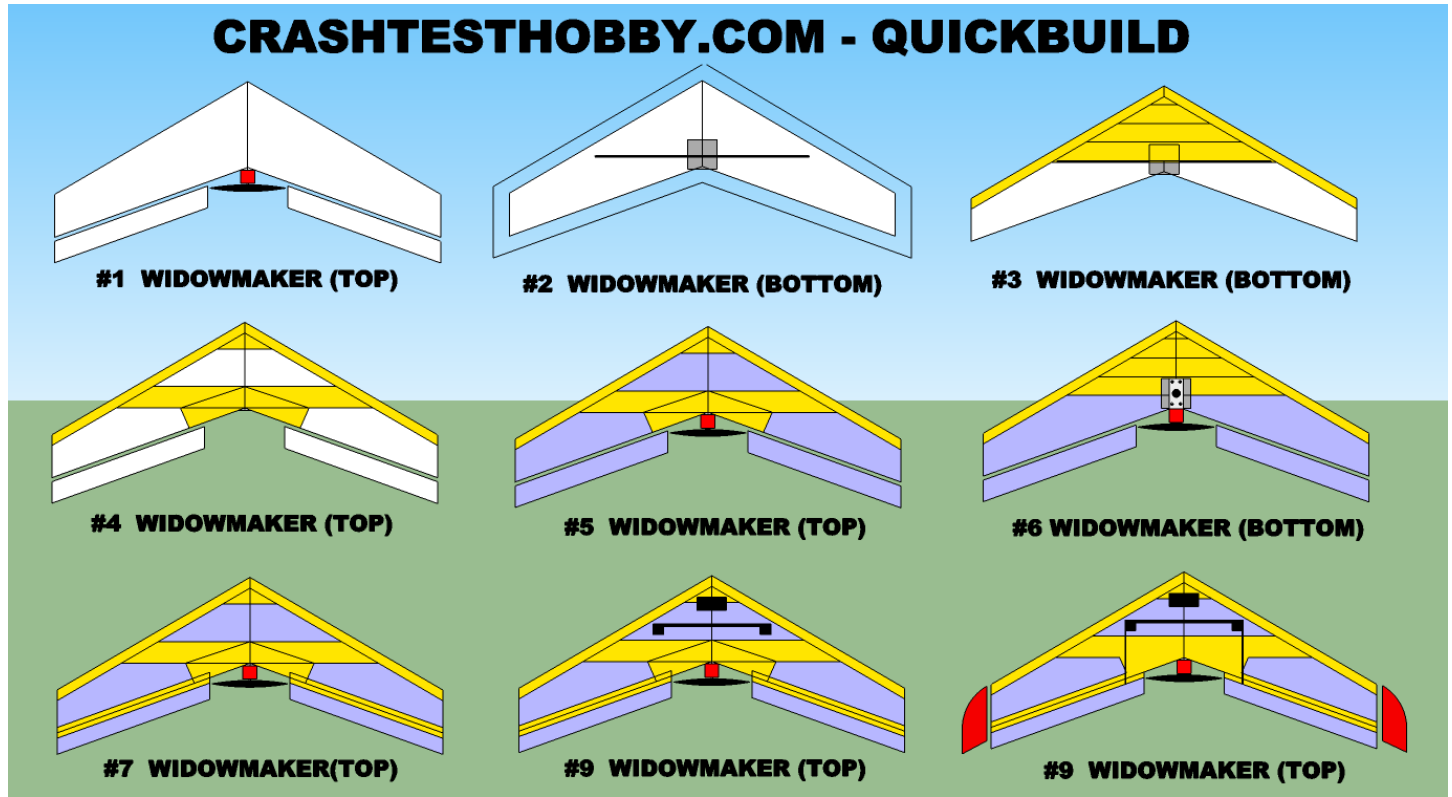# Widowmaker Building Instructions by CRASHTESTHOBBY.COM

The Widowmaker is the same size as the Assassin. It uses a thinner airfoil for improved glide and higher performance. It is also a tough plane and is often seen in combat. The thin wing requires fins for stability and the battery and servos to be laid on their side which is the main construction difference between the two planes. 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 make it stronger than other thin wings on the market. The Widowmaker is designed to use low cost off the shelf motors, ESCs, servos and batteries. You need one of these!!!! It's time to fly without worrying about breaking your plane.

CRASHTESTHOBBY.COM - QUICKBUILD

#1 WIDOWMAKER (TOP)   **#2 WIDOWMAKER (BOTTOM)**   **#3 WIDOWMAKER (BOTTOM)**

#4 WIDOWMAKER (TOP)   **#5 WIDOWMAKER (TOP)**   **#6 WIDOWMAKER (BOTTOM)**

#7 WIDOWMAKER(TOP)   **#9 WIDOWMAKER (TOP)**   **#9 WIDOWMAKER (TOP)**

WIDOWMAKER QUICK BUILD INSTRUCTIONS   -- Detailed instructions follow on page #2 .....

1. Glue cores together. Cut elevons to length.
2. Cut spar slit 7" back from nose. CA glue spar in slit. Install shock cord in slit around perimeter of wing. Glue Formica mount in center of wing.
3. On bottom of wing put 2" strips of Extreme tape from spar forward. Wrap 2" E-Tape around leading edge of wing.
4. On top of wing put 2" E-tape from 4" forward. Tape across center of wing over spar and reinforce core between elevons.
5. Put 2 layers of laminate (blue) 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
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 2" with battery laying flat on side. Cut radio slot 4" back with servo on each end of 10" slot. Servos lay on side. ESC and receiver sit on edge in slot.
9. Install radio, horns, and rods (and fins) Have servo arms to outside edge of slot. Pushrods should connect in center holes of servo arm and in top holes of elevon control horn for maximum leverage. Install pushrod guides.
10 Center of Gravity is 6.5" back from nose. Most Widowmakers will require 1-1.5 oz of additional lead in nose to balance. Elevon throws no more than 3/8". Trim both elevons up 1/4" (reflex). Make Velcro tie down for battery and radio

 *** 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 6.5" (16.5 cm) from nose of plane
- Spar is back 7" (17.5 cm) from nose of plane
- Elevon throws no more than 3/8" (1 cm) up and down
- Target all up weight 15-18 oz (450-540 gm)
- 2812-1534 motor with 25+ amp ESC and MG90 servos
- 1000-1800 mah 3S lipo batteries
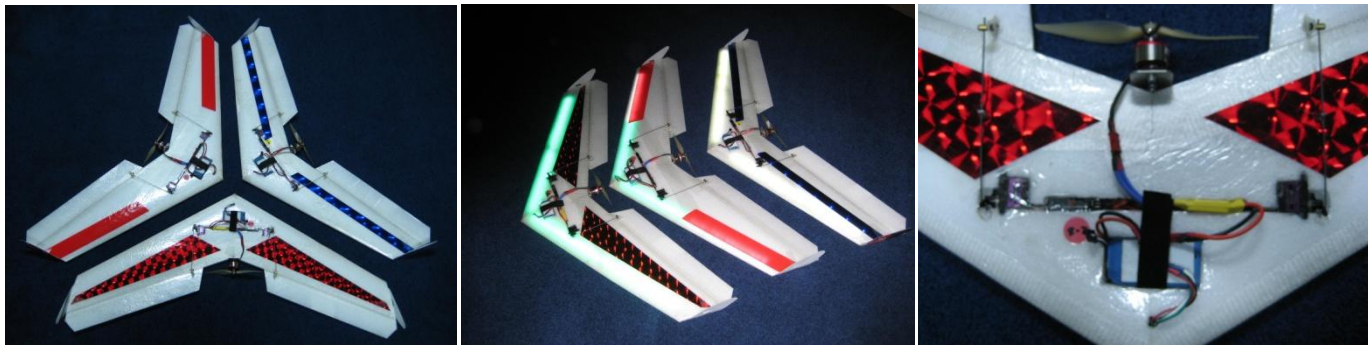
EQUIPMENT NEEDED

- Low-temperature hot glue gun and low-temp rated glue
- or Gorilla Glue (preferably white), or "Goop" brand glue
- Metal straight edge
- Soldering iron
- Pliers
- Pen
- Adjustable razor blade
- Philips head screwdriver
- Electric drill and bits
- Iron for applying laminate (hobby iron is preferable, but clothing iron may be used)
- Velcro strips

WING PREPARATION – the Widowmaker needs fins for stability because of its thin wing. The fins don't have to be big but they are needed to stabilize the plane.

1. Rub the EPP foam surfaces with another piece of EPP foam, to get the melted fibers off. Use your fingernail to pick off any stubborn fibers.
2. Glue the wing halves together with low-temperature hot glue, Gorilla Glue, or Shoe Goo.

SPAR – There is 1 flat carbon spar included in the kit, which will be installed across the width of the wing

3. On the bottom of the wing, lay a straight edge along the center of the wing, and place a mark at 7" (17.75cm) back from the nose
4. From the 7" mark, use a square to measure out 10" to either side. Mark the 10" point with your pen.
5. Use your straight edge and a new sharp razor blade to cut a slit 1/2" (1 cm) deep enough for the flat carbon spar.
6. You can work baking soda into the slit to act as a catalyst for the CA glue for a quicker set of the glue.
7. Baking soda is in the basing syringe (red bulb) you see in the attached picture.
8. Press the spar into the slit. Glue it in with CA glue.
9. You can also glue the spar in with Gorilla Glue, if you wish. Remember to activate the glue with a small amount of water, then tape over the spar quickly to keep the glue from expanding out beyond the surface of the wing.
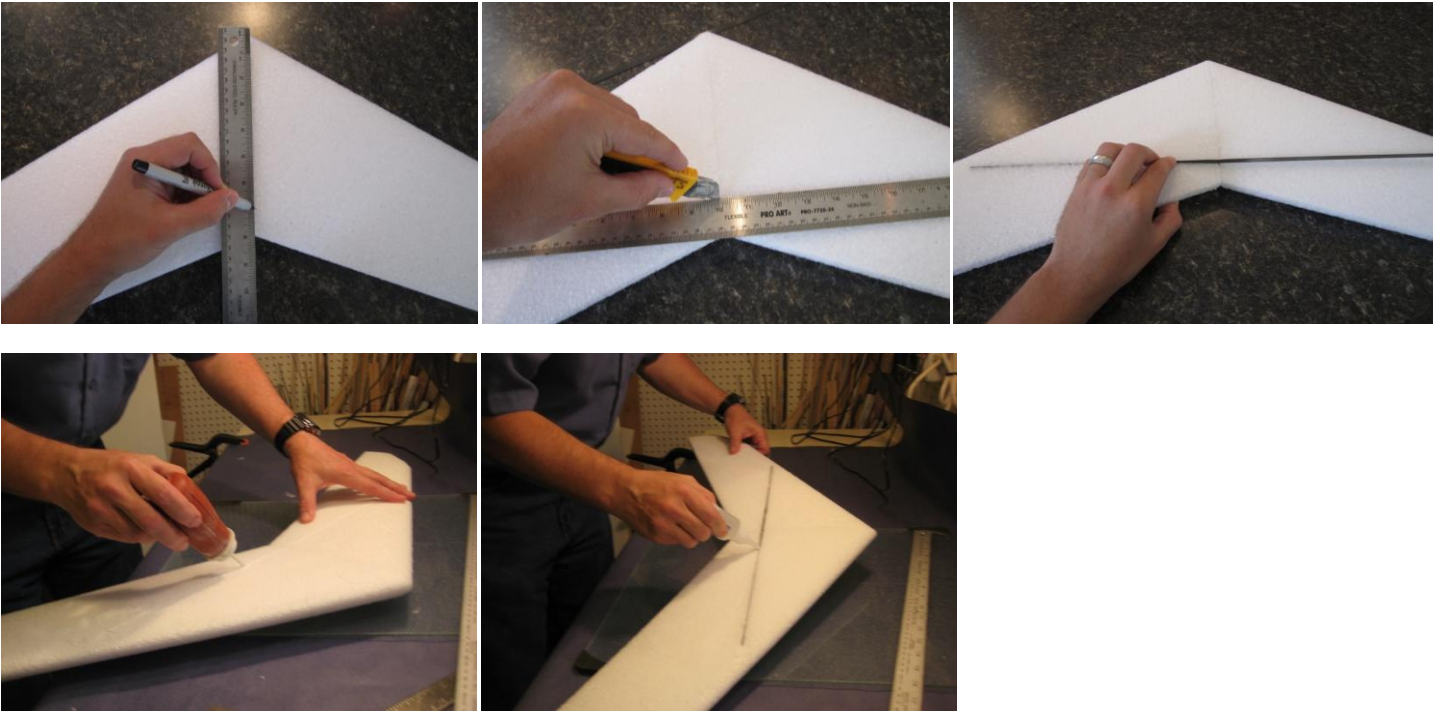
SHOCK CORD

10. 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 prevent this damage from occurring. The Shock cord can be glued in with baking soda and CA glue or gorilla glue and water.
11. Using a razor blade, cut a ¼" (0.5cm) deep slit around the entire perimeter (along the edge) of the wing.

12. If using CA glue, instead of Gorilla Glue, work a little baking soda in the slot and put some on the cord first to speed up curing later. CA glue the cord in. Make sure you have adequate ventilation and beware of the fumes.
13. If you are using Gorilla glue, moisten the shock cord with water. This way, when you squeeze in the Gorilla Glue later, it will react with the water in the cord. Gorilla glue will stain your hands so wear rubber gloves.
14. Insert the shock cord with the center of the cord at the tail, and the loose ends at the nose. Use your finger or a Philips Head screwdriver to push the cord into the slot. Keep tension on the cord as you work your way around the wing, so that it is snug, and all slack moves towards the loose ends at the nose. Tie the loose ends of the cord together at the nose, so that the knot tucks into the slot. Cut off excess cord, so that no cord is showing.
15. If using CA glue work your way around the wing slowly squeezing CA glue into the slit. Beware of fumes and extra glue. It can glue you to the plane.
16. Insert Gorilla Glue into the slot, over the wet shock cord, and allow it to dry. If there is too much glue, it will expand and spill out of the slit. This is normal. After it's dry use your razor blade to shave off excess glue.
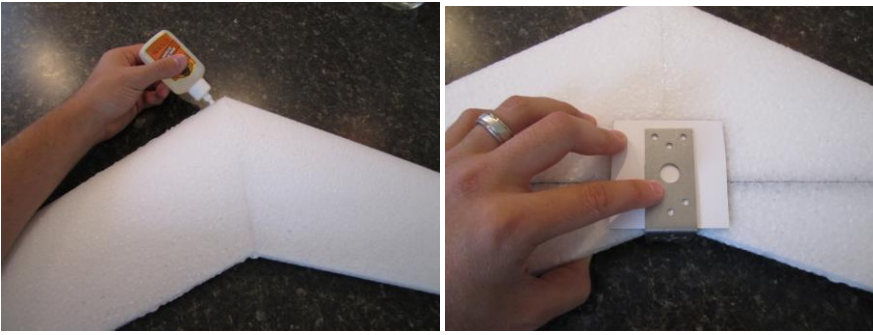
FORMICA PLATE – Formica is thinner and stronger than plywood.

17. Place the Formica plates on the **bottom** of the wing, white side out, at the center of the trailing edge. The plate should hang over the trailing edge at least enough that the stainless steel motor mount won't be resting on the foam.
18. Center the plate, and mark with a pen on the EPP foam where the corners are.
19. Put low temperature hot glue on the foam (not the plate) where the plate will be, and quickly but accurately affix the plate. If you apply the glue to the plate it will cool and set before you can get it in position on the wing.
20. Do not attach the stainless steel motor mount at this point. That will be done after laminating the wing.

SCOTCH EXTREME TAPE – available from many office supply stores and Amazon

21. Scotch Extreme Tape© will stick to EPP without a spray adhesive. It is lighter than many other reinforced tapes. It can hold up to 320 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 without wrinkles for maximum strength.
22. When 1" wide strips are needed, lay the strip on a piece of glass or a cutting table, then use a straight edge and sharp razor blade to split the 2" strip into two 1" strips.
23. The first set of tape will form an "X" over the Formica plate on the bottom of the wing and directly above it on the top of the wing to help the shock cord. The elevons will add more strength out farther on the wing when they are installed.
24. Lay a 1" strip of tape that begins along the right trailing edge, about 6" (15cm) from the Formica plate, that follows the angle of the trailing edge, goes over the Formica plate and across the opposite wing, toward the leading edge.
25. Lay another 1" strip, beginning on the left trailing edge and ending on the right leading edge to complete the "X" over the Formica plate.
26. Repeat on other side of the wing.
27. Lay a 1" wide strip of Extreme Tape over the spar, with the ends of the strip extending just over the edge of the wing. Repeat on top of the wing to protect the spar and add additional strength.
28. For additional strength in the nose of the plane, put strips of Extreme tape side to side that cover both the top and bottom of the nose of the plane back at least 5" from the front of the plane. Be careful not to add too much weight. (not shown in pictures)
29. 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, and covering the ends of the strips you laid over each spar.

ELEVONS - Two elevons move up and down like an elevator and opposite for aileron function or roll.

30. 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. Before cutting your elevons, you must determine which size of a propeller you will be using so you leave space for clearance.

31. **The elevons have a top and bottom. Make sure the point is at the top of the elevon is up and that you make a right and left elevon.**
32. Lay your elevons next to the trailing edge of the wing with the wing right side up, thick side towards the wing. The point of the slanted cut on the elevon should be on the top of the elevon.
33. Hold your motor/prop assembly on the Formica plate where they will later be installed, or use your square to simulate how far the ends of your prop will reach, (e.g. a 7" propeller will reach 3.5" from the center on either side).
34. Making sure the elevon reaches the wingtip, mark where the elevon must be cut to allow the prop at least ½" (1 cm) of clearance on either side.
35. Cut the trailing corner of the elevon nearest the center of the wing, with the cut being parallel to the center line of the wing.
36. 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.

37. 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 WING – Put one layer of laminate over the entire surface of the wing.

38. 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
39. 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.

LAMINATING THE ELEVONS - two layers of laminate on the elevons make them as stiff as balsa.

40. Place one of the elevons under one edge of the laminate, so that the rough side of the laminate is facing the EPP foam.
41. Wrap the laminate end up over the elevon and make sure the elevon is straight before ironing.
42. Use your iron to stick the laminate to the foam. Begin at the center and work your way outward to avoid wrinkles.
43. Fold the laminate over and continue ironing until the elevon is completely covered with two layers of laminate.
44. 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.

45. Make sure that the elevon turns out flat, after ironing. The heat can warp the foam a bit. If needed, re-heat and straighten the elevon, then hold it flat while it cools.

HINGING THE ELEVONS – **The hinge is made from a 1' wide piece of Extreme Tape covered with a 2' wide piece of laminate.**

46. Cut a piece of Extreme Tape into two 1" (2.5cm) wide strips, the length of the elevon
47. Position the laminated elevon next to the trailing edge of the wing, leaving a 1/16" gap between the two pieces. Attach the elevon to the wing with one 1" (2.5cm) strip of Extreme Tape, on the top first.

48. 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 hinge line
49. Cut 2" (5cm)-wide strips of laminate the length of the elevon. Cover the 1" (2.5cm) strips of tape you just placed, and iron the laminate in place. 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.
50. Repeat on other elevon.

MOTOR – **We recommend the 2812-1534kv motor with a 25A ESC and a 3S 1000-1300 3S lipo battery.**

51. Use bolts to mount the motor to the back of the bracket. (With the recommended 2812 motor, you can just screw on the red base.)
52. With the wing upside-down, place the motor mount on the Formica plate, and mark where the holes will be drilled Drill pilot holes through the Formica plates and plane.

53. Screw the bracket to the Formica plate using #6 X 1/2 " metal screws, being careful not to over-tighten and crack the Formica. You can leave the motor mounted to the bracket to properly measure the Center of Gravity later, but remove the prop for safety purposes.
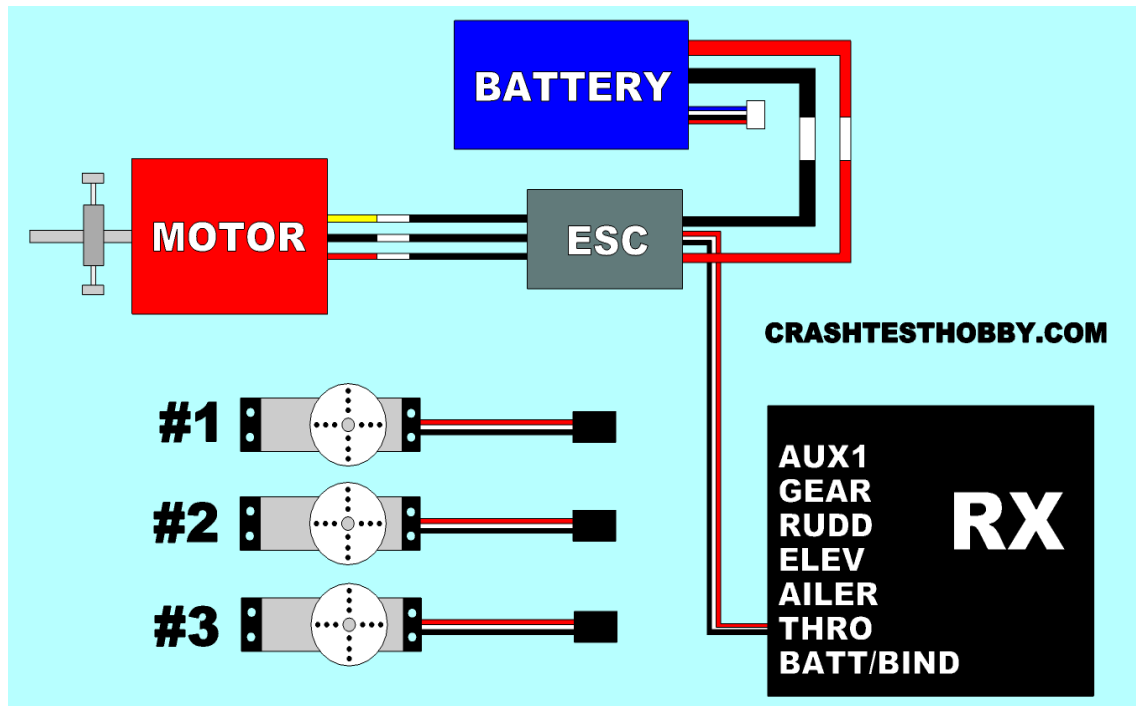

This is the basic schematic for the set up and installation of the radio gear and battery. Servos plug into the aileron and elevator and are mixed to elevons on most radios. Consult your manual for specific programing with your radio.

SERVOS, BATTERY, ESC, AND RECEIVER – CENTER OF GRAVITY IS 6.5" (25.5cm) BACK FROM THE NOSE

54. Install the battery is laid on its side back 2.5" (6cm) from the nose of the plane.
55. Cut a single slot with a soldering iron 4.5" (11cm) back and 10" (25.5cm) wide deep enough for the ESC and receiver to sit on their edge and the servos to lay on their side at the ends of the slot with the servo arms toward the wingtips.
56.
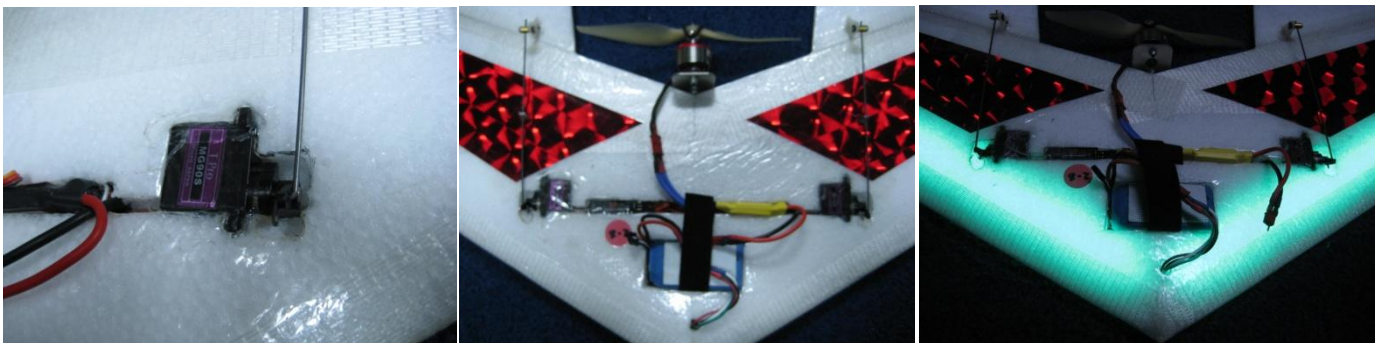
57. Put the arms of the servos to the outside edge of the slot to increase the distance between the horns on the elevons.
58. It is normal to need an oz or two of lead at the nose to help balance the Widowmaker.

59. On the bottom of the plane, measure 6.5" (16.5 cm)back from the nose, along the center line, and place push-pins or thumbtacks into those points so you will have a reference point as you balance your plane.

PUSH RODS AND SERVO HORNS

60. Put your push rods on the outside of the servo arms to get the maximum width. This allows you to place your push rod slightly further out the elevon, reducing the force required to move the entire elevon, and reducing any chance of twist in the elevon. You will want to use the hole closest to the servo.
61. 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. Depending on your servo, you may need to use a small drill bit to widen the hole in the servo arm, so that the rod fits through.
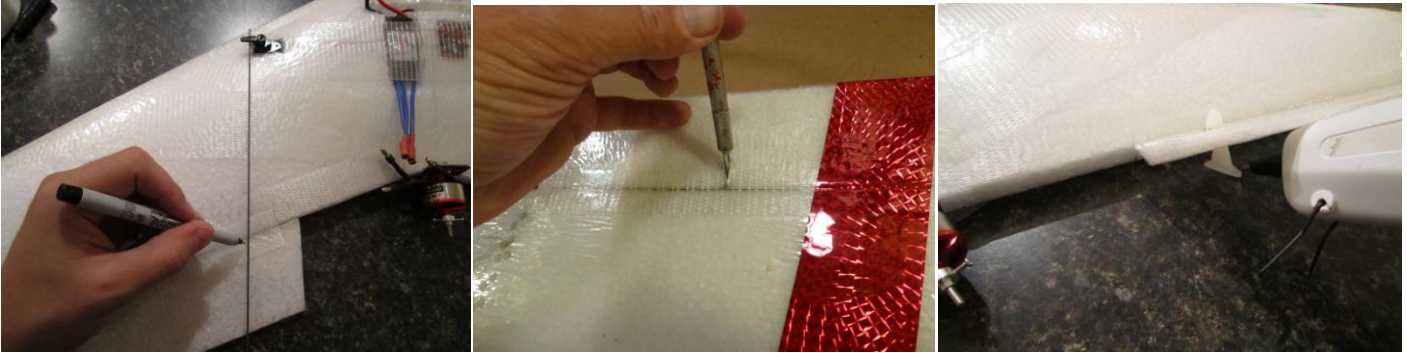

62. Use a sharp blade and cut a slit completely through the elevon where you want the horn. The mark you made in the previous step should be the *inside edge* of that slot, not the center to allow enough room for the EZ Connector on the servo horn.
63. Remove the extra tab that comes attached on the back of the servo horns.
64. Push the servo horns up through the bottom of the elevon so that the base is flat against the bottom of the elevon. Use hot glue along the base of the servo horn, and down through the melted slot, around the horn, to keep horn in place. As the hot glue dries, make sure the horn is facing straight forward. Your horns should point towards the servos, and the front of the horn should be directly over the elevon's hinge.

65. Attach the EZ Connectors to the control horns with a pair of pliers to the top hole in the control horn.
66. 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.
67. If the distance between the servo and the elevon is long enough that the push rod might flex, mark a spot on the wing about halfway between the servo and the elevon, directly underneath the push rod.
68. 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.
69. 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.
70. 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.
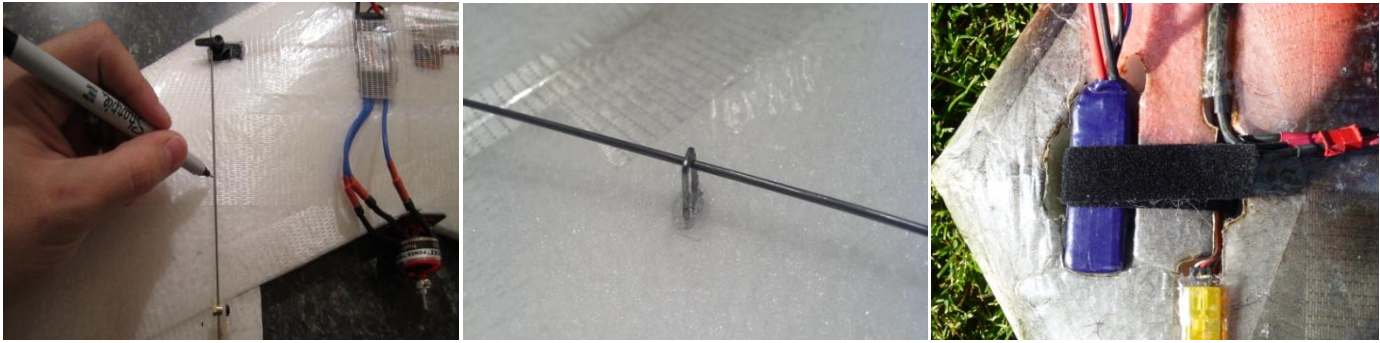
BATTERY BAY – VELCRO RETENTION STRAPS

71. 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

72. You will need elevon, delta or programmable mixing to mix the aileron and elevator channels to fly a plane with elevons.
73. 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.
74. 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.
75. 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.


76. With the EZ Connectors still loose, center the Subtrim function on your transmitter then put the servo arms perpendicular to the push rod.
77. Let the EZ Connector slide over the push rod as you lift your elevon so that the angle of the top 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.
78. Once in place, tighten the set screw on the EZ connector, and use snips to trim off excess push rod.
79. Repeat on other elevon and set it at the same angle.
80. 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

81. 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.
82. 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!*
83. To attach fins, hold the fins in place against the ends of each wing, and make a 1" (2.5cm) mark in the center of the fin, where it meets the top of the wing, then use your razor blade to cut out that 1" (2.5cm) section in the fin.
84. Shape the front and top of the fin as desired.
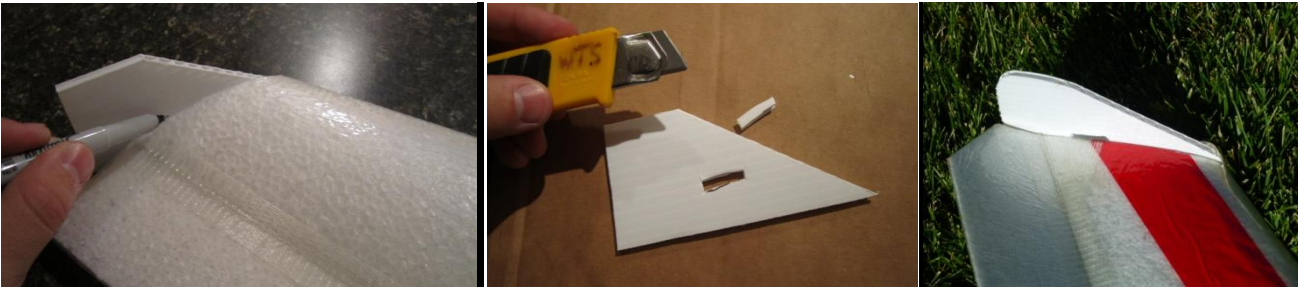
85. Use Goop (or Shoe Goo) to glue the fins to the ends of the wings, with the slit just above the top of the wing.
86. Place a 2" (5cm) wide strip of Extreme Tape along the entire bottom of the fin, wrapping around to the bottom of the wing. Allow the glue to dry.
87. Cut a 1" (2.5cm) wide strip of 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.
88. Install prop with numbers facing the plane (if prop is installed backwards, it will not give you the necessary power).
89. 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.
90. 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!

<u>LAUNCHING</u>
91. **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:
92. **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.
93. **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.
94. **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.**

We design our planes to use the same inexpensive motors, ESCs, batteries and servos to save you money and keep you flying.
- If you are learning and want a slow easy flyer or a great night flyer try our Albatross.
- If you want the **Toughest Plane on the Planet** get an Assassin. It is the same size and shape as a Widowmaker but has a wing that is thick and will fly without fins.
- If you want a delta wing try our Roswell.