Mach Dart Slope Soarer

Congratulations on your purchase of the Mach Dart Glider. This aircraft was crafted utilizing the latest technology in composite model aircraft design and manufacture. The Dart is a high-performance slope glider with an impressive flight envelope. It can be built with a mixed V-tail (although this will cause the finished weight to be slightly higher), or as a conventional aileron/elevator ship. Built as a conventional aileron/elevator ship, it is capable of stable flight in winds as light as 10 m.p.h. When ballasted, the Dart will fly in winds of up to 30 M.P.H., with speeds in excess of 120 m.p.h. While building this glider with a mixed V-tail can expand the Dart's aerobatic capabilities, the Dart's performance with the simpler, conventional controls is superb.

Upon opening the box, you will notice the high level of prefabrication of this airplane. There are no hinges to install, and the finish is *ready to fly* out of the box. These instructions are intended as a guide as most modelers have their own favorite methods for approaching certain tasks. If you construct this model using the methods employed in this instruction manual, expect to spend only a few hours (7-9) to complete it. At any stage of construction, feel free to employ your own methods if you feel they will be better. You may experiment with the recommended control throws, but do not deviate from the recommended CG limits. We hope you will enjoy building the Dart.

Required tools and hardware:*

Dremel Tool with Sanding Drums, Drill Bit and Cutoff Disc
Set of Allen Wrenches
Flat Screwdriver
Measuring Tape or Ruler
Marker or Pen
Drill Bits (1/16 and 3/32)

Additional Materials:*

3 Micro Servos (JR 331 or equivalent) 4 Servos if utilizing the Mixed V-Tail
Basswood Sticks for Servo Mounting (1/4x1/4x12 is enough)
Dave Brown Fiberglass Pushrod System (or other suitable pushrod system)
12" 2/56 Threaded Rod (3)
12" 2/56 All-Thread (1)
2/56 Clevises (4)
2/56 Ball Joint Set (2)
12" Servo Extension (2)
5 Minute Epoxy
Silicone Based Sealant (Dap "Carpenter's Goop" is the best)
¼"x 1/16" Brass Stock (12")
1/16" Music Wire (or slightly smaller)
Sandpaper (medium grit and fine grit)
Milled Fiber Powder
3/32" Plywood for Wing Control Horns

*Read through the entire manual first so that you may select hardware and supplies to best suit the construction techniques you will use.

Fuselage Assembly

Locate the V-Tail empenage. Note that the elevators are precut and hinged. Our task here is to install control horns to the elevators. From the ¼"x 1/16" brass, cut two pieces about 1-1/2" long. Roughen it up with sandpaper. Drill a 1/16 hole, centered, about 1/8" from one end (Photo #1). Do this for both pieces.

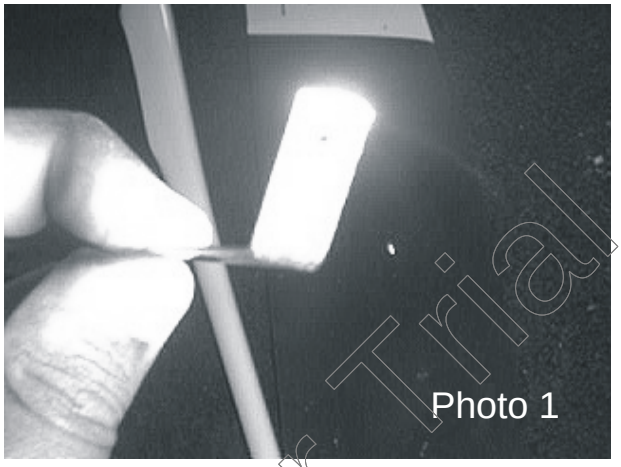


Photo 1

Photo 2

Make sure that the holes are in the same place on both pieces. Make a bend in the brass piece about 3/8" from the end with the hole. This angle should be about 75 to 80 degrees (Refer to Photo #2).

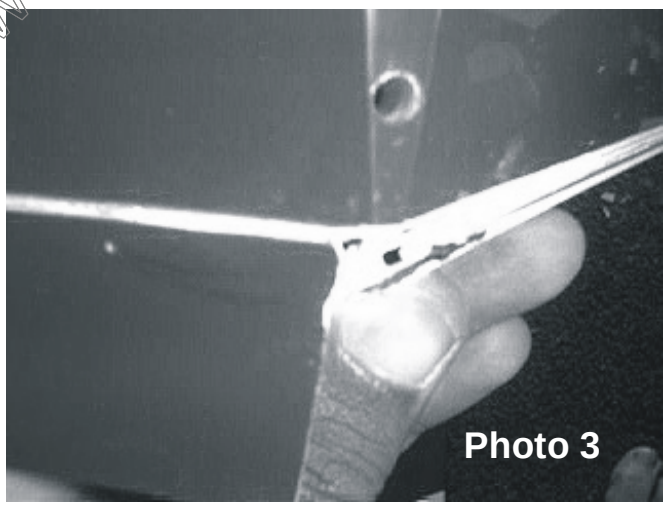
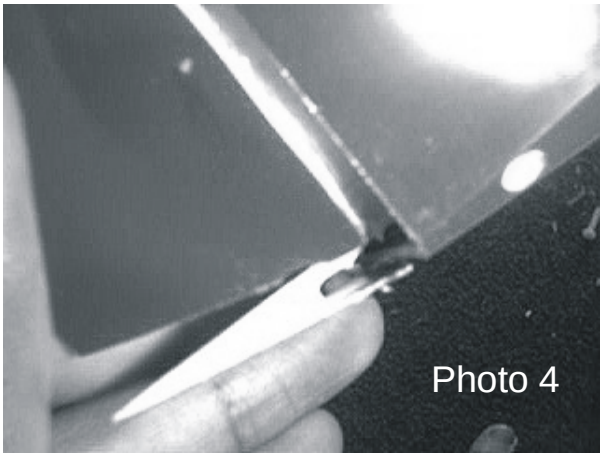
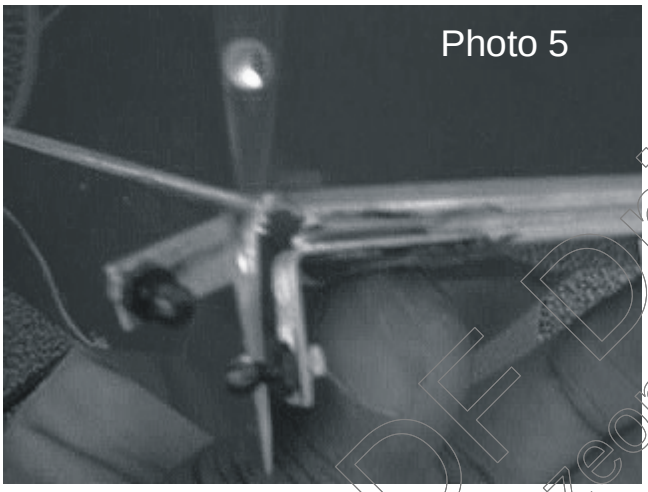


Photo 3

Take the empenage and turn it upside-down. Bend the elevators down, noting that break is opening as you do so. Using your Dremel tool with the drill bit (or very small circumference grinding bit), sand down the material on the bottom part of the elevator leading edge inside. Make sure you are sanding the inside of the elevator! Do this for a space about 1" long and 3/8" wide along the inside length of the elevator (Photos #3 and #4). We will later attach our brass control horns here. Be careful not to remove too much material or sand all the way through the elevator. If the finish on the outside of the elevator is affected, you are sanding too far through. The heat generated by the friction of your drill bit or grinding tool will 'trick out' the fiberglass finish on the outside of the elevator if you are not careful. Repeat for the other elevator.



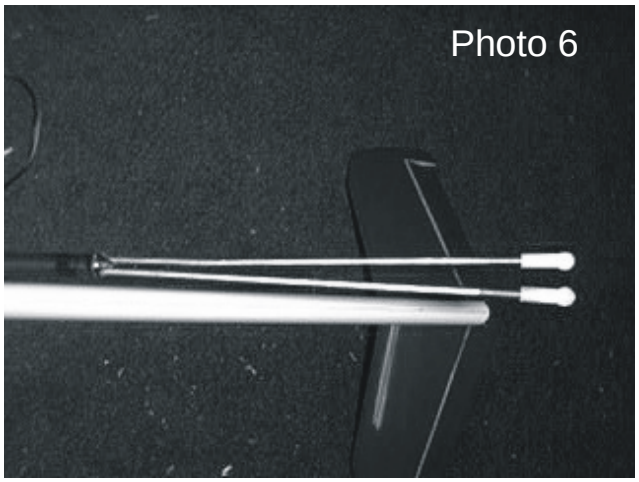
When both sides are relatively equal, prepare to glue in your horns. Make sure that your brass is sufficiently roughed up and that it is absolutely clean and free of dust or oil. Also, wipe away any dust from the inside of the elevators from the sanding. We use denatured alcohol for these steps. When you are ready, mix up a small amount of 5-minute epoxy and milled fiber. You don't want it too thick. Apply the epoxy and milled fiber paste to the inside area of the elevator that you prepared. Make sure not to get epoxy into the elevator's upper hinge line (where the elevator is joined to the stabilizer). This will cause the elevators to bind.



Place your brass horn in the elevator and make sure that there is a good glue joint. Don't be afraid to use a moderate amount of glue, but just make sure that when dried, it will not impede the free operation of the elevator. If for some reason it does, it can be addressed later with your Dremel. Make sure that the brass horn is firmly in place and that the inside of the brass angle is all the way up against the inner-most edge of the elevator. Also make sure that the length of the brass is relatively flush with the edge of the elevator (Photo #5). Repeat for the other side. Make sure that the two elevator horns are lined up symmetrically! They should look like mirror images to each other. For example, if the hole in the horn is farther away from the hinge line than the other, you will have differential throw on your elevators (not good).

When the epoxy is good and cured and the horns are fixed, install the ball studs to the horns from the inside of the V (Photo #5). Make sure they are nice and secure (use a thread locking agent on the studs).

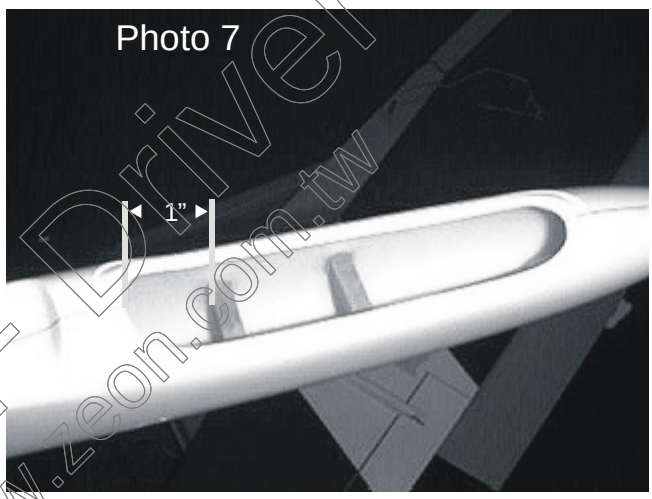
Locate the fuselage body. Remove the canopy. Using the Allen bolts provided, temporarily install the V-tail to the body. Push down the elevators and note how much (if any) stock will need to be removed from the back of the fuse body to allow the control horns to clear. It is O.K. to simply remove up to ½" off of the rear of the fuse body. Now push up on the elevators. Gradually remove material from the inner corners of the elevators so that they can reach a deflection of about 3/8" without hitting. When this is done, remove the empenage from the fuselage. You are done with the V-Tail.

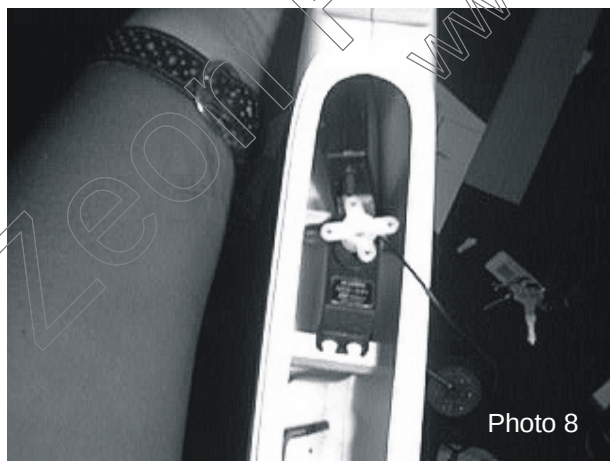


Make up a Pushrod. We used Dave Brown's fiberglass rod. Use the bullet-end with the twin holes. We need to have one pushrod control both elevators (if you are building the conventional tail version). If you build the mixed V-Tail, we do not recommend the Dave Brown pushrods as there is not enough room for two of them inside the fuselage. For that, use a smaller diameter, sleeve-and-rod type pushrod system.

Use the 2/56 threaded rod (with the thread on the outside) on the double end of the pushrod. The 2/56 rod should extend from the fiberglass rod about six inches. If it is too long, it could result in flexing. The overall length of the pushrod should be about 31" (including the 5" of 2/56 rod at the servo end of the fiberglass rod. Install the 2/56 ball cups to the end of the rods (Photo #6).

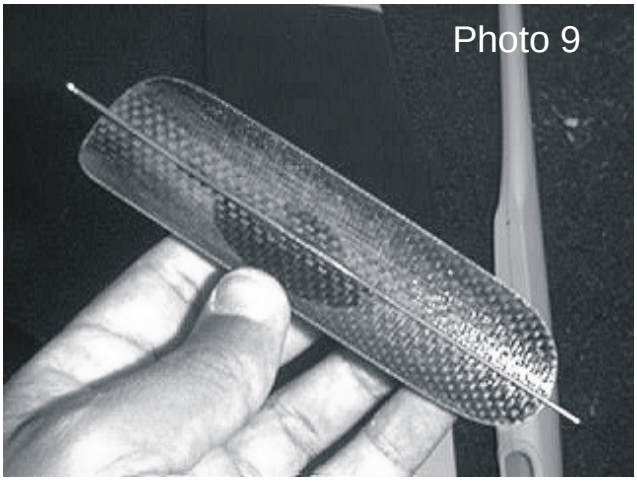
Cut two pieces of basswood for the elevator servo rails. They should be about 1-1/2" long. You will need to custom trim them, so don't cut them too short. Position the first one about 1" forward of the rear edge of the canopy opening. Use your servo to position the second rail (Photos #7 and #8).



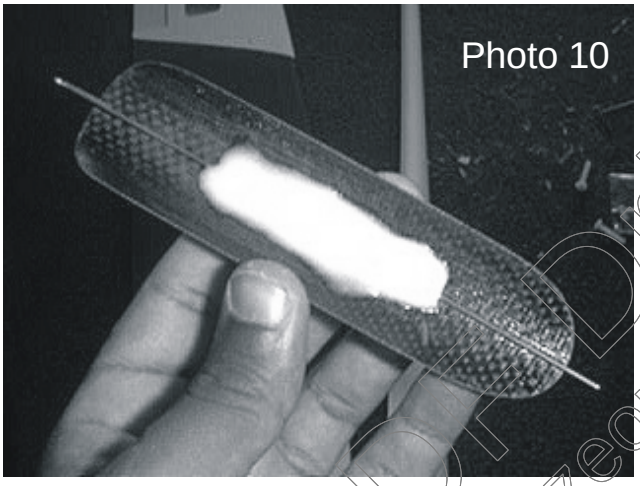


Glue the rails in with epoxy, making sure that they are deep enough that the top of the servo arm is no higher than flush with the side edges of the canopy opening (Photo #8). Temporarily remove the servo. If you are building the mixed V-tail, you will install two servos, side by side.

Through the canopy opening, insert your completed pushrod into the fuselage. Snap the ball cups onto the balls and check that the elevators are straight. They should both line up with the stabilizer tips with the pushrod connected. If they do not, pop the ball cup off and adjust it until they do. Reinstall the elevator servo(s). Turn on your radio system and center the elevator servo. Connect the servo to the pushrod using your favorite method. We used a Du-Bro Easy Connector, but you could also use a clevis or a Z-bend. Recheck that the elevators are moving freely and without differentiation. Disconnect the servo and put the wire inside.



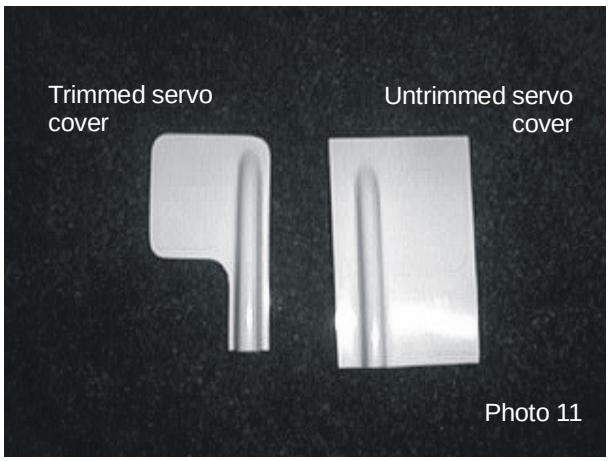
Make up the canopy latch with a 6”piece of 1/16” (or slightly smaller) music wire. Bend the wire slightly so that it follows the contour of the inside of the canopy. Position the wire so that it is centered lengthwise and 1/8” protruding at the front and about ½” in the back. Hold in place with a spot of CA glue.

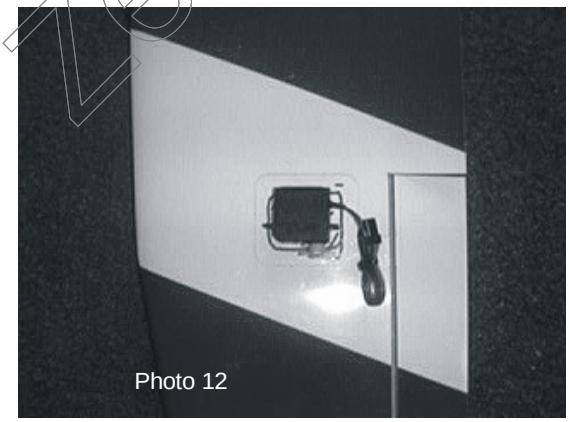


Mix up some 5 minute epoxy and milled fiber. Run a thick bead of glue down the middle of the inside of the canopy, about ¾” wide and 2-1/2” long (Photo #10). Let this cure. When cured, install the canopy on the fuselage by inserting the wire in the back of the canopy into the opening and sliding the canopy back until the wire in the front of the canopy can be pushed down into the opening with a fingernail. Then slide the canopy into position. You will finish the fuselage in the final assembly steps.

Wing Construction:

Locate the servo-covers. Trim them along the scribed lines first, then custom fit them to the servo openings in the wing (Photo #11).





Place your aileron servo on the scribed opening. Using a pen or marker, mark the outline of your servo (Photo #12).

Using your Dremel and a sanding drum, grind out the opening in the wing for the servo. Depending on your servo, and the servo-mounting method you employ, it may be necessary to remove the mounting flanges from the servo (Photo #13). We used Carpenter's Goop to adhere the servo directly to the servo cover. This is an excellent method. It saves time to build a servo box, and is lighter. Should the servo need to be removed, simply remove the cover. Do not worry about the servo coming unglued. It will only come off if you really want it to! Place the servo arm on the servo and use the arm and the arm-fairing to position the servo on the cover. When in place, mark the location with a pen. Use a little bit of sandpaper to rough up the side of the servo to be glued. Clean it off with a little alcohol. Put a little dab of Goop on the servo and spread it thin. Place the servo on the servo cover and use a clamp or a weight to hold it in place while the Goop dries (refer to Photo #14). Give it a few hours before handling.

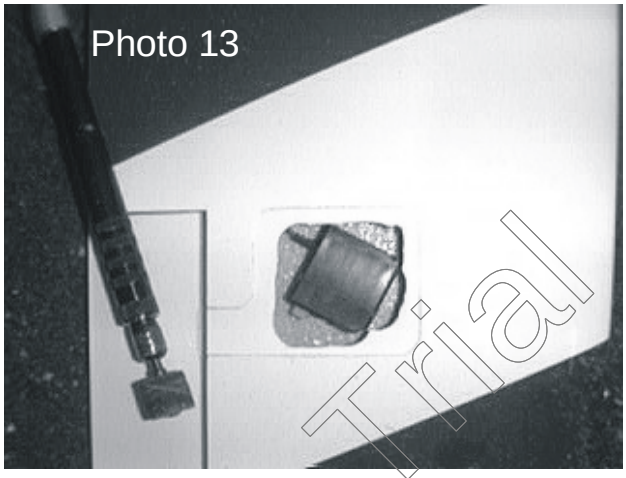


Photo 13

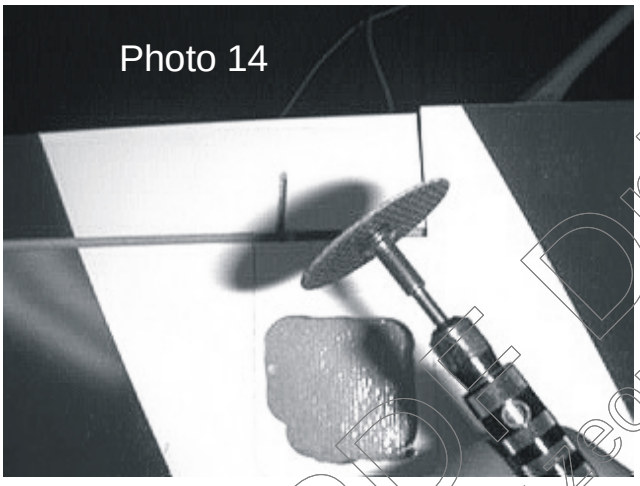


Photo 14

Use the control rod fairing on the servo cover to mark the location for the aileron control horn slot. Using your Dremel and cutoff disc, grind a slot in the bottom of the aileron for the horn. The slot should be about 3/32" wide and ¾" long (Photo #14). Do not go too deep!

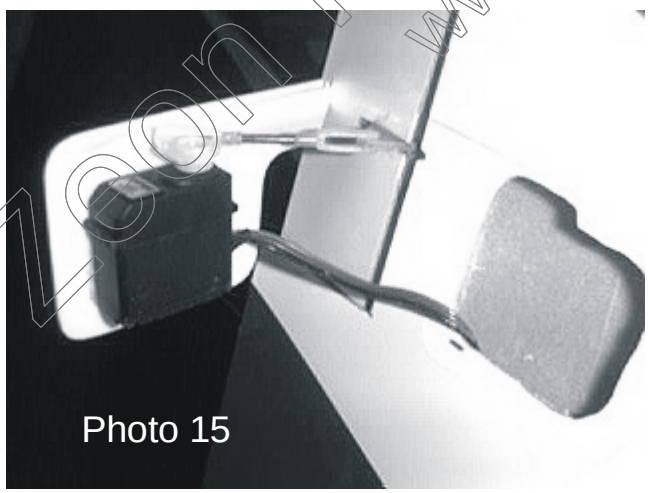
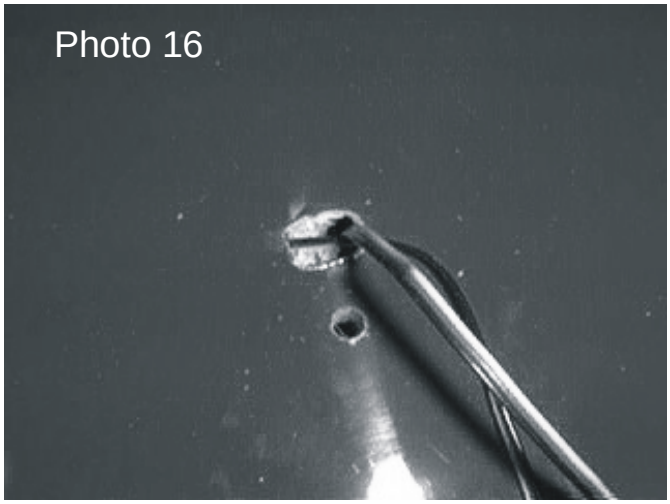


Photo 15

Cut from the 3/32" plywood, a rectangular piece about 1"x 1-1/4". Cut this in half, diagonally, so as to make two triangular pieces. Drill a 1/16" hole in the top corner of the triangle (put the right angle on the bottom and locate the hole in the corner of the short side, perpendicular to the bottom). Glue the horn into the slot in the aileron. Make sure that the horn is standing straight up, and that the bottom of the horn is securely glued to the inside of the top of the aileron. Also, make sure the horn is glued securely to the sides of the slot (see Photo #15).

Connect your servos to the radio system and center the servos. Install the servo arm to the servo. Measure the distance from the hole in the servo arm to the hole in the control horn (with the aileron taped at neutral). Make up the linkage using the 2-56 all thread and the two small

clevises using the measurement you took. You can connect the linkage to the servo and the aileron horn.



Using your Dremel and drill bit, make a hole in the center of the wing, about ¾" behind the main wing bolt. The hole should be about the diameter of a dime. Attach a 12" aileron extension cable to the servo and feed it through to the center hole that you made (Photo 16). Do the same for the other side. You may now install the aileron servo to the wing. We used Prather Radio Box Tape to simply tape the servo cover to the wing. This method works very well. It is easy to remove in case the servo or linkage needs to be accessed. You can use whatever method you prefer. Some will decide to permanently affix the cover, others may use backing plates and screws. Be sure to install the servo arm screw once the linkage has been adjusted. That completes construction of the wing!

Final Assembly:

Transfer the location of the wing hole to the wing saddle in the fuselage. Grind the hole in the wing saddle and feed the leads through. Install the wing using the two bolts provided. Plug all servos and the switch harness (we recommend a micro switch) into the receiver. Install the receiver and battery pack into the fuselage. Depending on your equipment, you can squeeze it all into the space in front of the servo. Otherwise, install the receiver behind the servo rails with Velcro.

Connect the elevator pushrod to the servo using an EZ Connector (or whatever you prefer). Adjust it so that the elevator function is perfect.

Balance the plane at 2-5/8" to 2-3/4" behind the leading edge of the wing at the fuselage sides. A hole can be routed in the wing saddle (in front of the main wing bolt) for ballast. Use lead in the front, in front of the battery pack, to balance the model if necessary. Run the receiver antenna down the length of the fuselage.

Control throws should be: Ailerons—1/4" up and down (at high rates). Elevator—3/8" up and down (at high rates). Rudder—1/4" left and right.

You have now finished your **Mach Dart** and the model should be ready to fly. Make your trim flights on a day with at least moderate wind. Simply throw the model straight into the wind. You should require little trim adjustment for level flight. When you get the model up high, go ahead and put the nose down and watch how the model speeds up!. She makes a great sound, too!

We sincerely hope you enjoyed building this model. We know you will enjoy flying it. We welcome your calls if you have any comments or questions. Happy flying!