Turn-E-Cat

Build your own foam Pylon racer

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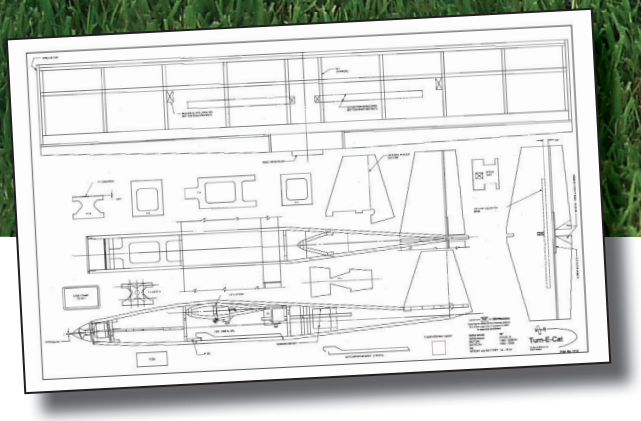
Photos by the author



DOWNLOADABLE PLANS

The first Turn-E-Cat prototype is ready for a test flight.

The Turn-E-Cat design came about as an experiment in building a symmetrical wing using the foam material from Model Plane Foam. The model is patterned after the first electric model that I built. It was an electric Pylon racer called Fast Eddie.

Fast Eddie had a semisymmetrical wing, and used a speed 500 brushed motor from an RC car, and had an electronic on-off switch that plugged into the throttle channel on the receiver. Up until then, you would use a servo to mechanically actuate an on-off switch. An electric on-off switch was high tech.

I thought that the Turn-E-Cat would make a simple model to test the construction capability of the new Model Plane Foam. The foam is similar to Depron, but it currently only comes in roughly 5 mm thickness. It is soft and it's easier to roll-form the wing skins. I used Foam-Tac adhesive. Test your contact cement before using it on your model; some of them will eat the foam.

Building the Turn-E-Cat

Before you start, decide if you want to add rudder control. Adding rudder opens up more control and maneuvering possibilities. Hammerheads, spins, barrel rolls, and rolling circles are all possible with added rudder. Rudder control is not required, especially if you are only going to race around pylons.

Start by cutting out the 5-1/2 x 35-5/8-top and 4-11/16 x 35-5/8-inch bottom wing sheeting. Lay out the spar, rib, and trailing edge (TE) locations on the top sheet and the aileron servo and servo wire access panels on the bottom sheet.

Cut out the fuselage sides and all of the formers. Note that all of the formers are 2-1/4 wide. Cut out the tail parts. The elevator will be cut out as one piece and the center area will be removed after the elevator joiner is glued in place.

Lay out the thrustline and the location of all of the formers on the right and left fuselage sides. Cut out the air exit outlets, but reinstall each one and hold them in place with a piece of tape on the outside. Cut out the plywood motor mount, F-1, and the cowling frame.

Make a 1/4-inch thick plywood pattern for the wing ribs and cut out 10 of them. Make the cuts perpendicular to the foam. An easy way to shape the wing ribs is to

use a belt sander. Start by making a wing rib template using 1/4-inch plywood. Cut out 10 foam blanks slightly larger than the rib template. Glue them together in two stacks of five each using a glue stick or other temporary adhesive.

Make sure the sanding belt is 90° to the table and sand the foam flush to the template. To cut the notches for the wing spars, glue a strip of sandpaper to a 4-inch piece of spar material and carefully sand the cutouts for the top and bottom spars. Repeat for the remaining stack of five.

Building the Wing

Form the leading edge (LE) of the top and bottom sheeting to conform to the wing ribs. Use a broomstick or 3/4- to 1-inch diameter dowel and roll the foam back and forth over the dowel until the sheet conforms to the rib profile. Model Plane Foam is easier to form than Depron.

Start the wing assembly by gluing the 1/8 x 1/4 x 39-inch spar to the top sheeting with epoxy. Test the spar cutout in the wing ribs for a tight fit and correct if necessary. Cut a notch in the bottom edge of four of the ribs for the aileron servo wire. Next, glue the ribs and TE in place with contact cement.

Cut out foam shear webs to fit between each rib. They should fit snugly and be even with the second spar's cutout. Glue with epoxy. When cured, glue in the second spar.

Lay out the servo locations and the servo wire access panels so that you can cut these areas out when the wing assembly is complete. Install the bottom sheeting using 30-minute epoxy at the spar and contact cement for everything else.

Sand the LE so that the upper and lower sheeting and all of the ribs are even. Use contact cement to add two thicknesses of foam. When everything has cured, sand the LE to shape and sand the TE to match the wing's contour. Add the wingtip caps.

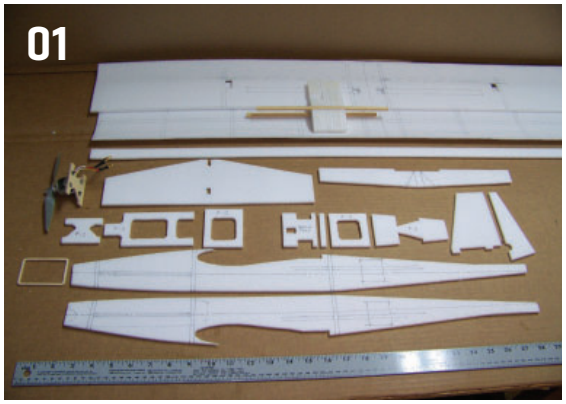
Building the Fuselage

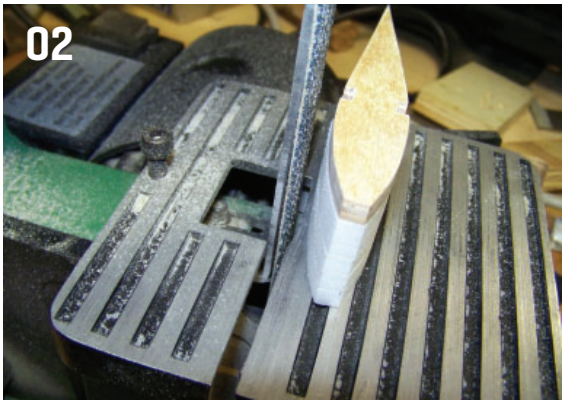
The fuselage is a simple box structure with a low parts count. It incorporates cooling air exit ports on both sides aft of the wing. Start by scoring the foam with a dull pencil slightly behind F-4, roughly a third of the way through. This will make it easier to bend the sides.

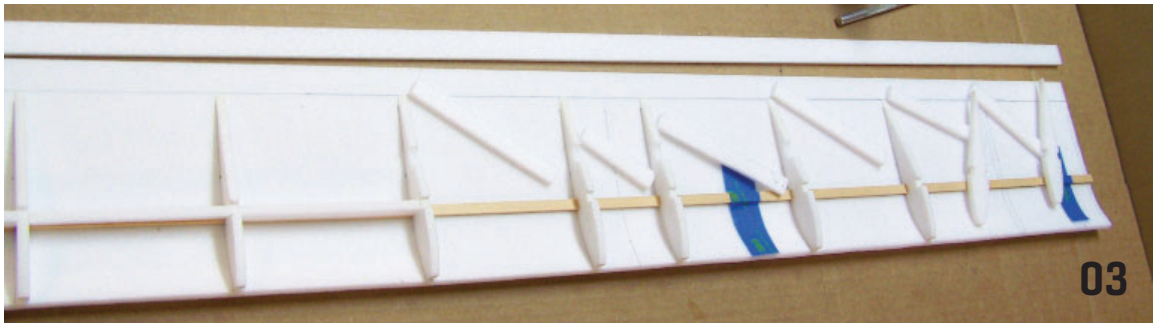
Install t-nuts on F-1 to accommodate your motor and epoxy this assembly to F-1A. Note that F-1 is located 1/32 inch below the top of F-1A (see the plans).

To help align the formers and increase the gluing area, add 3/8-inch foam strips along the former location lines. Now add the motor mount assembly, F2, F2A, F3, F4 and the servo tray to one fuselage side. Use epoxy for the motor mount assembly and contact cement for everything else.

Test-fit the opposite fuselage side for alignment and when you are satisfied, glue it into place. Glue in F-5 and bring the sides together at the tail. Remove the foam from the air exit outlets and







01. Cut out all of the parts needed for the wing and fuselage so they will be ready when needed.

02. The author used a belt sander to shape the wing ribs.

03. Foam shear webs were added between the wing ribs.

04. The author added bottom sheeting and clamped the assembly until it cured.

05. The completed wing should ultimately look like this.

06. Score the foam roughly a third of the way through with a dull pencil.

07. Add foam strips to the fuselage sides to increase the gluing area and help align the formers.

build up the air splitter. Sand for smoother airflow.

Install conduits for the elevator and rudder (if used). Sand the top and bottom of the fuselage so that the formers are even with the fuselage sides.

Install the front and rear bottom sheeting. This is a good time to build the battery hatch. With the hatch in place, mark the inside edge of the fuselage. Align the hatch reinforcements and glue in place. Test-fit it when it is dry.

I used a simple hatch latch made from a #10-24 nylon screw and some 1/8- and 1/64-inch plywood. Make the latch pawl and drill and tap it for the #10 screw. Harden the threads with CA. This gives the threads enough friction to rotate the pawl until it hits the stop.

The baseplate for the stops is made from 1/64-inch plywood. Make a 1/64-inch plywood washer for under the screw head on the outside. When you tighten the screw, it rotates the pawl until it hits the fuselage stop, capturing the hatch. Further turning the screw tightens it. Loosen the screw and it rotates the pawl free of the fuselage until it hits the hatch stop. Then the hatch can be removed!

Fit the wing to the fuselage. Check from the front and rear and adjust it so that the wing is 90° to the fuselage sides and centered. Sand the fuselage wing saddle as required. Temporarily pin the wing in place. Next, measure from the TE wingtip to the fuselage tail. The right and left sides should be equal. Take the time to get this right because the tail surfaces will be adjusted to the wing. With alignment complete, use epoxy to glue the wing in place.

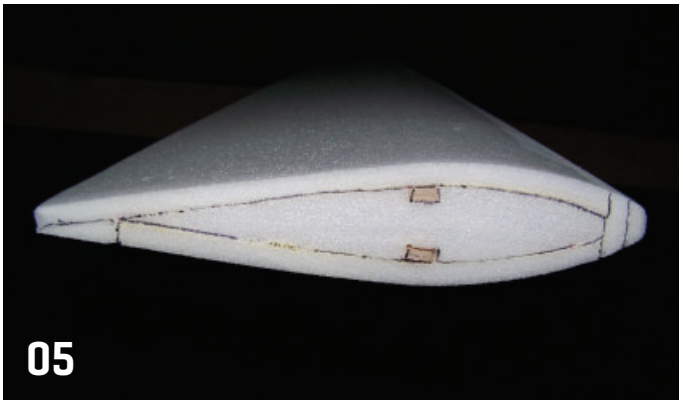
When the epoxy has cured, add scrap strips to follow the fuselage contour over the wing and sand to match the fuselage shape. Add top sheeting and trim/sand to round the corners.

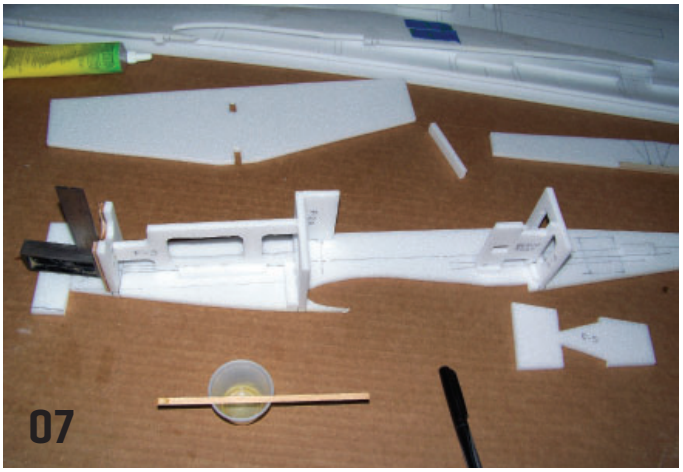
Prepare the horizontal stabilizer by sanding a groove for the 1/8 x 1/4 x 8-inch spar. Make a sanding block from a 4-inch piece of spar stock that is tapered at each end. Glue this to a wood block 3/8 inch from the long edge. Attach a strip of sandpaper to the spar stock. Sand the groove in the bottom of the stabilizer and taper the ends to match the spar. The spar should be flush with the surface of the foam.

Glue the spar in place with epoxy. Place a piece of waxed paper over the spar and cover it with a flat, heavy weight until it has cured. Cut and fit the elevator joiner and epoxy it in place. When it has cured, remove the center portion to allow clearance for the fixed (or movable) rudder.

At a Glance

Specifications
Wingspan: 39 inches
Wing area: 273 square inches
Length: 28.75 inches
Motor: 370-size brushless, 1,300 to 2,200 Kv
Battery: 1,300 to 2,200 mAh
Weight: 14 to 16 ounces without battery





Now is a good time to cut the slots for the CA hinges. Mark the centerline on the wing and the control surfaces. Use four small hinges for each aileron, three or four for the rudder, and six for the elevator. Only apply foam-safe CA where the hinge enters the airframe. Install the hinges in the wing, the horizontal stabilizer, and vertical fin if a rudder is used. Use CA accelerator to speed up the process.

With hinge slots cut in the control surfaces, sand the edge to a < shape. Control surfaces will be installed later. Install the hinges so that each one stands out slightly less than the previous one. This will allow you to insert the hinges into the control surface one at a time starting with the longest one, making the process a little easier.

Fit the horizontal stabilizer to the fuselage and wing. The stabilizer should be centered and parallel with the wing when viewed from behind, and the TE should be equidistant from the wing's TE on both sides. When satisfied, epoxy it into place. After the glue has cured, add the vertical fin, ensuring it is 90° to the stabilizer and aligned with the fuselage's centerline. Add reinforcement pieces to both sides of the fin at the base.

Install ailerons, elevator, and rudder (if used). Install servos, control linkages, and the motor/ESC assembly. You might have to cut a temporary hatch in the bottom front sheeting for the motor/ESC hookup. I used a full-range receiver that has a long and a short antenna. The short antenna goes through a hole through the top of the fuselage. The long antenna goes out through one of the air exit outlets. Adjust the battery location to achieve the proper center of gravity (CG). Add hook-and-loop material and foam stops to hold the battery in place during maneuvers.

Painting

Some types of spray paint will attack this foam. Test them on a piece of scrap foam.

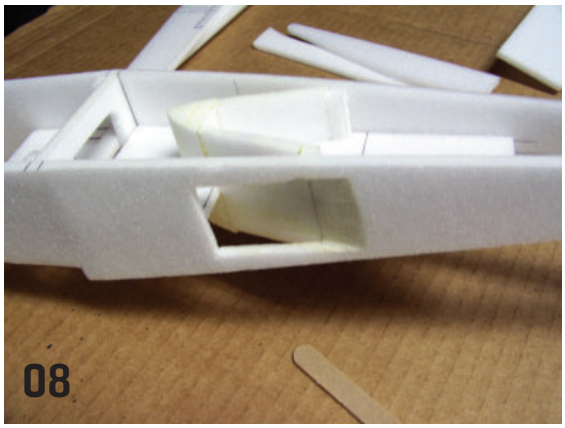
The blue graphics on the first prototype were sprayed on. In several places the paint bled under the tape. I used white to touch up the spots with mixed results.

I used acrylic paint on the second Turn-E-Cat prototype for the yellow and some MonoKote trim for the blue strips. To prevent the paint from bleeding under the tape, paint the edge with white. It will seal the pores of the foam to prevent the color from bleeding under the tape.

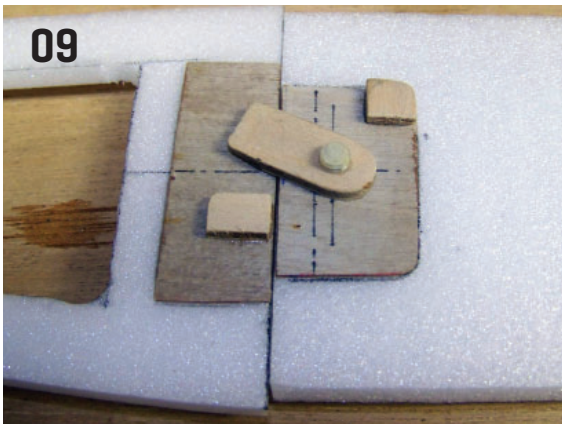
Control Linkage Setup

Set up your control linkage to use as much of the servo throw as possible. You might have to use the innermost hole on the servo arm and the outermost hole on the control horn. As a guide, here are the setups that I used:

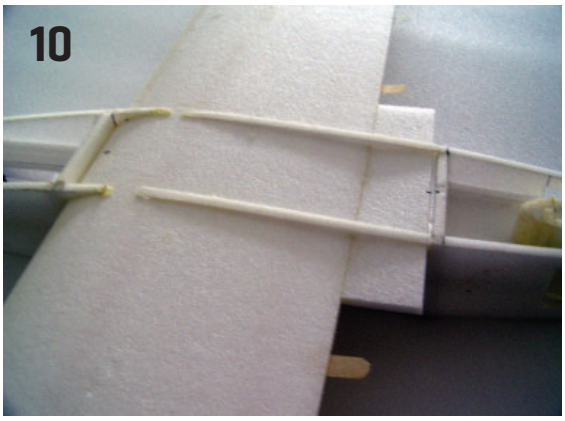
- Elevator low rate: 1/4 inch; high rate: 5/16 inch; exponential: 50%
- Ailerons low rate: 3/16 inch; high rate: 1/4 inch; exponential: 45%



08. Sand the air splitter for a smoother air flow.



09. The hatch latch is made from 1/8- and 1/64-inch plywood and a #10-24 screw.



10. Sand the strips to follow the contour of the fuselage.

11. Sand a groove for the stabilizer spar.

- Rudder low rate: 1/4 inch; high rate: 5/16 inch; exponential 45%
- CG range: 1-7/8 to 2-1/8 inches from the wing's LE

This is a starting point. Adjust your controls and CG to your liking.

Flying

Check the control throws and direction, CG, and side-to-side balance. Also note the motor rotation and correct any discrepancies while it is still in the shop.

The first Turn-E-Cat prototype used an E-flite 370 1,360 Kv motor with a 1,200 mAh three-cell LiPo battery pack. The ready-to-fly model weighed 14.6 ounces. This worked out to a wing loading of 7.55 ounces per square foot.

On the first flight, an assistant hand launched the model while I applied roughly 5/8 throttle. With a light push, the model was off and flying. It wanted to climb, so I added a few clicks of down-elevator. When I applied full throttle, it again went into a steep climb. Its vertical performance is amazing. It will go straight up until the speed bleeds off.

If you use the 370 1,360 Kv motor and an 8 x 4 propeller, I recommend using a folding propeller. On the first landing, I broke the fixed 8 x 4 propeller and pulled the motor mount loose. This offered an opportunity to add in 3-1/2° of downthrust to cure the full-throttle tendency to climb. This resulted in no more worries about propeller and motor mount damage; however, the model seemed slower and vertical performance seems to have suffered.

My second Turn-E-Cat prototype was built with a 2,200 Kv motor and a 6 x 4 fixed propeller. The motor mount was also reinforced. F-4 was moved back for more servo and receiver room, and the battery area was enlarged. A rudder servo was also added. These changes were incorporated on the plans.

The 2,200 Kv motor turns this airplane into a rocket! The first flight was flown at roughly half throttle while I sorted out the control settings. Applying full throttle made the airplane jump forward with amazing speed.

The model is easy to fly, especially with the 370 motor. The light wing loading takes the drama out of hand launching and allows it to slow down nicely for landing. Open the throttle and the symmetrical wing cuts through the air without being overly sensitive to wind gusts. It exhibits neutral stability and goes where you point it.

If you want a hot rod, build it with the 2,200 Kv motor and hang on! I think anyone who builds a Turn-E-Cat will have fun with it. Go fast and turn left!

SOURCES:

Model Plane Foam
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www.modelplanefoam.com

AMA Plans Service
(800) 435-9262, ext. 507
www.modelaircraft.org/ama-plan-service