

SU-31

Almost-Ready-to-Fly Electric 3D Aerobat

PERFORMANCE SERIES™

INSTRUCTION MANUAL



Wingspan: 41 in [1040mm]
Wing Area: 343 in² [22.1dm²]
Weight: 27.5 – 31 oz [780 – 880g]
Wing Loading: 11.5 – 13 oz/ft² [35 – 40g/dm²]
Length: 38 in [965mm]
Radio: 4+ channel transmitter, 4 micro servos

Motor: RimFire™ .10 (35-30-1250) out-runner brushless motor
ESC: SS-35 35A brushless ESC
Battery: 3-cell 1250 to 2100mAh LiPo battery and LiPo compatible charger

WARRANTY

Great Planes® Model Manufacturing Co. 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 Great Planes' liability exceed the original cost of the purchased kit.** Further, Great Planes reserves the right to change or modify this warranty without notice.

In that Great Planes 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.

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



Champaign, Illinois
(217) 398-8970, Ext 5
airsupport@greatplanes.com

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INTRODUCTION

Congratulations on your purchase of the Great Planes Sukhoi SU-31 EP ARF! Like the other models in the E-Performance line, the Sukhoi SU-31 EP ARF will deliver the performance that 3D pilots are looking for as well as being a great sport plane for the casual flier. As a new feature, the Sukhoi SU-31 EP ARF is designed with removable wing panels around a carbon wing tube for transporting convenience. However, the compact wingspan of the Sukhoi will allow it to fit into most vehicles in one piece.

For the latest technical updates or manual corrections to the Sukhoi SU-31 EP ARF visit the Great Planes web site at www.greatplanes.com. Open the "Airplanes" link, then select the Sukhoi SU-31 EP ARF. If there is new technical information or changes to this model a "tech notice" box will appear in the upper left corner of the page.

AMA

If you are not already a member of the AMA, please join! The AMA is the governing body of model aviation and membership provides liability insurance coverage, protects modelers' rights and interests and is required to fly at most R/C sites.



The AMA has two classes of membership available. Open membership or their Park Pilot Program which this aircraft qualifies for. The Park Pilot Program is for people flying electric aircraft and gliders under two pounds and which fly slower than 60mph. This will enable you to enjoy most AMA benefits and organize clubs and flying sites in more congested areas.



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>

<http://www.modelaircraft.org/parkflyer.aspx>

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 Sukhoi SU-31 EP 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 Sukhoi SU-31 EP ARF, 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 motor and components 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 a motor 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.

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 Sukhoi SU-31 EP ARF that may require planning or decision making before starting to build. Order numbers are provided in parentheses.

Radio Equipment

A 4-channel radio system with four micro servos and a small receiver are required for this plane. The servos and receiver shown in the manual are Futaba S3114 micro servos and the Futaba® R617FS receiver. If you are planning on doing extreme, high stress 3D flying, it is recommended that you use the Futaba S3154 micro servos instead of the Futaba S3114 servos. If using any of the S3154 servos it is also recommended that you use an external BEC or separate

receiver battery. Two 6" [150mm] servo extensions and two 12" [305mm] servo extensions are also required. Order numbers for these items are provided below.

(4) Futaba® S3114 Micro High Torque Servo 7.7g (FUTM0414)

-OR-

(4) Futaba S3154 Digital Micro High Torque High Speed Servo (FUTM0654)

-PLUS-

Futaba R617FS 2.4 GHz Receiver (FUTL7627)

(2) Futaba C-25 Extension Slim Wire 150mm (FUTM4506)

(2) Futaba C-26 12" [300mm] Slim Servo Extension Futaba J (FUTM4507)

Futaba 6" Dual Servo Extension J (FUTM4130)

Motor Recommendation

The recommended motor for the Sukhoi SU-31 EP ARF is the Great Planes RimFire™ .10 (35-30-1250) brushless out-runner motor (GPMG4595)

Note: Motors from other manufacturers may work with the Sukhoi SU-31 EP ARF; however the included motor mounting components are designed to work specifically with the Great Planes motor listed.

Propeller

The recommended propeller for the Sukhoi SU-31 EP ARF when using the Great Planes RimFire .10 (35-30-1250) motor is the APC 10 x 7" E Propeller (APCQ4123)

Electronic Speed Control (ESC)

A brushless ESC is required for this plane. We recommend using the Great Planes Silver Series 35A Brushless ESC 5V/2A BEC (GPMM1830).

Battery Pack

The Sukhoi SU-31 EP ARF has been tested with 11.1V LiPo packs ranging from 1250mAh to 2100mAh. Order numbers are provided for packs of this size. The more powerful 2100mAh pack is suggested for maximum performance.

Great Planes LiPo 1250mAh 11.1V 20C Discharge w/Balance (GPMP0609)

Great Planes LiPo 1500mAh 11.1V 20C Discharge w/Balance (GPMP0613)

Great Planes LiPo 2100mAh 11.1V 20C Discharge w/Balance (GPMP0617)

Required Adhesive & Building Supplies

This is the list of adhesive and building supplies required to finish the Sukhoi SU-31 EP ARF. Order numbers are provided in parentheses.

- 1/2 oz. [15g] Thin Pro™ CA (GPMR6001)
- 1/2 oz. [15g] Medium Pro CA+ (GPMR6007)
- Pro 30-minute epoxy (GPMR6047)
- Denatured alcohol
- Drill bits: 1/8" [3mm]
- #1 Hobby knife (HCAR0105)
- #11 Blades (5-pack, HCAR0211)
- Hobbico® steel T-Pins 1" [25mm] (100) (HCAR5100)
- Great Planes Pro Threadlocker (GPMR6060)
- CA applicator tips (HCAR3780)
- 220-grit Sandpaper
- Masking tape

OPTIONAL SUPPLIES & TOOLS

Here is a list of optional tools mentioned in the manual that will help you build the Sukhoi SU-31 EP ARF.

- 21st Century® sealing iron (COVR2700)
- 21st Century iron cover (COVR2702)
- 2 oz. [57g] Spray CA activator (GPMR6035)
- 4 oz. [113g] Aerosol CA activator (GPMR6034)
- CA debonder (GPMR6039)
- Epoxy brushes (6, GPMR8060)
- Mixing sticks (50, GPMR8055)
- Mixing cups (GPMR8056)
- Panel line pen (TOPQ2510)
- Rotary tool such as Dremel®
- Hobbico flexible 18" [457mm] stainless steel ruler (HCAR0460)
- Hobbico heavy duty diagonal cutter 7" [178mm](HCAR0627)

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 motor 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 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.

ORDERING REPLACEMENT PARTS

Replacement parts for the Great Planes Sukhoi SU-31 EP ARF are available using the order numbers in the **Replacement Parts List** that follows. The fastest, most economical service can be provided by your hobby dealer or mail-order company.

To locate a hobby dealer, visit the Hobbico web site at www.hobbico.com. Choose "Where to Buy" at the bottom of the menu on the left side of the page. Follow the instructions provided on the page to locate a U.S., Canadian or International dealer.

Parts may also be ordered directly from Hobby Services by calling (217) 398-0007, or via facsimile at (217) 398-7721, but full retail prices and shipping and handling charges will apply. Illinois and Nevada residents will also be charged sales tax. If ordering via fax, include a Visa® or MasterCard® number and expiration date for payment.

Mail parts orders **Hobby Services**
and payments by 3002 N. Apollo Drive, Suite 1
personal check to: 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@greatplanes.com, or by telephone at (217) 398-8970.

Replacement Parts List

Description	How to Purchase
Missing pieces	Contact Product Support
Instruction manual	Contact Product Support
Full-size plans	Not available

Contact your hobby supplier for the following parts:

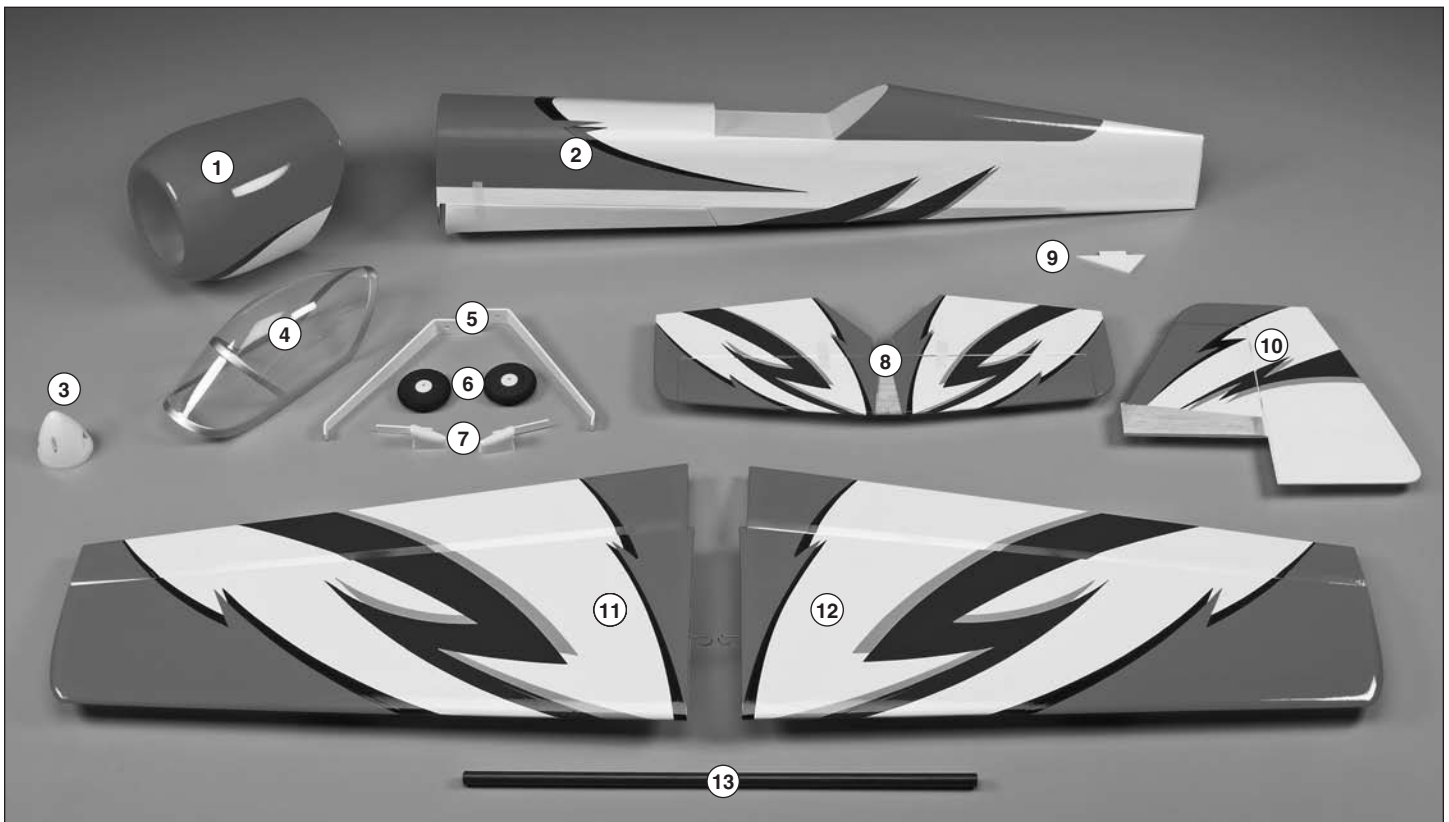
GPMA3125	Wing Kit	GPMA3130	Cowl
GPMA3126	Fuselage Kit	GPMA3131	Canopy
GPMA3127	Tail Set	GPMA3132	Wing Tube
GPMA3128	Landing Gear	GPMA3133	Decal
GPMA3129	Wheel Pants	GPMA3134	Battery Hatch

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.

Great Planes Product Support:
3002 N. Apollo Drive, Suite 1
Champaign, IL 61822
Telephone: (217) 398-8970, ext. 5
Fax: (217) 398-7721
E-mail: airsupport@greatplanes.com

KIT CONTENTS

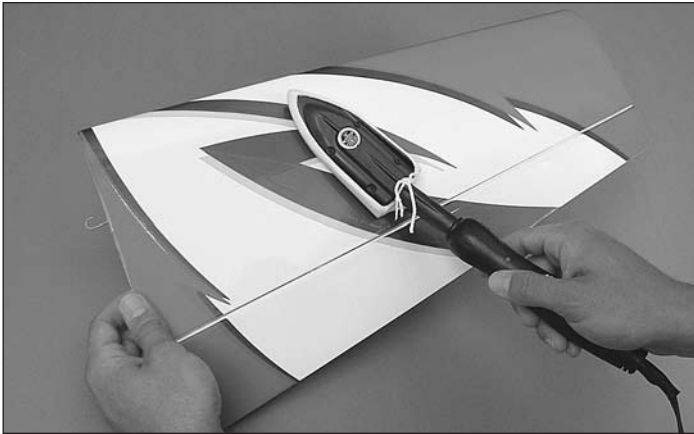


Kit Contents

1	Cowl	9	Tail Skid
2	Fuselage	10	Vertical Fin & Rudder
3	Spinner	11	Right Wing Panel w/Aileron
4	Canopy	12	Left Wing Panel w/Aileron
5	Main Landing Gear (L&R)	13	Wing Tube
6	Main Wheels (2)		
7	Wheel Spats (L&R)		
8	Horizontal Stabilizer & Elevators		

PREPARATIONS

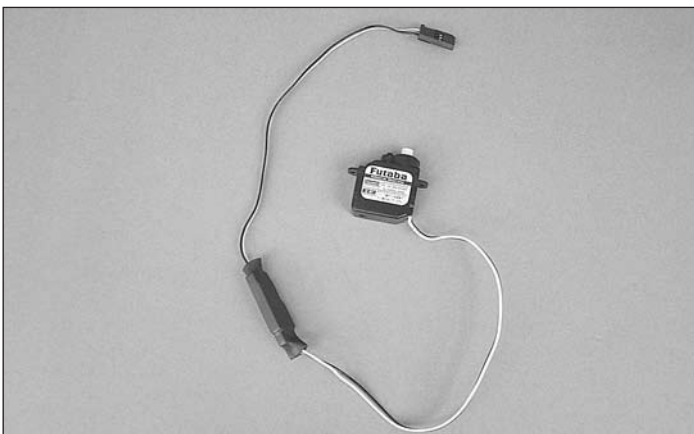
1. If you have not done so already, remove the major parts of the kit from the box and inspect for damage. If any parts are damaged or missing, contact **Product Support** at the address or telephone number listed in the *"Kit Inspection"* section on page 5.



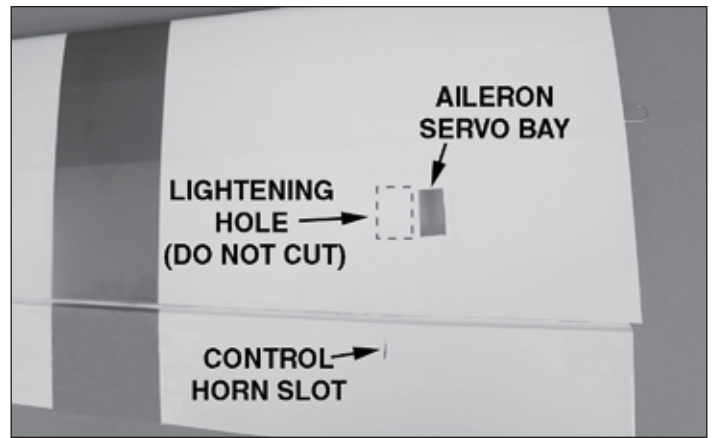
2. Carefully remove the tape on the horizontal stabilizer and separate the elevators. Use a covering iron with a covering sock on medium/high heat to tighten the covering if necessary. Apply pressure over sheeted areas to thoroughly bond the covering to the wood.

ASSEMBLE THE WING PANELS

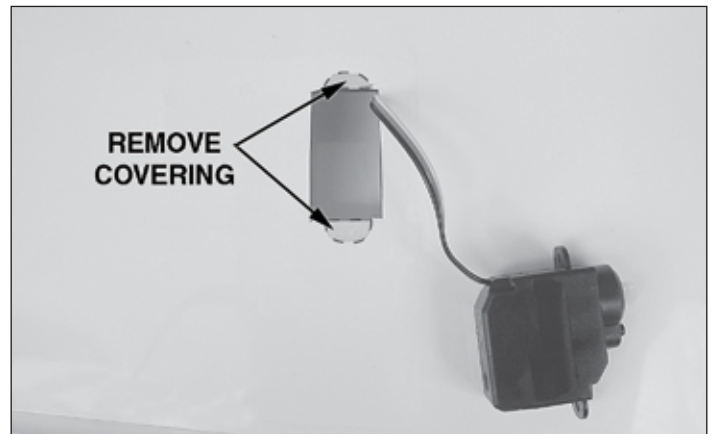
1. The aileron hinges for the SU-31 have been preinstalled. Please check them to be certain they are properly glued. If any of them are loose simply add a few drops of thin CA glue to the top and bottom of the hinge.



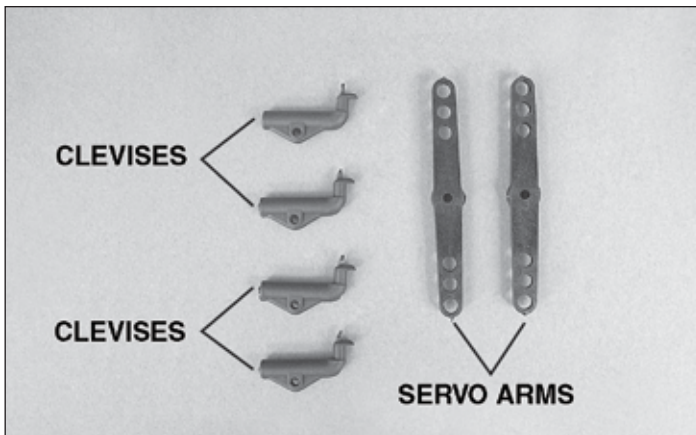
2. Attach a 6" [152mm] servo extension to each aileron servo and wrap the connection with electrical tape or 3/8" [9.5mm] diameter heat shrink tubing (not included).



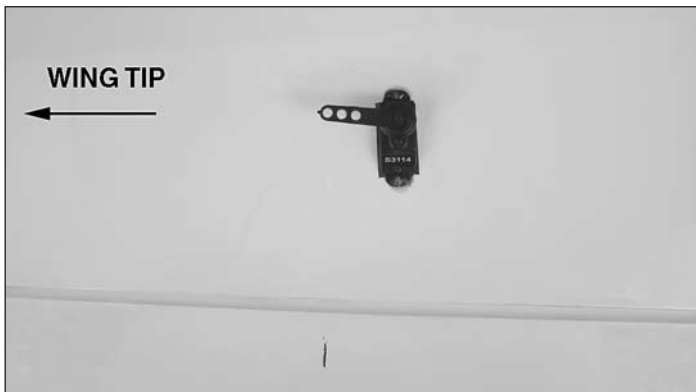
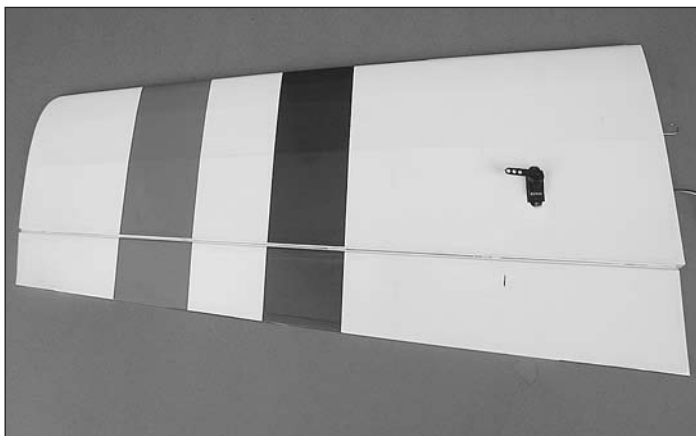
3. Trim the covering from the aileron servo bays on the undersides of the wing panels. Also trim the covering from the control horn slots in the ailerons. **Note:** The servo bay is on the inside portion of the servo mounting plate. There is a lightning hole on the outboard portion of the servo mounting plate that may easily be mistaken for the servo mounting position.



4. Insert the servo leads into the servo bays and pull them through the wing ribs. The servos can be installed using the hardware included with the servos or they can be glued in place. If gluing the servos in place, remove the covering just beneath the servo mounting tabs where they will contact the wing. This will ensure that the servo will be glued to the plywood servo bay, not just the covering. Roughing up the underside of each servo mounting tab with sandpaper will also improve glue adhesion. Glue the aileron servos into the servo bays using epoxy or CA glue with the servo splines facing the leading edge of the wings. After the glue has cured, confirm that the servos are properly secured to the wings and reinforce with extra glue if necessary.

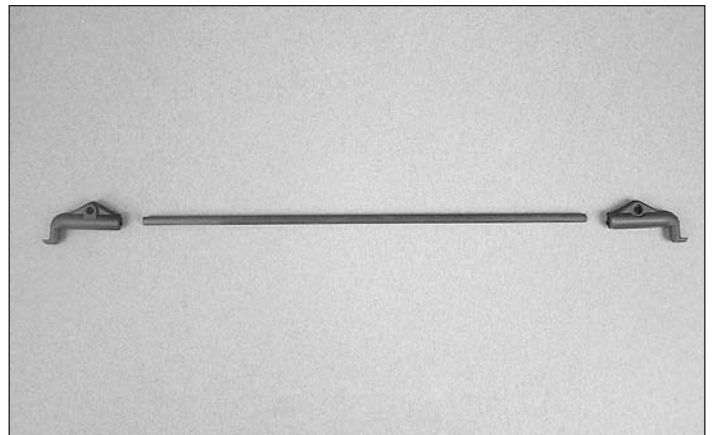


❑ 5. Locate two double-sided servo arms that fit the output splines of your aileron servos. Also, locate four adjustable clevises. If necessary, remove the flashing from the top of the clevises using some sandpaper. Be certain that the flashing is fully removed, or it will be very difficult to install the clevises.

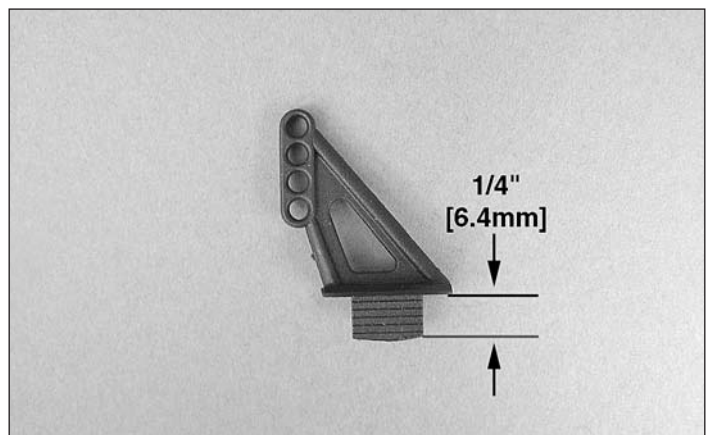


❑ 6. Temporarily connect the aileron servos and battery pack to your radio. Center the servos and trim levers on the

transmitter. Test fit the double-sided servo arms parallel to the aileron hinge line. Decide which way fits best (closest to parallel) and cut off the arm that isn't used. The remaining arm should point toward the wing tip. Be sure to make a left and right servo arm.



❑ 7. Fit an adjustable clevis onto both 2 x 100mm aileron pushrods.

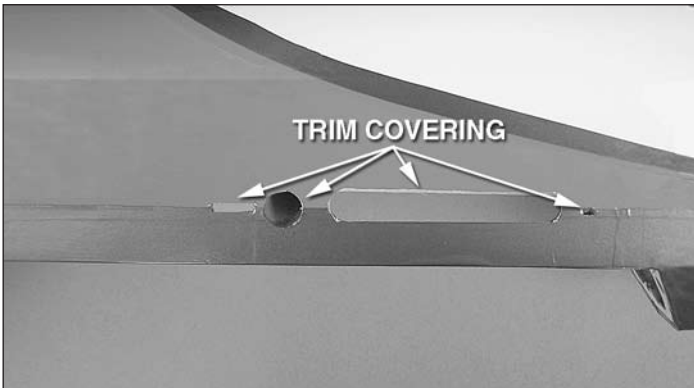


❑ 8. Trim the mounting tabs on two control horns so that they are 1/4" [6.4mm] long. Test fit the control horn into the control horn slot in the wing. Check to be sure that the horn holes sit over the hinge line. If they do not, use a hobby knife to enlarge the slot so that the horn holes sit over the hinge line. Coat the control horn mounting tabs with medium CA and press them into the slots in the ailerons.

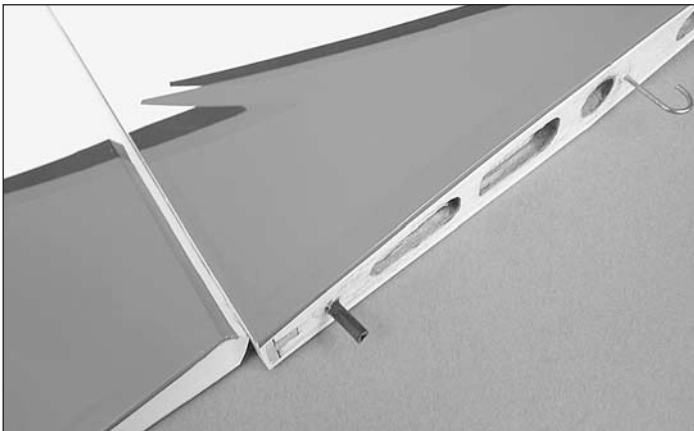


❑ 9. Fit the clevises on the aileron pushrods into the outer holes of the aileron control horns and servo arms as shown. (You may need to temporarily remove the servo arms from the servos.) With the servo arms parallel to the hinge lines and the ailerons in the neutral positions, center the length of the pushrods between the two clevises. When satisfied, lock the clevises onto the pushrods by threading a 2 x 4mm screw into each clevis screw hole. The screw head should fit into the recessed hole in the adjustable clevises as shown (installing the screws in the wrong direction may not properly tighten the clevises onto the pushrods).

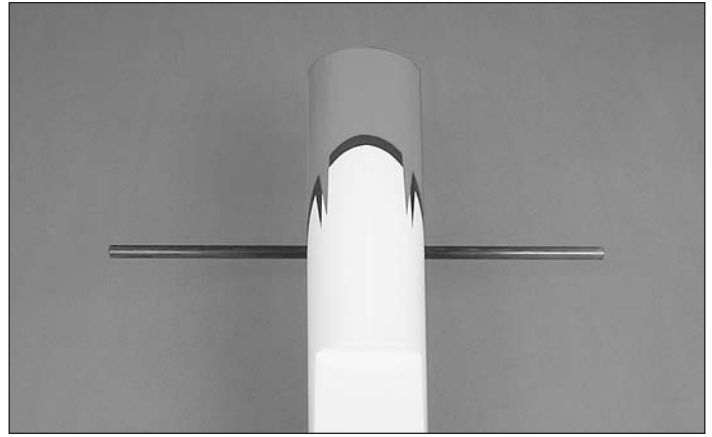
INSTALL THE WING PANELS



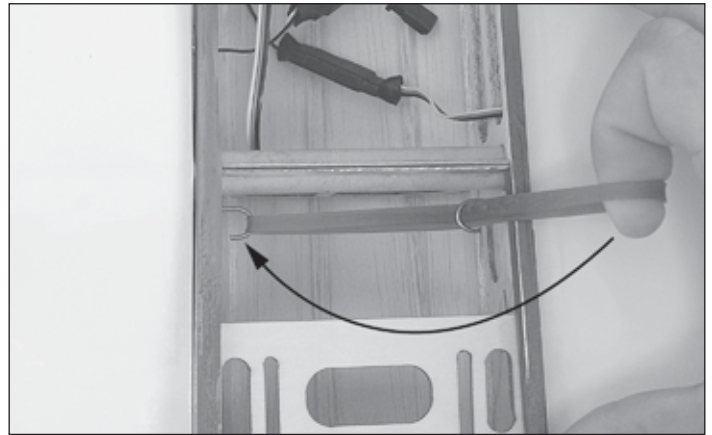
❑ 1. Trim the covering in the fuselage for the wing tube, wing mounting hooks, servo lead holes and anti-rotation pin.



❑ 2. Glue the 3 x 15mm carbon anti-rotation pins halfway into the holes in the wing root ribs using medium CA glue.

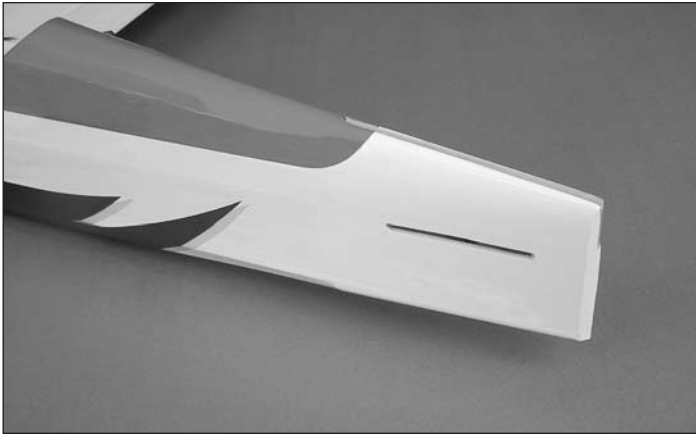


❑ 3. Slide the carbon wing tube into the wing tube channel in the fuselage and center its position.

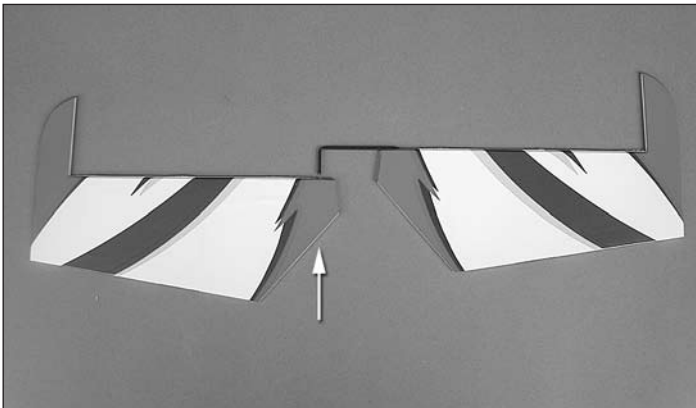


❑ 4. Slide the wing panels onto the wing tube and push them in place against the fuselage sides by fitting the anti-rotation pins into their mating holes. Secure the wing by hooking one end of a rubber band to one wing hook, wrapping the rubber band around the other wing hook and returning the rubber band to the original wing hook. Further secure the wing with a second rubber band, installing it in the same manner.

ASSEMBLE THE TAIL SECTION



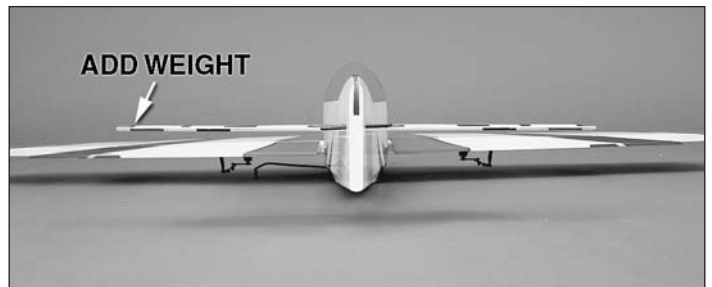
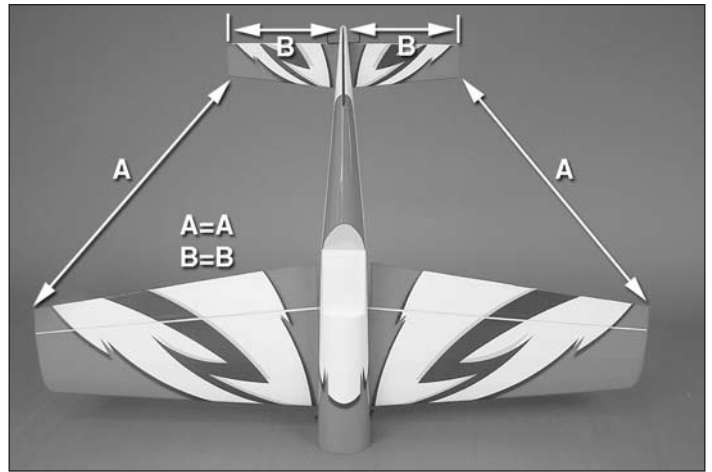
- ❑ 1. Trim the covering from the horizontal stabilizer slot in the fuselage.



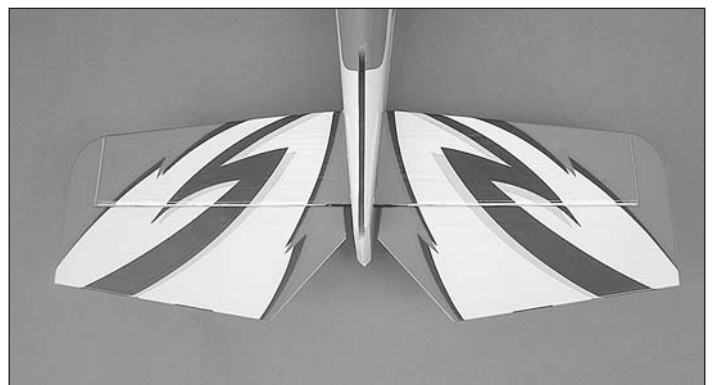
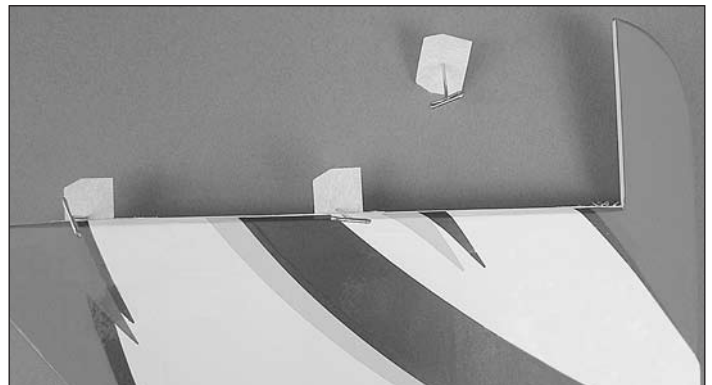
- ❑ 2. **Test fit** the elevator joiner wire into the elevator halves. Lay the elevators on a flat surface to confirm that they both lay flat. If not, “tweak”, or bend, the elevator joiner wire slightly until they do. Do not attempt to bend the joiner wire while it is installed in the elevators. Do not glue the joiner wire in place at this time.



- ❑ 3. Insert the elevator joiner wire into the aft end of the stab slot. Test fit the horizontal stab into the slot in front of the joiner wire. The joiner wire must be able to swivel freely inside the slot. If it cannot, remove the horizontal stab and carefully enlarge the slot as necessary with a hobby knife. Place a few drops of oil on the center portion of the elevator joiner so that it does not get glued.



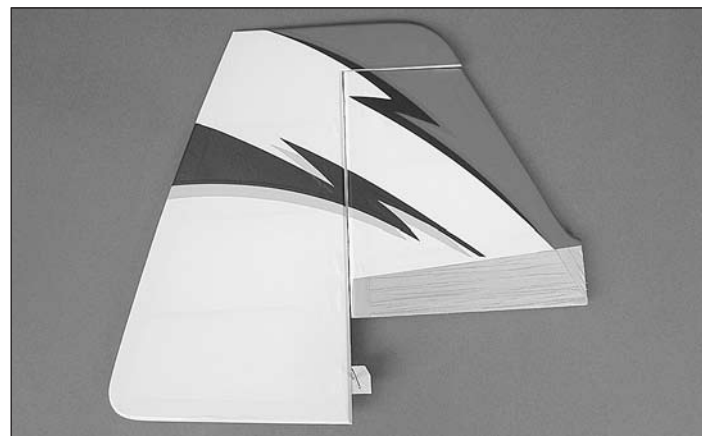
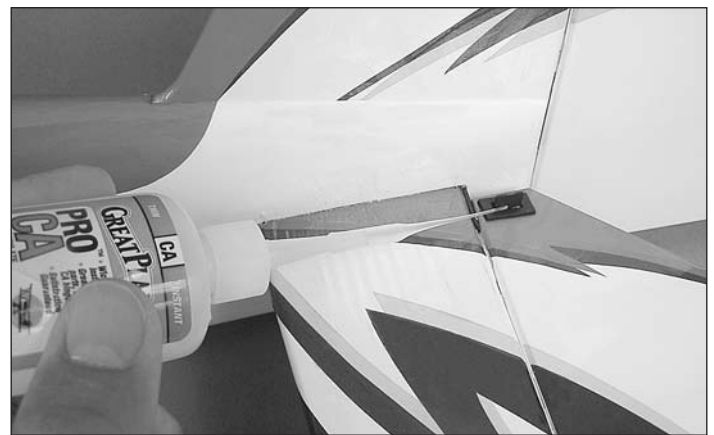
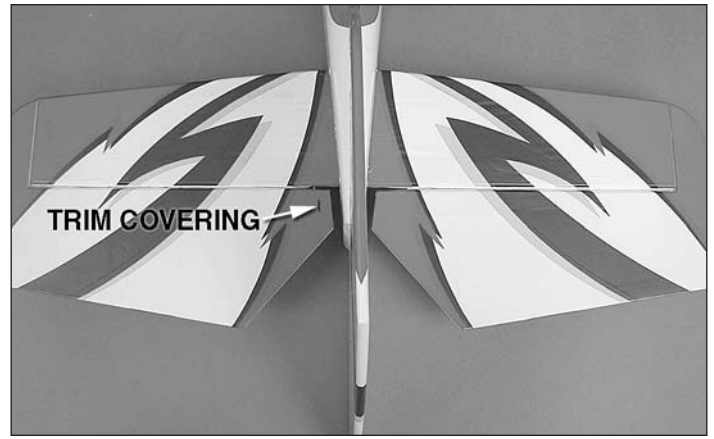
- ❑ 4. Position the horizontal stabilizer into the stab saddle, centering it left and right and making it square to the wings. Stand back several feet behind the model and view it from the rear. Confirm that the stabilizer is parallel with the wing panels. If not, use tape or a weight to straighten it. **Be sure that the elevator joiner wire is in place before gluing the stab!** Thin CA glue or epoxy can be used to glue the stabilizer in place.



- ❑ 5. Before gluing the elevator halves, roughen the ends of the elevator joiner wire with sandpaper and clean them off

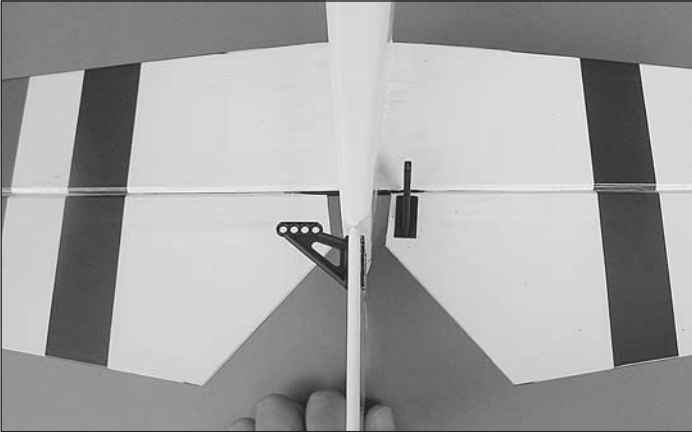
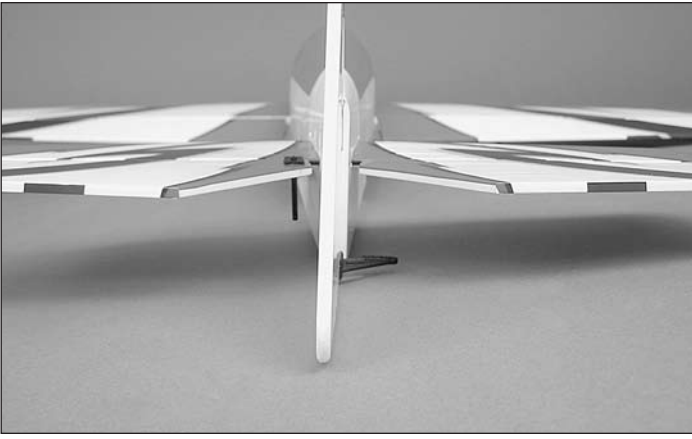
with alcohol. Prepare the elevators by inserting a CA hinge into each hinge slot. Use T-pins to keep the hinges centered. Put a light coating of epoxy onto the ends of the elevator joiner wire. Install the elevators onto the joiner wire while fitting the CA hinges into their mating slots in the horizontal stabilizer. Use thin CA to glue the hinges in place. Set the airplane aside to let the epoxy cure.

❑ 6. Trim the covering from the vertical fin slot in the fuselage. Test fit the vertical fin into the slot. Confirm that the fin is perpendicular to the wings. If not, carefully sand the slot as necessary until the correct fit is achieved. Remove the fin.

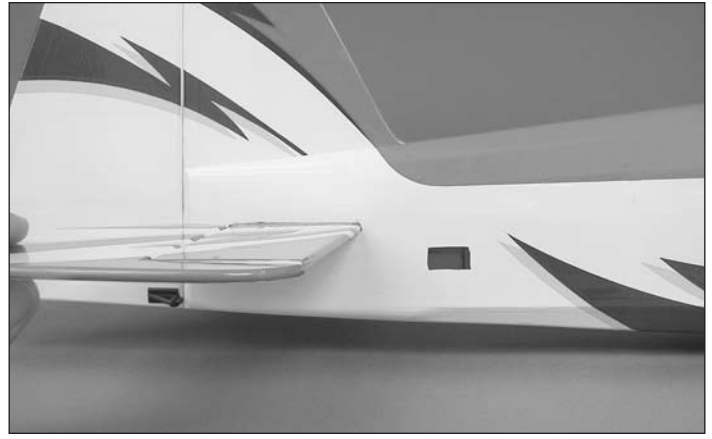


❑ 7. Insert a T-pin into the center of a CA hinge. Insert half of the hinge into the bottom of the rudder. Slide the hinge and the fin into place. Glue the fin in place using some thin CA or epoxy. Add some thin CA to the hinge at the bottom of the rudder.

❑ 8. Trim the covering from the control horn slot in the left elevator (both top and bottom) and insert a control horn into the slot on the underside of the elevator. Press a control horn backplate onto the control horn tab on top of the elevator. Apply a few drops of CA glue to the control horn and backplate to secure them in place. The control horn tab can be trimmed flush with the backplate.

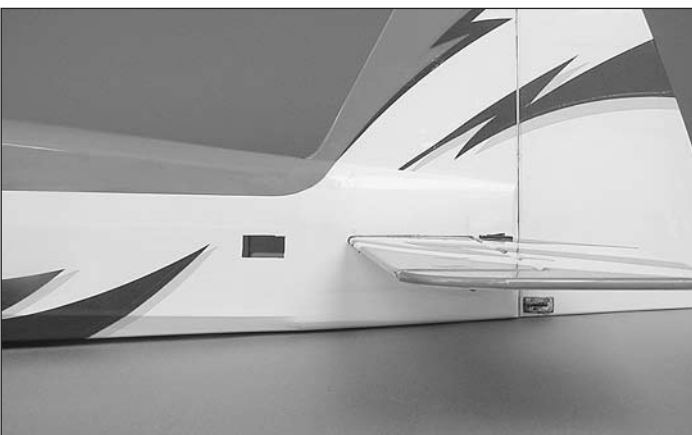


❑ 9. Attach a control horn to the right side of the rudder in the same manner.



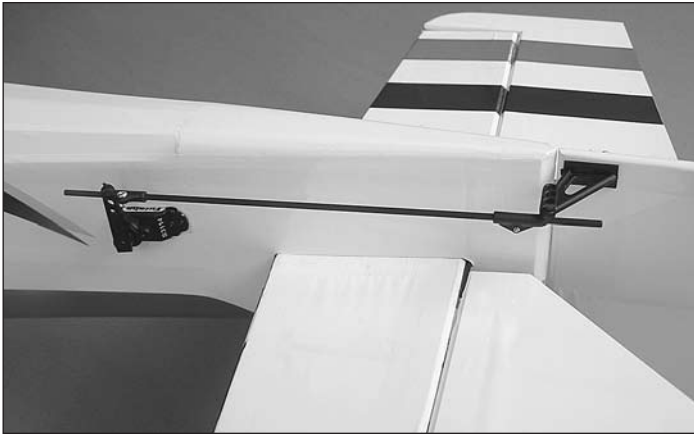
❑ 1. Trim the covering from the elevator and rudder servo bays on both sides of the fuselage as shown. **Note:** Please pay close attention to the location of the servo mounting holes in the preceding pictures. There are several lightening holes in this area of the airframe that might be mistaken for servo mounting holes. The servo mounting holes can be distinguished because they have sharp 90° corners.

INSTALL THE TAIL SERVOS & PUSHRODS

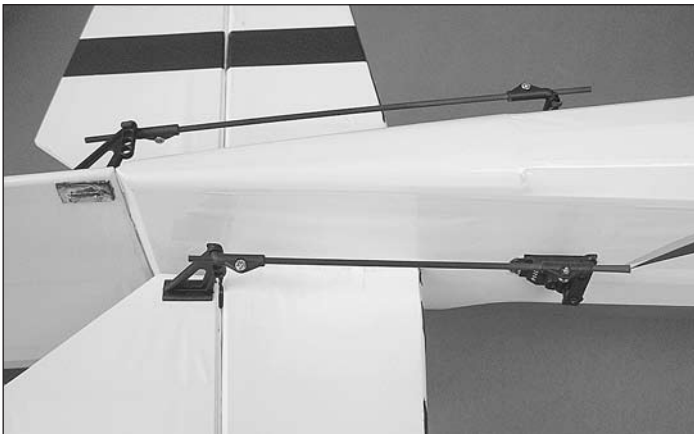


❑ 2. Attach a 12" [305mm] slim servo extension to the elevator and rudder servos. Use your radio system to center the servos. Before installing the servos, test fit double-sided servo arms to determine which arm is closest to perpendicular with the tail servo case sides. Cut off the arm that is not used. If neither of the servo arms are close to perpendicular with the servo case sides, locate the single-sided servo arm and check it. Secure the servos in the servo bays with the splines facing forward. If using CA glue to mount the servos, do not forget to trim the covering so that the servo mounting tabs can be glued directly to the wood underneath.

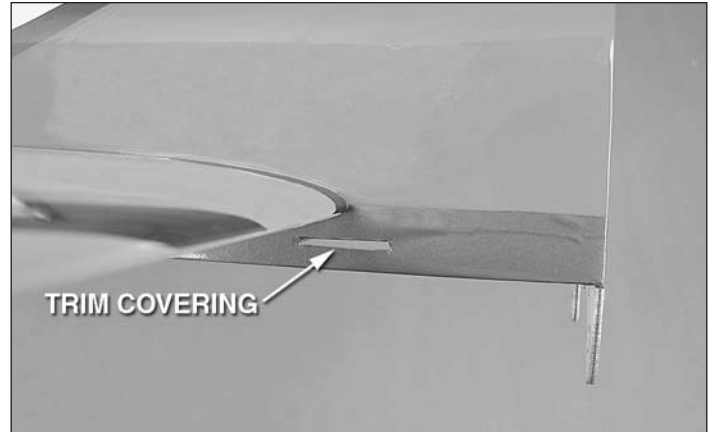
INSTALL THE LANDING GEAR



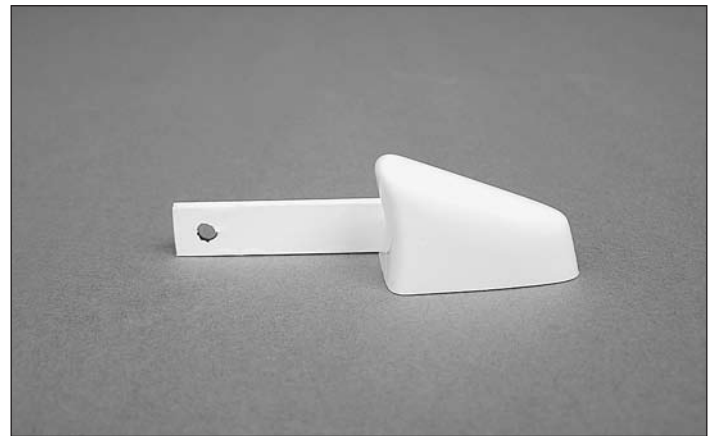
❑ 3. Attach an adjustable clevis to the outer holes of the servo arm and rudder control horn. Attach the arm to the servo with the servo arm screw. Install a 6-3/4" [170mm] pushrod into the clevises, center the control surface, and use 2 x 4mm self-tapping screws to secure the clevises to the pushrod.



❑ 4. Install the elevator pushrod in the same manner using the remaining 6-3/4" [170mm] pushrod. Use some diagonal cutters or a rotary tool to trim the pushrod so that it extends 1/2" [13mm] past the clevis.



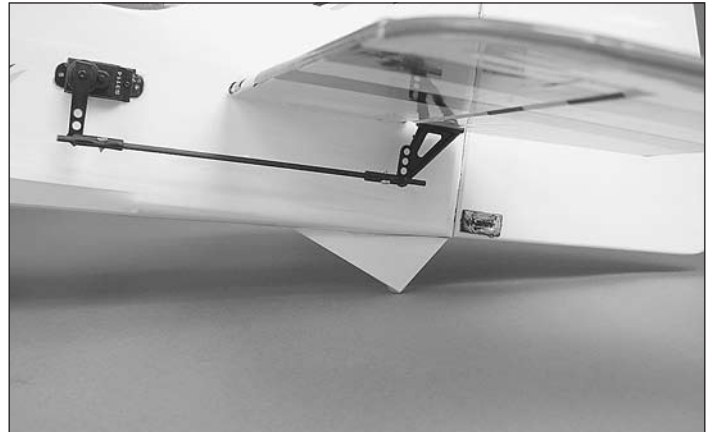
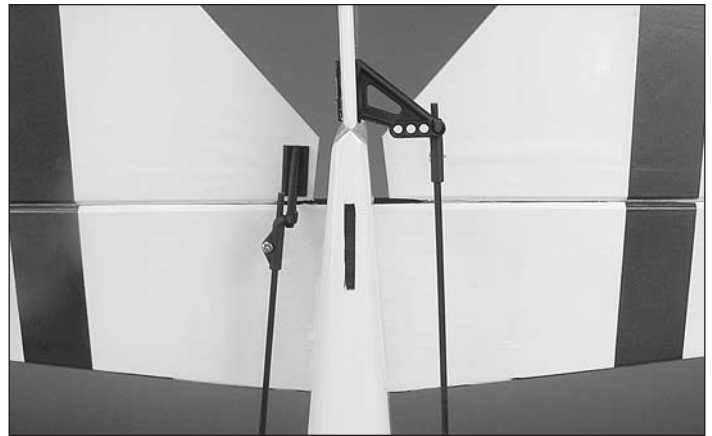
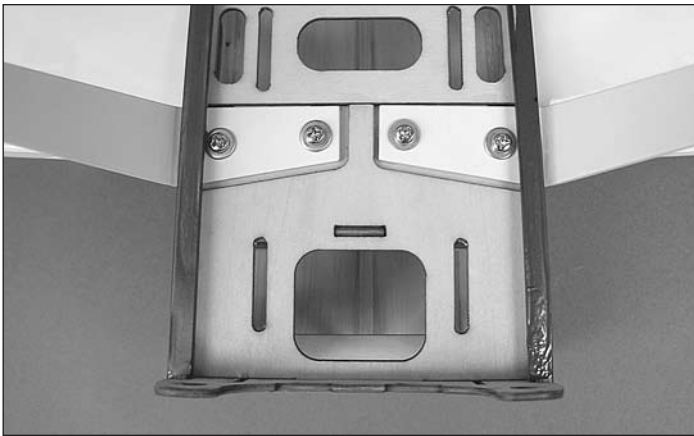
❑ 1. Trim the covering from the landing gear slots in the fuselage. This slit is located just under the LE of the wing root.



❑ 2. Locate the wheel spats and open up the spat mounting hole.



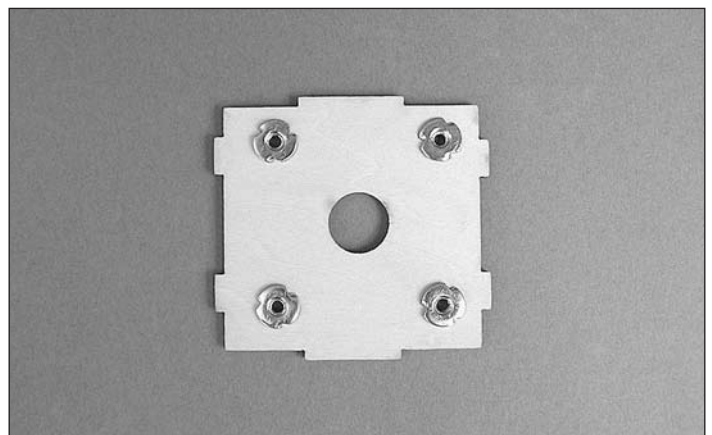
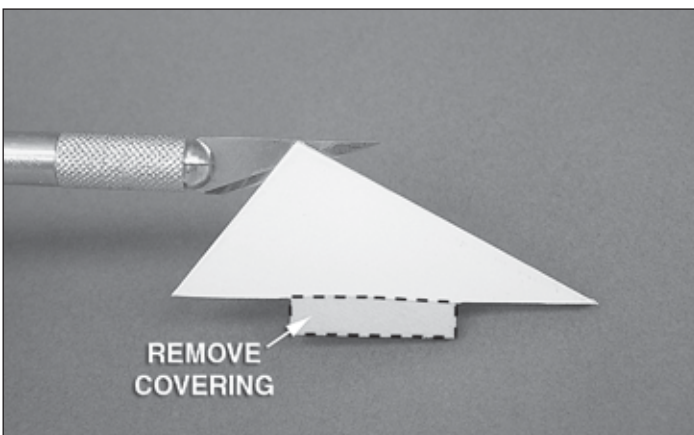
❑ ❑ 3. Fit the 3 x 25mm machine screw (axle) through the axle hole in the wheel and secure the wheel to the axle using a 3mm nut, 3mm washer, and threadlocking compound. Be sure the nut is loose enough to allow the wheel to rotate freely on the axle. Add a 3mm washer, wheel spat, landing gear, second 3mm washer, and 3mm nut to the axle. When assembled correctly, the tapered sides of the landing gear should face the front of the plane and sweep slight rearward when installed. Repeat this step for the other landing gear.



❑ 4. Attach the landing gear to the fuselage using four 3 x 8mm machine screws, four 3mm washers, and threadlocking compound. Adjust the wheel spats so that they sit parallel with the wing and fuselage.

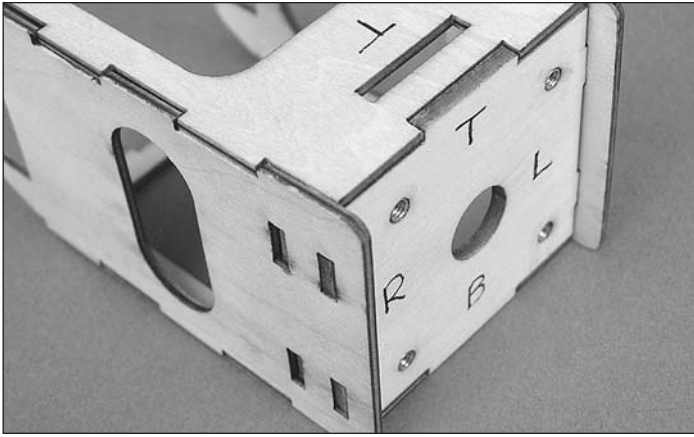
❑ 6. Trim the covering from the tail skid slot at the aft end of the fuselage. Glue the tail skid into the slot using medium CA or epoxy.

MOUNT THE MOTOR, ESC & RECEIVER



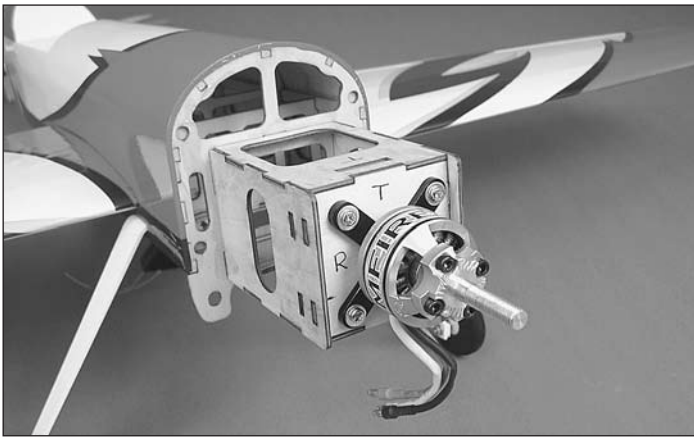
❑ 5. Remove the covering from the tab portion of the tail skid. Use a hobby knife to cut open the covering over the slot in the bottom tip of the tail skid. Glue a 3mm washer into the slot. The washer will prevent the tail skid from being worn down when flying from a paved runway.

❑ 1. Install four 3mm blind nuts to the back of the motor mount. The back of the motor mount does not have any writing on it. If you are installing a non-ElectriFly motor you may need to drill different holes and install the blind nuts in those.

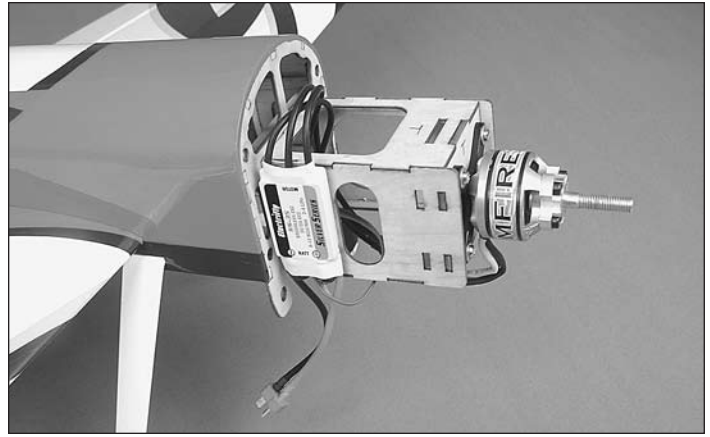


❑ 2. Test fit the motor mount box together. The pieces are labeled and the motor mount is correspondingly marked. When the motor mount box is correctly assembled it should have right thrust and the four holes the blind nuts have been installed in should be slightly offset to the left. If using the recommended RimFire .10 (35-30-1250) brushless out-runner motor, it is best to use the motor mounting position that is farthest forward, as shown in the photo.

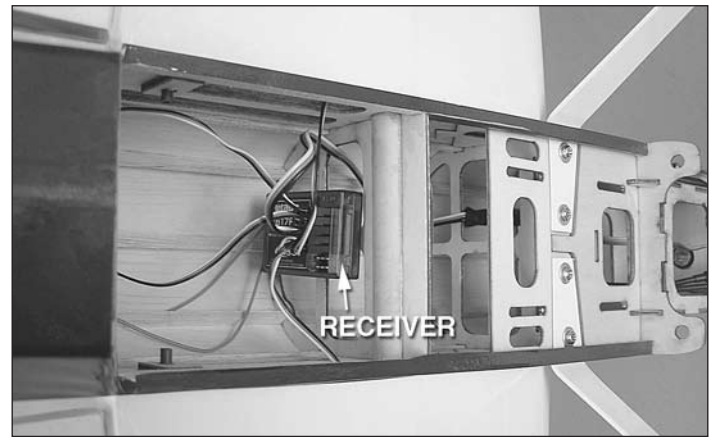
❑ 3. Test fit the assembled motor mount onto the front of the airplane. Once certain that the motor mount is assembled correctly, epoxy the motor mount together using 30-minute epoxy. Use some clamps or wrap tape around the motor mount to hold it in position. While the glue is still curing, epoxy the motor mount to the front of the airplane. Use some tape or clamps to hold it in position while the glue cures. **Note:** It may be helpful to stand the airplane on its nose while the glue cures.



❑ 4. Once the epoxy has had plenty of time to cure, remove the tape and install the motor using the "X" shaped mount provided with the motor. Secure the motor to the motor mount with four 3 x 8mm machine screws and 3mm washers. Do not forget to use threadlocking compound when installing the "X" mount to the motor and when installing the motor to the airplane.

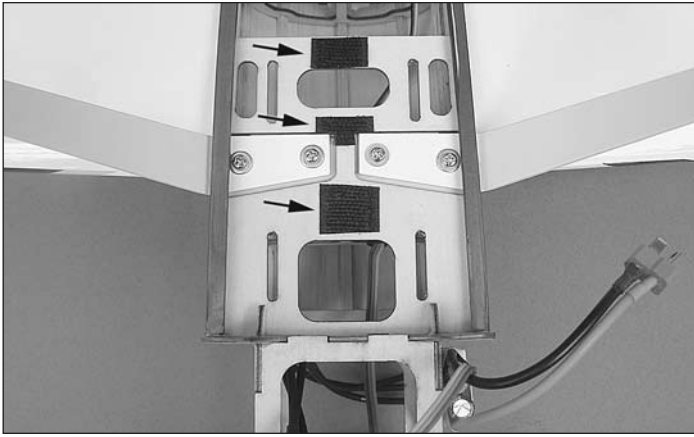


❑ 5. Connect the motor leads on the ESC to the motor. This is a good time to confirm that the motor will rotate the correct direction (use your radio system to test the motor operation). If the motor is rotating the wrong direction, disconnect any two of the three motor leads and swap their position. Using some double-sided foam tape, mount the ESC to the side of the motor box, as shown. A thin coating of epoxy will improve the adhesion of the double-sided foam tape. Allow the epoxy to fully cure before applying the tape.



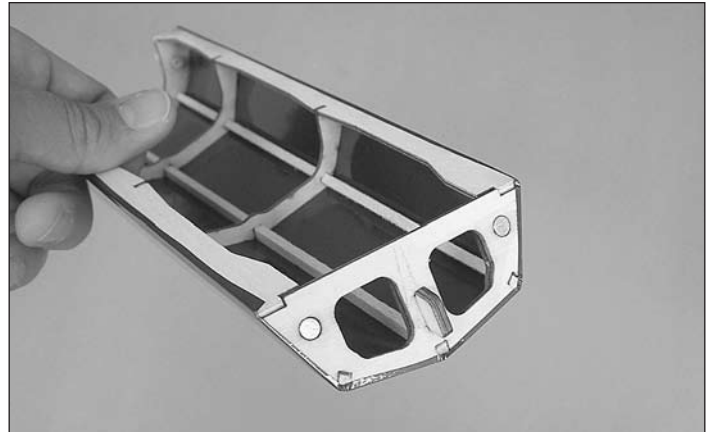
❑ 6. Connect the servo leads and ESC to the receiver. Depending on where you mount the receiver, you may need to add a 6" [152mm] servo extension to the ESC lead. If you are using a 4-channel receiver, you will need a dual servo extension or Y-harness for the aileron servos. Cut a piece of double-sided servo tape to secure the receiver inside the fuselage.

❑ 7. If using a 2.4 GHz receiver, tape the antennas to the inside of the fuselage. If using a 72 MHz receiver, make a small hole in the fuselage, just under the wing. Run the antenna out of the hole and tape it to the rear, underside of the fuselage.

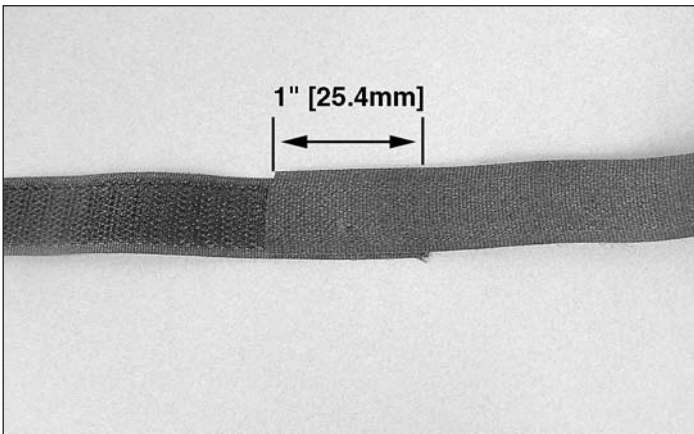


❑ 8. Cut a small amount of the hook side of the non-adhesive back, hook and loop material. Apply it to the battery tray using some CA glue in the locations shown. Apply the loop side of some self-adhesive hook and loop material to the underside of the battery. This will keep the battery from sliding when it is strapped in.

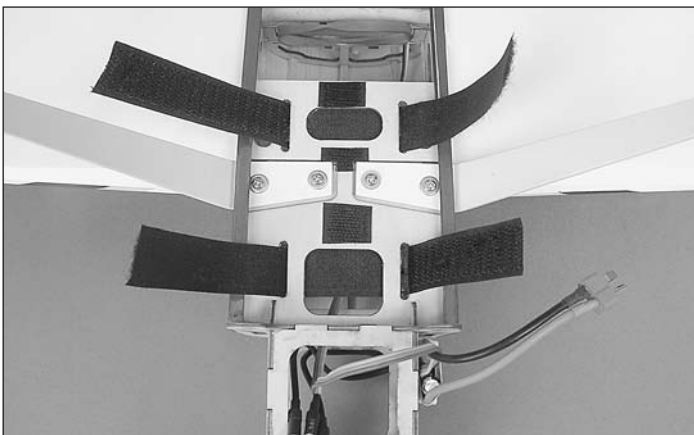
you balance the model, the exact position of the battery pack will be determined. When you know where the pack will need to be to be balanced mark its position onto the battery tray.



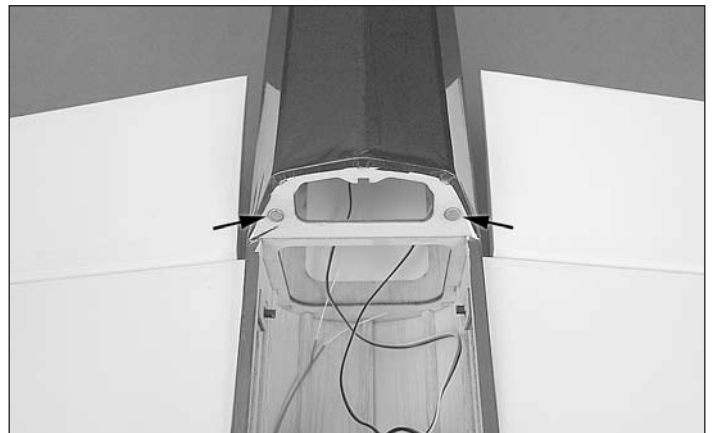
❑ 10. Glue the two hatch dowels halfway into the holes in the front of the battery hatch. Glue two magnets into the battery hatch with thin CA glue as shown. Do not use too much CA because it may prevent the magnets from sitting flush inside the holes. If the magnets do not sit flush with the aft end of the hatch, use long nose pliers to carefully press them in place. Let the CA glue harden without accelerator.

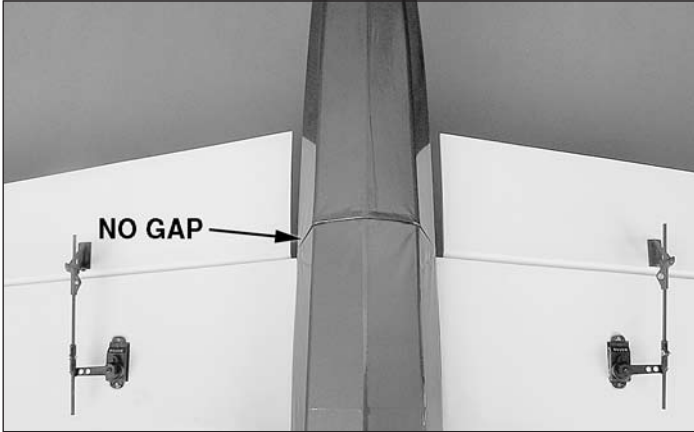
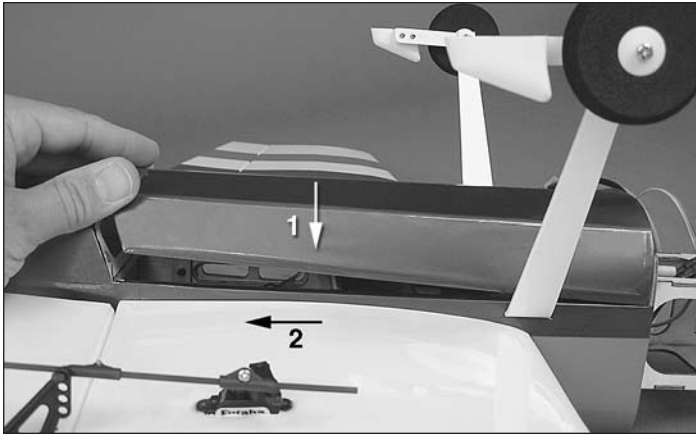


❑ 11. The magnets in the fuselage must be attracted to the magnets in the battery hatch. **Be sure that the magnets are oriented correctly and glue two magnets into the fuselage in the locations shown.**



❑ 9. Cut the provided non-adhesive hook and loop material in half. Straps can be made from the included non-adhesive hook and loop material for securing the battery pack to the tray by overlapping the mating ends of the pieces. The straps should be wrapped around the tray and battery tightly. When

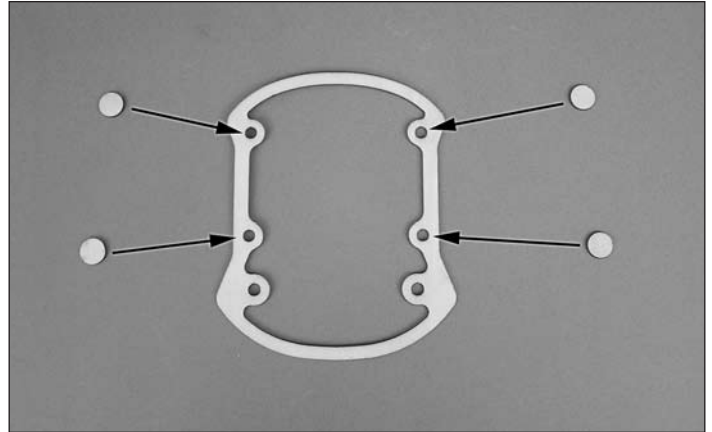




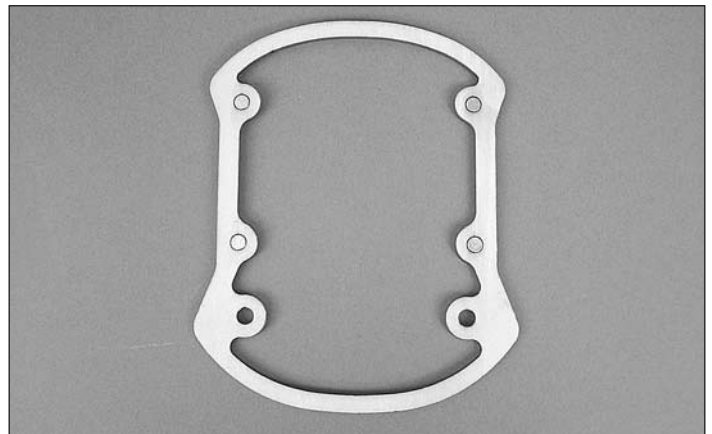
❑ 12. To install the hatch, slide the dowels into the former at the front of the airplane. Then press the hatch against the fuselage and slide it rearward. When it is installed properly there should not be a gap between the aft end of the hatch and the fuselage.

INSTALL THE COWL, CANOPY & SPINNER

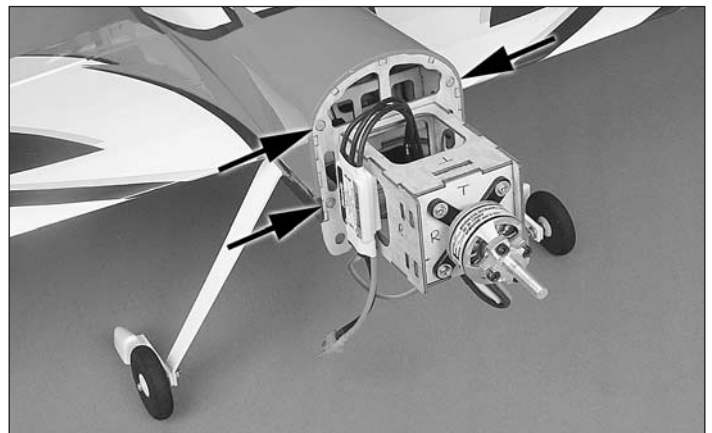
❑ 1. Prepare the inside of the cowl by lightly scuffing it with 220-grit sandpaper. When satisfied, clean the inside with alcohol.



❑ 2. Glue the four plywood magnet back pieces to the cowl ring. **Note:** Pay attention to the position of the cowl magnet mounting holes in the photograph. The cowl ring is designed so that it is locked in place with the hatch dowels. Do not glue the magnet back pieces over the lower cowl ring holes.

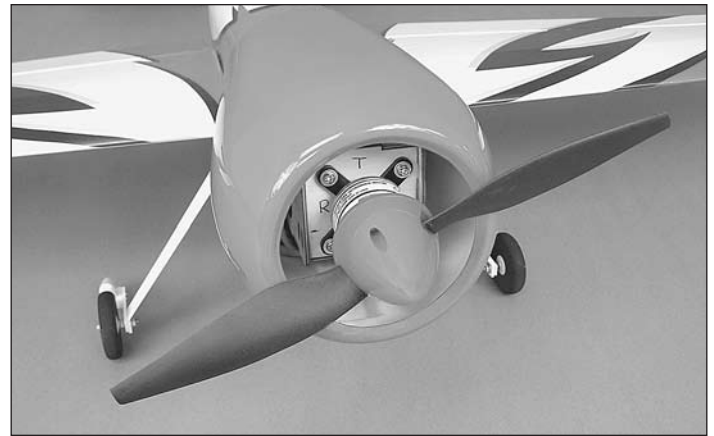
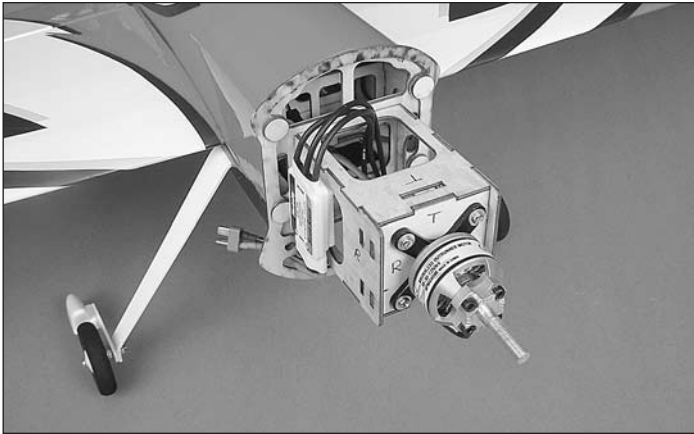


❑ 3. Glue a magnet into each of the four holes in the cowl ring by coating the insides of the holes with medium CA. Let the CA glue cure without accelerator.

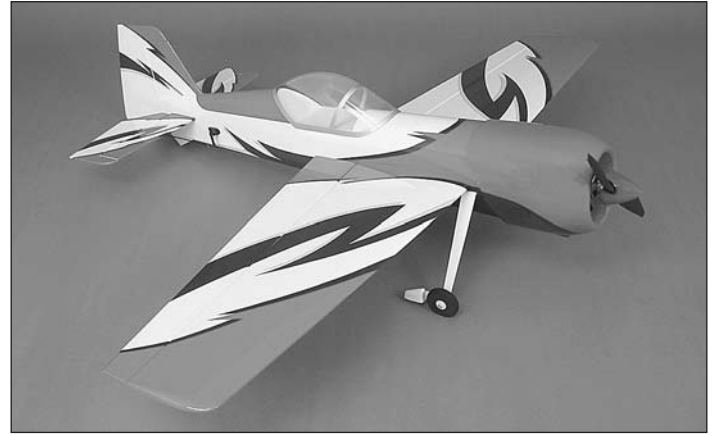


❑ 4. Glue four magnets into the holes in the fuselage as shown. **Be sure that the magnets are glued with the**

correct polarity facing out! The magnets in the fuselage must be attracted to the magnets in the cowl ring. Let the CA cure without accelerator.



❑ 7. Reattach the cowl to the fuselage. Install the propeller, prop washer, and prop nut onto the prop shaft. Install the spinner cone using the included spinner screws. Depending on the size propeller being used, the slots in the spinner cone may need to be enlarged using a hobby knife or rotary tool.



❑ 5. If the hatch is installed, remove it. Connect the cowl ring onto the fuselage. Slide the cowl over the cowl ring and onto the fuselage. Confirm that the spinner backplate and propeller fit your motor shaft. If not, ream or drill them to the correct diameter. Temporarily install the spinner backplate and propeller onto the prop shaft. Adjust the position of the cowl on the fuselage so that the colors line up with the covering on the fuselage. The spinner backplate should be centered over the front cowl opening, and the prop should be approximately 1/8" [3.2 mm] beyond the front edge of the cowl, all the way around. When satisfied, tack glue (medium or thick CA recommended) the cowl to the cowl ring in three or four spots by reaching through the front opening in the cowl. A CA applicator tip is very useful in this step. If you do not have an applicator tip long enough, use a stick to apply a dot of epoxy to each of the four cowl ring corners. **Be careful not to glue the cowl ring to the firewall!** As an additional precaution, you can use one of the plastic bags that came in the plane box as a protective liner between the cowl ring and firewall.

❑ 8. If you plan to install the instrument panel decal, do so now. Finish up the assembly by taping the canopy in position. Clear tape works well for this.

❑ 6. Carefully remove the cowl (and cowl ring) from the fuselage and apply a fillet of medium or thick CA glue along the front of the cowl ring where it touches the cowl.

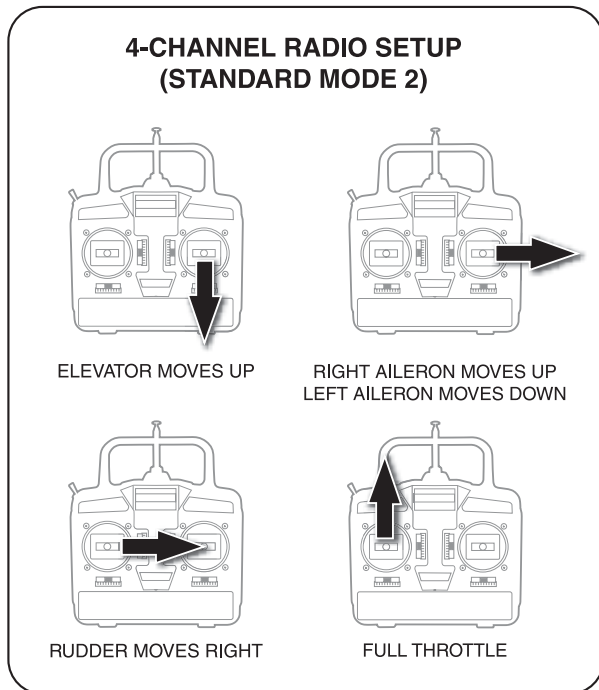
Apply the Decals

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 and 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

Check the Control Directions

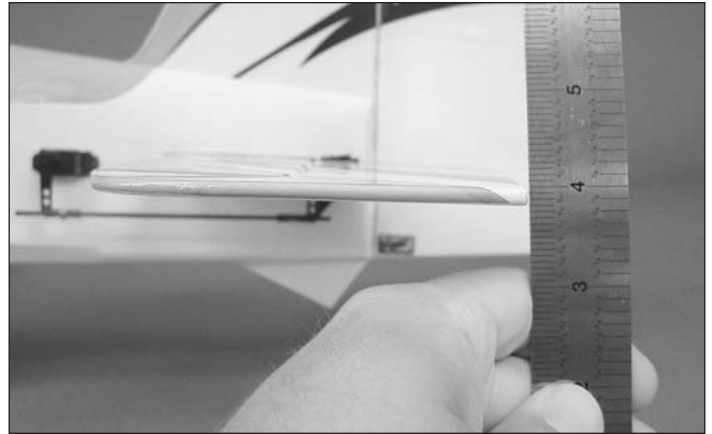
- ❑ 1. Turn on the transmitter and receiver and center the trims. If necessary, remove the servo arms from the servos and reposition them so they are centered. Reinstall the screws that hold on the servo arms.
- ❑ 2. With the transmitter and receiver still on, check all the control surfaces to see if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



- ❑ 3. Make certain that the control surfaces and the throttle 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.

- ❑ 4. After checking the control directions and centering the control surfaces, it is recommended to apply a drop of thin CA glue to each carbon pushrod where it meets the adjustable clevis. This will ensure that the pushrods will not change position in the clevises during flight.

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 for your first few flights 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:

LOW RATE

ELEVATOR:	3/8" [9.5mm], 7° up 3/8" [9.5mm], 7° down
RUDDER:	1-1/4" [32mm], 16° left 1-1/4" [32mm], 16° right
AILERONS:	1/2" [13mm], 9° up 1/2" [13mm], 9° down

HIGH RATE

ELEVATOR:	1/2" [13mm], 10° up 1/2" [13mm], 10° down
RUDDER:	2" [51mm], 26° left 2" [51mm], 26° right
AILERONS:	3/4" [19mm], 14° up 3/4" [19mm], 14° down

3D RATE

ELEVATOR:	2-1/4" [57mm], 48° up 2-1/4" [57mm], 48° down
RUDDER:	3-1/4" [83mm], 45° left 3-1/4" [83mm], 45° right
AILERONS:	1-5/8" [41mm], 32° up 1-5/8" [41mm], 32° down

Note: It is highly recommended that a computer radio with exponential be used if this airplane is to be flown using the 3D control surface throws. Use the exponential function to lessen the control movement around center without changing the control surface endpoints. -50% is a good exponential starting value to use for these 3D rates. Feel free to adjust the 3D throw exponential value to suit your flying style.

IMPORTANT: The Sukhoi SU-31 EP 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 Sukhoi SU-31 EP ARF 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."

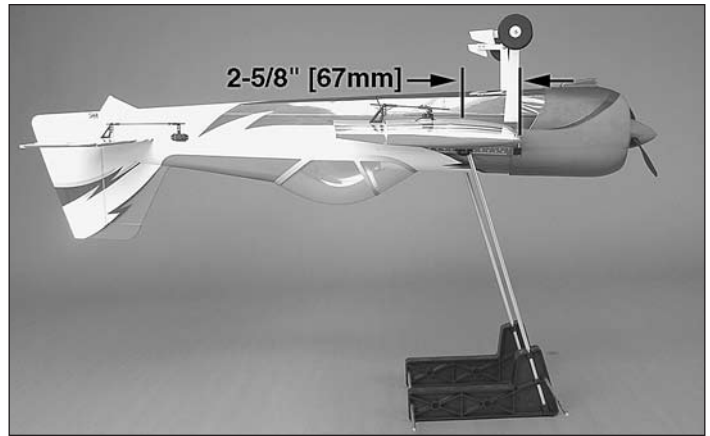
Balance the Model (C.G.)

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 motor, landing gear, battery pack, and the radio system.

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 recommended C.G. is located 2-5/8" [67mm] back from the LE of the wing at the fuselage.

This is where your model should balance for the first flights. Later, you may wish to experiment by shifting the C.G. up to 5/32" [4mm] forward or 7/32" [5.6mm] 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 all parts of the model installed (ready to fly) and the battery pack installed, place the model upside-down on a Great Planes C.G. Machine, or lift it 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 to balance. If the nose drops, the model is "nose heavy" and the battery pack and/or receiver must be shifted aft to balance. If possible, move the battery pack and receiver to minimize or eliminate any additional ballast required.

4. **IMPORTANT:** If you found it necessary to move the battery pack or receiver for the Sukhoi SU-31 EP ARF to balance, recheck the C.G. after this has been done.

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 fuselage 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

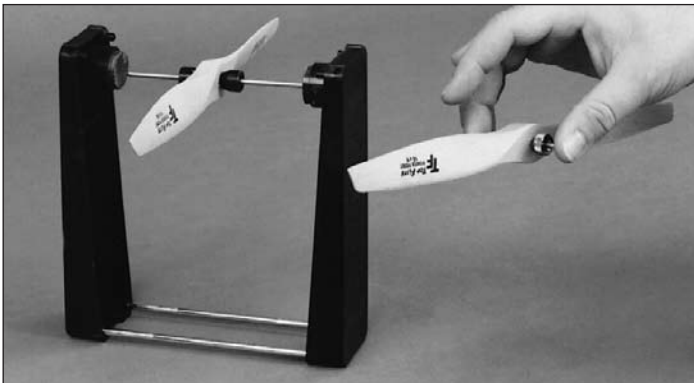
No matter if you fly at an AMA sanctioned R/C club site or if you fly somewhere on your own, you should always have your name, address, telephone number and AMA number on or inside your model. It is **required** at all AMA R/C club flying sites and AMA sanctioned flying events. Fill out the identification tag on page 23 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 battery 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 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.

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 away from the model and still have control. (Consult your radio manual for range checking 2.4 GHz systems.) 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 motor 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.

MOTOR SAFETY PRECAUTIONS

Failure to follow these safety precautions may result in severe injury to yourself and others.

Get help from an experienced pilot when learning to operate electric motors.

Use safety glasses when running electric motors.

Do not operate the motor 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 operate the motor.

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

The motor gets hot! Do not touch it during or right after operation.

LITHIUM BATTERY HANDLING & 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 LiPo 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 3.0V 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.

- 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 fuselage. 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. Add a drop of oil to the axles so the wheels will turn freely.
- 6. Make sure all hinges are **securely** glued in place.
- 7. Confirm that all controls operate in the correct direction and the throws are set up according to the manual.
- 8. Make sure that all servo arms are secured to the servos with the screws included with your radio.
- 9. Secure connections between servo wires and Y-connectors or servo extensions with heat shrink tubing or special clips suitable for that purpose.
- 10. Balance your propeller (and spare propellers).
- 11. Tighten the propeller nut and spinner.
- 12. Place your name, address, AMA number and telephone number on or inside your model.
- 13. If you wish to photograph your model, do so before your first flight.
- 14. Range check your radio when you get to the flying field.

FLYING

The Sukhoi SU-31 EP ARF is a great-flying model that flies smoothly and predictably. The Sukhoi SU-31 EP ARF does not, however, possess the self-recovery characteristics of a primary R/C trainer and should be flown only by experienced R/C pilots.

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

If you have access to a smooth, paved runway, we suggest using it to takeoff, especially for the first few flights. Position the Sukhoi SU-31 EP ARF onto the runway pointed into the wind. Slowly advance the throttle stick to half throttle, leaving the elevator in the neutral position. As the tail rises off the ground, slowly increase throttle and apply a bit of up elevator to lift the model into the air. As you become accustomed to the takeoff characteristics of the Sukhoi SU-31 EP ARF, they can be performed quickly, only requiring five to ten feet of runway until the model is airborne.

If you do not have access to a smooth runway, the Sukhoi SU-31 EP ARF can be hand launched. For the first flight, it is a good idea to have someone launch the airplane for you. This allows you to keep your hands on the radio sticks and correct any trim problems that are present.

Have the person launching the Sukhoi SU-31 EP ARF hold the plane by the fuselage just below the canopy. Throttle up to full power and have your helper give the plane a gentle, underhanded toss at about a 30° angle upward into the wind. The high thrust-to-weight ratio will allow the plane to accelerate to flying speed almost instantly. Climb to a comfortable altitude and throttle back to a lower power setting.

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 Sukhoi SU-31 EP ARF 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 battery charge, 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 she 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.

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!

This model belongs to:	
	Name
	Address
	City, State Zip
	Phone number
	AMA number

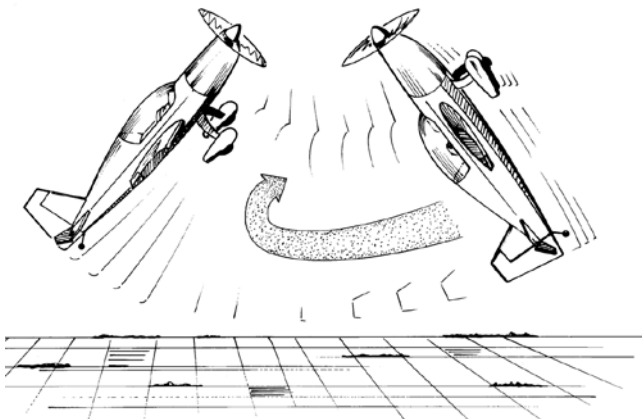
Make a copy of this identification tag and put it on or inside your model.

3D FLYING

Because of the power-to-weight ratio on 3D planes, straight-and-level flight should be at a reduced throttle and full power should be used only when the airplane is “loaded” during a maneuver. Learn to manage the throttle and experiment while in the maneuver. The power needed will depend on the maneuver being performed. C.G. also plays a large role in the 3D capability of models as well. Experiment, but keep in mind that being tail heavy is not always the best way to go.

Another thing to remember is that maximum control throw is not necessary for all 3D maneuvers. Occasionally, too much throw can place the model too far into a stall, causing it to become uncontrollable. Practice your maneuvers at a higher altitude while you become accustomed to your particular plane’s stall characteristics.

WATERFALLS



With the model pointing vertically (almost in a hover), push full down elevator and full throttle. As the model rotates and begins to point downwards, reduce the throttle (to keep the model from being pulled downwards). As the model flattens

out, add power to pull the model around. Many models will require some rudder correction (usually right rudder) during this maneuver. Some planes will require aileron correction to keep the wings level.

UPRIGHT FLAT SPINS

Pull the nose up slightly and slowly decrease power. As the model slows to a few mph, slowly apply full left rudder and power. Next, start adding up elevator as needed to keep the model flat in the spin. Most airplanes will require some aileron as well to keep the wings level. This is one of the maneuvers to experiment on; try different C.G. positions and different amounts of throw and power to see how flat the spin will go. It is possible to maintain altitude in the flat spin and in some cases it is also possible to climb during the spin.

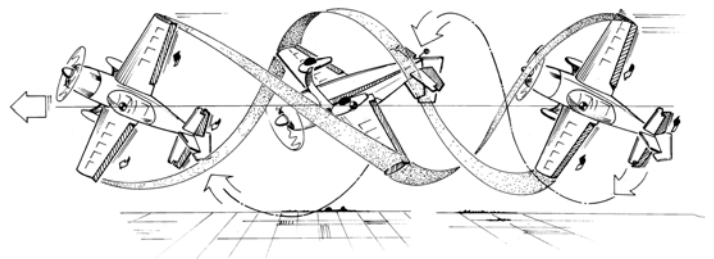
INVERTED FLAT SPINS

This is the same as the up-right flat spin except most planes like to spin in the opposite direction, for example: right rudder and down elevator.

THE WALL

Fly straight across the field at a moderate speed and simply pull full up until vertical. Adjust the power as necessary to maintain a hover.

KNIFE EDGE TUMBLE



This is an impressive looking maneuver that really isn’t as difficult as it looks. (Before learning this maneuver you must be able to confidently Snap and Tumble your plane and stop the aircraft exactly, without over rotating.) Fly the model Knife Edge from the right at a moderate airspeed, using just enough rudder to maintain Knife Edge, not climbing or diving. Perform one full right negative Tumble by maintaining your rudder setting while applying full throttle, full down elevator, and full right aileron, releasing in time to end again flying Knife Edge to the right. Note that you may need to use some positive elevator and/or left aileron to stop the Tumble at exactly Knife Edge. This maneuver is easier to the right because torque helps stop the Tumble and it can be done at varied airspeeds with proper throttle and rudder modulation.

VERTICAL HOVER

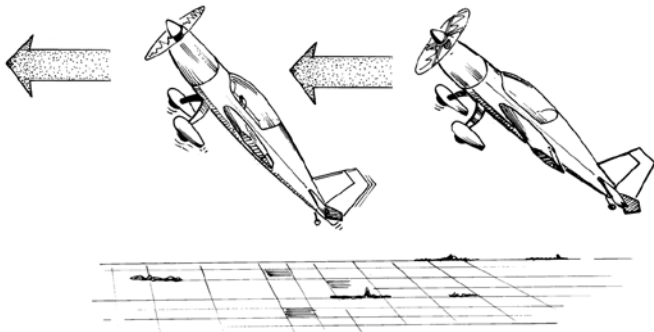
Fly a straight pass across the field at 75ft high and 100ft out and pull the model vertical. Roll the model until the top of it is facing you and slowly begin to reduce power. As the model begins to slow down to 10 mph or so, slowly add a little bit of power back in. You will have to adjust the throttle as needed,

but make your adjustments smooth. Some right aileron may be needed to keep the model from torque rolling. Use the rudder and elevator to keep the nose pointing straight up. Be patient as this maneuver will take a while to learn.

TORQUE ROLL

This is the same as the vertical hover but without the use of right aileron to keep the model from rolling. If needed, you can use a little left aileron to speed the roll up. As the model rotates around, the controls will appear to be reversed to you but only the orientation of the model has changed.

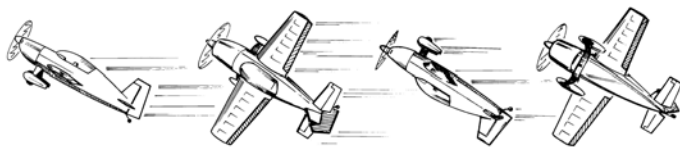
HARRIER



The harrier is nothing more than a high angle of attack flying stall. Check the stall characteristics of your plane before proceeding with this maneuver. Bring your plane across the field at 75ft high and 100ft out away from yourself. Slowly pull back on the elevator while reducing throttle. The nose of the plane should come up. Depending on the plane/setup, you may have to make constant aileron (wing walking) and rudder corrections for this maneuver. As the nose of the plane comes up, start adding in a little bit of power to help maintain airspeed. The rudder is now used to turn the model. This maneuver will take some practice as there are a lot of small corrections made to keep most planes in the maneuver.

This is one maneuver where less control is needed. Too much elevator and the model goes into an uncontrollable stall. The C.G. of the plane will have a large effect on the stability of the model during this maneuver. Some planes perform better with more elevator deflection and a farther forward C.G. while other planes prefer a further aft C.G. and less elevator deflection. Elevator to flap mixing can be used on airplanes with marginal wing area, and some planes won't stall so elevator to spoileron mixing will be needed.

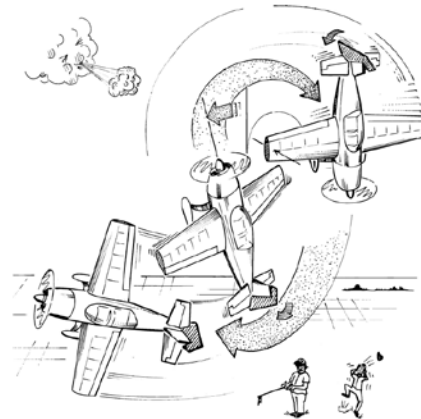
ROLLING HARRIER



Once you get comfortable with the up-right harrier, it's time to work rolls into the mix. From an up-right harrier, add in left aileron and

change from up elevator to down elevator when inverted. If you are comfortable with four point rolls and slow rolls, inputting rudder on the knife edges can improve the maneuver considerably. To turn the model, simply input the elevator or rudder a little sooner or later in the rotation. It's all a matter of timing.

PINWHEEL



Climb vertically and bring the model to a vertical hover, but do not stop long enough to let the torque pull the model around (climbing or sliding slightly will not be noticeable to spectators but will keep air flowing over the ailerons and provide you roll authority to stop the torque). When the model is hanging, rock the plane left with rudder, then apply full throttle and full right rudder and hold both, completing 3/4 of a VERY tight Knife Edge Loop and flying out Knife Edge. When done correctly, the plane pivots around the wingtip in a very small area. This maneuver can be done in either direction.