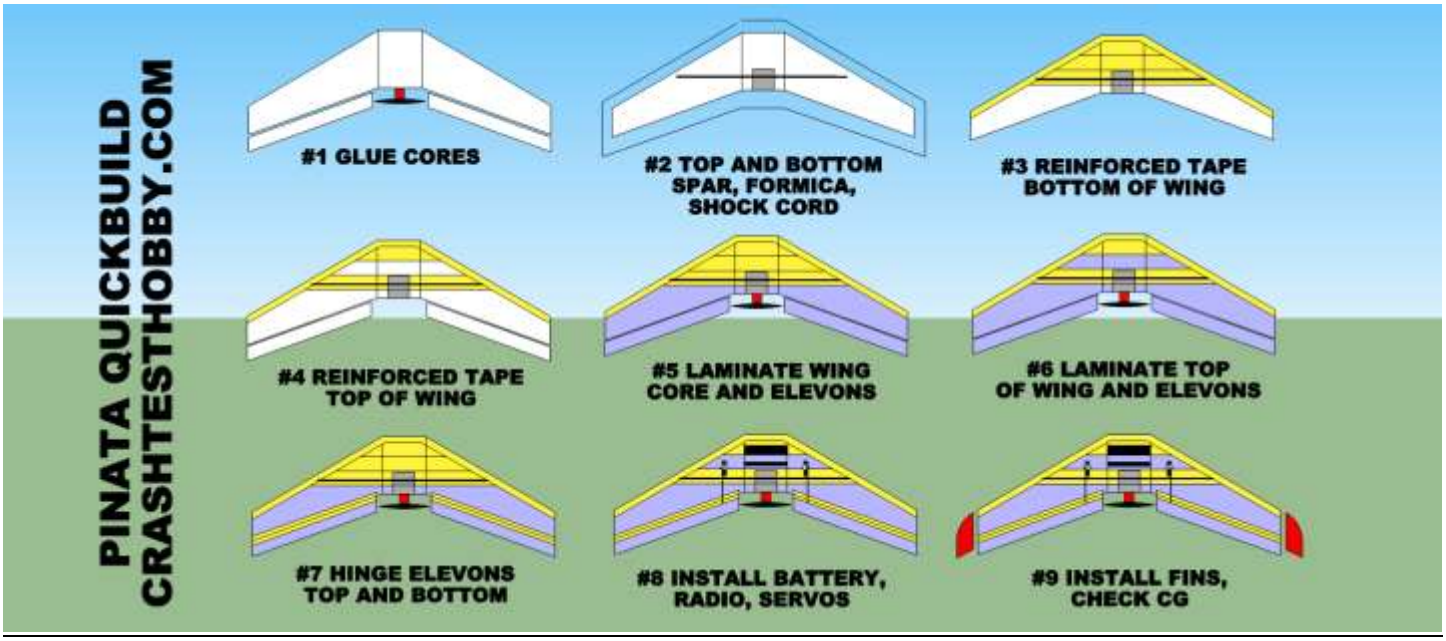
Pinata Building Instructions by CRASHTESTHOBBY.COM

The Pinata may be the toughest plane on the planet!!! It can take more abuse and keep on flying better than any other plane we have seen. The Pinata is the Assassin with a blunt nose extension. It is cut from solid EPP foam that doesn't crush. It has EPP elevons that don't split. It uses a shock cord that spreads out the forces of impact. It has bidirectional reinforced Extreme Tape hinges and laminate to protect the battery and radio. The plane is designed to use low cost off the shelf motors, ESCs, servos and batteries. You need one of these!!!! Your club needs a bunch of these. It's time to fly without worrying about breaking your plane.



PINATA / ASSASSIN QUICK BUILD INSTRUCTIONS

Go watch our building videos to see how we build at http://www.crashtesthobby.com/pinata-instructions.html

1. Glue three wing cores together. Check prop size then cut elevons to length leaving room from propeller.
2. Cut spar slots 6.0" back from nose on the top and bottom of the wing. Glue the spars in slot. Install the shock cord in a slit around perimeter of wing that is cut with a new razorblade. Glue Formica mount on the top and bottom in center of wing.
3. On bottom of wing put 2" strips of Extreme Tape from spar forward.
4. On top of wing put 2" E-tape from 4" forward. Tape across center of wing over spar. E-Tape around leading edge of wing.
5. Put 2-3 layers of laminate on elevons. Put one layer of laminate on top and bottom of wing over foam and tape.
6. Mount motor on metal motor mount. Screw motor mount on Formica plate. You can bolt through to the top Formica.
7. Make elevon hinges with 1" wide E-Tape top and bottom of wing. Iron 2" wide laminate strips over tape to protect from UV light.
8. Cut out battery hole with battery back 1.5" with battery on edge.
9. Cut radio slot 4.5" back and 6" wide. ESC and receiver sit on edge in slot.

10. Servos are in their own holes and stand upright deep in foam with arm near surface of wing.
11. Install radio, horns, and rods (and fins) Have servo arms to outside edge of slot. Pushrod near center of servo arm and at tip of elevon control horn for maximum leverage. Install pushrod guides.
12. CG is 6.0 back. Elevon throws 1/2"
13. Trim both elevons up 1/4" (reflex) make Velcro tie down for battery and radio.
14. Install fins with tape and goop.

*** To build an ultra light plane replace all E-Tape with 2" laminate strips and use lighter battery and radio. ***

Specifications

- Center of gravity is back 6." (15.5 cm) from nose of plane
- Spar is back 6.0" (15.5 cm) from nose of plane which helps to check the CG location
- Start with elevon throws at 1/2" (1 cm) up and down, more throw is fun later.
- Target all up weight 24-32 oz
- Light build use 2812-1534 motor with 7x6 prop, 25+ amp ESC, and MG90 servos
- Heavy build use 3530-1700 motor with 7x6 prop, 40 amp ESC, and full size servos
- 2200-3300 mah 3S lipo batteries

EQUIPMENT NEEDED

1. Low-temperature hot glue gun and low-temp rated glue
2. or Gorilla Glue (preferably white), or “Goop” brand glue
3. Metal straight edge
4. Soldering iron
5. Pliers
6. Bidirectional reinforced tape, (Scotch Extreme Tape)
7. Adjustable razor blade
8. Philips head screwdriver
9. Electric drill and bits
10. Iron for applying laminate (hobby iron is preferable, but clothing iron may be used)
11. Velcro strips

WING PREPARATION –

1. Rub the EPP foam surfaces with another piece of EPP foam to get the melted fibers off.
2. Use your fingernail to pick off any stubborn fibers. You can also use a razor to shave the EPP foam to get cut fibers off.
3. Glue the wing cores together with low-temperature hot glue, Goop, or Shoe Goo.

SPARs – Install the two 24" round fiberglass spars on the top and bottom of the plane across the width of the wing

4. Place a mark at 6.0” (15.5 cm) back from the nose
5. Mark 6.0” back, use a square to make 24" lines top and bottom on the wing where the spars will be installed.
6. You can cut 2" off of the top spar to get a better fit by staying away from the curve on the edge.
7. On the top and bottom of the wing, lay a straight edge along the center of the wing

8. Use a metal straight edge and a soldering iron to cut a slots for the spars.
9. I like to put a wheel collar or cut the tip off an old soldering iron to get a consistent depth. (see picture below)
10. Sand the spars lightly to take the shine off it. Press the bottom spar in first then glue it in with hot glue or Goop.

SHOCK CORD

11. The weakest point of a flying wing is the space between the elevons on the trailing edge. In a head-on impact, the weight of the wingtips tears the wing in half from the back forward. The Shock Cord ties the trailing edge of the wing together to help prevent this damage from occurring. The Shock Cord can be glued in with baking soda and CA glue.
12. Using a razor blade, cut a 3/8" (0.7cm) deep slit around the entire perimeter (along the edge) of the wing.

13. Work a little baking soda in the slot and put some baking soda on the cord first to speed up curing later.
14. Make sure you have adequate ventilation and beware of the fumes. CA glue and baking soda have a fast reaction.
15. Insert the shock cord with the center of the cord at the tail, and the loose ends at the nose. Use a Philips Head screwdriver to push the cord into the slot.
16. Keep tension on the cord as you work your way around the wing so that it is snug.
17. Tie the loose ends of the cord together at the nose, so that the knot tucks into the slot. Cut off excess cord.
18. Using CA glue work your way around the wing slowly squeezing CA glue into the slit. Beware of fumes and extra glue.

<u>Install the FORMICA PLATES</u> on the **top and bottom** of wing to screw the motor mount**.**

19. Mark the places for the Formica plates on the top and bottom of the wing,
20. The Formica will be installed white side out, at the center of the trailing edge.
21. **Do not damage the spars with screws.**
22. You will need to make sure that the spars won't be under the screw holes in the motor mount.
23. Center the plate, and mark the area to be glued.
24. Put low temperature hot glue **on the foam** (not the plate) where the plate will be, and quickly but accurately install the plate.
25. If you apply the glue to the plate it will cool and set before you can get it in position on the wing.
26. Do not attach the stainless steel motor mount at this point. That will be done after laminating the wing.

<u>SCOTCH EXTREME TAPE</u> – available from many office supply stores and Amazon

27. Scotch Extreme Tape© will stick to EPP without a spray adhesive. It is lighter than many other reinforced tapes. It can hold up to 150 lbs of weight per inch. It is available at many office supply, hardware, and postage stores. Extreme tape needs to be covered with laminate or it will yellow and dry, and come off in UV sunlight. The tape needs to be tight for maximum strength.
28. Look at the taping pattern for the top and bottom of the Assassin shown in the quick build instructions at the first of the instructions. This pattern will be similar to the Piñata. The reinforced tape adds about 2.5 oz to the plane.
29. Pinatas can be built with for combat and rough landings with 2" tape, They can be built lighter with 1" without covering the entire bottom of the front of the fuselage and ultra light with double laminate strips instead of tape.
30. On the top of the wing I put a 2' piece of E-tape across the spar then two strips back on the nose ahead of the battery.
31. Lay a 2” wide strip along the leading edge, the entire length of the wing, folding equally over the top and bottom of the wing.

<u>ELEVONS</u> - **Two elevons move up and down like an elevator and opposite for aileron function or roll.**

32. EPP elevons will feel floppy until they are laminated and hinged to the wing. This flexibility keeps them from breaking in an impact. They are more durable than balsa elevons.
33. **The elevons have a top and a bottom. The thick side is towards the wing. The pointed corner is on the top.**
34. **Make sure you cut the angles properly with the top up, so you make a right and left elevon.**
35. Lay your elevons next to the trailing edge of the wing, thick side towards the wing, with the point of the slanted cut at the top .
36. Cut the elevons to length to get the prop clearance and angle on each end.
37. Repeat on the other elevon and make sure they are the same size and that you have cut a right and left elevon.

LAMINATE – the kit includes clear laminate that has UV protection to protect the Extreme Tape and foam.
The laminate included in this kit adds strength and protects the foam, tape, and plane from UV light, dirt, and water. This laminate is stronger than most iron-on coverings, and easier to work with. It is crystal clear and easily decorated with colored packing tape, holographic tape, or other iron-on coatings. LED lights shine brightly though the laminate for night flying. The rough side of the laminate goes against the foam. The EPP foam can't handle as much heat as the laminate, so make sure your iron isn't so hot that it will change the shape of the foam.

38. The temperature of the iron should be hot enough to activate the adhesive in the laminate but cool enough it won't change the shape of the foam. Start cooler and practice on a scrap and iron it to the box to get the feel of ironing the laminate.

LAMINATING THE ELEVONS - 2-3 layers of laminate on the elevons make them as stiff as balsa.
If I am using a big motor and on a heavy plane I will use 3 layers of laminate.

39. Place one of the elevons under one edge of the laminate, so that the rough side of the laminate is facing the EPP foam.
40. Wrap the laminate end up over the elevon and make sure the elevon is straight before ironing.
41. Do not get your iron too hot!!! To hot will warp the elevon and wrinkle the laminate.
42. Use your iron to stick the laminate to the foam. Begin at the center and work your way outward to avoid wrinkles.
43. Roll the elevon as you continue to iron keeping the laminate tight and ironing as you go. Keep the elevon straight.
44. Fold the laminate over and continue ironing until the elevon is completely covered with 2-3 layers of laminate.
45. Cut the extra laminate on the ends of the elevon to fold over neatly. Iron the laminate around the ends of the elevon. Repeat process with other elevon.
46. Make sure that the elevon turns out flat, after ironing. If needed, re-heat the elevon, then hold it flat while it cools.

LAMINATING THE WING – Put one layer of laminate over the entire surface of the wing.
47. Cut lengths of laminate that will cover each wing. Make sure the pieces will completely overlap (by about 2" (5cm)) in the center of the wing. Fold the laminate over the wing with the rough side of the laminate towards the foam, making sure it covers the entire top and bottom, overlapping the center
48. Laminate the bottom of the wing first.
49. Iron the laminate down by working from the middle to the edges, using short strokes to keep wrinkles out as much as possible. Laminate directly over the Formica plates, and make sure to wrap around and seal the edges of the wing. Repeat on other side of the wing.

HINGING THE ELEVONS – The hinge is made from a 1" (2.5cm) wide piece of Extreme Tape covered with a 2" (5cm) wide piece of laminate.
50. Cut a piece of Extreme Tape into two 1" (2.5cm) wide strips, the length of the elevon
51. Position the laminated elevon next to the trailing edge of the wing, leaving a 1/16" (2mm) gap between the two pieces. Attach the elevon to the wing with one 1" (2.5cm) strip of Extreme Tape, on the top first.
52. Fold the elevon up and over, so it rests upside-down on the wing. Use the other 1" (2.5cm) strip of Extreme Tape to cover the bottom side of the hinge line.
53. The laminate hinges will fail in a few months if you don't put a laminate layer over them to shield the tape from UV rays.

54. Cut 2” (5cm)-wide strips of laminate the length of the elevon.
55. Cover the 1” (2.5cm) strips of E-tape you just placed with the 2" wide laminate strips and iron the laminate in place.
56. Make sure, as you iron, that the elevons end up flat and flush with the wing, not bending up in places. If they seem to be pulled in places, reheat the area with the iron, and lay an object over the elevon to keep it flat as the laminate cools.
57. Repeat on other elevon.

The basic schematic for the set up and installation of the radio gear and battery can be found at the end of the instructions. Servos plug into the aileron and elevator and are mixed to elevons on most radios. Consult your manual for specific programming with your radio.

58. We recommend 3mm bolts with nylon lock nuts or lock washers or equivalent to attach the base of the motor to the stainless steel motor mount. If you are using a 2812 motor, you can just screw on the red base and screw the red base on the metal motor mount.
59. The mount is designed so many different motors will work.
60. With the wing upside-down, place the motor mount on the Formica plate, and mark where the holes will be drilled.
61. Drill small pilot holes through the Formica plates and plane.
62. You can put bolts through the top plate if you want extra strength.
63. Do not drill into the fiberglass spars.
64. Make sure you will have prop clearance.
65. Screw the bracket to the Formica plate using #8 x 1/2 “ metal screws, being careful not to over-tighten and crack the Formica.
66. You can leave the motor mounted to the bracket to properly measure the Center of Gravity later, but remove the prop for safety purposes

SERVOS, BATTERY, ESC, AND RECEIVER – CENTER OF GRAVITY IS 6” BACK FROM THE NOSE

The flat nose of the Pinata leaves room for the batteries to be put farther forward to help balance the plane.

67. Fit your battery electronics tightly in the foam.
68. You don't want to leave any extra open space in your wing. This decreases the strength of the wing.
69. Determine the best position for your battery so that it balances the plane 6" back on the center of gravity.
70. The battery shown below is back 1.5" or 40 mm from the front of the wing.
71. The battery is better protected in an accident if it is positioned on its edge with a flat side facing forward.
72. Many bigger batteries are too tall so they need to be laid on their side as shown.

73. Position the battery on the wing and trace the outline of the battery.
74. Use a razor blade to cut through the laminate and E-Tape.
75. Use a soldering iron or box knife cut a battery box deep enough to allow the battery to be out of the wind.
76. The size and shape of your battery will determine where you can mount the receiver, speed control and servos.
77. Check the length of your motor wires and adjust this distance so your ESC wires will reach the motor.
78. Some flyers that prefer to cut individual holes for each of the radio parts. This is OK as long as the CG is correct.
79. My ESC and receiver should sit on their edge in a narrow tight slot back 3/4" behind the battery.
80. My ESC/RX slot goes all the way through the wing so I can see the E-Tape on the bottom of the wing.
81. Cut the slot 6" wide across the extension for the ESC and receiver with a soldering iron or box knife.
82. Leave the slot tight enough to help hold the ESC and receiver securely in place.
83. Lay out the servos and servo wires to find the best place for the servos.
84. The servos should sit deep but stand upright with the servo arms just above the top of the wing.
85. Aim the arms of the servos to the wing tips to increase the distance between the horns on the elevons.
86. Cut holes for the servos that are slightly smaller than the servo so the servos have to be pressed in.
87. Shape the holes to match the shape of your servo.
88. Make the servos holes deep enough that only the servo arm is above the surface of the wing to increase strength and decrease drag.
89. Cut a slit with a razor blade for the servo wire to reach the receiver.
90. The wire can be pressed into a slit and a clear piece of tape used to cover the slit and keep the laminate in place.





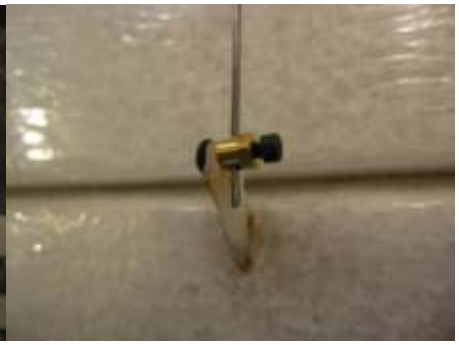

PUSH RODS AND SERVO HORNS

91. Put your push rods on the second hole out from center on the servo arms.
92. You may need to use a small drill bit to widen the hole in the servo arm, so that the rod fits through.
93. Use the push rod to measure directly back from the hole in the servo arm, and place a mark on the front edge of the elevon.



94. Use a sharp blade and cut a slit completely through the elevon where you want the horn. The mark you made in the previous step should be the *inside edge* of that slot, not the center to allow enough room for the EZ Connector on the servo horn.
95. Remove the extra tab that comes attached on the back of the servo horns.
96. Push the servo horns up through the bottom of the elevon so that the base is flat against the bottom of the elevon.
97. Use hot glue along the base of the servo horn, and down through the melted slot, around the horn, to keep horn in place.
98. As the hot glue cools, make sure the horn is facing straight forward. Your horns should point towards the servos
99. The front of the horn should be directly over the elevon's hinge.
100. Attach the EZ Connectors to the control horns with a pair of pliers to the top hole in the control horn.
101. Remove the servo arms, slide the push rod through the hole in the servo arm. Place the end of the push rod through the EZ Connector, then set the servo arm back on the servo.
102. Mark a spot on the wing about halfway between the servo and the elevon, directly underneath the push rod.





103. Remove the push rod, and use your soldering iron to melt a hole at the mark you just made. This hole should be wide enough and deep enough that the push rod guide (the metal staple included in the kit) can sit in it, and extend just over the push rod.
104. Fill the hole with hot glue, and set the push rod guide (staple) in place. Hold it there while the glue dries. The staple keeps the push rod from flexing to the sides/up and down to keep the rod more stable.
105. Permanently attaching the push rods from servo arm to servo horn is best done later. This allows you to properly set the sub trim once all electronics are installed. It also keeps the rods out of the way as you finish the build.



BATTERY BAY – VELCRO RETENTION STRAPS

106. To hold the battery in place during flight, you can install Velcro strap. A simple way to do this is to cut a slit through the bottom front of the battery hole and one through the bottom in the middle of the slot that contains the radio and then feed the Velcro through and fasten it on the top of the wing. The Velcro over the wires will help hold the receiver and ESC in place along with securing the battery. See photo above.

PUSH RODS & ELECTRONICS TESTING

107. You will need elevon, delta or programmable mixing to mix the aileron and elevator channels to fly a plane with elevons.
108. Consult your radio manual for help if needed. On the Spektrum DX6i you may want to do manual mixing as described on our web site.
109. Remove the servo arms from the servos. Connect all electronics, including a battery, but for safety purposes, make sure you do not have prop attached to your motor at this point. Turn on your transmitter(tx) and allow the servo gears to "center" themselves.
110. Slide the push rod through the closest hole to the servo in the servo arm (still unattached to the servo), then slide the end of the push rod through the guide, and into the EZ Connector on the elevon. Then re-attach the servo arm to the servo so that the arm is perpendicular to the push rod.

111. Let the EZ Connector slide over the push rod as you lift your elevon so that the angle of the bottom of the elevon is parallel to the bottom of the wing. This is an approximate angle and may need to be adjusted during test flights depending on CG and weight. This is called **REFLEX** and is used on all flying wings and deltas.
112. Once in place, tighten the set screw on the EZ connector, and use snips to trim off excess push rod.
113. Repeat on other elevon and set it at the same angle.
114. Set the wing on a flat surface, and hold a ruler vertically next to the trailing edge of each elevon. Use your tx to set the throw (range of movement) on the elevons to 3/8" (1cm) up and 3/8" down. Make sure your stick movement translates to the proper up/down on your elevons:

STICK UP	Both elevons down	NOSE DOWN
STICK DOWN	Both elevons up	NOSE UP
STICK LEFT	Left elevon up / Right elevon down	ROLL LEFT
STICK RIGHT	Right elevon up / Left elevon down	ROLL RIGHT

ELECTRONICS COVERING, DECALS, & FINS

115. After testing all electronics, cover your receiver, ESC, and the slots you buried wires in, with clear tape and/or laminate to keep the radio from ejecting in an accident. The ESC gets hot and needs ventilation. The receiver and wires do not.
116. Add any other decals as you wish, but be careful not to add so much that it changes the Center of Gravity. *The lighter, the better!*
117. Use your razor blade to cut out that 1" (2.5cm) section in the fin.
118. Shape the nose and top of the fin as desired. Paint the fins if desired.

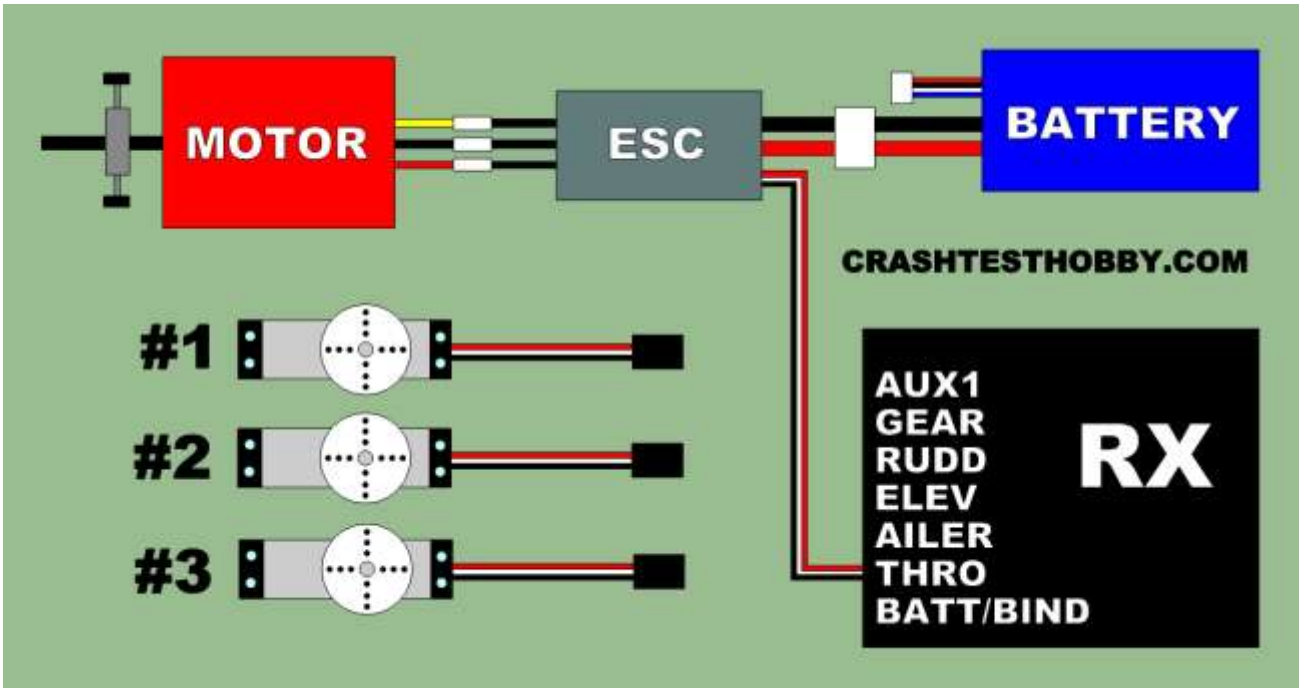
119. Use Goop (or Shoe Goo) to glue the fins to the ends of the wings, with the slit just above the top of the wing.
120. Place a 2" (5cm) wide strip of Extreme Tape along the entire bottom of the fin, wrapping around to the bottom of the wing. Allow the glue to dry.
121. Cut a 1" (2.5cm) wide strip of Extreme Tape and feed it through the slit in the fin, so that the tape attaches to both the top and bottom of the wing, around the bottom portion of the fin.
122. Install prop with numbers facing the plane (if prop is installed backwards, it will not give you the necessary power).
123. Test the throttle and make sure the motor is turning in the correct direction. If not, unplug two of the three connectors between the motor and the ESC and reverse them. Try again.
124. Check your CG, the throw on the elevons, your linkages and reflex (slight up trim on the elevons) before launching.
125. It's always a good idea to have someone else double check your work. Field test and range check your equipment, then launch, trim, and enjoy!

LAUNCHING

126. **Launching from the tip is an art form and hard for many new flyers.** In the videos you see us launch our flying wings holding the plane by a wingtip while swinging it forward. We are actually setting the plane on the air without Frisbee spinning the plane. If you spin the plane at all the outside wing will have more lift because it is moving faster and the plane will roll the opposite direction and hit the ground. If you have any trouble, launch from the center of the plane with fingers on each side of the motor and toss the plane at the horizon. Don't throttle up till your hand is clear of the propeller.

The most common problems we see are:

127. **CG too far back.** Flying wings will not fly tail heavy. A good sign you are tail heavy is you can't control the plane or the plane won't stay trimmed. When you try to loop the plane will roll over. Add weight to the nose to see if the problems resolve. It is not uncommon to need an extra oz or two of lead depending on how light you build.
128. **Too much movement in the elevons** so the plane stalls on launch as you pull up on the elevator. Our planes have huge elevons to decrease drag so they don't need as much movement in the elevons as planes with small elevons. This is a very common problem!!!! May be combined or confused with tail heavy airplane symptoms.
129. **Loose servos in the foam, linkages and push rods that flex, and poor leverage with push rods not installed per plans, elevons are too soft and twisting.**



Connecting your battery to the ESC (electronic speed control).

a) Look at the battery plugs that come on your batteries from the factory.
b) There are several different plugs being offered.
c) You won't have to change the plug on the battery if you match the plug with the plug you put on your ESC.
d) Make sure your battery plugs can only be plugged together in only one way to protect the ESC.
e) Frequently power wires get crossed during assembly. Make sure you solder the plug so the red wire from the battery only goes to the red wire plug on the ESC and the black wire to black wire.
f) If these wires are switched, even for a second, the ESC will be destroyed and have to be replaced. This is not a defective part but the fault of the person assembling the electronics.

Connecting the ESC to the motor.

a) The motor has three wires that connect to the ESC. You can plug these wires in any order.
b) If the motor runs backwards trade any two wires and the motor will reverse direction.
c) Make sure you heat shrink the connectors so they can't short out.
d) If these wires touch and short out, while the motor is running, it will burn out the ESC.
e) This is also not a defective product but the fault of the builder doing the assembly.
f) There is no need for a reverse prop because it is so easy to change the direction the motor turns.

Connecting the ESC to the RX (receiver).

a) The three strand wire with a plug on the ESC, plugs into the throttle plug on the RX (receiver).
b) Look at the receiver for clues to which way the plug is inserted. Usually the black wire is to the back.
c) Polarity is important. The ESC won't work if plugged in backwards but this does not harm "most" receivers.

Binding the 2.4G RX (receiver) to the 2.4G TX (transmitter) 72 meg transmitters do not have to be bound

a) Consult your radio manual for 2.4G binding process for your radio.
b) For most radios:
c) Plug a binding plug in the battery/bind plug on the receiver.
d) Attach the battery and ESC to the receiver. An LED light should be blinking on RX.
e) If your Tx can do more than one model set the Tx to the model location where you want to bind the RX.
f) Turn the transmitter off and hold the binding switch on the transmitter while turning it back on.
g) LED light on receiver will flash for a few flashes and then stay on and stop flashing or go out depending on the brand.
h) Transmitter is bound to the receiver. Servos should respond when you move the sticks on the transmitter.
i) Pull the binding plug out of the RX before unplugging the battery or you will have to bind again.

Connecting the Servos to the RX (receiver).

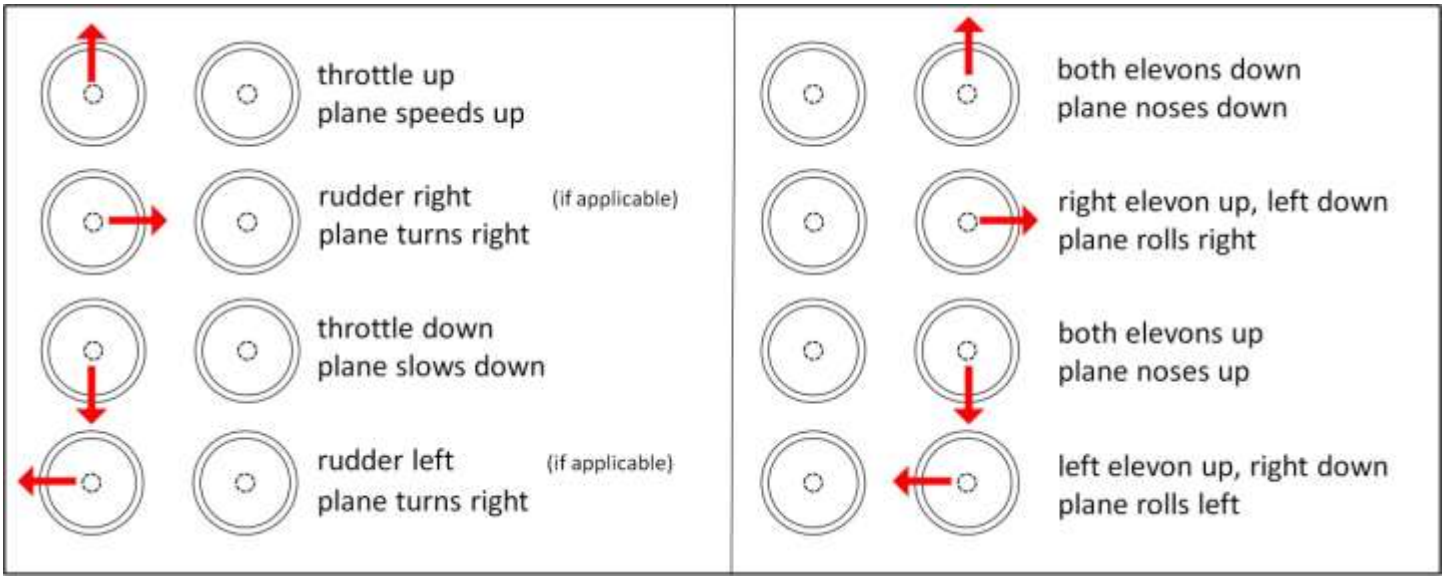
a) Servos also have polarity and can only be plugged in one way and work.
b) The servo plug will be inserted in with the dark wire to the back on most receivers.
c) Choose the function you want the servo to do and plug that servo into that plug on the receiver.
d) The servo may not turn the direction you want so you either need to flip a reversing switch on the transmitter or put the push rod on the other side of the servo.

Flying Wing Set up

a) Flying wings use a mixing function which mixes two channels so that two servos will share the function of two different commands.
b) Find out which two functions are mixed in your radio manual for elevons, delta or V-tail mixing.
c) Most elevons are mixed with the elevator and aileron servos so in a flying wing you should plug the servos in to these plugs in the receiver.
d) Check that your radio is working before turning on the mixing on your transmitter.
e) Both servos should move with the up/down transmitter command and also with the right/left command.
f) Both servos should be moved only by the right stick on the transmitter. (in USA)
g) Some radios have other options. Some radios let you program which servos will be mixed.
h) We have specific instructions for programming the Spektrum DX6i radio on our web site under "Instructions".

There are 8 different possible set-up for servo plugs and reversing switches and only one will work.

a) Do a bench test to make sure all parts of your radio are working.
b) Plug your servos in to the receiver after installing them in your plane in a way that you think will make it work.
c) Test the movement and see if it goes in the right direction.
d) If they aren't moving in the right direction, try different combinations of reversing the plugs in the receiver and flipping the reversing switches on your TX (transmitter) for the aileron/elevator servos until they work properly.
e) Remember there are 8 different possibilities of ways they can be plugged and reversing switches set so it can be confusing at times.
f) Your flight surfaces should move as follows when you move the right stick on the transmitter.



g) Both elevons should be trimmed up 1/4" from center to set the "reflex" required by all flying wings and tailless planes.

h) Set the wing on a flat surface, and hold a ruler vertically next to the trailing edge of each elevon. Use your tx to set the throw (range of movement) on the elevons to 3/8" (1cm) up and 3/8" down. Make sure your stick movement translates to the proper up/down on your elevons.

i) If the elevons move too much move the pushrod closer to the center of the servo arm and move the pushrod to the tip of the horn on the elevon. This not only will decrease throws but increase leverage and make the servo forces stronger.

j) If you still have too much movement, turn down the throws in the programming on the transmitter to get the throws in the right range.

k) Most problems we see are: CG is wrong, too much throw in the elevons, plane is too heavy and pilot inexperienced.