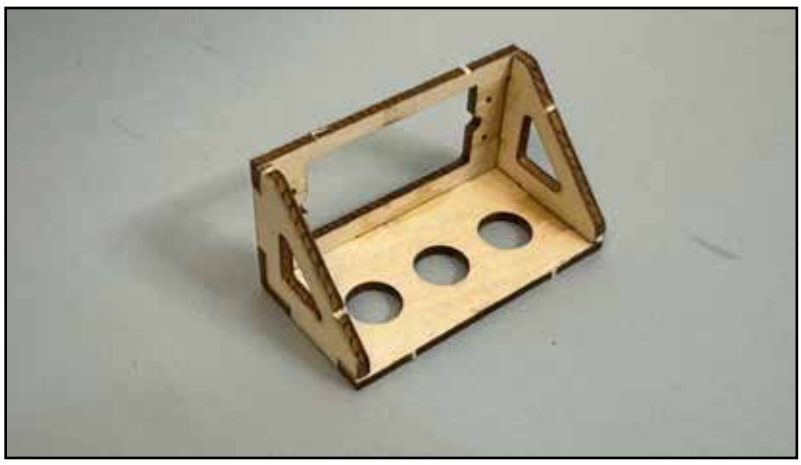


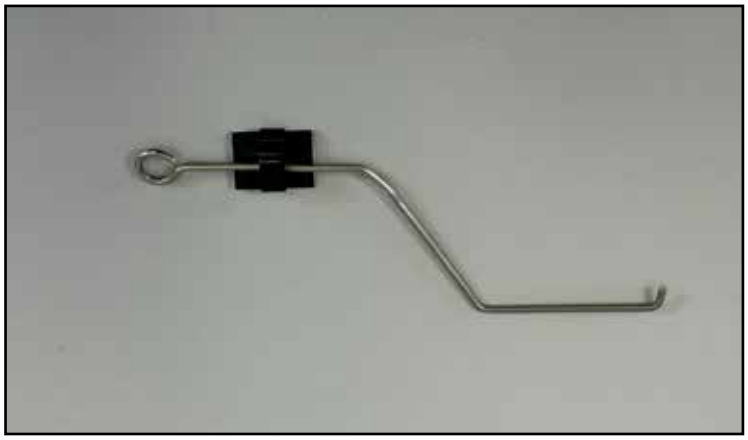
2. Mount your engine. Your can orient the bolts with the nuts to the either the front or rear, but you must use self-locking (Nyloc) nuts and you must use washers against the wood on the inside of the firewall. If you use the plastic spacers which are included with the Blazing Star mount, place the spacers between the mount and the wood firewall.

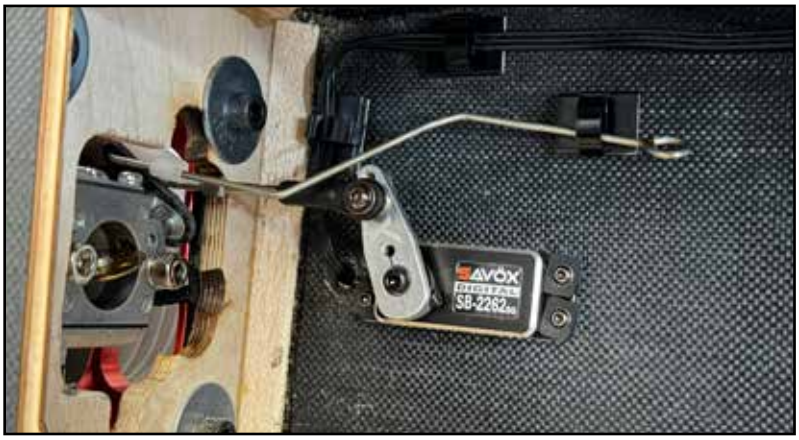
Install the throttle servo. In this build, we are using a header so we chose a low-profile throttle servo for additional clearance. If you use a standard muffler you can use a standard-height servo with no modifications. We have elected to make a hole and install rubber grommet for the servo wire as shown. You can also side-mount the servo inside the motor box, using the included laser cut servo mount.

We have used an Extreme Flight 1" metal servo arm for the throttle linkage as shown. You have an option to run the choke linkage forward to the front of the cowl (which is typical for other aircraft, but a bit more challenging with the narrow and highly styled Raven cowl) or rearward to access from inside the fuse. Alternately a mini servo can be used to actuate the choke.







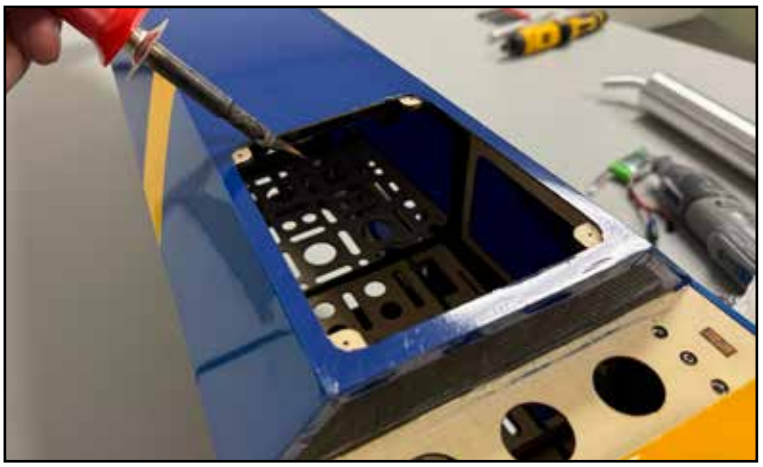


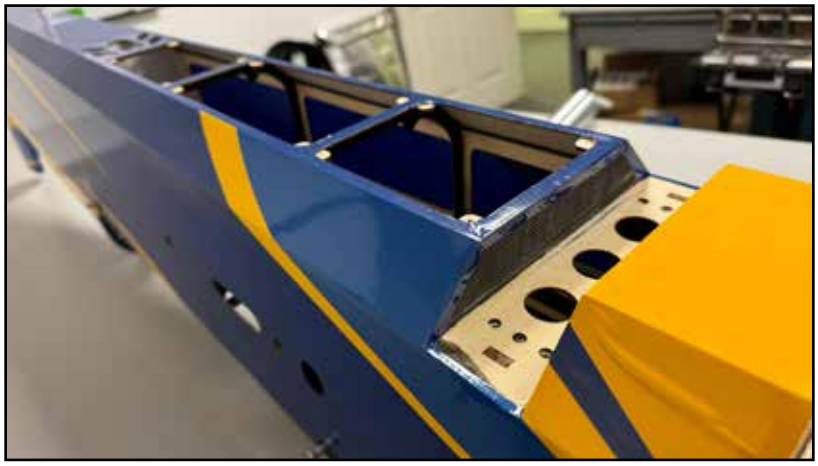
3.

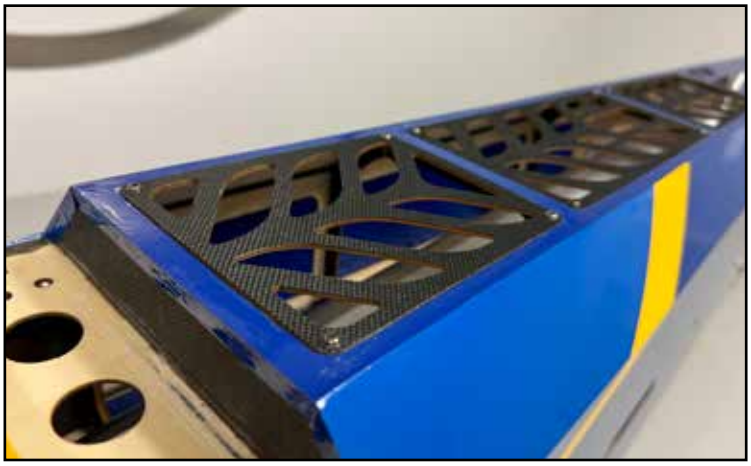
The Turbo Raven has several options for cooling air outlets. There is a pre-made outlet on the bottom rear of the cowl. In addition, you can add up to three additional cooling outlets to the bottom of the fuselage as shown. The two rear outlet plates have outlets for canister and tuned pipe exhaust. If you are using electric power, we recomend you install all of the available cooling outlets to assist with battery cooling. We use a hot knife tool or a soldering iron to remove the covering over these cooling outlets.

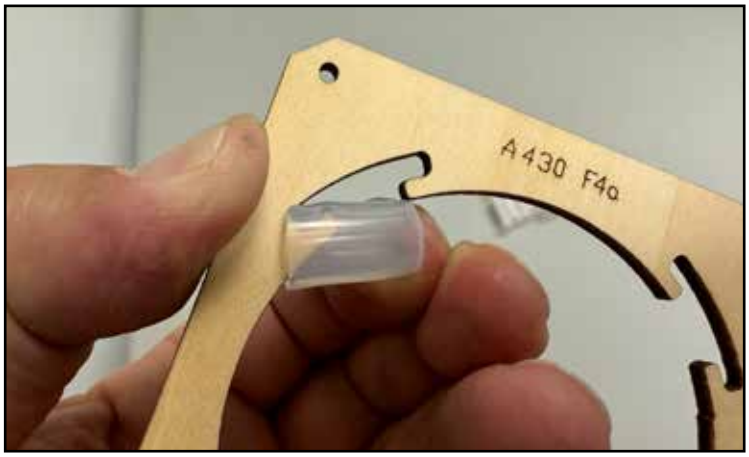
If you are using a gas engine with stock or compact muffler, you can install the included blocking plate on the bottom part of the firewall to seal the fuselage.

If you are using a tuned pipe, locate the mounts for the pipe and install the silicone tube soft mounts. Because there are many different types of canister mufflers with different sizes and outlets, expect to do some fabrication to accommodate yours if you elect to use one.



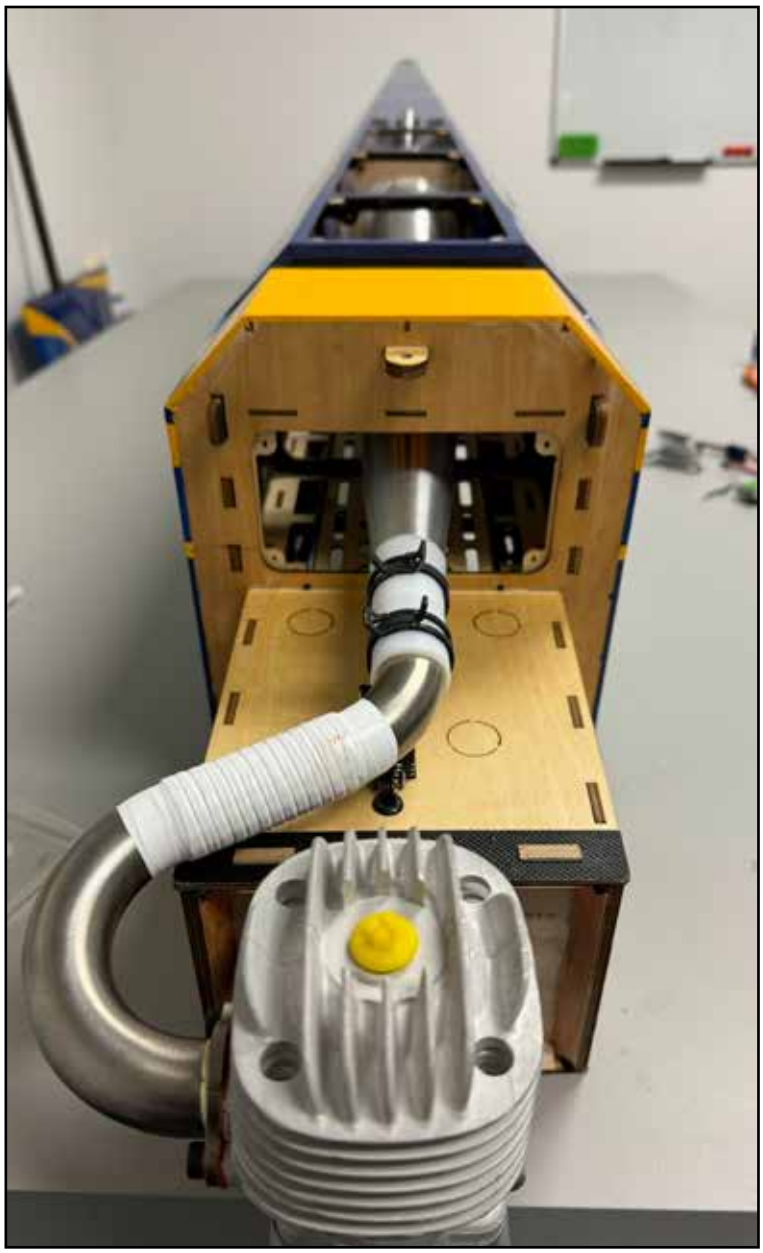






4.

Our tuned pipe install details: We used an RE2 tuned pipe and 25mm drop header. We shortened the header approximately 5CM. The wooden pipe mounts are installed into the fuselage mounting locations with wood screws as shown. We use wood screws as keepers to prevent the coupler from moving or slipping on the pipe or header.

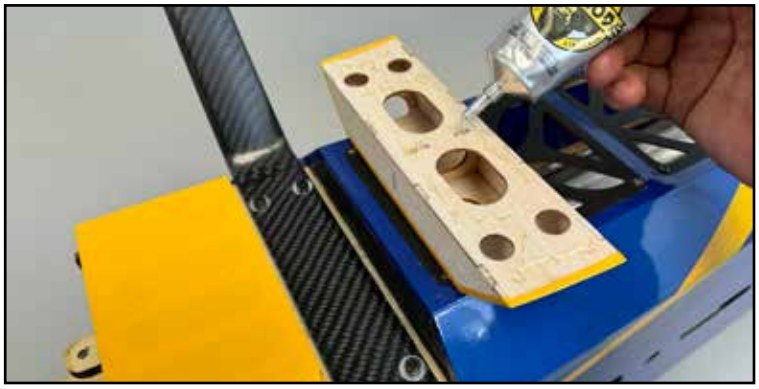


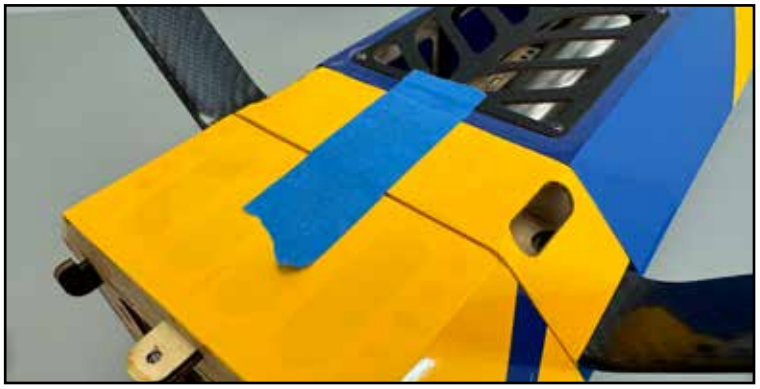
5.

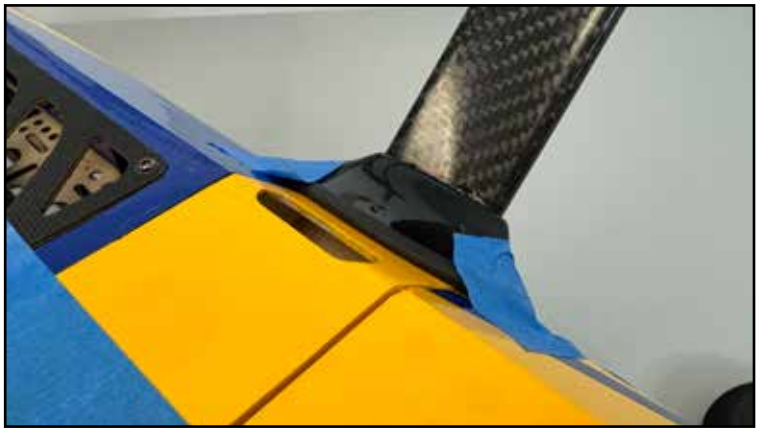
Locate the landing gear parts as shown. The carbon landing gear legs sweep slightly forward when installed in the correct orientation. Attach the gear unit to the fuselage with bolts and washers, we recommend the use of blue loctite thread locker on these bolts.

6. Locate the cover plate for the landing gear area, clean the mating area of the landing gear with alcohol, allow to dry, and then apply a rubberized glue, such as Goop, Welder, or Gorilla Glue Clear Grip. Tape the cover plate in place to dry.

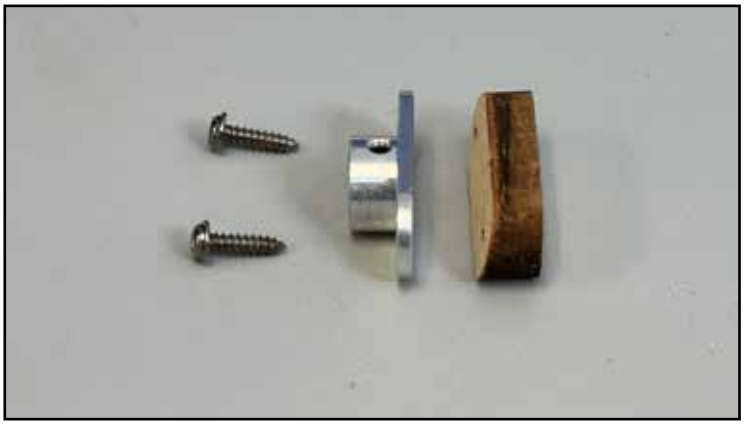
Locate the landing gear fairings. Determine which side is the best fit, and mark the gear leg at the end of the fairing. Use sandpaper to scuff the leg under the fiaring, and apply rubberized glue to this area. Slide the fairing on, making sure there is enough glue to grip the fairing, and tape in place to dry.





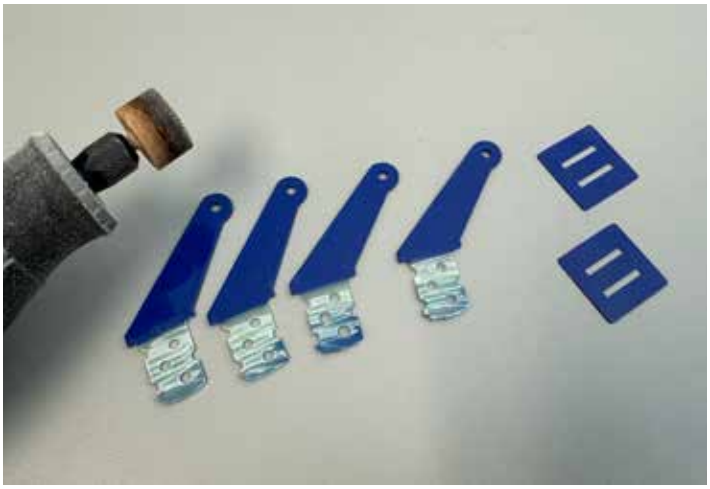


7. Atttach the axles to the landing gear legs, make sure the flat spot in the axle points DOWN toward the runway. Assemble the wheel pant savers with two wood screws each as shown. Install the wheels onto the axles, and install the wheel pant savers as the outer wheel retainers. Apply a drop of blue loctite to the set screws in the pant savers. The wheel pant savers glue to the inside face of the wheel pants to prevent the pant twisting and cracking, here we use Gorilla Glue to attach the wooden pad of the pant saver to inner surface of the wheel pant, epoxy glue is a good alternate choice. Install the pant to the leg with two 3mm bolts and blue loctite.



8.

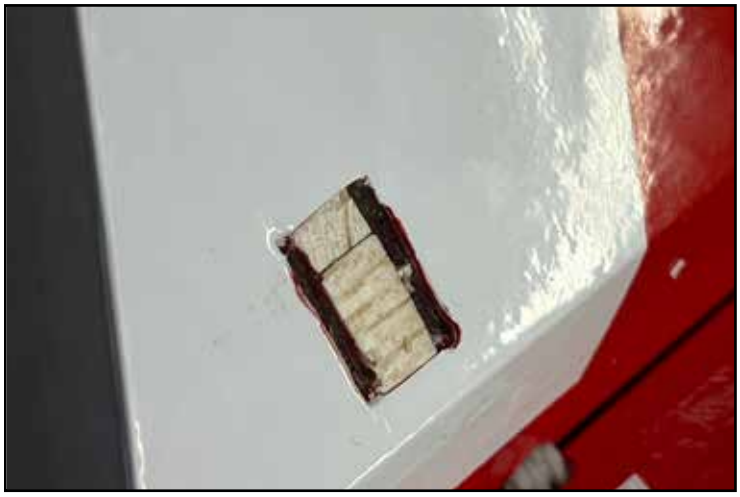
Locate the hardware for the control surfaces, labeled for each. Use sandpaper, an emery board, or a rotary tool with a sanding drum as shown, to scuff the part of the horn which goes into the slots in the control surface. Refer to the photo for the assembly of the pushrods onto the horns. Note that the nuts are the self-locking "Nyloc" type so loctite is not necessary. For some connections, a tapered "cone" spacer is included to space the ball link away from the servo arm.

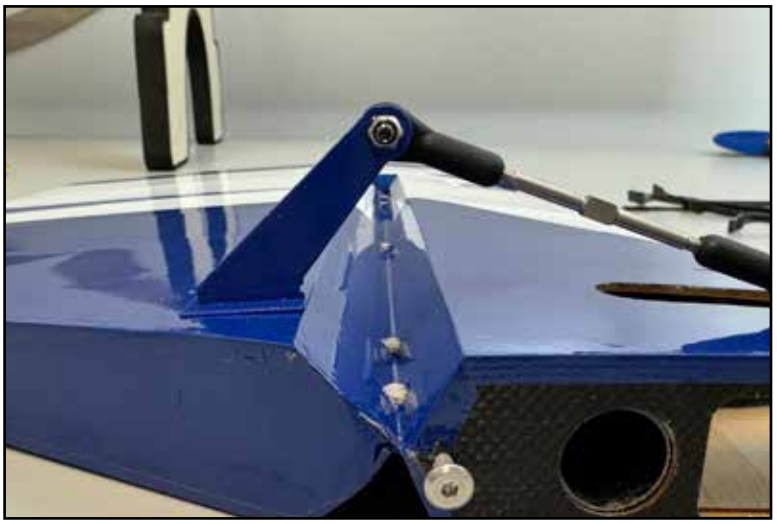


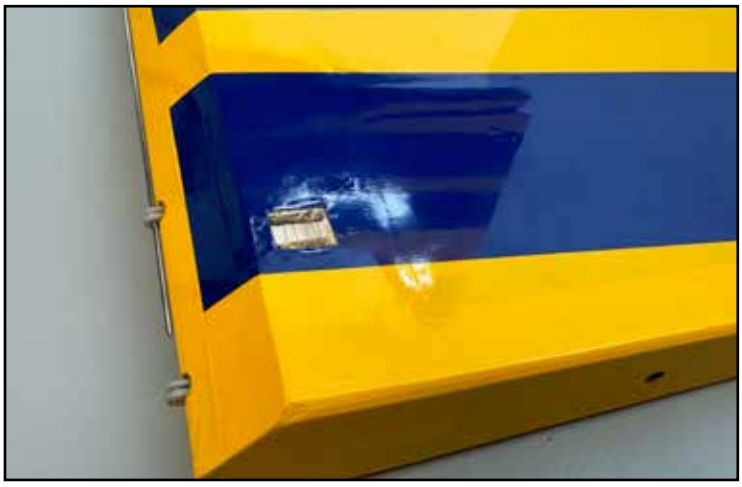
9.

Locate the slots in the control surfaces and remove the covering in-between the slots as shown to expose bare wood. Test fit each horn into its slots and make sure you can seat it all the way into the slot, until the square trim plate is in solid contact with the surface. Permanently install the horn with epoxy glue of at least 15 minutes cure time. We want to have enough cure time to be certain you get the horns seated properly. We use an epoxy gun as shown, this is a convenient way to get the epoxy easily into the slots, however the gun is not necessary. You can hand mix the epoxy, be sure to get plenty into the slots. Also put plenty of epoxy on the scuffed part of the horns and seat the horns firmly into the slots. Some epoxy will squeeze out. This is good, it means we have sufficient glue. Clean up any excess with denatured alcohol on a rag. Set the surfaces aside and allow to dry while you complete the other steps.

NOTE- There are two optional positions for the rudder horn, step continued on next page.



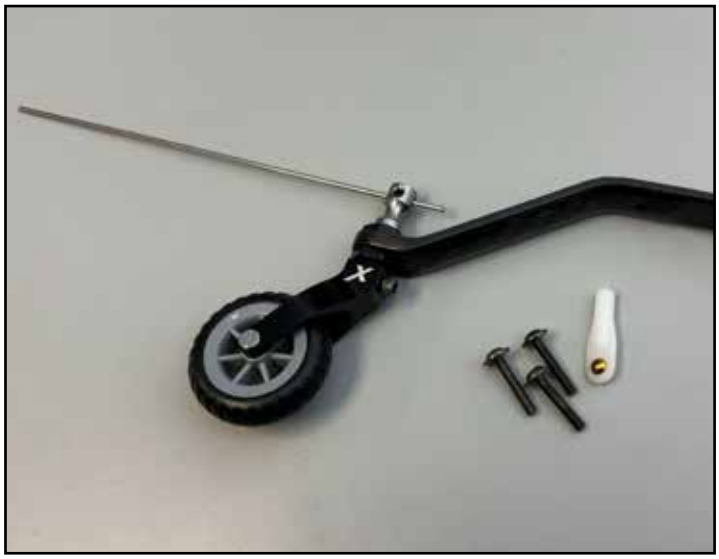




There are two positions for the rudder horn. A lower for a push-pull install, and an upper for a pull-pull install. The pull-pull installation uses control horns on both sides of the rudder. If you aren't sure which one to use, skip ahead to step 17 for explanation on this topic. Currently we are including a wooden jig as shown to assist in locating the pull-pull rudder horns, we recommend that you use this jig to check the side-to-side locations of the horns, but the front-to-back position of the horns does not need to be as precise and the bolts do not have to fit perfectly as shown.

10.

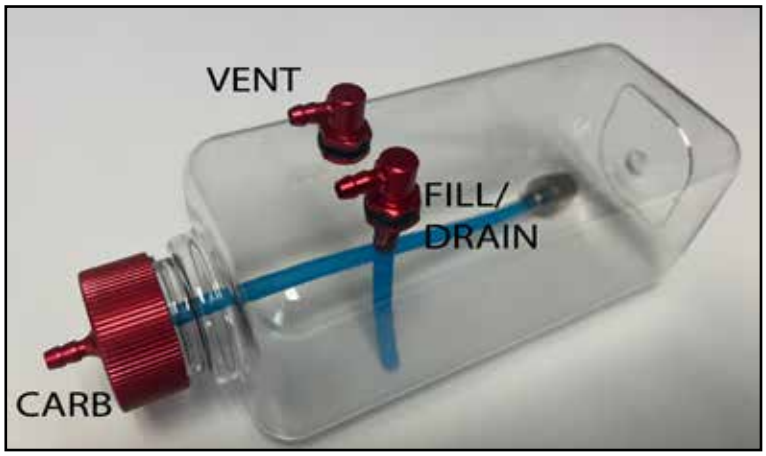
Locate the tailwheel and parts. Attach the tailwheel to the fuselage as shown, using blue loctite on the three bolts. Glue the ball link into the hole in the bottom of the rudder with epoxy to capture the tiller wire.

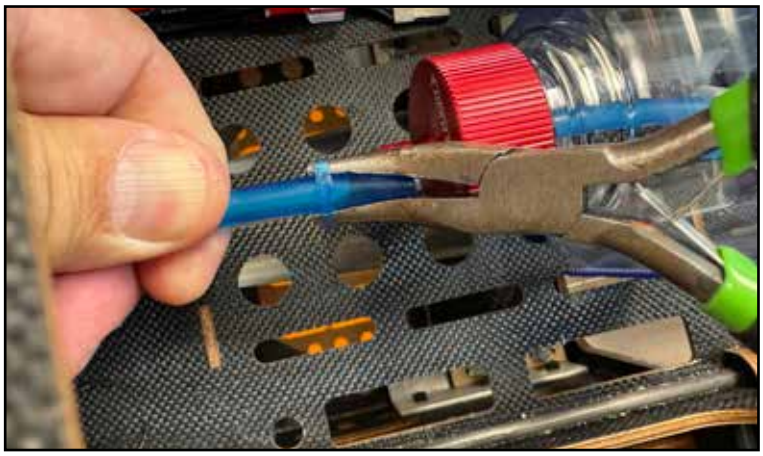


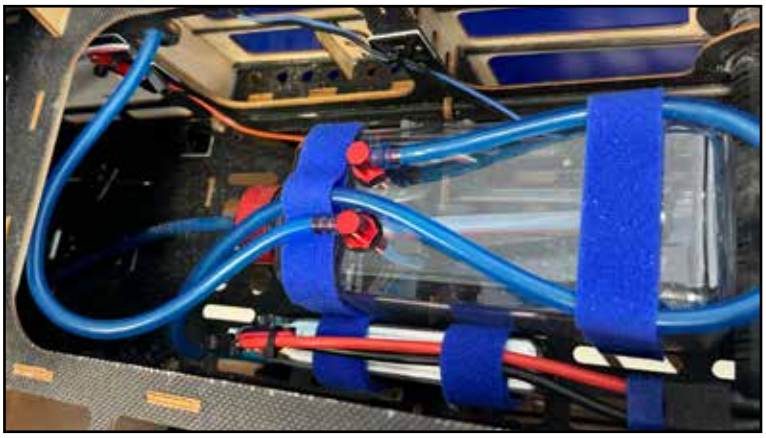
11.

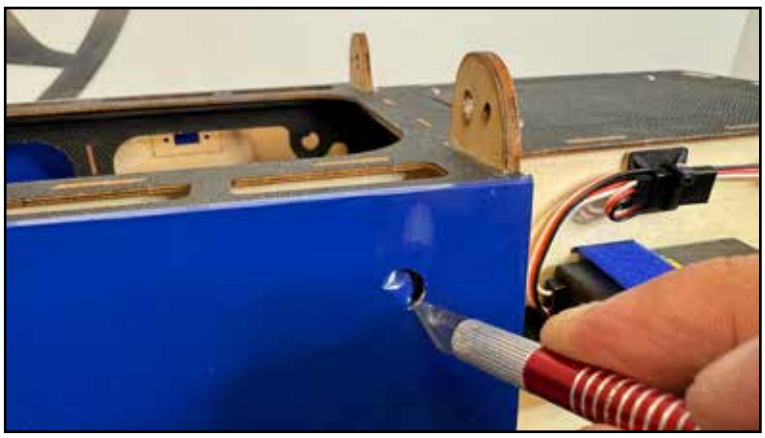
Install your fuel tank with two heavy-duty straps around the tank and velcro underneath. When you plumb your fuel and vent lines, consider using a short piece of tubing as a "clamp" over the connections as shown. Route your lines securely, don't let them flop around unconstrained inside the fuselage. Create a loop in your vent line as shown, this prevents fuel siphoning out during flight.

In the position shown, there is a small "starter" hole cut for your fuel dot. If your dot is larger in diameter, ream the hole as shown to fit.





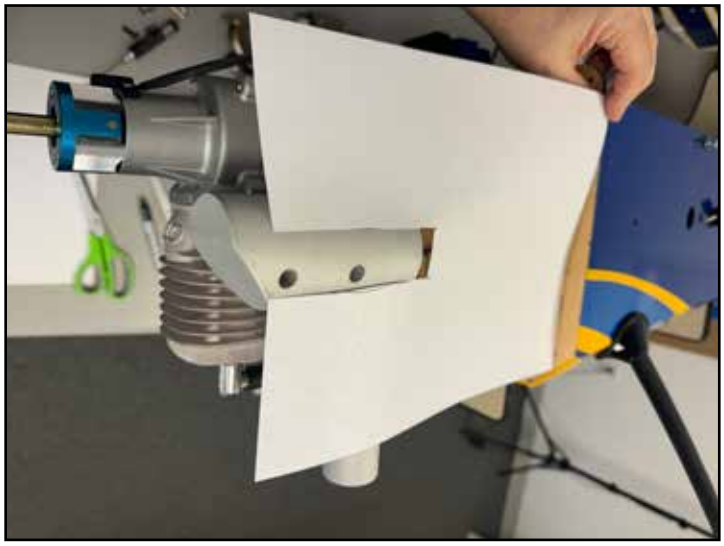


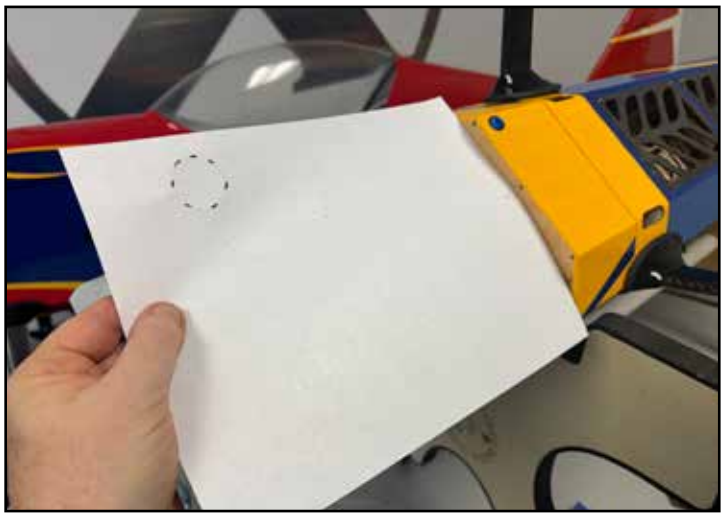


12.

If you are using gas power, be aware that the Raven has a very narrow and compact fuselage for performance reasons and exhaust installation is not like other aircraft. Each type of system has unique challenges. You may be aware of the template technique, where you use a piece of paper or cardstock, lay it against the installed engine and exhaust system, mark the exhaust locations, and then transfer these location to the cowl for cutting. This is illustrated below. On the raven, however, it can be helpful to make two templates, one for the bottom of the cowl if you have an outlet there, and one for the side. This is also shown. For pitts mufflers, note that a small canister section is needed, a large canister will likely interfere with the motor box. For tuned pipes and canister mufflers, note that we used an MTW 25mm drop header with flex section, and it requires a small cowl cutout as shown.

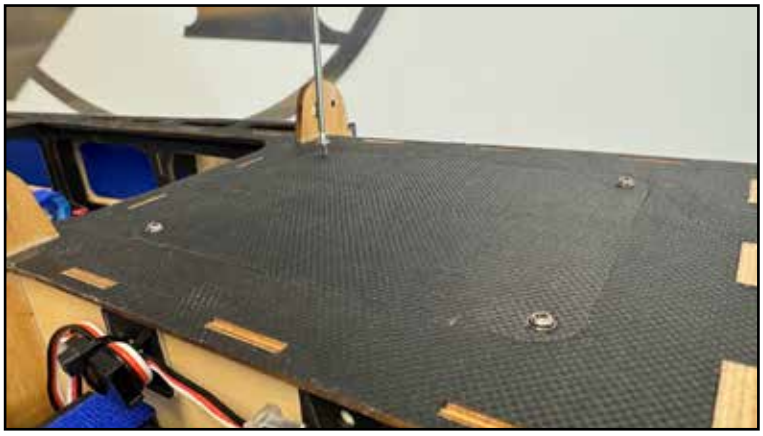
For our installation, we added some 3mm rubber channel to the edge of our cutouts, various types of rubber channel are available from online retailers inexpensively.

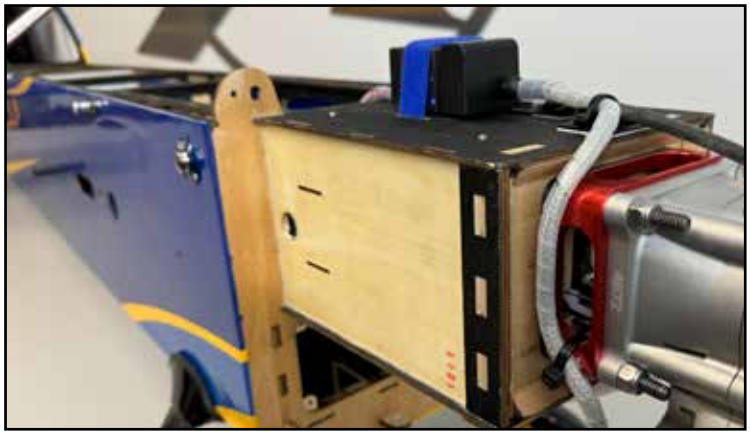




13. The top of the engine box has a cover plate which installs with bolts as shown. For as a gas installation, this is one possible location for the ignition unit, since the Raven is too narrow for most units to fit on the side of the box. For electric power, you will need a path for cooling air to reach the batteries, this cover plate may be left off for this purpose.

Locate the parts for the turbo exhaust stacks. These attach to the sides of the cowl as shown. Use goop/gorilla glue and use blue loctite on the central bolts.





14.

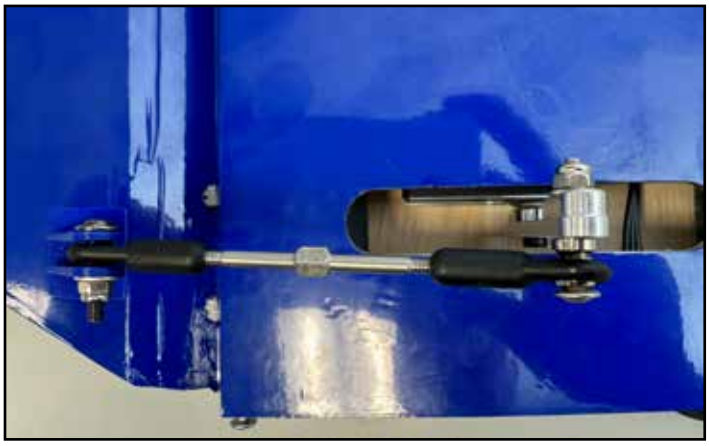
Electric power notes:

We recommend the XPWR60cc brushless outrunner motor with the Castle Creations Edge 160amp ESC. To make this ESC fully compatible with this motor, use firmware 4.22, not any other firmware. Other settings on the ESC can remain at default. Use the BlazingStar XL stand-off kit as shown. The mounting pattern for the XPWR 60cc motor is identical to the DA60, marked on the firewall. Other brushless outrunner motors in the 6KW range are also appropritate. We prefer a 24x12 or 24x13 prop for the 85" Raven.

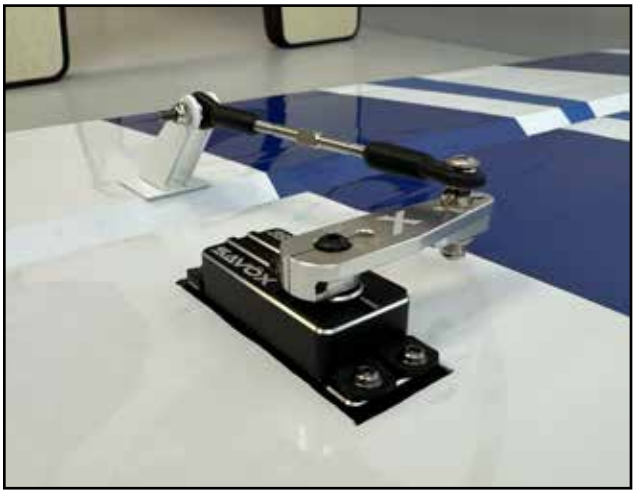
Your kit includes a cooling duct which glues into the front scoop with epoxy or gorilla/goop glue. It directs air to the brushless motor. This scoop may be trimmed to change the proportion of air which is directed to the ESC as well.

15.

The elevator servos of the Raven install into the horizontal stabilizers as shown. The port for the servo is covered with a number plate when you unpack the stabs, snip these out of the way and discard. Prepare your servo with its mounting grommets and hardware. The fit of the servos into their openings in the stab may need to be adjusted with a file or emery board. Here we are using Extreme Flight servo screws, which use a 2mm hex driver and are frequently easier to use in recessed locations than phillips-head screws. The depth of the servo mount vs. the output slot is set for common servos using Extreme Flight servo arms. Some combinations of servo/arm may rub on the slot. If so, either space the servo out with washers/spacers, or trim the slot as needed. Install your pushrod onto the servo arm as shown. For most servo/radio combinations, we use the 1.75" location on the 2" servo arm for the elevator.



16. The aileron installation will require a servo wire extension, be certain to use some kind of plug lock on this connection to be certain it cannot become unplugged in flight. Note that the linkage is "crooked" at the neutral position. This is by design, so that the linkage is "Straight" and applies no unwanted side forces to the horn system at full deflection. For most radio/servo combinations, we use the 1.5" hole on the 1.5" servo arm for the ailerons.



17.

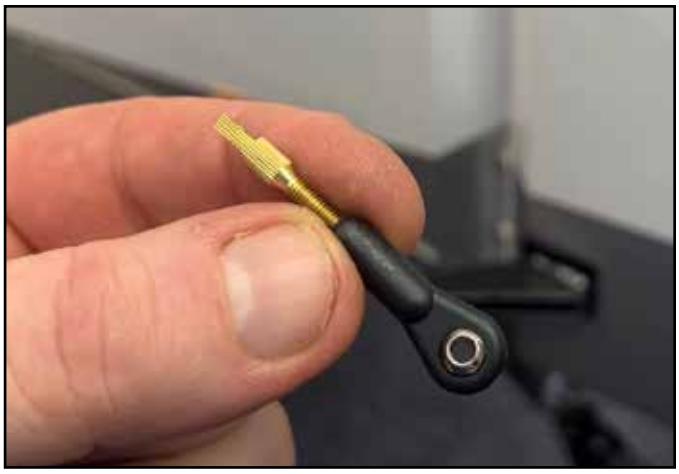
The rudder servo installation on the 85" Raven has an option, you can either mount the rudder servo in its rear location with a pushrod, or you can mount the rudder servo under the canopy hatch and use pull-pull cables which are included. For most power systems, electric or gas, we recommmend the rear-mounted, pushrod installation. It is simple and requires no maintenance. Note that with some servo/arm combinations, the linkage may have more clearance if mounted to the inside of the servo arm as shown in one photo below. For most servo/radio-combinations, we use the 1.75" location on the 2" arms for the rudder.

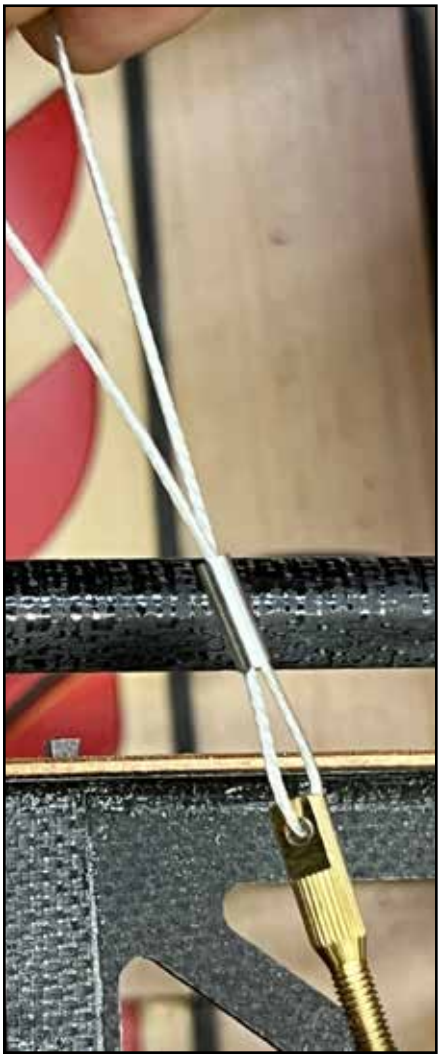
If you want a more nose-heavy installation to balance extra-light electric battery packs or a very light power system such as a true 50CC engine or a belt-drive electric, then you can use the pull-pull system. Consult the photos below to find the locations of the pull-pull cable exit in the fuselage and open a slit in the covering. Insert the cables and run them through the fuselage, they cross once inside to form an "X" shape, and go through the slots in the foam airflow director.

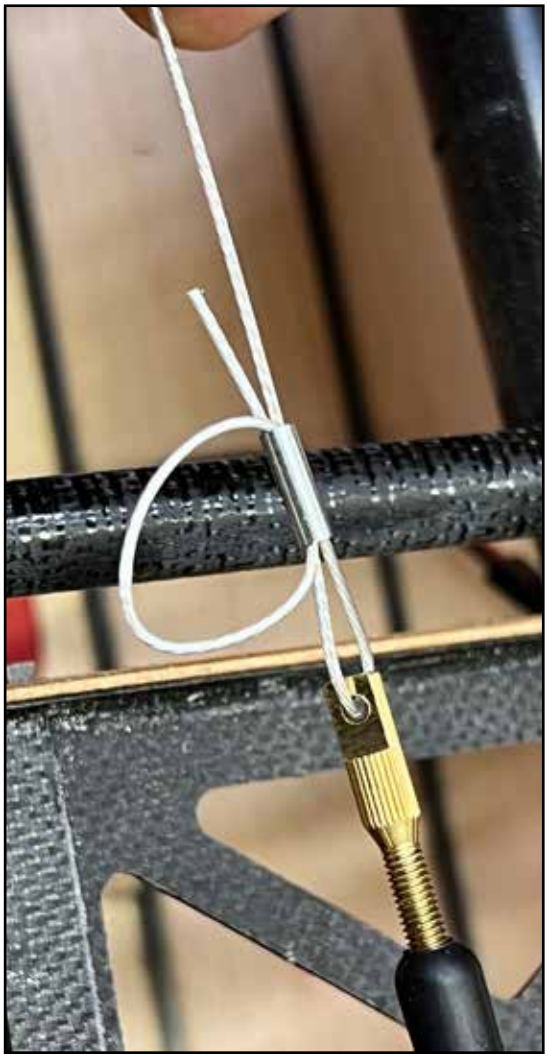
To terminate the cables at each end, you will use a ball link, a brass threaded end, and the small metal crimp tube. Thread the ball link onto the brass threaded end, and attach to the servo arm and control horn with screws, washers, locking nuts and cone spacers as applicable.

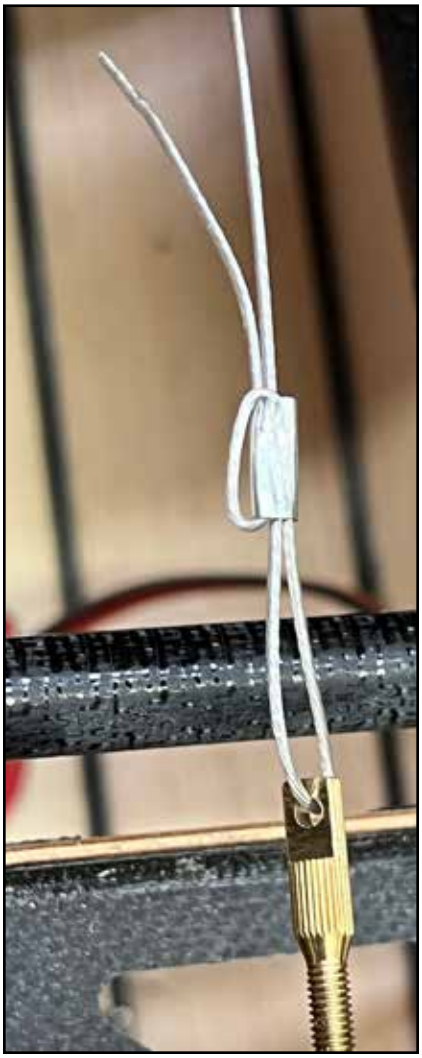
To attach the cables, lace them through the crimp tube and brass end in the pattern shown. Pull the cable snug (not banjo-string tight) and crimp the tube with pliers to lock the cable in place, and drip one small drop of thin CA into the crimp tube.

To adjust the tightness/slackness of the cables, rotate the brass threaded into or out of the ball links. Check the tightness of your cables periodically. We want no sag and no looseness, so the rudder is held firm, but extra tightness beyond this only causes wear and robs servo torque.



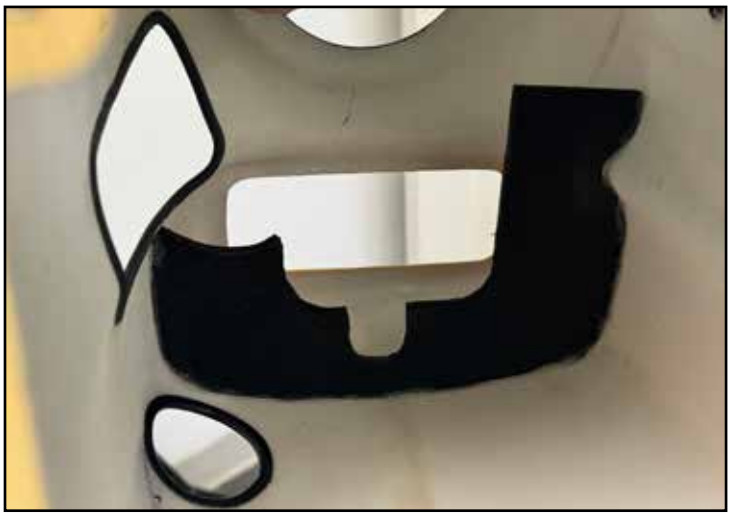


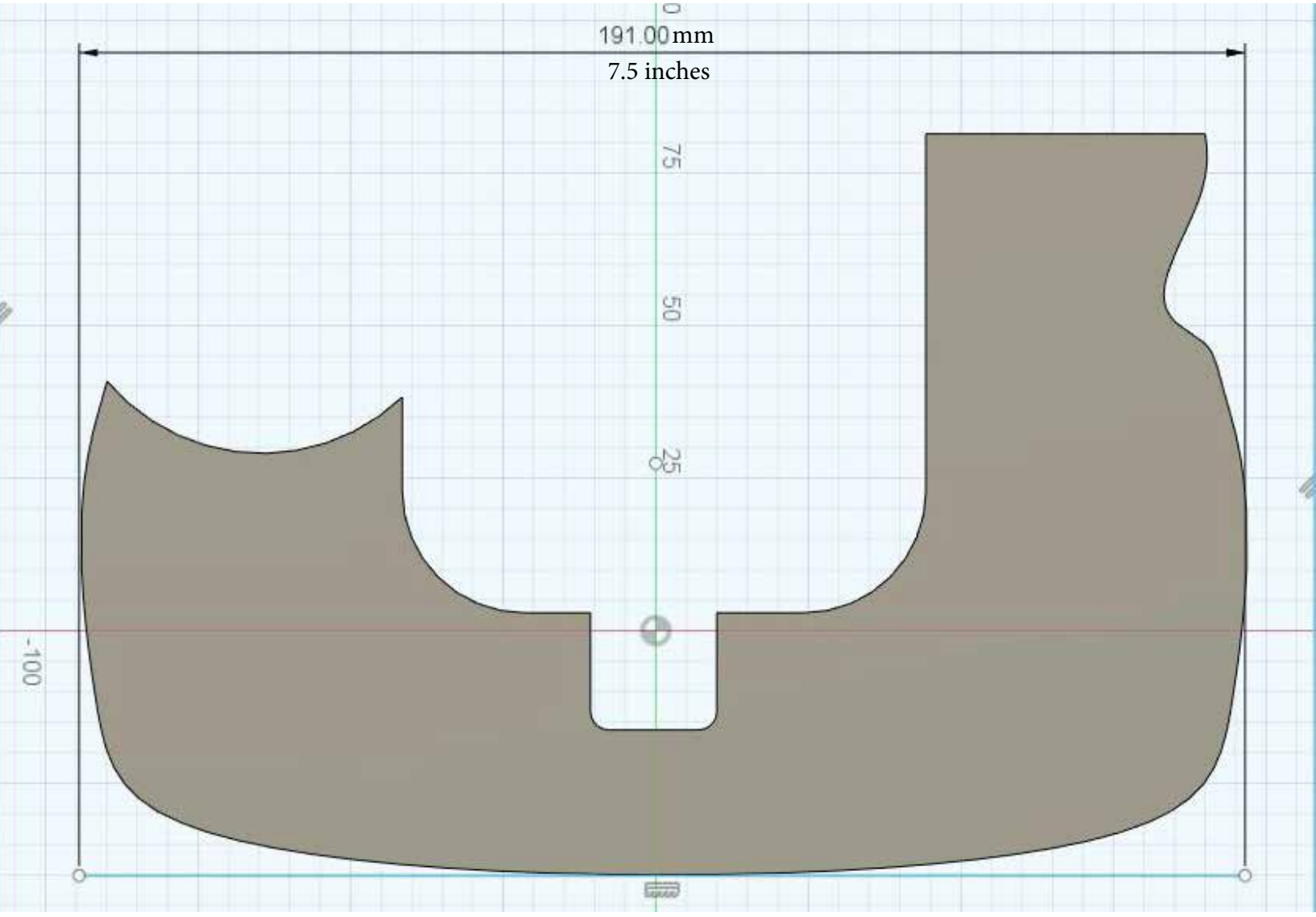




18.

For the best operating temp in warm weather, it is helpful to add a cooling baffle to gas installations. The purpose of a baffle is to make sure that 100% of the air which enters the cowl passes close enough to the cylinder head and its cooling fins to have an effect. The exact shape of the baffle will vary with engine choice. Here we have included some photos and a printable template for the baffle which fits the GP-61 engine. Our preferred material for this baffle is .25"/6mm thick Craft/EVA foam. We glue the baffle in place as shown using medium or thick CA glue.





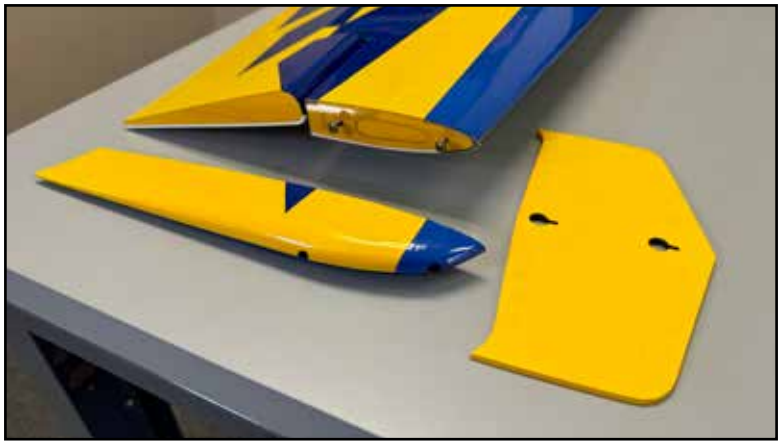
19.

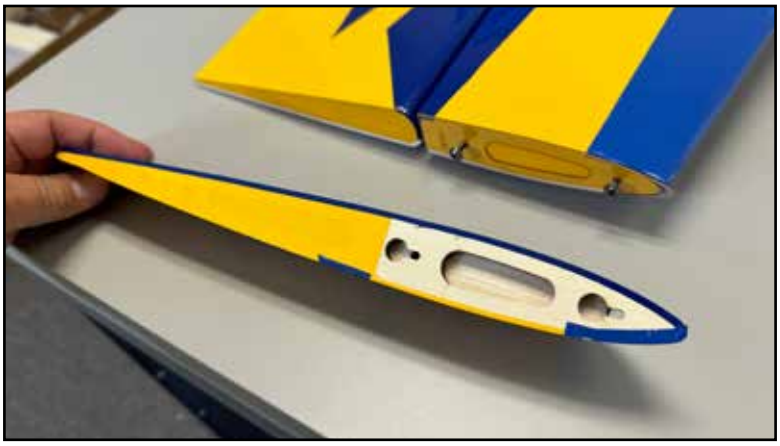
These photos show typical equipment installations for gas and electric installations. This gas installation with GP-61 uses the rear push-pull rudder location and with the Rx battery pack forward by the fuel tank, is slightly nose-heavy and perfect for a maiden flight.

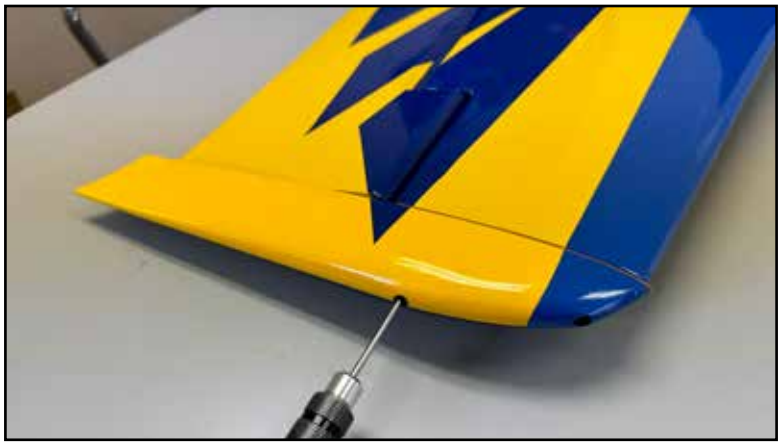
This electric setup is shown with pull-pull rudder, and shows where the 12S 5000mah lipo packs ended up for an aerobatic CG location. If you use the rear-mounted rudder servo location, expect your packs to end up slightly farther forward.

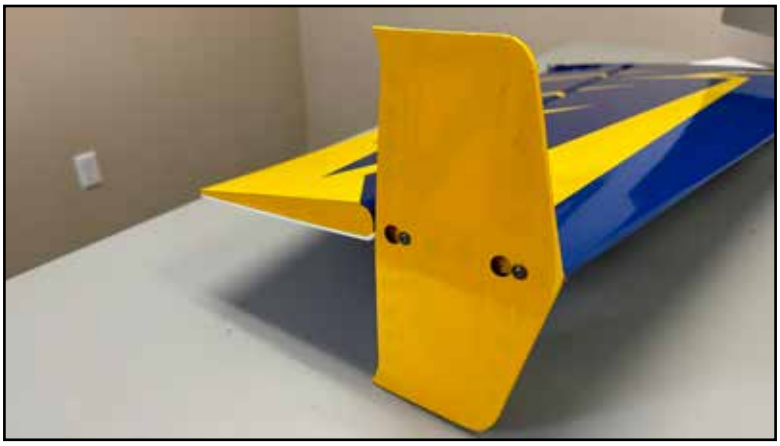
20.

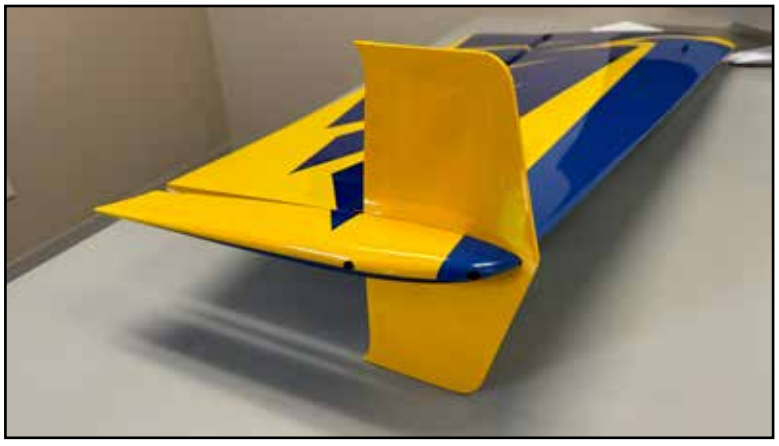
The Raven has multiple options for wingtip devices. There is a clear plastic spacer which is used with any wingtip device to keep it from rubbing the aileron. You can install the SFG plate, or the extension wingtip, or both (or none), using the included bolts. Try each of these configurations, they all feel different.











21.

Our preferred Center of Gravity for a maiden flight is the rear edge of the wing tube. After your maiden you can move the CG back according to your liking.

Control setup:
Elevator: Low Rate 8-10 deg. 15-20% expo
3D Rate 45-50 deg. 60-65% expo
XA/Tumbling rate 55 deg. 65-70% expo

Aileron: Low Rate 15-20 deg. 40-45% expo
High Rate 38 deg. up, 37 deg. down 70-75% expo

Rudder: Low Rate 20 deg 40-45% expo
High Rate 45-50 deg. 70-80% expo

These exponential values are high, to soften response for early flights. If you have a typical expo value you like to run on other aircraft, apply it.