

# RAZOR 3D™

## INSTRUCTION MANUAL



### WARRANTY

Tower Hobbies® guarantees this kit to be free from defects in both material and workmanship at the date of purchase. This warranty does not cover any component parts damaged by use or modification. In no case shall Tower Hobbies' liability exceed the original cost of the purchased kit. Further, Tower Hobbies reserves the right to change or modify this warranty without notice.

In that Tower Hobbies has no control over the final assembly or material used for final assembly, no liability shall be assumed nor accepted for any damage resulting from the use by the user of the final user-assembled product. By the act of using the user-assembled product, the user accepts all resulting liability.

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 unused condition to the place of purchase.

To make a warranty claim send the defective part or item to Hobby Services at the address below:

Hobby Services • 3002 N. Apollo Dr. Suite 1 • Champaign IL 61822 • USA

Include a letter stating your name, return shipping address, as much contact information as possible (daytime telephone number, fax number, e-mail address), a detailed description of the problem and a photocopy of the purchase receipt. Upon receipt of the package the problem will be evaluated as quickly as possible.

**LENGTH** ◀  
54.5 in [1385mm]

**WINGSPAN** ◀  
52 in [1320mm]

**WING LOADING** ◀  
20 – 22 oz/sq ft [61 – 67 g/dm<sup>2</sup>]

**WING AREA** ◀  
579 sq in [37.3 dm<sup>2</sup>]

**RADIO** ◀  
4-channel minimum with 4-5 servos  
and standard size receiver

**WEIGHT** ◀  
5 – 5.5 lb [2270 – 2490 g]

**ENGINE / MOTOR** ◀  
.46 – .55 cu in [7.5 – 9cc] two-stroke engine,  
.70 – .81 cu in [11.5 – 13.5cc] four-stroke engine,  
RimFire .55 (42-60-480) brushless out-runner motor

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

### TOWER HOBBIES

Champaign, Illinois  
(217) 398-8970 ext. 5

Entire Contents  
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TOWA2055MNL V1.0

TOWER HOBBIES®

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## INTRODUCTION

Congratulations on your purchase of the Tower Hobbies Razor 3D ARF! The Razor is a great flying model that is an ideal sport plane for the casual flier or a capable 3D performer. Both glow and electric provisions are provided with the kit. Radio equipment and battery packs are easily accessible beneath the canopy hatch that can be removed quickly without tools.

### AMA

We urge you to join the AMA (Academy of Model Aeronautics) and a local R/C club. The AMA is the governing body of model aviation and membership is required to fly at AMA clubs. Though joining the AMA provides many benefits, one of the primary reasons to join is liability protection. Coverage is not limited to flying at contests or on the club field. It even applies to flying at public demonstrations and air shows. Failure to comply with the Safety Code (excerpts printed in the back of the manual) may endanger insurance coverage. Additionally, training programs and instructors are available at AMA club sites to help you get started the right way. There are over 2,500 AMA chartered clubs across the country. Contact the AMA at the address or toll-free phone number below:

### Academy of Model Aeronautics



5151 East Memorial Drive  
Muncie, IN 47302-9252  
Tele. (800) 435-9262  
Fax (765) 741-0057

Or via the Internet at: <http://www.modelaircraft.org>

**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.

### PROTECT YOUR MODEL, YOURSELF & OTHERS.... FOLLOW THESE IMPORTANT SAFETY PRECAUTIONS —

1. Your Razor 3D ARF 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, the Razor, if not assembled and operated correctly, could possibly cause injury to yourself or spectators and damage to property.

2. You must assemble the model **according to the instructions**. Do not alter or modify the model, as doing so may result in an unsafe or unflyable model. In a few cases the instructions may differ slightly from the photos. In those instances the written instructions should be considered as correct.

3. You must take time to **build straight, true and strong**.

4. You must use an R/C radio system that is in first-class condition, and a correctly sized engine and components (fuel tank, wheels, etc.) throughout the building process.



5. You must correctly install all R/C and other components so that the model operates correctly on the ground and in the air.

6. 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.

7. 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.

8. While this kit has been flight tested to exceed normal use, if the plane will be used for extremely high stress flying, such as racing, or if an engine 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.

9. **WARNING:** The cowl and wheel pants included in this kit are made of fiberglass, the fibers of which may cause eye, skin and respiratory tract irritation. Never blow into a part to remove fiberglass dust, as the dust will blow back into your eyes. Always wear safety goggles, a particle mask and rubber gloves when grinding, drilling and sanding fiberglass parts. Vacuum the parts and the work area thoroughly after working with fiberglass parts.

We, as the kit manufacturer, provide you with a top quality, thoroughly tested kit and instructions, but ultimately the quality and flyability of your finished model depends on how you build it; therefore, we cannot in any way guarantee the performance of your completed model, and no representations are expressed or implied as to the performance or safety of your completed model.

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

## DECISIONS YOU MUST MAKE

This is a partial list of items required to finish the Razor 3D ARF that may require planning or decision making before starting to build. Order numbers are provided in parentheses.

### RADIO EQUIPMENT

The Razor 3D ARF requires a minimum 4-channel radio system with four 44 oz.-in. [3.2 kg-cm] minimum standard servos. If you are installing a glow engine, an additional standard servo is required for the throttle. For maximum performance, we recommend installing Tower Hobbies TS-160 digital servos for the control surfaces.

In addition, two 12" [305mm] servo extensions are required for the aileron servos and two 24" [610mm] servo extensions are required for the elevator and rudder servos. If you are using a radio system that does not support mixing functions, a Y-harness will also be required to connect the aileron servos to the receiver.

A charge jack receptacle is optional, but is useful for recharging and checking the voltage of the receiver pack without removing the canopy hatch. Recommended part numbers for the radio components are provided below:

- Tower Hobbies TS-53 Standard Servo U (TOWM4525)
- Tower Hobbies TS-160 Std Digital HT HS 2BB MG Servo U (TOWM4612)
- Hobbico® Extension 12" [152mm] Futaba® J (HCAM2100)
- Futaba® Dual Servo Extension 6" J (FUTM4130)
- Hobbico Servo Extension 24" Futaba J (HCAM2200)
- Ernst Charge Receptacle Futaba J FM (ERNM3001)

The recommended receiver pack is:

- Hobbico HydriMax™ 4-Cell 4.8V 2000mAh NiMH Flat AA Rx U (HCAM6321)

### POWER SYSTEM RECOMMENDATIONS

The recommended engine/motor size for the Razor 3D ARF is a .46-.55 cu in [7.5-9cc] two-stroke engine, .70-.81 cu in [11.5-13.5cc] four-stroke engine, or a RimFire .55 (42-60-480) brushless outrunner motor. Recommended engine and motor order numbers are provided below:

- O.S.® 55AX ABL w/Muffler (OSMG0556)
- O.S. 81FS-a (OSMG0981)
- Great Planes® RimFire™ .55 (42-60-480) Out-Runner Brushless (GPMG4715)
- Great Planes Brushless Motor Mount Medium Motors (GPMG1255)

If using the recommended brushless motor, a 60A brushless ESC is required:

- Great Planes Silver Series 60A Brushless ESC High Volt (GPMM1850)

### PROPELLER

If you are installing a glow engine, choose a prop based on the engine manufacturer's recommendation. If you are installing the recommended RimFire brushless motor, we suggest a 14×7E APC propeller.

- APC 14×7 Electric Propeller (APCQ4145)

### BATTERIES AND CHARGER

For a brushless motor installation, two 3200mAh 11.1V Lithium Polymer battery packs connected in series are recommended. Order numbers for the battery packs and series connector are provided below:

- Great Planes LiPo 3350mAh 11.1V 25C Discharge w/Balance (GPMP0541)



- Great Planes Series Deans® U 2 to 1 Adapter (GPMM3143)

A cell balancer is required for the LiPo battery pack listed above:

- Great Planes ElectriFly® Equinox™ LiPo Cell Balancer 1-5 (GPMM3160)

A suitable charger is also required. The Great Planes PolyCharge4™ is designed for LiPo packs only, but is able to charge four LiPo packs simultaneously. The Great Planes Triton2™ charger will only charge one pack at a time, but is capable of charging NiCd, NiMH, LiPo, and Pb acid batteries. Order numbers for both are provided below:

- Great Planes PolyCharge4 DC Only 4 Output LiPo Charger (GPMM3015)

**OR**

- Great Planes ElectriFly Triton2 DC Comp Peak Charger (GPMM3153)

## ADDITIONAL ITEMS REQUIRED

### REQUIRED HARDWARE AND ACCESSORIES

This is the list of hardware and accessories required to finish the Razor 3D ARF. Order numbers are provided in parentheses:

- R/C foam rubber (1/4" [6mm] - HCAQ1000, or 1/2" [13mm] - HCAQ1050)
- 3' [900mm] standard silicone fuel tubing (GPMQ4131) (Glow engine installation only)
- Great Planes Velcro Hook & Loop 1x6" (2) (GPMQ4480) (Brushless installation only)

### ADHESIVES AND BUILDING SUPPLIES

This is the list of Adhesives and Building Supplies that are required to finish the Razor 3D ARF:

- Tower Hobbies Build-It™ CA Thin Glue 2 oz. (TOWR3800)
- Tower Hobbies 30-Minute Epoxy 4 oz. (TOWR3811)
- Threadlocker thread locking cement (GPMR6060)
- Dead Center™ Engine Mount Hole Locator (GPMR8130)
- Denatured alcohol (for epoxy clean up)
- Drill bits: 1/16" [1.6mm], 5/64" [2mm], 3/32" [2.4mm], 1/8" [3.2mm]
- Great Planes Tap & Drill Set 6-32 (GPMR8102) (Glow engine installation only)
- Tap handle (GPMR8120) (Glow engine installation only)
- Small metal file
- #1 Blade Handle w/#11 Blade & Cap (TOWR1010)
- #11 Blades (5) (TOWR1015)
- Medium T-pins (100, HCAR5150)
- Tower Hobbies Custom Sealing Iron (TOWR3250)
- Top Flite Hot Sock™ iron cover (TOPR2175)

- 220 grit sandpaper
- Panel Line Pen (TOPQ2510)

### OPTIONAL SUPPLIES AND TOOLS

Here is a list of optional tools that will help you build the Razor 3D ARF:

- Build-It CA+ Medium Glue 2 oz. (TOWR3801)
- Build-It CA- Thick Glue 2 oz. (TOWR3802)
- 2 oz. [57g] spray CA activator (GPMR6035)
- Build-It Activator 2 oz. w/Pump (TOWR3804)
- CA applicator tips (HCAR3780)
- Build-It Debonder 2 oz. (TOWR3803)
- 6-Minute Epoxy 4 oz. (TOWR3807)
- Epoxy brushes 6, (GPMR8060)
- Mixing sticks (GPMR8055)
- Mixing cups (GPMR8056)
- Pliers with wire cutter (HCAR0630)
- Great Planes Aluminum Fuel Line Plugs (2) (GPMQ4166)
- Rotary tool such as Dremel®
- Rotary tool reinforced cut-off wheel (GPMR8020)
- Servo horn drill (HCAR0698)
- Hobby Heat™ micro torch II (HCAR0755)
- Precision Magnetic Prop Balancer (TOPQ5700)
- AccuThrow™ Deflection Gauge (GPMR2405)
- CG Machine™ (GPMR2400)
- Hobbico Flexible 18" Ruler Stainless Steel (HCAR0460)
- Top Flite MonoKote® trim seal iron (TOPR2200)
- Tower Hobbies Deluxe Heat Gun (TOWR3200)
- Hobbico Pin Vise 1/16 Collet w/6 Bits (HCAR0696)
- Hobbico 8-Piece Ball Tip Hex L Wrench SAE (HCAR0520)
- Great Planes Clevis Installation Tool (GPMR8030)

### BUILDING STAND



A building stand or cradle comes in handy during the build. We use the Robart Super Stand II (ROBP1402) for all our projects in R&D, and it can be seen in pictures throughout this manual.



## IMPORTANT BUILDING NOTES

- When you see the term *test fit* in the instructions, it means that you should first position the part on the assembly **without using any glue**, then slightly modify or *custom fit* the part as necessary for the best fit.
- Whenever the term *glue* is written you should rely upon your experience to decide what type of glue to use. When a specific type of adhesive works best for that step, the instructions will make a recommendation.
- Whenever just *epoxy* is specified you may use *either* 30-minute (or 45-minute) epoxy *or* 6-minute epoxy. When 30-minute epoxy is specified it is **highly** recommended that you use only 30-minute (or 45-minute) epoxy, because you will need the working time and/or the additional strength.
- **Photos and sketches** are placed **before** the step they refer to. Frequently you can study photos in following steps to get another view of the same parts.
- The stabilizer and wing incidences and engine thrust angles have been factory-built into this model. However, some technically-minded modelers may wish to check these

measurements anyway. To view this information visit the web site at [www.greatplanes.com](http://www.greatplanes.com) and click on "Technical Data." Due to manufacturing tolerances which will have little or no effect on the way your model will fly, please expect slight deviations between your model and the published values.

## KIT INSPECTION

Before starting to build, take an inventory of this kit to make sure it is complete, and inspect the parts to make sure they are of acceptable quality. If any parts are missing or are not of acceptable quality, or if you need assistance with assembly, contact **Product Support**. When reporting defective or missing parts, use the part names exactly as they are written in the Kit Contents list.

### Tower Hobbies Product Support

3002 N Apollo Drive, Suite 1

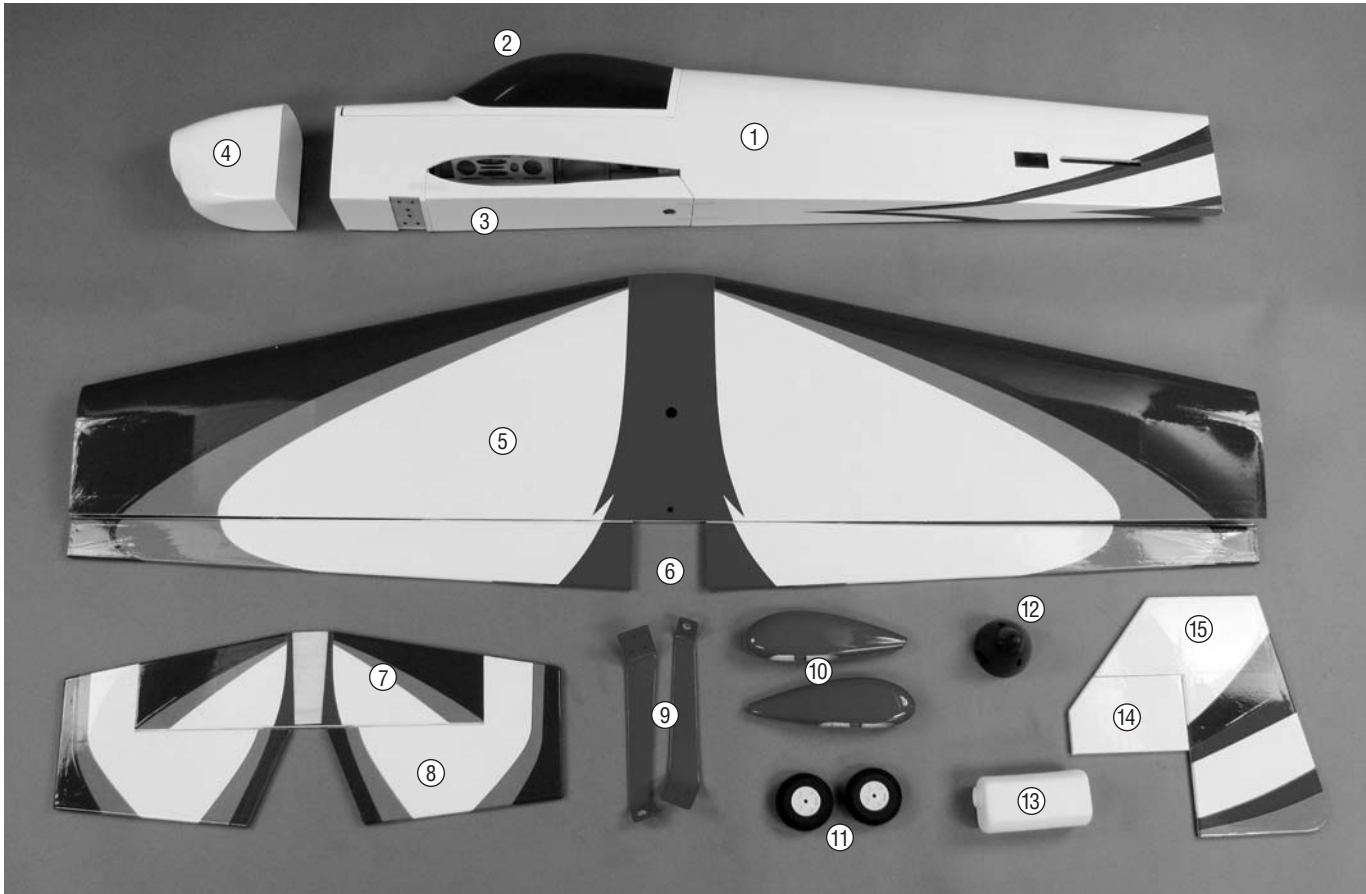
Champaign, IL 61822

Telephone: (217) 398-8970, ext. 5

Fax: (217) 398-7721

E-mail: [productsupport@towerhobbies.com](mailto:productsupport@towerhobbies.com)

## KIT CONTENTS



- |                 |                          |                  |
|-----------------|--------------------------|------------------|
| 1. Fuselage     | 6. Ailerons              | 11. Wheels       |
| 2. Canopy Hatch | 7. Horizontal Stabilizer | 12. Spinner      |
| 3. Belly Pan    | 8. Elevator Halves       | 13. Fuel Tank    |
| 4. Cowl         | 9. Main Landing Gear     | 14. Vertical Fin |
| 5. Wing         | 10. Wheel Pants          | 15. Rudder       |





## ORDERING REPLACEMENT PARTS

Replacement parts for the Razor 3D ARF are available from Tower Hobbies or Hobby Services using the order numbers in the **Replacement Parts List** that follows. Contact Tower at [www.towerhobbies.com](http://www.towerhobbies.com), or call toll free (800) 637-6050. Contact Hobby Services by calling (217) 398-0007, or via facsimile at (217) 398-7721. If ordering via fax, include a Visa® or MasterCard® number and expiration date for payment.

Mail parts orders and payments by personal check to:

### Hobby Services

3002 N Apollo Drive, Suite 1  
Champaign IL 61822

Be certain to specify the order number exactly as listed in the **Replacement Parts List**. Payment by credit card or personal check only; no C.O.D.

If additional assistance is required for any reason contact Product Support by e-mail at [productsupport@towerhobbies.com](mailto:productsupport@towerhobbies.com), or by telephone at (217) 398-8970.

## REPLACEMENT PARTS LIST

REPLACEMENT PARTS LIST	
Order No.	Description
TOWA6040	Fuse Set Tower Razor 3D ARF
TOWA6041	Wing Tower Razor 3D ARF
TOWA6042	Tail Set Tower Razor 3D ARF
TOWA6043	Canopy Tower Razor 3D ARF
TOWA6044	Landing Gear Tower Razor 3D ARF
TOWA6045	Wheel Pants Tower Razor 3D ARF
TOWA6046	Cowl Tower Razor 3D ARF
TOWA6047	Decal Set Tower Razor 3D ARF

## BUILDING INSTRUCTIONS

### PREPARATIONS

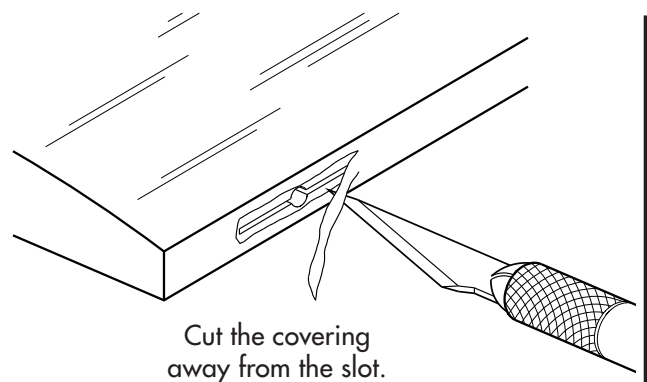
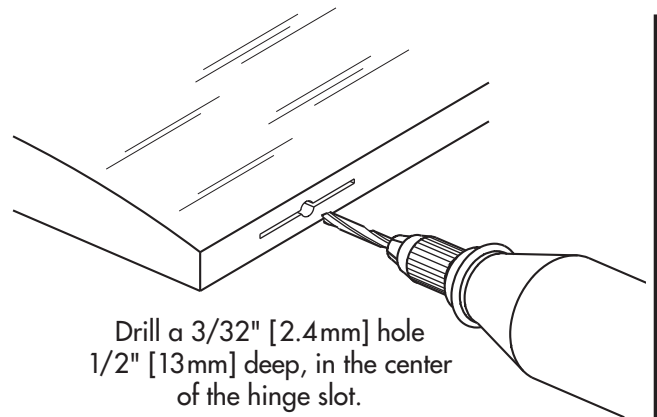
❑ 1. If you have not done so already, remove the major parts of the kit from the box and inspect for damage. If any parts are damaged or missing, contact Product Support at the address or telephone number listed in the “Kit Inspection” section on page 5.



❑ 2. Carefully remove the tape and separate all the control surfaces. Use a covering iron with a covering sock on high heat to tighten the covering if necessary. Apply pressure over sheeted areas to **thoroughly** bond the covering to the wood.

## BUILD THE WING

### INSTALL THE AILERONS

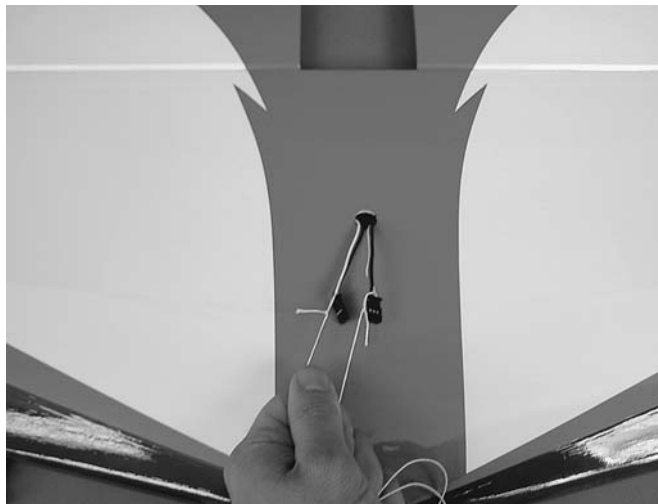


❑ 1. Drill a 3/32" [2.4mm] hole 1/2" [13mm] deep into the center of each hinge slot in the **ailerons** and **wing**. Trim the covering away from each hinge slot to ensure that the hinges will be properly glued in place.

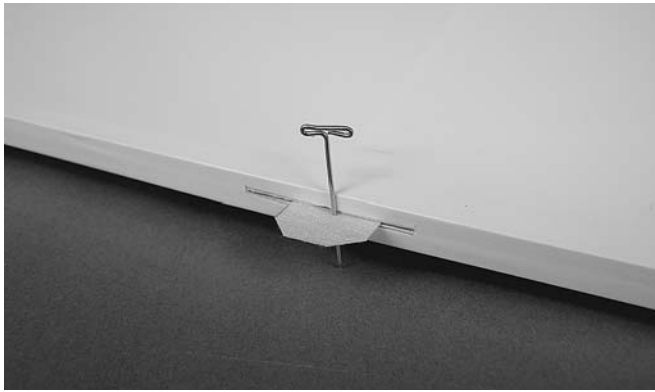
## INSTALL THE AILERON SERVOS AND PUSHRODS



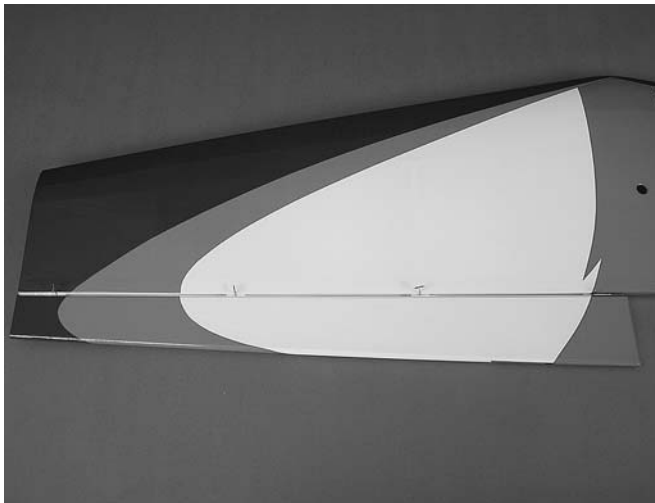
- ❑ 1. Attach a 12" [305mm] servo extension to each aileron servo. Secure the connections using tape, heat shrink tubing (not included) or special clips designed for that purpose.



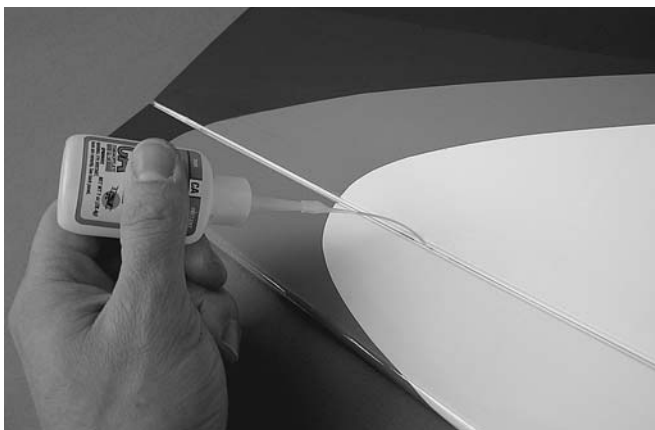
- ❑ 2. Locate the strings taped inside the aileron servo bays and tie the ends of the strings to the servo extensions. With the string ends securely tied to the extensions, use needle nose pliers to retrieve the center of the string from the servo lead exit hole in the center of the top of the wing. Use the string to pull the servo leads through the wing ribs and out the servo lead exit hole.



- ❑ 2. Test fit a CA hinge into each of the hinge slots in the wing and ailerons. If necessary, enlarge the slots with a hobby knife. When satisfied with the fit, insert a CA hinge halfway into each hinge slot in the wing panel. Push a pin through the middle of each hinge to keep them centered.

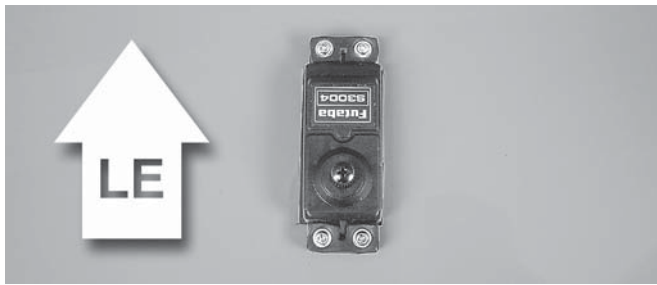


- ❑ 3. Join the ailerons to the wing and remove the pins from the hinges. Align the tips of the ailerons with the wing tips. Adjust the ailerons so there is a small gap between the LE of the ailerons and the wing. The gap should be small, just enough to see light through the gap or to slip a piece of paper through.

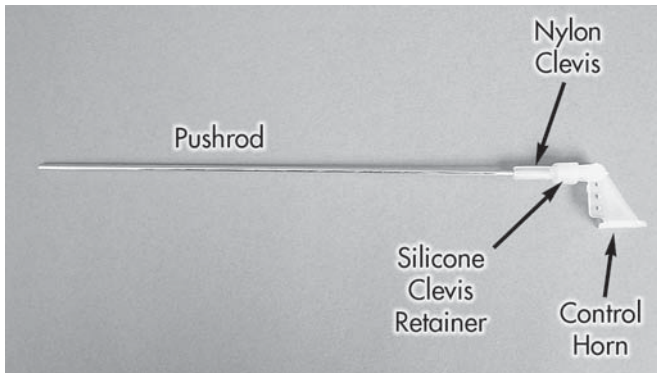


- ❑ 4. Apply six drops of thin CA to the top and bottom of each hinge without using accelerator. After the CA glue has hardened, confirm that the ailerons are secure by pulling on them and deflecting them up and down.

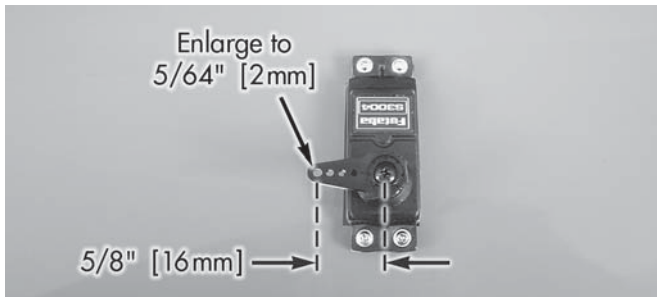
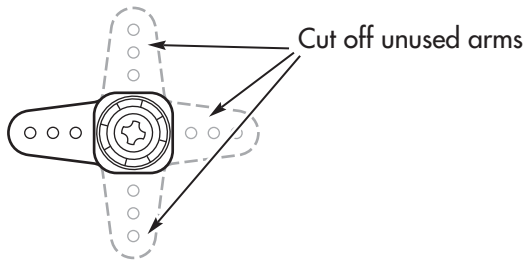




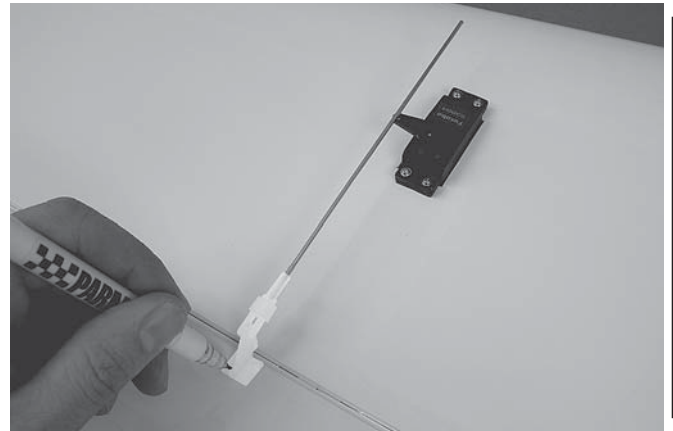
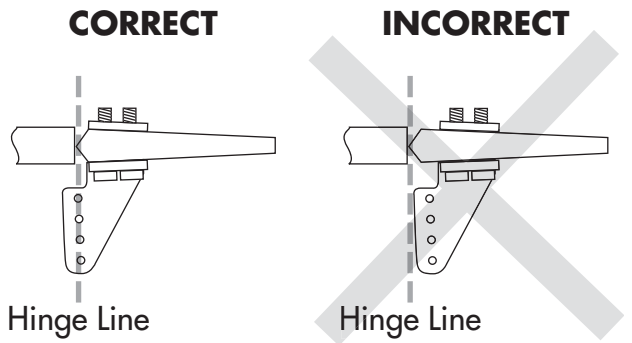
3. Position the servos in the aileron servo bays in the orientation shown. Drill 1/16" [1.6mm] holes through the servo mounting tabs. Thread a servo mounting screw (included with the servos) into each hole and back it out. Apply a drop of thin CA to each hole to harden the wood. When the glue has cured, install the servos using the hardware included in the servo hardware bags.



4. Thread a nylon clevis 20 complete turns onto each 6" [152mm] pushrod. Slide a silicone clevis retainer onto each clevis and connect the clevises to the outer holes of two control horns.



5. Cut three arms from a four-armed servo arm for the aileron servo. Enlarge the outer hole of the remaining arm with a 5/64" [2mm] drill bit. Center the servo with your radio system and install the servo arm to the servo perpendicular to the servo case as shown. Be sure to reinstall the servo arm screw into the servo.



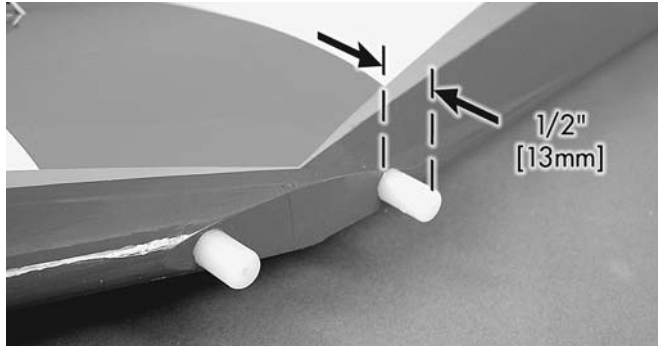
6. Position the control horns over the hardwood blocks embedded in the ailerons (if you cannot see them, hold the aileron at a shallow angle in good lighting or use a small pin to puncture the covering). Use the position of the servo arms as a guide. Align the holes in the control horns directly over the aileron hinge line and mark the location of the control horn mounting holes.



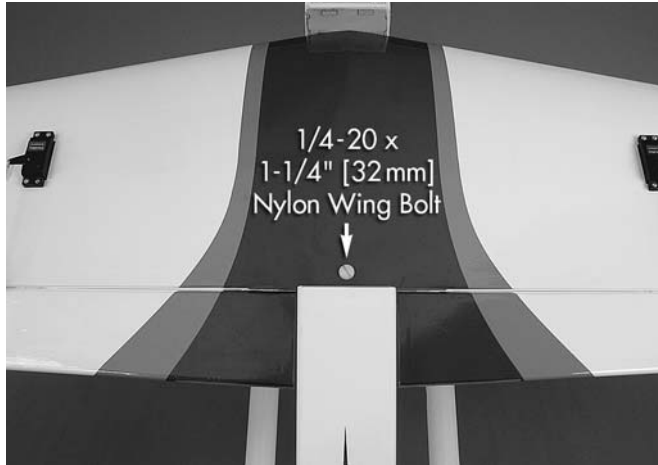
7. Drill 5/64" [2mm] holes at the marks you made through the hardwood blocks. Apply a couple drops of thin CA glue

to each hole to harden the wood surrounding the holes. When the glue has cured, install the control horns onto the ailerons using four 2-56 x 1/2" [13mm] machine screws and control horn backplates.

## FINISH THE WING



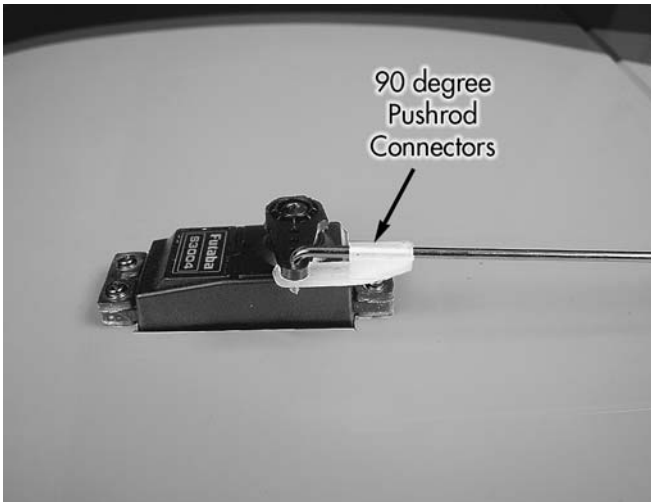
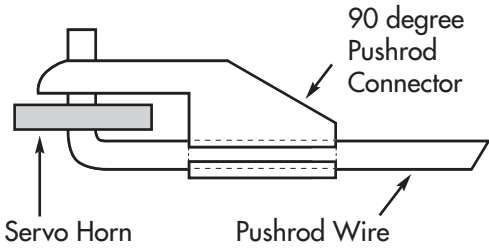
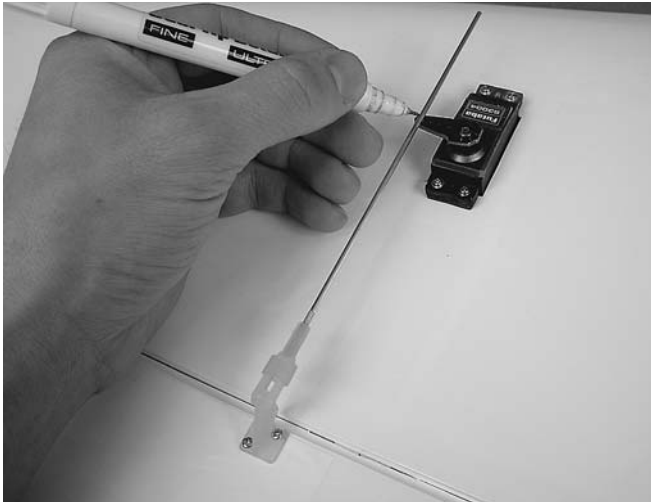
❑ 1. Use epoxy to glue the nylon **wing dowels** into the center LE of the wing. The smooth ends of the dowels should protrude from the root ribs approximately 1/2" [13mm]. Use a paper towel dampened with denatured alcohol to wipe away any excess epoxy.



❑ 2. Temporarily mount the wing onto the fuselage using the 1/4-20 x 1-1/4" [32mm] nylon wing bolt.



❑ 3. Put the **belly pan** in place onto the underside of the wing and align it with the fuselage. When satisfied with its position, tape it in place to the fuse. Use a felt-tip pen to trace along the sides of the belly pan onto the wing.



❑ 8. Use tape or a small clamp to hold the ailerons in the neutral position. Make a mark on the pushrods where they cross the outer holes in the servo arms. Make a 90 degree bend at the mark on the pushrod and cut off the excess pushrod 1/4" [6mm] beyond the bend. Attach the pushrods to the servo arms using 90 degree pushrod connectors. Thread the clevises up or down on the pushrods as necessary to center the ailerons with the servo arms centered. When satisfied, slide the silicone clevis retainers to the ends of the clevises to secure them.



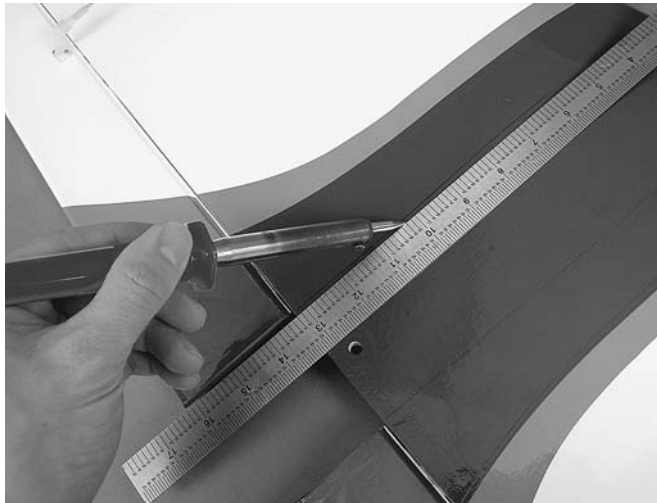


❑ 4. Remove the belly pan from the wing and the wing from the fuse. Cut away the covering 1/16" [1.6mm] inside the lines you drew, being careful to cut only the covering itself, not into the wood sheeting beneath. You can also remove the covering using the following tip.

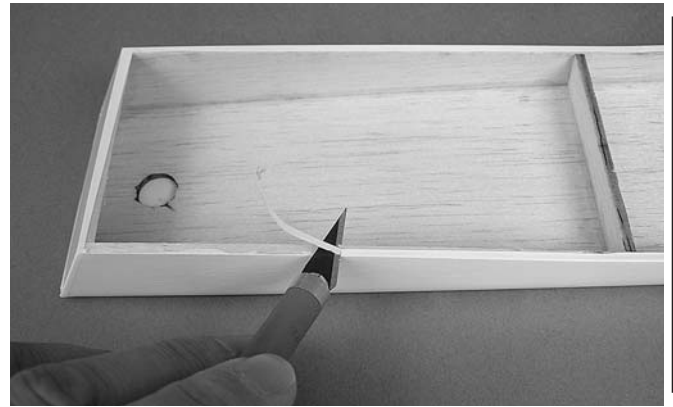
## HOT TIP

### HOW TO CUT COVERING FROM Balsa

Use a soldering iron to cut the covering from the area beneath the belly pan. The tip of the soldering iron doesn't have to be sharp, but a fine tip does work best. Allow the iron to heat fully.

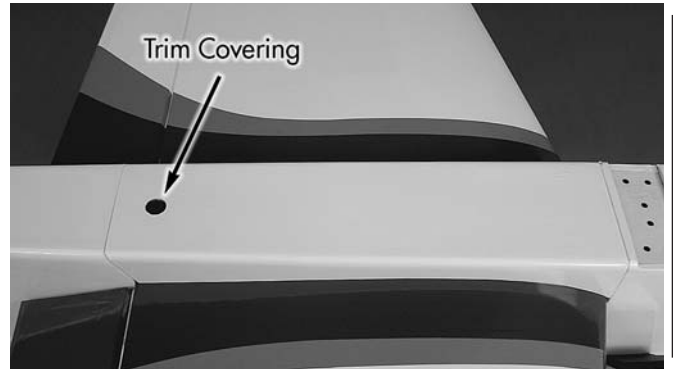


Use a straightedge to guide the soldering iron at a rate that will just melt the covering and not burn into the wood. The hotter the soldering iron, the faster it must travel to melt a fine cut. Peel off the covering.



❑ 5. Trim the covering away from the gluing edges of the belly pan.

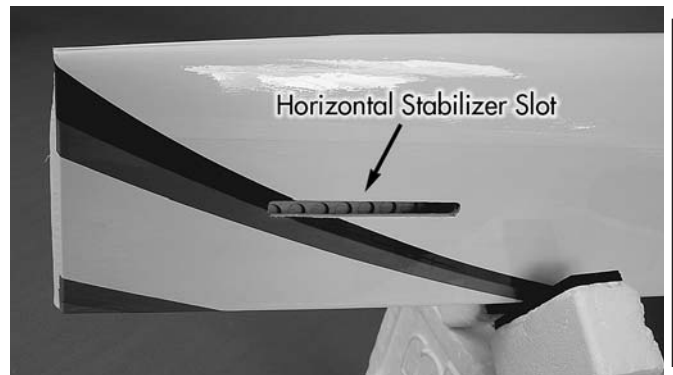
❑ 6. Reinstall the wing onto the fuse (we recommend lining the LE and TE of the wing between it and the fuse with wax paper to avoid accidentally gluing the wing to the fuse when gluing the belly pan in place.) Mix up approximately 1/4 oz [7.5 ml] of epoxy and glue the belly pan in place. Tape it or put a weight on it to prevent it from moving while the epoxy cures. A paper towel dampened with denatured alcohol can be used to wipe away any excess epoxy. Do not glue the belly pan to the fuselage!

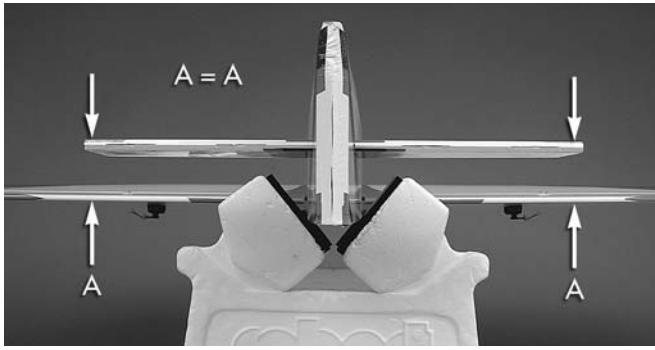


❑ 7. Trim the covering from the wing bolt hole in the belly pan.

## BUILD THE FUSELAGE

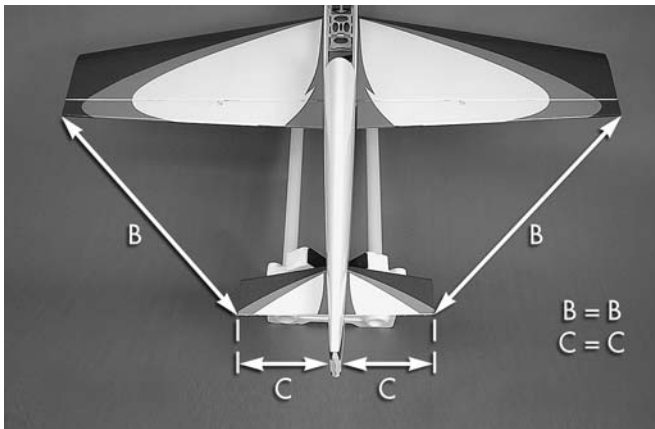
### INSTALL THE TAIL SECTION





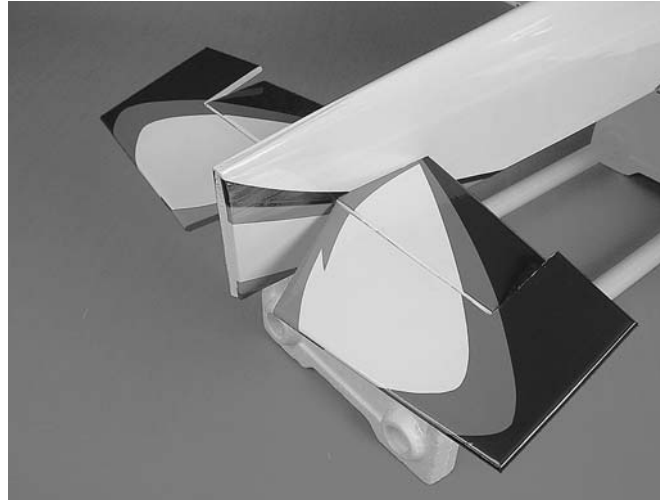
❑ 1. Temporarily install the horizontal stabilizer into the horizontal stabilizer slot. Stand back 5-6 ft [1.5 - 1.8m] and view the model from behind. Confirm that the stab and wing are parallel. If not, sand the slot as necessary until they are parallel.

*Before beginning step 2, have some paper towels, denatured alcohol, and a tape measure or length of string with some masking tape on hand and ready to use. When gluing the stab into the slot, it is recommended to coat both the stab itself and the slot with epoxy. Doing so will require additional cleaning of excess epoxy from one side of the stab. However, a better glue joint is achieved when both mating sides have epoxy applied to them. We also suggest dry fitting the stab with the elevator joiner in place to confirm that the joiner wire rotates smoothly.*

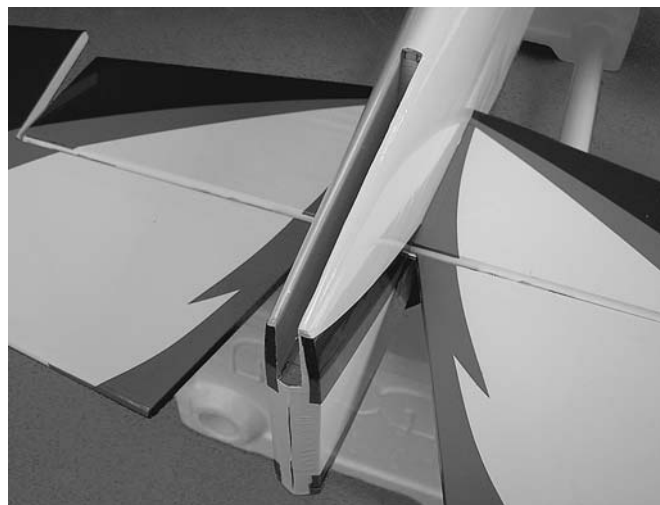


❑ 2. Insert the **elevator joiner wire** into the aft end of the stab slot. Coat the exposed wood on the top and bottom of the stab with 30-minute epoxy as well as the mating edges of the stab slot. Insert the stab into the slot and center it left and right.

Measure from the wing tips to the stab tips and make those distances equal. Wipe away excess epoxy with paper towels dampened with denatured alcohol. Confirm that the stab and wing are still parallel. A weight can be added to one side of the stab to make any small corrections. Allow the epoxy to cure undisturbed. The wing can now be removed from the fuselage and set aside.



❑ 3. Test fit the elevator halves onto the stab with CA hinges. The elevator joiner wire ends fit into the pre-drilled holes and slots at the LE of the elevators. Make any adjustments to the slots as necessary for a good fit. When satisfied, roughen the ends of the elevator joiner wire with sandpaper and clean them with denatured alcohol. Mix up a small amount of epoxy and coat the ends of the joiner wire. Install the elevator halves onto the stab with CA hinges as you did the ailerons, being sure that there are even gaps between the stab tips and elevators on each side. Wipe away any excess epoxy with denatured alcohol. The CA hinges will hold the elevators in place while the epoxy on the joiner wire cures.

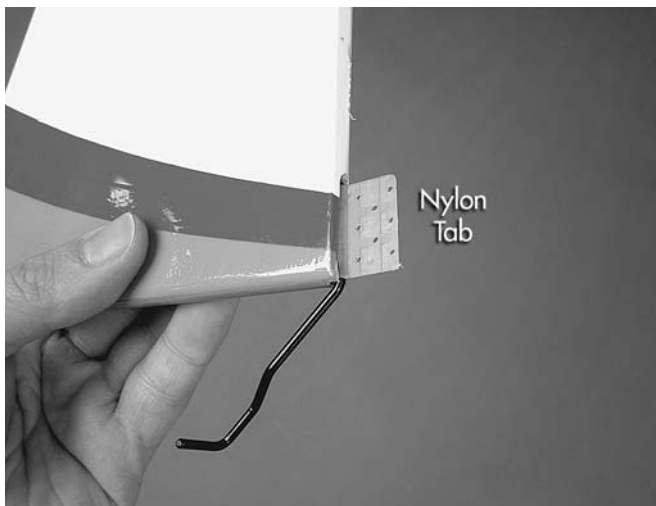


❑ 4. The balsa supporting block at the aft end of the vertical fin slot must be cut away. A razor saw works well for this, but a hobby knife will also suffice.





5. Glue the vertical fin into the slot using thin CA.

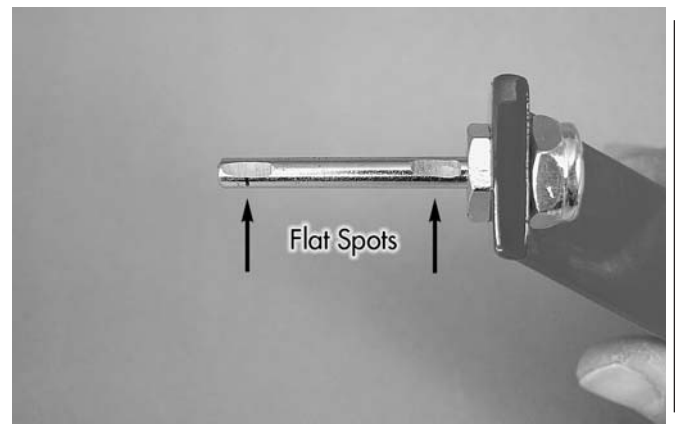


6. Test fit the tail wheel assembly into the slot at the LE of the **rudder**. Confirm that the wire fully seats into the pre-drilled hole in the rudder. Test fit the rudder onto the fuselage. When satisfied with the fit, remove the tail wheel assembly and roughen the end that fits into the rudder with sandpaper and clean it with alcohol. Coat that part of the wire as well as the nylon tab with epoxy and attach the rudder with CA hinges. Take care not to epoxy the nylon tab to the tail wheel wire, preventing it from rotating. Some oil or petroleum jelly will help prevent this.

ASSEMBLE AND INSTALL THE LANDING GEAR

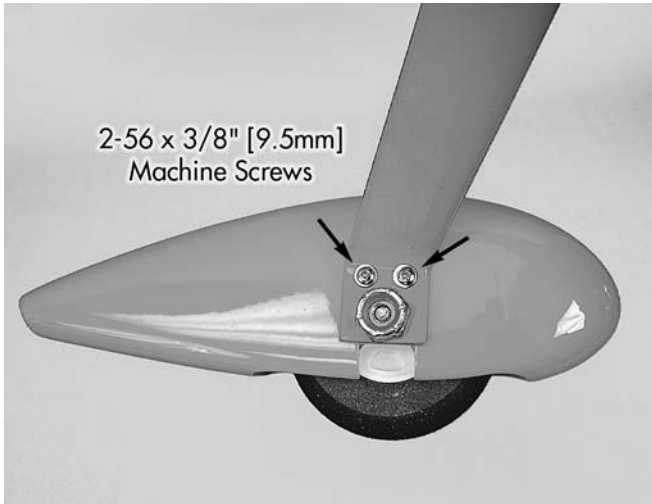


1. Secure the axles to the landing gear legs using the 5/16"-24 nylon lock nuts.

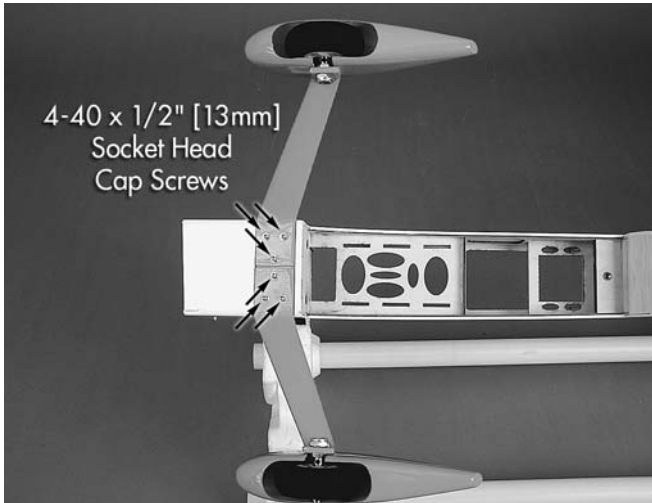


2. Slide a 5/32" [4mm] wheel collar onto each axle followed by a 2-1/2" [64mm] wheel and then another 5/32" [4mm] wheel collar. Mark the location of the threaded holes in the wheel collars onto the axles. Use a file or rotary tool such as a Dremel to grind flat spots at the marks on the axles.

3. Reinstall the wheel collars and wheels onto the axles. Thread a 6-32 set screw into each wheel collar and tighten the screws against the flat spots on the axles with thread locking compound. Be sure that the wheel rotates freely on the axle if necessary.



- ❑ 4. Attach the wheel pants to the landing gear legs using four 2-56 x 3/8" [9.5mm] machine screws, four #2 flat washers, four #2 lock washers, and thread locking compound.



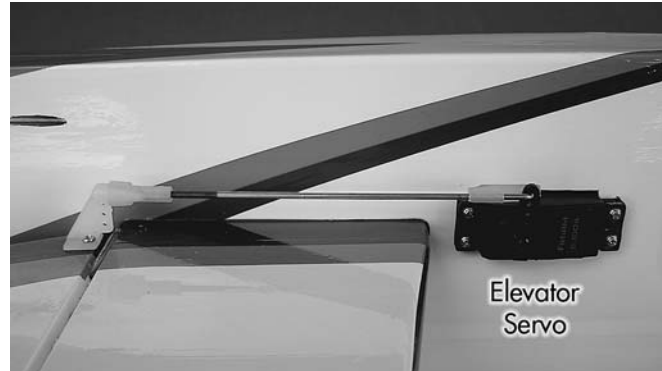
- ❑ 5. Attach the landing gear legs to the fuselage using six 4-40 x 1/2" [13mm] socket head cap screws, six #4 flat washers, six #4 lock washers, and thread locking compound.



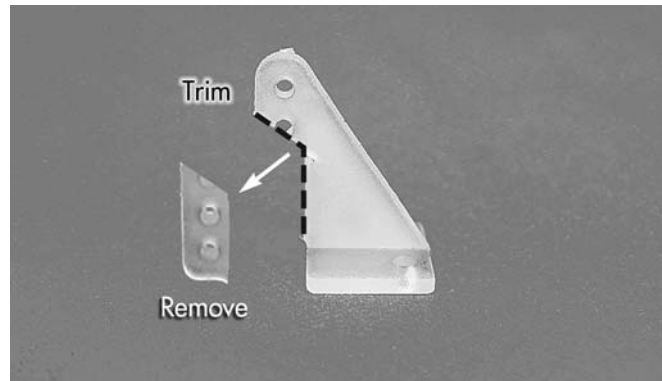
- ❑ 6. Secure the tail wheel to the tail wheel assembly with a 3/32" [2.4mm] wheel collar, 4-40 set screw and thread locking compound. Be sure that the tail wheel rotates freely on the axle. Oil the axle if necessary.

## INSTALL THE TAIL SERVOS AND PUSHRODS

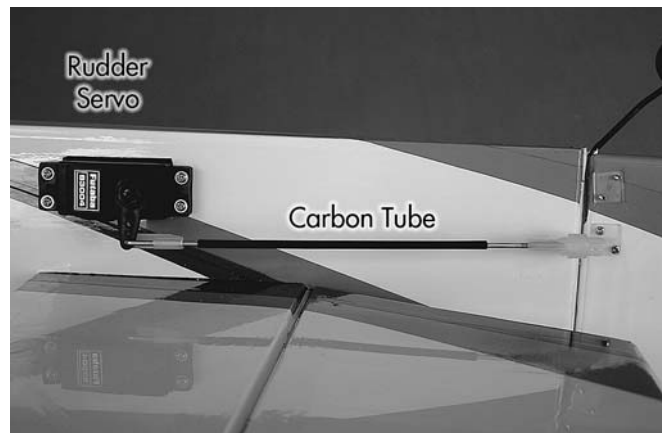
- ❑ 1. Attach a 24" [610mm] servo extension to the rudder and elevator servos.



- ❑ 2. The installation of the elevator servo and pushrod is the same as it was for the ailerons. Make the elevator pushrod from a 12" [305mm] pushrod wire. Be sure to harden the servo mounting screw holes with thin CA.



- ❑ 3. Trim the rudder control horn as shown before installing it onto the rudder.



- ❑ 4. Before making the 90 degree bend in the rudder pushrod, epoxy the included 4" [102mm] carbon tube onto the pushrod as shown. Be sure to leave enough room for the 90 degree pushrod connector to connect to the pushrod wire. The carbon tube will prevent the pushrod from flexing during flight.



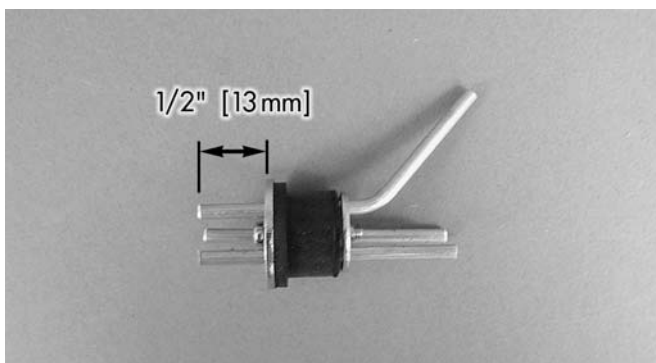
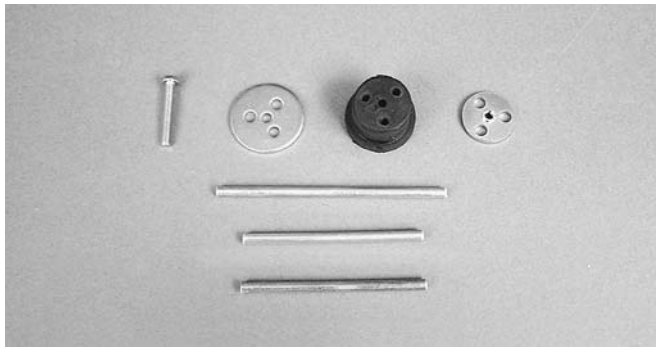
## GLOW ENGINE INSTALLATION

The Razor 3D ARF is designed to be flown with a .46-.55 two-stroke glow engine, .70-.81 four-stroke glow engine, or a brushless out-runner motor. If you plan to install a brushless motor, skip this section as it only contains information relevant to installing a glow engine.

A 2-stroke engine is shown in this section. The installation of a 4-stroke engine will require a similar procedure.

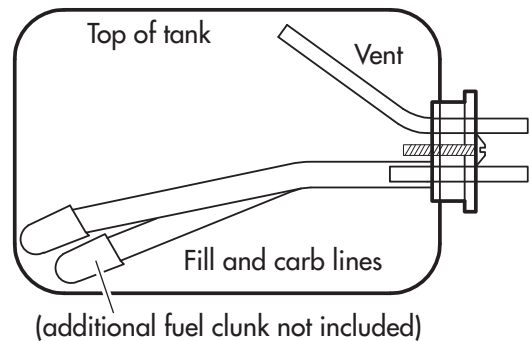


- ❑ 1. Seal up the electric cooling hole cutout with thick CA or epoxy.

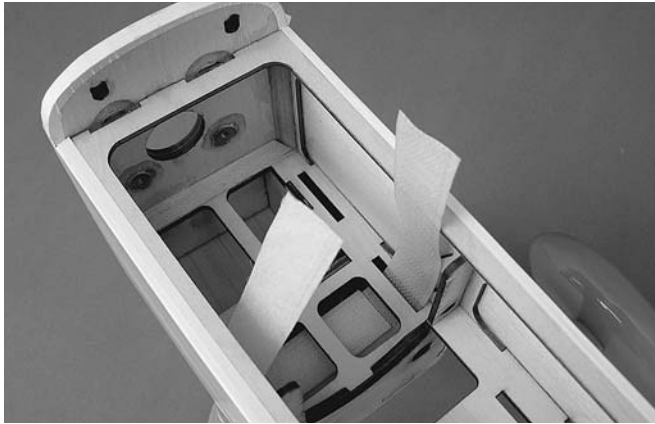
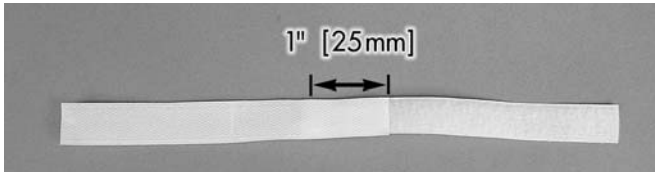


- ❑ 2. The fuel tank can be assembled as a two line system consisting of a vent (pressure) line to the muffler and a carb line.

Filling and emptying of the tank would need to be done through the carb line, or an optional fuel fill valve (not included). The tank can also be assembled as a three line system (additional fuel clunk not included) having a vent line, carb line, and fill line. If installing a fill line, puncture the top of the stopper above the sealed off fuel tube hole (the photos show the installation of a fill line). The fill and carb lines should extend out 1/2" [13mm] beyond the stopper and the vent line should be bent upwards and left uncut. With the tubes installed in the stopper, fit the stopper plates loosely in place with the 3 x 25mm phillips screw to hold the assembly together.



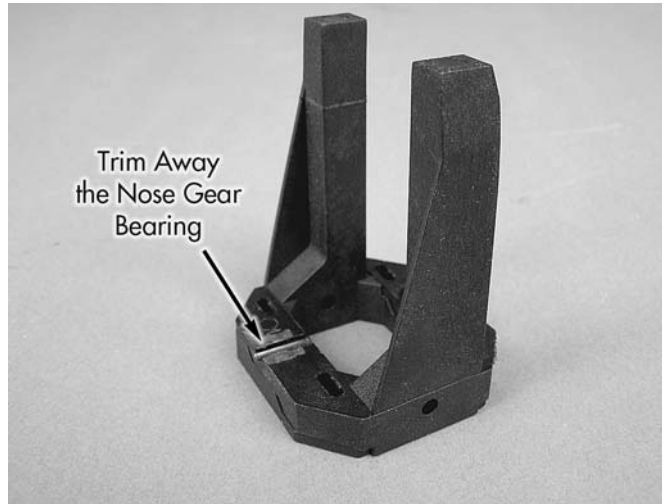
- ❑ 3. Fit the stopper assembly into the tank with the vent line pointing toward the top of the tank, but not touching. The fuel tubing and clunk (fuel pickup) on the carb line should almost reach the back of the tank but not touch. The clunk(s) must be able to move freely inside the tank when assembled. Adjust the length of the fuel tubing accordingly. When satisfied, tighten the 3x25mm screw in the stopper to secure it in place (do not over-tighten). Mark the side of the tank that must face up when installed in the plane, and we also suggest marking the tubes in the stopper.



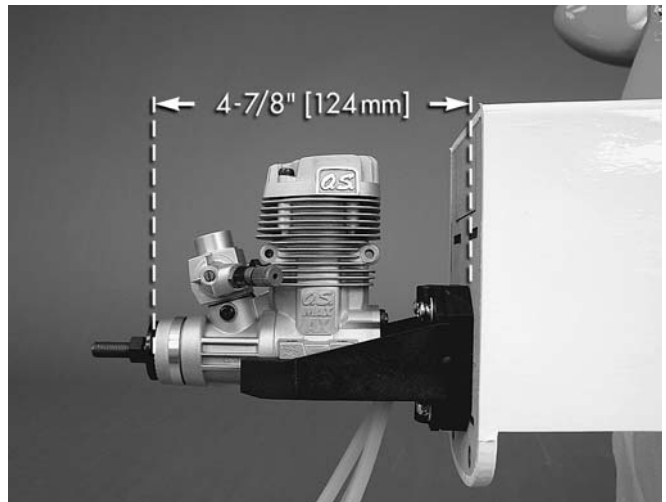
❑ 4. Make a 10" [254mm] long strap from the included hook and loop material by overlapping the mating ends by approximately 1" [25mm]. Insert the strap through the slots in the fuel tank tray. Cut a piece of 1/4" [6mm] foam rubber (not included) to line the fuel tank tray. Fit the neck of the fuel tank through the hole in the firewall and tightly secure the tank in place with the strap.



❑ 5. Attach a 6"-7" [152mm-178mm] piece of fuel tubing onto each line coming from the tank.

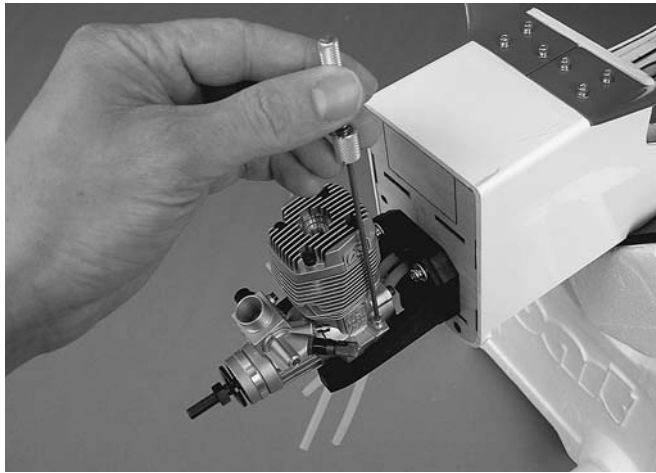


❑ 6. If you are installing the O.S. FS81-a engine, you will need to trim away the nose gear bearing on the top side of the engine mount as shown. A rotary tool works well for this.



❑ 7. Using four 6-32 x 1" [25mm] machine screws, four #6 flat washers, four #6 lock washers, and thread locking compound, attach the engine mount inverted to the firewall. Leave the screws slightly loose. Test fit your engine between the mount halves. Slide the mount halves against the sides of the engine and finish tightening the mount screws. Position the front of the engine drive washer 4-7/8" [124mm] from the firewall.

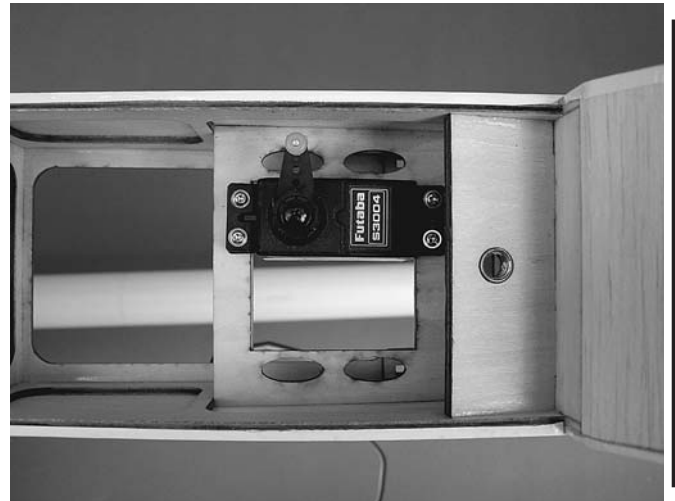
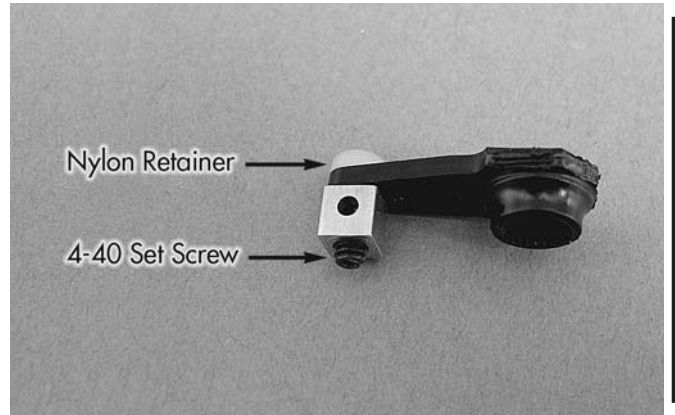




❑ 8. Mark the location of the engine mount holes onto the mount rails using a Dead Center Hole Locator. Remove the engine from the mount and use a 6-32 tap and drill set to create threads in the four mounting holes. Attach the engine to the mount using four 6-32 x 3/4" [19mm] machine screws, four #6 flat washers, and four #6 lock washers.

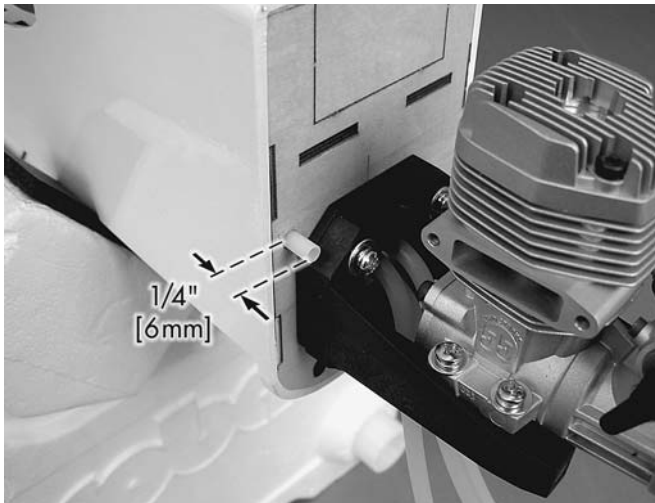
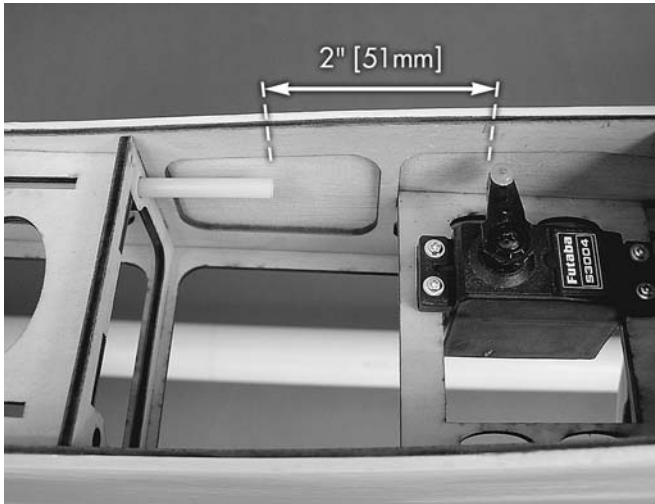


❑ 9. Install the throttle servo onto the throttle servo tray using the hardware supplied with the servo.

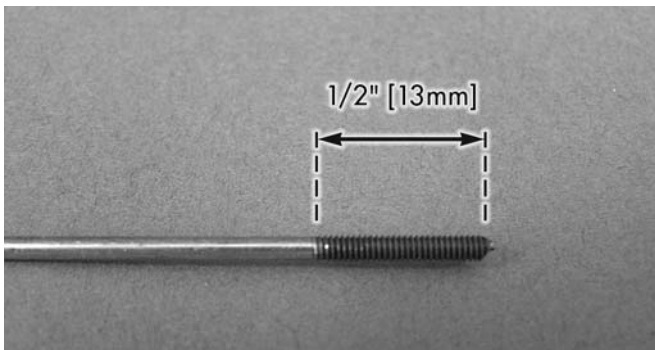


❑ 10. Loosely thread a 4-40 set screw into the brass screw-lock pushrod connector. Install the screw-lock connector on the **underside** of the outer hole in the throttle servo arm using a nylon retainer. Install the servo arm onto the servo, being sure to replace the servo arm screw.

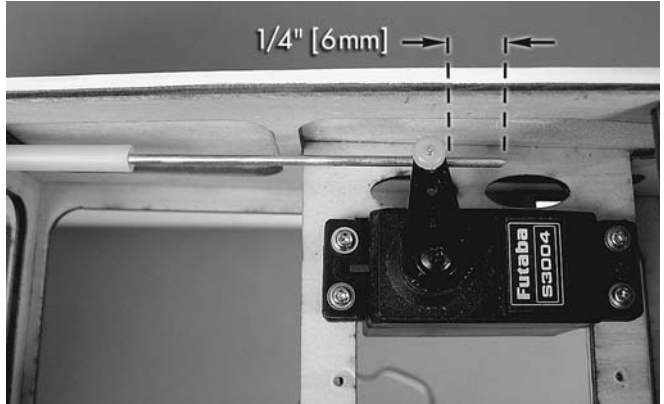
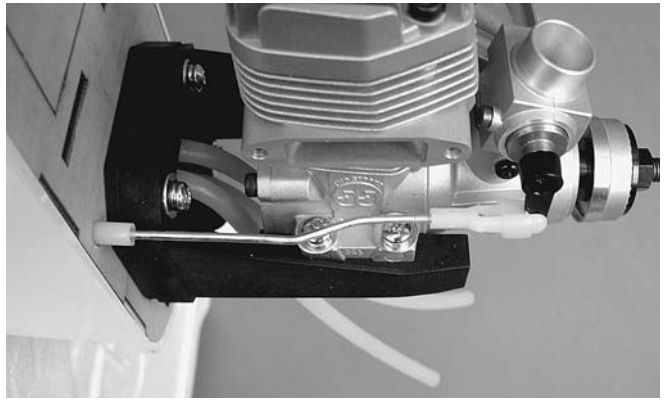




❑ 11. Insert the outer pushrod tube through the holes in the firewall and formers. Mark and cut the tube to length so the aft end is 2" [51mm] in front of the throttle servo arm and the forward end protrudes beyond the front of the firewall 1/4" [6mm]. Roughen the outside of the pushrod tube using 220-grit sandpaper. Glue the outer pushrod tube to the holes in the firewall and formers.



❑ 12. (If you are installing an engine with a rear mounted carb, cut off a portion of the threaded end from the 20" [508mm] long pushrod leaving 1/2" [13mm].) Thread a nylon clevis onto the pushrod 20 complete turns and install a silicone clevis retainer onto the clevis.



❑ 13. Insert the pushrod through the outer pushrod tube and through the screw-lock pushrod connector on the throttle servo arm. Connect the clevis to the throttle arm on the carburetor. Make any necessary bends in the pushrod so the pushrod can actuate the throttle without binding. When satisfied, adjust the pushrod position in the screw-lock pushrod connector so that the throttle servo properly opens and closes the carburetor. Use the radio system to test the operation of the throttle. Tighten the set screw in the screw-lock pushrod connector and cut off the excess pushrod 1/4" [6mm] behind it.



❑ 14. Cut the carb line to length and connect it the fuel inlet. If you put a fill line in the tank, you will need a fuel line plug (not included). The line can hang free from the bottom of the plane or can be secured in which ever way you see fit. Attach the muffler and connect the pressure line to it (the muffler may need to be removed when fitting the cowl depending on how you choose to make the muffler cutout).



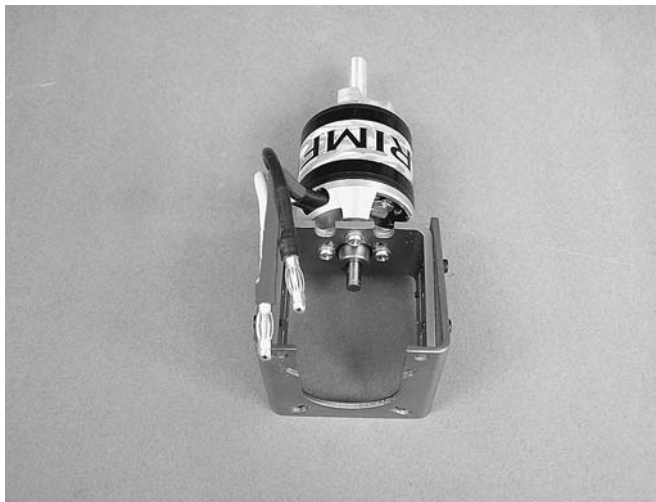
## BRUSHLESS MOTOR INSTALLATION

The Razor 3D ARF is designed to be flown with a .46-.55 two-stroke glow engine, .52-.81 four-stroke glow engine, or a brushless out-runner motor. If you have installed a glow engine, skip this section as it only contains information relevant to installing a brushless motor.

Be sure to read and understand the instructions that come with the ESC and motor before attempting to operate the system. Also read the lithium battery handling and usage warning on page 28 of this manual.



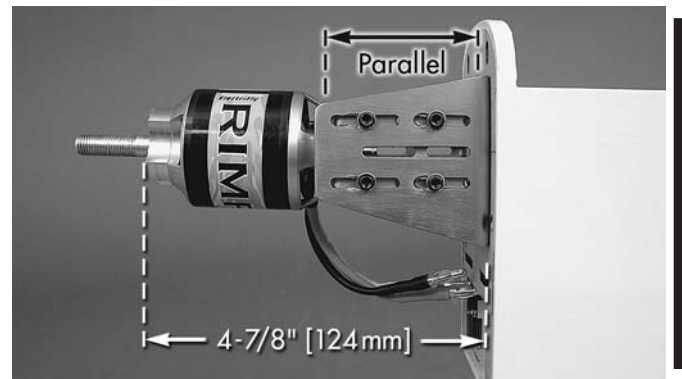
1. Cut the perforations on the cooling hole cutout in the firewall and remove the piece.



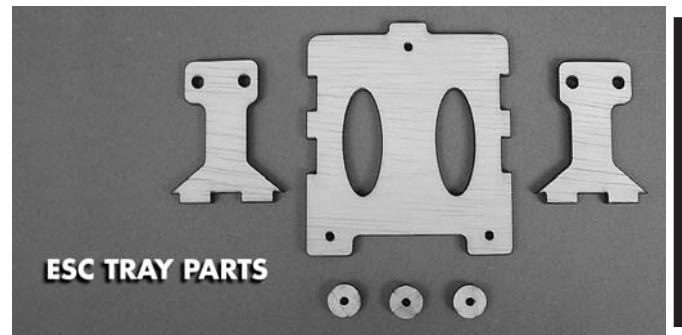
2. Attach the out-runner motor to the brushless motor mount using the included 3 x 8mm machine screws and thread locking compound. If you haven't done so yet, install the prop adapter to the motor case with the hardware included with the motor and thread locking compound.



3. Attach the motor mount to the firewall using four 6-32 x 3/4" [19mm] machine screws, four #6 flat washers, four #6 lock washers, and thread locking compound.



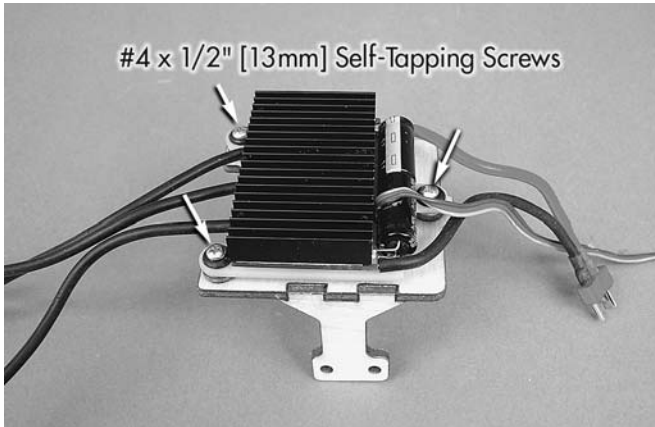
4. Loosen the screws that join the aluminum motor mount halves and slide them together so that the front of the prop adapter is 4-7/8" [124mm] from the firewall. When adjusting the aluminum motor mount, take care not to inadvertently increase or decrease the amount of down thrust from what is already built into the motor mounting box.



5. Locate the plywood **ESC tray** parts. Glue the three disks over the ESC mounting holes on the tray as shown.



❑ 6. Glue the ESC tray side pieces to the tray in the orientation shown. Be sure the side pieces are thoroughly glued.



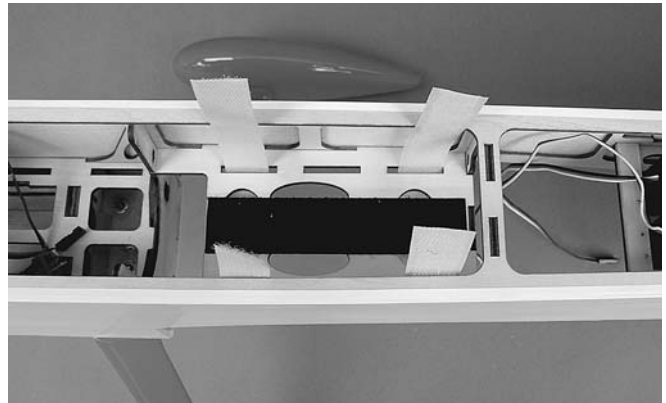
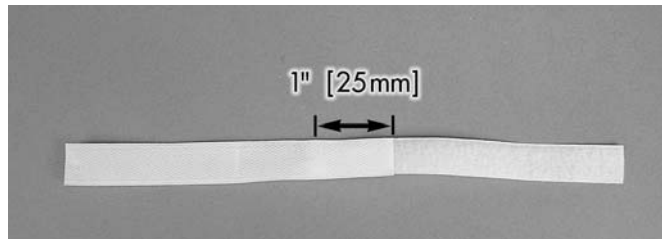
❑ 7. Thread a #4 x 1/2" [13mm] self-tapping screw into each tray hole and back it out. Apply a drop of thin CA to each hole to harden the wood. When the CA has dried, mount the ESC onto the underside of the tray using three #4 x 1/2" [13mm] self-tapping screws. If you are using a different brand ESC, you may need to modify the tray to fit the ESC.



❑ 8. Mount the ESC tray to the brushless motor mount as shown. Put a #4 flat washer onto each of the four 4-40 x 5/8" [16mm] machine screws and insert the screws through the holes in the tray side pieces and through the center slots in the brushless motor mount. Tighten a 4-40 locknut and #4 flat washer onto each screw to secure the tray to the mount.



❑ 9. Connect the motor lead wires to the ESC. Wrapping the wires behind the ESC tray below the mount will keep the excess length neatly out of the way.



❑ 10. Make two straps from the included hook and loop material by overlapping the mating ends by approximately 1" [25mm]. The straps should be long enough to wrap around



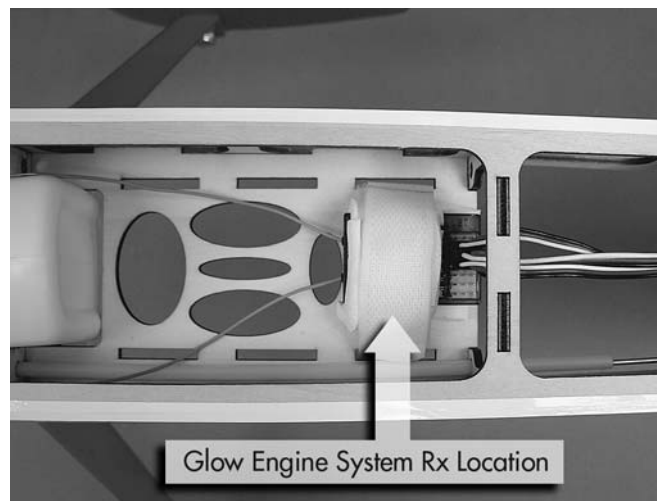
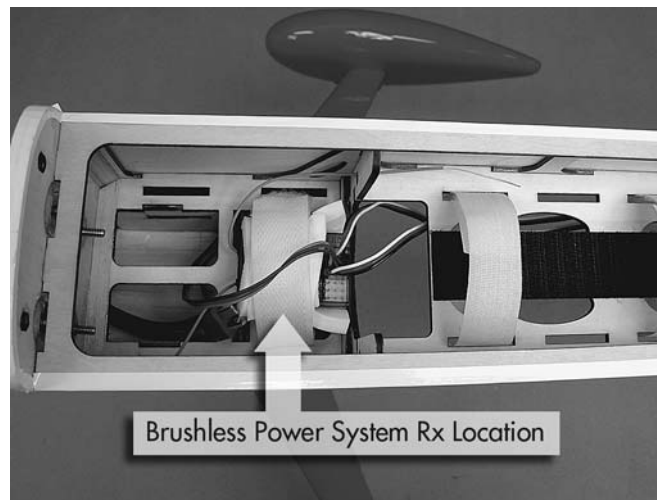


your battery packs. Apply a thin coat of epoxy to the battery tray and let it cure undisturbed. The epoxy will improve the adhesion of the self-adhesive hook and loop material. Cut a piece of the hook side from a package of self-adhesive hook and loop material (not included) and apply it to the center of the battery tray. The loop side should be applied to the bottom of the battery pack. Additional pieces can also be used to hold multiple packs together. Insert the straps you made through the slots in the tray as shown. Test fit the pack onto the tray. Now would also be a good time to confirm that the motor will rotate the correct direction by temporarily powering up the motor using the ESC and your radio system (do not install a propeller yet!). If the motor rotates the wrong direction (it should rotate counter-clockwise when viewing it from the front), disconnect any two of the three motor leads and swap their position.



11. Cut the covering from the cool air exit on the underside of the fuselage in the location shown.

## INSTALL THE RECEIVER, BATTERY PACK AND SWITCH HARNESS



1. Make a strap from the included hook and loop material to fit your receiver. Connect the servos to the receiver. Cut a piece of foam rubber (not included) to fit your receiver and strap the receiver in the location shown that matches your power system. A receiver antenna tube is provided for FM and PCM receivers. Be sure the antenna will not interfere with the tail servos.

This model belongs to:

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Name

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Address

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City, State, Zip

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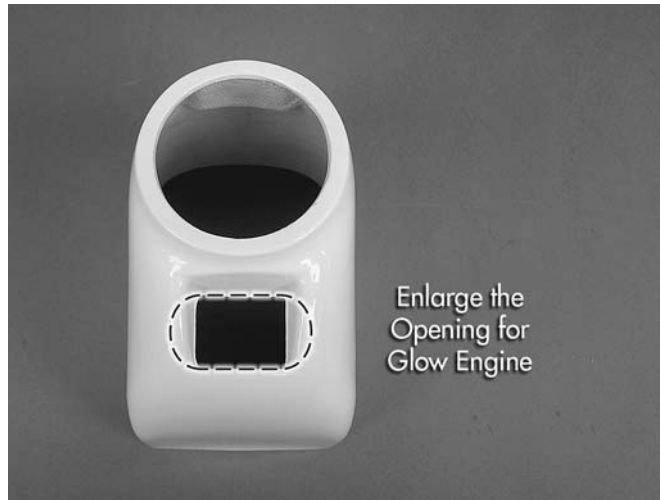
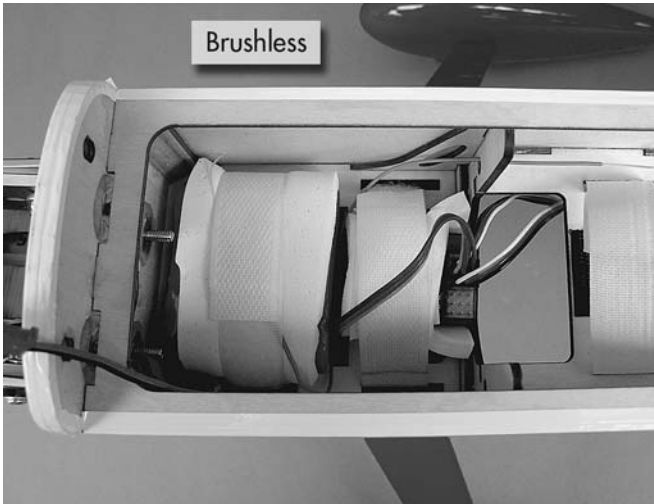
Phone Number

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AMA Number

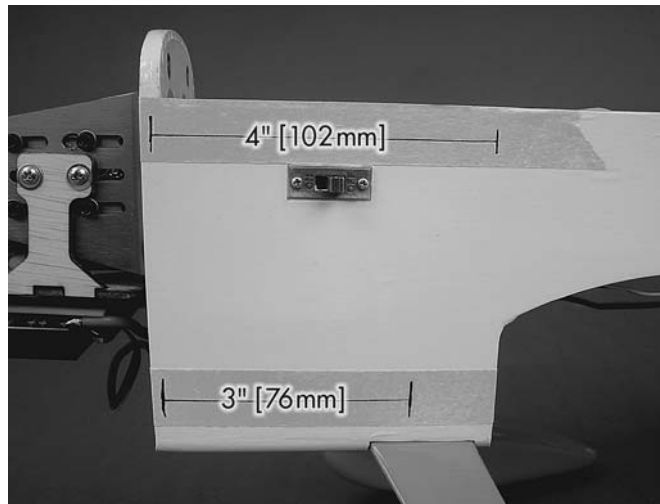
Instructions for this tag are on page 25.

## FINISH THE MODEL

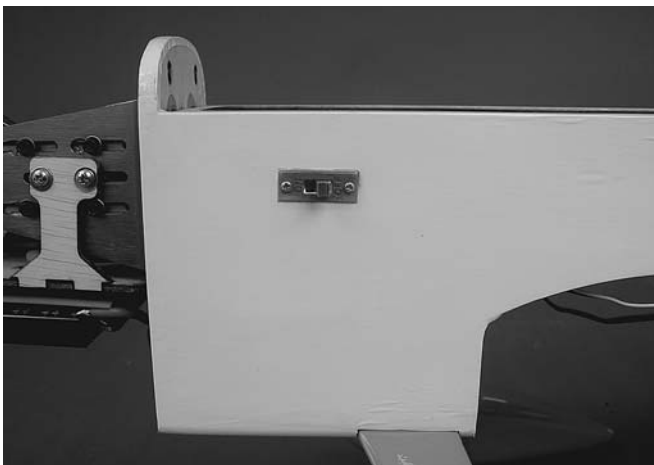


❑ 1. Before fitting the cowl, make any cutouts necessary for your power system. If you have installed a glow engine, a cutout must be made for the exhaust, needle valve access, glow plug access, and cool air exit. A rotary tool such as a Dremel works very well for cutting holes in fiberglass. We also suggest enlarging the air inlet with a glow engine installed to improve air flow across the engine head.

❑ 2. Install your receiver battery in front of the receiver in the same manner.

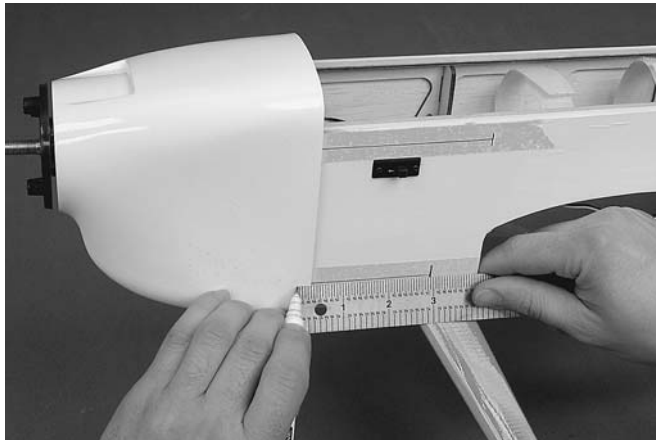
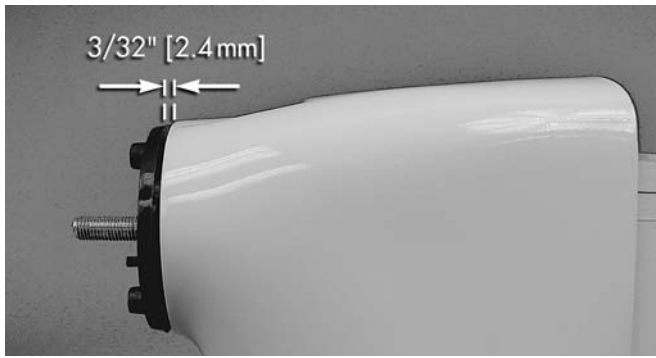


❑ 2. Put 5" [127mm] strips of masking tape on the sides of the fuselage parallel to the fuse length (two per side) as shown. Make a mark 1/8" [3.2mm] behind the front of the firewall on each piece of tape. Use a ruler to accurately draw a 4" [102mm] line from the mark onto the top pieces of tape and a 3" [76mm] line on the bottom pieces. Make a mark at the aft end of each line.



❑ 3. Two pre-cut switch locations are provided on the fuselage side. Choose the one that best matches your power system choice. An external mounted charge jack could be mounted below the switch. However, the canopy hatch is easily removable for access to the receiver pack.



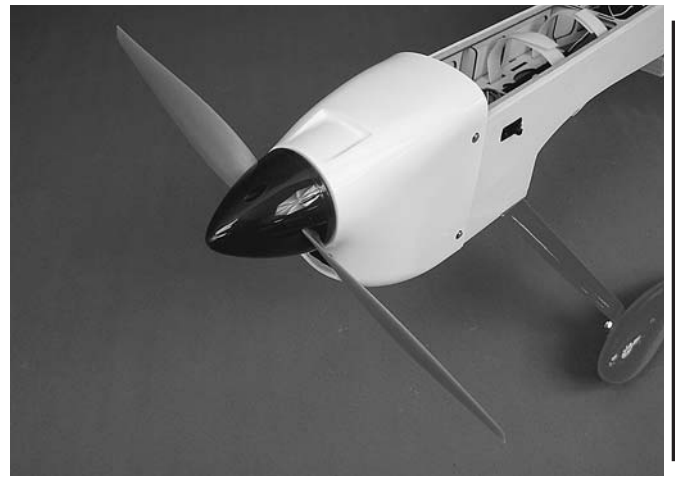


❑ 3. Fit the cowl onto the fuselage. Use the spinner backplate (you may need to enlarge the hole in the backplate to match the size of your motor shaft) to center the position of the front of the cowl  $3/32$ " [2.4mm] behind the backplate. Temporarily tape the cowl in place or have a helper hold the cowl. Measure back along the lines from the aft marks on the tape and mark on the cowl where to drill the four cowl mounting holes.

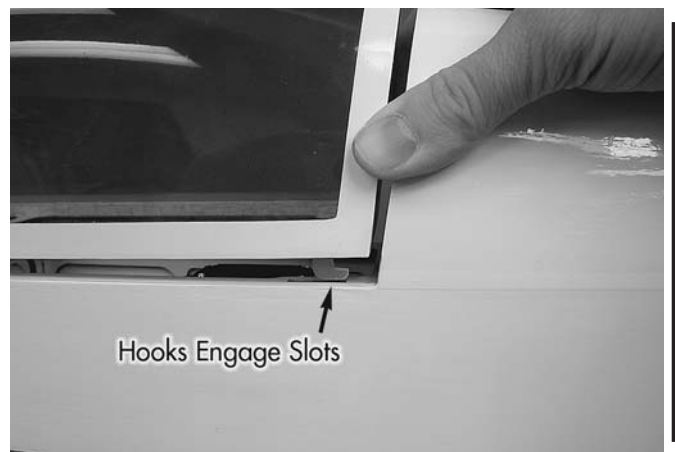
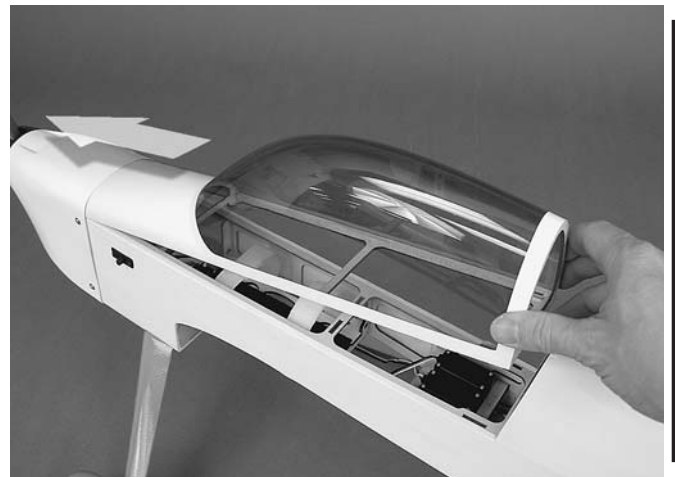


❑ 4. Drill  $5/64$ " [2mm] holes at the marks you made on the cowl through the cowl and fuse. Remove the cowl and thread a #4 x  $3/8$ " [9.5mm] self-tapping screw into each hole in the fuse and back it out. Apply a couple drops of thin CA to each hole in the blocks. Enlarge the four holes in the cowl with a  $1/8$ " [3.2mm] bit. Install the cowl onto the fuselage using four #4 x  $3/8$ " [9.5mm] self-tapping screws and four #4 flat washers.

❑ 5. If you haven't done so already, attach the muffler to the engine and connect the vent line from the fuel tank to the muffler. Trim it to length if needed.



❑ 6. Install your propeller using the prop washer and nut that came with the motor. Enlarge the propeller slots in the spinner cone as necessary to fit over the propeller blades. When satisfied, install the spinner cone onto the backplate using the provided screws.



❑ 7. Fit the canopy hatch in place by first inserting the canopy pins into their mating holes in the fuse. Push the hatch forward until the hooks at the aft end of the hatch can fit into the slots. Releasing the canopy hatch will allow the magnets to become attached to the magnets in the fuselage, and engagement of the hooks. The hatch should now be securely held in place. Now attempt to remove the hatch in the reverse order.



☐ 8. You have now completed the assembly!

## APPLY THE DECALS

1. Use scissors or a sharp hobby knife to cut the decals from the sheet.
2. Be certain the model is clean and free from oily fingerprints and dust. Prepare a dishpan or small bucket with a mixture of liquid dish soap and warm water—about one teaspoon of soap per gallon of water. Submerge the decal in the soap and water and peel off the paper backing. **Note:** Even though the decals have a “sticky-back” and are not the water transfer type, submersing them in soap & water allows accurate positioning and reduces air bubbles underneath.
3. Position decal on the model where desired. Holding the decal down, use a paper towel to wipe most of the water away.
4. Use a piece of soft balsa or something similar to squeegee remaining water from under the decal. Apply the rest of the decals the same way.

## GET THE MODEL READY TO FLY

### INSTALL AND OPERATE THE MOTOR BATTERY (BRUSHLESS ONLY)

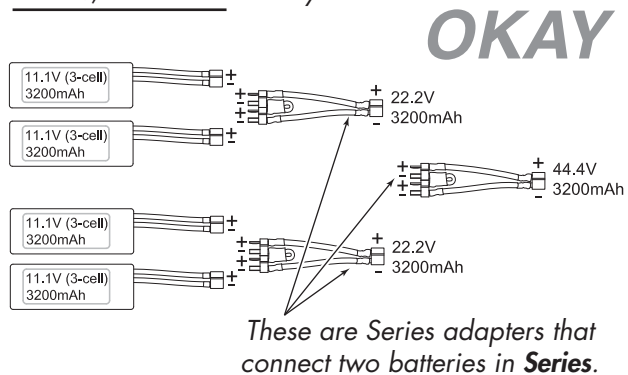
- ☐ 1. Remove the propeller. **IMPORTANT:** Whenever setting up or working on an electric-powered model, always remove the propeller in case of accidentally providing power to the motor.
- ☐ 2. Before you can power the radio system and set up the controls, the motor batteries will need to be charged. Never charge the motor batteries while they are in the model. Always remove the motor batteries from the model while charging.

**IMPORTANT:** If using multiple battery packs that are connected with an adapter, never charge the batteries together through the adapter. Always charge each battery pack separately. Charge the batteries, then read the following precautions on how to connect multiple packs for flying the model.

## BATTERY PRECAUTIONS

### This is how to connect four batteries in Series:

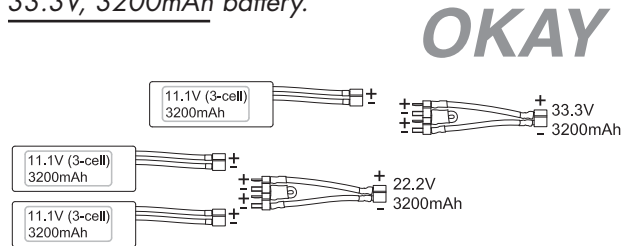
*These are four 11.1V, 3200mAh batteries. When joined in **Series**, the result will be a 44.4 V, 3200mAh battery.*



Connecting batteries in “Series” means to connect the +’s to the –’s and the –’s to the +’s. This combines the batteries’ voltages, but the capacity remains the same.

### This is how to connect three batteries in Series:

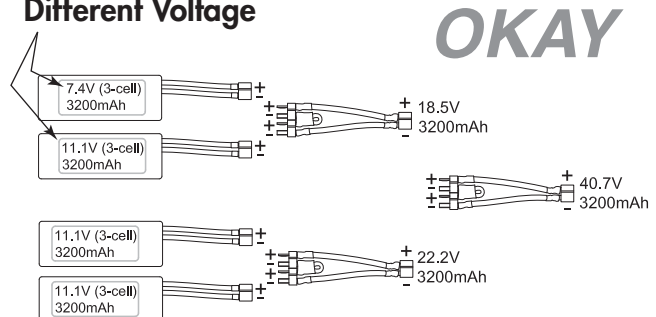
*These are three 11.1V, 3200mAh batteries. When joined in **Series**, the result will be a 33.3V, 3200mAh battery.*



**Batteries of different voltages, but not different capacities may also be connected in Series:**

*These are three 11.1V, 3200mAh batteries **and** one 7.4 V, 3200mAh battery. When joined in **Series**, the result will be a 40.7V, 3200mAh battery.*

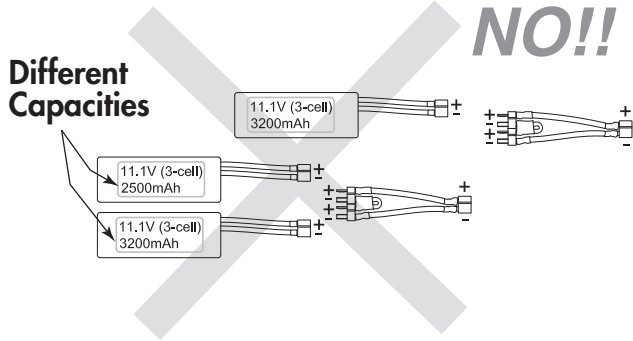
### Different Voltage



*It’s okay to connect batteries with different Voltages in **Series** to achieve the new, desired Voltage.*



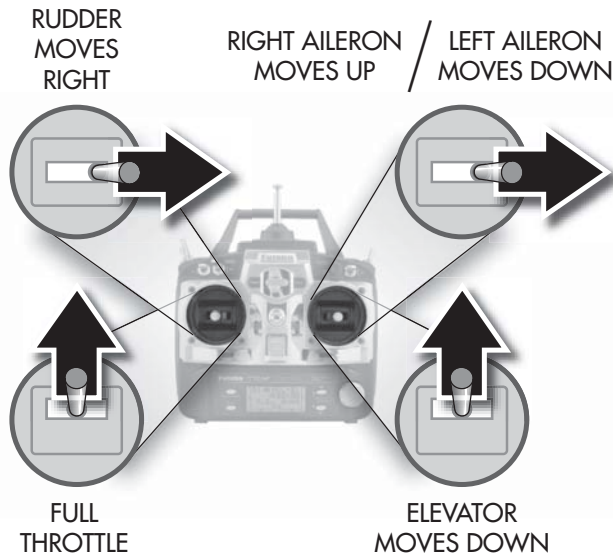
**NEVER** connect batteries that have different capacities!



### CHECK THE CONTROL DIRECTIONS

- ❑ 1. Turn on the transmitter and receiver and center the trims. If necessary, remove the servo arms from the servos and reposition them so they are centered. Reinstall the screws that hold on the servo arms.
- ❑ 2. With the transmitter and receiver still on, check all the control surfaces to see if they are centered. If necessary, adjust the clevises on the pushrods to center the control surfaces.

### 4-CHANNEL RADIO SETUP (STANDARD MODE 2)



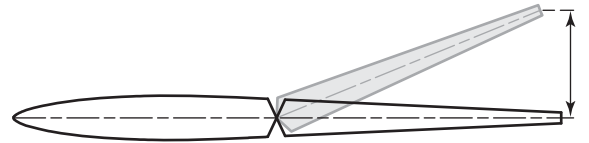
- ❑ 3. Make certain that the control surfaces and the carburetor respond in the correct direction as shown in the diagram. If any of the controls respond in the wrong direction, use the servo reversing in the transmitter to reverse the servos connected to those controls. Be certain the control surfaces have remained centered. Adjust if necessary.

### SET THE CONTROL THROWS



Use a Great Planes AccuThrow (or a ruler) to accurately measure and set the control throw of each control surface as indicated in the chart that follows. If your radio does not have dual rates, we recommend setting the throws at the **low** rate setting.

**NOTE:** The throws are measured at the **widest part** of the elevators, rudder and ailerons.



THESE ARE THE RECOMMENDED CONTROL SURFACE THROWS:					
	HIGH RATE		LOW RATE		3D
	▼		▼		▼
ELEVATOR	UP	DOWN	UP	DOWN	U & D
	3/4"	3/4"	1/2"	1/2"	2-1/2"
	[19mm] 10 deg	[19mm] 10 deg	[13mm] 7 deg	[13mm] 7 deg	[64mm] 37 deg
RUDDER	RIGHT	LEFT	RIGHT	LEFT	L & R
	2"	2"	1-3/16"	1-3/16"	3-1/2"
	[51mm] 19 deg	[51mm] 19 deg	[30mm] 11 deg	[30mm] 11 deg	[89mm] 36 deg
AILERONS	UP	DOWN	UP	DOWN	U & D
	5/8"	5/8"	3/8"	3/8"	1-3/4"
	[16mm] 12 deg	[16mm] 12 deg	[10mm] 7 deg	[10mm] 7 deg	[44mm] 34 deg



**IMPORTANT:** The Razor 3D ARF has been **extensively** flown and tested to arrive at the throws at which it flies best. Flying your model at these throws will provide you with the greatest chance for successful first flights. If, after you have become accustomed to the way the Razor flies, you would like to change the throws to suit your taste, that is fine. However, too much control throw could make the model difficult to control, so remember, “more is not always better.”

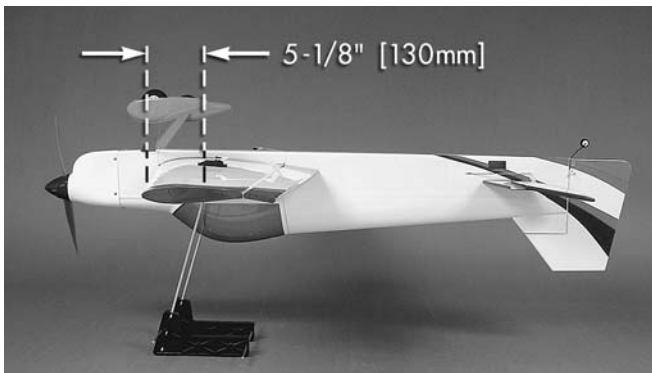
## BALANCE THE MODEL (C.G.)

More than any other factor, the **C.G.** (balance point) can have the **greatest** effect on how a model flies, and may determine whether or not your first flight will be successful. If you value this model and wish to enjoy it for many flights, **DO NOT OVERLOOK THIS IMPORTANT PROCEDURE.** A model that is not properly balanced will be unstable and possibly unflyable.

At this stage the model should be in ready-to-fly condition with all of the systems in place including the engine or brushless motor, landing gear, and the radio system (and battery pack if applicable).

❑ 1. Use a felt-tip pen or 1/8" [3mm]-wide tape to accurately mark the C.G. on the top of the wing on both sides of the fuselage. The C.G. is located 5-1/8" [130mm] back from the leading edge of the wing.

This is where your model should balance for the first flights. Later, you may wish to experiment by shifting the C.G. up to 3/8" [9.5mm] forward or 5/8" [16mm] back to change the flying characteristics. Moving the C.G. forward may improve the smoothness and stability, but the model may then require more speed for takeoff and make it more difficult to slow for landing. Moving the C.G. aft makes the model more maneuverable, but could also cause it to become too difficult to control. In any case, **start at the recommended balance point** and do not at any time balance the model outside the specified range.



❑ 2. With the wing attached to the fuselage, all parts of the model installed (ready to fly) and an empty fuel tank, place the model upside-down on a Great Planes CG Machine, or lift it upside-down at the balance point you marked.

❑ 3. If the tail drops, the model is “tail heavy” and the battery pack and/or receiver must be shifted forward or weight must be added to the nose to balance. If the nose drops, the model is “nose heavy” and the battery pack and/or receiver must be shifted aft or weight must be added to the tail to balance. If possible, relocate the battery pack and receiver to minimize or eliminate any additional ballast required. If additional weight is required, nose weight may be easily added by using a “spinner weight” (GPMQ4645 for the 1 oz. [28g] weight, or GPMQ4646 for the 2 oz. [57g] weight). If spinner weight is not practical or is not enough, use Great Planes (GPMQ4485) “stick-on” lead. A good place to add stick-on nose weight is to the firewall (don’t attach weight to the cowl—it is not intended to support weight). Begin by placing incrementally increasing amounts of weight on the bottom of the fuse over the firewall until the model balances. Once you have determined the amount of weight required, it can be permanently attached. If required, tail weight may be added by cutting open the bottom of the fuse and gluing it permanently inside.

**Note:** Do not rely upon the adhesive on the back of the lead weight to permanently hold it in place. Over time, fuel and exhaust residue may soften the adhesive and cause the weight to fall off. Use #2 sheet metal screws, RTV silicone or epoxy to permanently hold the weight in place.

❑ 4. **IMPORTANT:** If you found it necessary to add any weight, recheck the C.G. after the weight has been installed.

## BALANCE THE MODEL Laterally

❑ 1. With the wing level, have an assistant help you lift the model by the engine propeller shaft and the bottom of the fuse under the TE of the fin. Do this several times.

❑ 2. If one wing always drops when you lift the model, it means that side is heavy. Balance the airplane by adding weight to the other wing tip. **An airplane that has been laterally balanced will track better in loops and other maneuvers.**

## PREFLIGHT

### IDENTIFY YOUR MODEL

No matter if you fly at an AMA sanctioned R/C club site or if you fly somewhere on your own, you should always have your name, address, telephone number and AMA number on or inside your model. It is **required** at all AMA R/C club flying sites and AMA sanctioned flying events. Fill out the identification tag on page 20 and place it on or inside your model.

### CHARGE THE BATTERIES

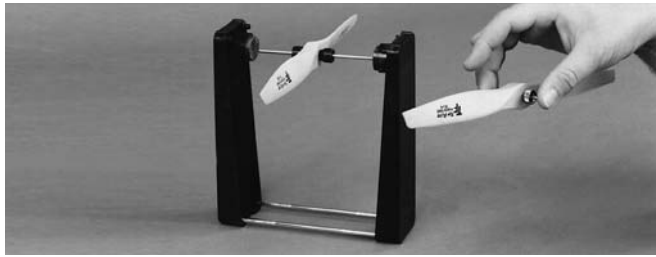
Follow the battery charging instructions that came with your radio control system to charge the batteries. You should always charge your transmitter and receiver batteries the night before you go flying, and at other times as recommended by the radio manufacturer.





**CAUTION:** Unless the instructions that came with your radio system state differently, the **initial** charge on **new** transmitter and receiver batteries should be done for 15 hours **using the slow-charger that came with the radio system.** This will “condition” the batteries so that the next charge may be done using the fast-charger of your choice. If the initial charge is done with a fast-charger the batteries may not reach their full capacity and you may be flying with batteries that are only partially charged.

## BALANCE PROPELLERS



Carefully balance your propeller and spare propellers before you fly. An unbalanced prop can be the single most significant cause of vibration that can damage your model. Not only will engine mounting screws and bolts loosen, possibly with disastrous effect, but vibration may also damage your radio receiver and battery. Vibration can also cause your fuel to foam, which will, in turn, cause your engine to run hot or quit.

We use a Top Flite Precision Magnetic Prop Balancer (TOPQ5700) in the workshop and keep a Great Planes Fingertip Prop Balancer (GPMQ5000) in our flight box.

## GROUND CHECK

**If the engine is new, follow the engine manufacturer’s instructions to break-in the engine.** After break-in, confirm that the engine idles reliably, transitions smoothly and rapidly to full power and maintains full power—indefinitely. After you run the engine on the model, inspect the model closely to make sure all screws remained tight, the hinges are secure, the prop is secure and all pushrods and connectors are secure.

## RANGE CHECK

Ground check the operational range of your radio before the first flight of the day. With the transmitter antenna collapsed and the receiver and transmitter on, you should be able to walk at least 100 feet [30m] away from the model and still have control (follow the instructions that came with your radio if you are using a 2.4GHz system). Have an assistant stand by your model and, while you work the controls, tell you what the control surfaces are doing. Repeat this test **with the engine running** at various speeds with an assistant holding the model, using hand signals to show you what is happening. If the control surfaces do not respond correctly, **do not fly!** Find and correct the problem first. Look for loose servo connections or broken wires, corroded wires on old servo connectors, poor solder joints in your battery pack or a defective cell, or a damaged receiver crystal from a previous crash.

## ENGINE SAFETY PRECAUTIONS

**FAILURE TO FOLLOW THESE SAFETY PRECAUTIONS MAY RESULT IN SEVERE INJURY TO YOURSELF AND OTHERS.**

Keep all engine fuel in a safe place, away from high heat, sparks or flames, as fuel is very flammable. Do not smoke near the engine or fuel; and remember that engine exhaust gives off a great deal of deadly carbon monoxide. Therefore **do not run the engine in a closed room or garage.**

Get help from an experienced pilot when learning to operate engines.

Use safety glasses when starting or running engines.

Do not run the engine in an area of loose gravel or sand; the propeller may throw such material in your face or eyes.

Keep your face and body as well as all spectators away from the plane of rotation of the propeller as you start and run the engine.

Keep these items away from the prop: loose clothing, shirt sleeves, ties, scarves, long hair or loose objects such as pencils or screwdrivers that may fall out of shirt or jacket pockets into the prop.

Use a “chicken stick” or electric starter to start the engine. Do not use your fingers to flip the propeller. Make certain the glow plug clip or connector is secure so that it will not pop off or otherwise get into the running propeller.

Make all engine adjustments from behind the rotating propeller.

The engine gets hot! Do not touch it during or right after operation. Make sure fuel lines are in good condition so fuel will not leak onto a hot engine, causing a fire.

To stop a glow engine, cut off the fuel supply by closing off the fuel line or following the engine manufacturer’s recommendations. Do not use hands, fingers or any other body part to try to stop the engine. To stop a gasoline powered engine an on/off switch should be connected to the engine coil. Do not throw anything into the propeller of a running engine.

## LITHIUM BATTERY HANDLING AND USAGE

**WARNING!!** Read the entire instruction sheet included with your battery. Failure to follow all instructions could cause permanent damage to the battery and its surroundings, and cause bodily harm!

- ONLY use a Li-Po approved charger. NEVER use a NiCd/NiMH peak charger!
- NEVER charge in excess of 4.20V per cell.
- ONLY charge through the “charge” lead. NEVER charge through the “discharge” lead.
- NEVER charge at currents greater than 1C.
- ALWAYS set charger’s output volts to match battery volts.
- ALWAYS charge in a fireproof location.
- NEVER trickle charge.
- NEVER allow the battery temperature to exceed 150° F (65° C).

- NEVER disassemble or modify pack wiring in any way or puncture cells.
- NEVER discharge below 2.5V per cell.
- NEVER place on combustible materials or leave unattended during charge or discharge.
- ALWAYS KEEP OUT OF REACH OF CHILDREN.

## AMA SAFETY CODE (excerpts)

Read and abide by the following excerpts from the Academy of Model Aeronautics Safety Code. For the complete Safety Code refer to *Model Aviation* magazine, the AMA web site or the Code that came with your AMA license.

### GENERAL

1) I will not fly my model aircraft in sanctioned events, air shows, or model flying demonstrations until it has been proven to be airworthy by having been previously, successfully flight tested.

2) I will not fly my model aircraft higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator. I will give right-of-way and avoid flying in the proximity of full-scale aircraft. Where necessary, an observer shall be utilized to supervise flying to avoid having models fly in the proximity of full-scale aircraft.

3) Where established, I will abide by the safety rules for the flying site I use, and I will not willfully and deliberately fly my models in a careless, reckless and/or dangerous manner.

5) I will not fly my model unless it is identified with my name and address or AMA number, on or in the model. Note: This does not apply to models while being flown indoors.

7) I will not operate models with pyrotechnics (any device that explodes, burns, or propels a projectile of any kind).

### RADIO CONTROL

1) I will have completed a successful radio equipment ground check before the first flight of a new or repaired model.

2) I will not fly my model aircraft in the presence of spectators until I become a qualified flier, unless assisted by an experienced helper.

3) At all flying sites a straight or curved line(s) must be established in front of which all flying takes place with the other side for spectators. Only personnel involved with flying the aircraft are allowed at or in the front of the flight line. Intentional flying behind the flight line is prohibited.

4) I will operate my model using only radio control frequencies currently allowed by the Federal Communications Commission.

5) **I will not knowingly operate my model within three miles of any pre-existing flying site except in accordance with the frequency sharing agreement listed** [in the complete AMA Safety Code].

9) Under no circumstances may a pilot or other person touch a powered model in flight; **nor should any part of the model other than the landing gear, intentionally touch the ground, except while landing.**

## CHECK LIST

During the last few moments of preparation your mind may be elsewhere anticipating the excitement of the first flight. Because of this, you may be more likely to overlook certain checks and procedures that should be performed before the model is flown. To help avoid this, a check list is provided to make sure these important areas are not overlooked. Many are covered in the instruction manual, so where appropriate, refer to the manual for complete instructions. Be sure to check the items off as they are completed (that's why it's called a *check list!*).

- 1. Check the C.G. according to the measurements provided in the manual.
- 2. Be certain the battery and receiver are securely mounted in the fuse. Simply stuffing them into place with foam rubber is not sufficient.
- 3. Extend your receiver antenna.
- 4. Balance your model *laterally* as explained in the instructions.
- 5. Use threadlocking compound to secure critical fasteners such as the set screws that hold the wheel axles to the struts, screws that hold the carburetor arm (if applicable), screw-lock pushrod connectors, etc.
- 6. Add a drop of oil to the axles so the wheels will turn freely.
- 7. Make sure all hinges are **securely** glued in place.
- 8. Reinforce holes for wood screws with thin CA where appropriate (servo mounting screws, cowl mounting screws, etc.).
- 9. Confirm that all controls operate in the correct direction and the throws are set up according to the manual.
- 10. Make sure there are silicone retainers on all the clevises and that all servo arms are secured to the servos with the screws included with your radio.
- 11. Secure connections between servo wires and Y-connectors or servo extensions, and the connection between your battery pack and the on/off switch with vinyl tape, heat shrink tubing or special clips suitable for that purpose.
- 12. Make sure any servo extension cords you may have used do not interfere with other systems (servo arms, pushrods, etc.).
- 13. Secure the pressure tap (if used) to the muffler with high temp RTV silicone, thread locking compound or J.B. Weld.
- 14. Make sure the fuel lines are connected and are not kinked.
- 15. Balance your propeller (and spare propellers).
- 16. Tighten the propeller nut and spinner.
- 17. Place your name, address, AMA number and telephone number on or inside your model.
- 18. Cycle your receiver battery pack (if necessary) and make sure it is fully charged.
- 19. If you wish to photograph your model, do so before your first flight.
- 20. Range check your radio when you get to the flying field.



## FLYING

The Razor 3D ARF is a great-flying model that flies smoothly and predictably. The Razor does not, however, possess the self-recovery characteristics of a primary R/C trainer and should be flown only by experienced R/C pilots.

### FUEL MIXTURE ADJUSTMENTS

A fully cowled engine may run at a higher temperature than an uncowed engine. For this reason, the fuel mixture should be richened so the engine runs at about 200 rpm below peak speed. By running the engine slightly rich, you will help prevent dead-stick landings caused by overheating.

**CAUTION (THIS APPLIES TO ALL R/C AIRPLANES):** If, while flying, you notice an alarming or unusual sound such as a low-pitched “buzz,” this may indicate control surface *flutter*. Flutter occurs when a control surface (such as an aileron or elevator) or a flying surface (such as a wing or stab) rapidly vibrates up and down (thus causing the noise). In extreme cases, if not detected immediately, flutter can actually cause the control surface to detach or the flying surface to fail, thus causing loss of control followed by an impending crash. The best thing to do when flutter is detected is to slow the model **immediately** by reducing power, then land as soon as safely possible. Identify which surface fluttered (so the problem may be resolved) by checking all the servo grommets for deterioration or signs of vibration. Make certain all pushrod linkages are secure and free of play. If it fluttered once, under similar circumstances it will probably flutter again unless the problem is fixed. Some things which can cause flutter are; Excessive hinge gap; Not mounting control horns solidly; Poor fit of clevis pin in horn; Side-play of wire pushrods caused by large bends; Excessive free play in servo gears; Insecure servo mounting; and one of the most prevalent causes of flutter; Flying an over-powered model at excessive speeds.

### TAKEOFF

Before you get ready to takeoff, see how the model handles on the ground by doing a few practice runs at **low speeds** on the runway. Hold “up” elevator to keep the tail wheel on the ground. If necessary, adjust the tail wheel so the model will roll straight down the runway. If you need to calm your nerves before the maiden flight, shut the engine down and bring the model back into the pits. Top off the fuel, then check all fasteners and control linkages for peace of mind.

Remember to takeoff into the wind. When you’re ready, point the model straight down the runway, hold a bit of up elevator to keep the tail on the ground to maintain tail wheel steering, then gradually advance the throttle. As the model gains speed decrease up elevator, allowing the tail to come off the ground. One of the most important things to remember with a tail dragger is to always be ready to apply **right** rudder to counteract engine torque. Gain as much speed as your runway and flying site will practically allow before gently applying up elevator, lifting the model into the air. At this moment it is likely that you will need to apply more right rudder to counteract engine torque. Be smooth on the elevator stick, allowing the model to establish a **gentle** climb to a safe altitude before turning into the traffic pattern.

## FLIGHT

For reassurance and to keep an eye on other traffic, it is a good idea to have an assistant on the flight line with you. Tell him to remind you to throttle back once the plane gets to a comfortable altitude. While full throttle is usually desirable for takeoff, most models fly more smoothly at reduced speeds.

Take it easy with the Razor for the first few flights, gradually getting acquainted with it as you gain confidence. Adjust the trims to maintain straight and level flight. After flying around for a while and while still at a safe altitude with plenty of fuel, practice slow flight and execute practice landing approaches by reducing the throttle to see how the model handles at slower speeds. Add power to see how the model climbs as well. Continue to fly around, executing various maneuvers and making mental notes (or having your assistant write them down) of what trim or C.G. changes may be required to fine tune the model so it flies the way you like. Mind your fuel level, but use this first flight to become familiar with your model before landing.

### LANDING

To initiate a landing approach, lower the throttle while on the downwind leg. Allow the nose of the model to pitch downward to gradually bleed off altitude. Continue to lose altitude, but maintain airspeed by keeping the nose down as you turn onto the crosswind leg. Make your final turn toward the runway (into the wind) keeping the nose down to maintain airspeed and control. Level the attitude when the model reaches the runway threshold, modulating the throttle as necessary to maintain your glide path and airspeed. If you are going to overshoot, smoothly advance the throttle (always ready on the right rudder to counteract torque) and climb out to make another attempt. When you’re ready to make your landing flare and the model is a foot or so off the deck, smoothly increase up elevator until it gently touches down. Once the model is on the runway and has lost flying speed, hold up elevator to place the tail on the ground, regaining tail wheel control.

One final note about flying your model. Have a goal or flight plan in mind for **every** flight. This can be learning a new maneuver(s), improving a maneuver(s) you already know, or learning how the model behaves in certain conditions (such as on high or low rates). This is not necessarily to improve your skills (*though it is never a bad idea!*), but more importantly so you do not surprise yourself by impulsively attempting a maneuver and suddenly finding that you’ve run out of time, altitude or airspeed. Every maneuver should be deliberate, not impulsive. For example, if you’re going to do a loop, check your altitude, mind the wind direction (anticipating rudder corrections that will be required to maintain heading), remember to throttle back at the top, and make certain you are on the desired rates (high/low rates). A flight plan greatly reduces the chances of crashing your model just because of poor planning and impulsive moves. **Remember to think.**

**Have a ball! But always stay in control  
and fly in a safe manner.**

**GOOD LUCK AND GREAT FLYING!**

