STYROFOAM

CONSTELLATION

Build your own multiengine electric model

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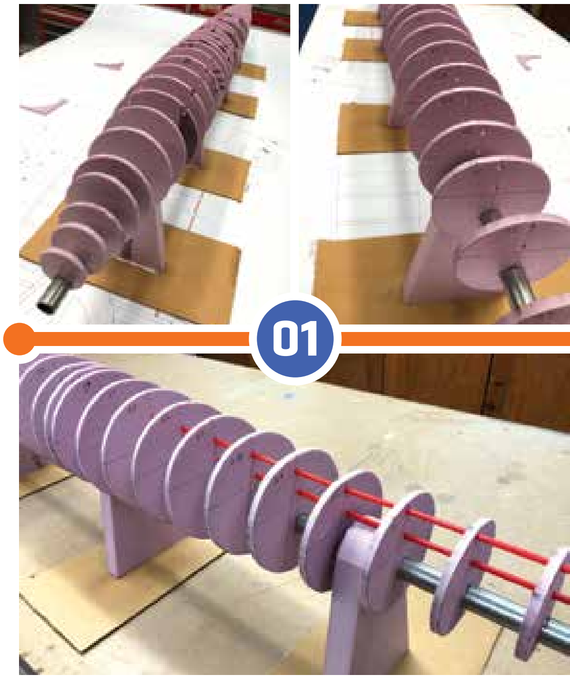
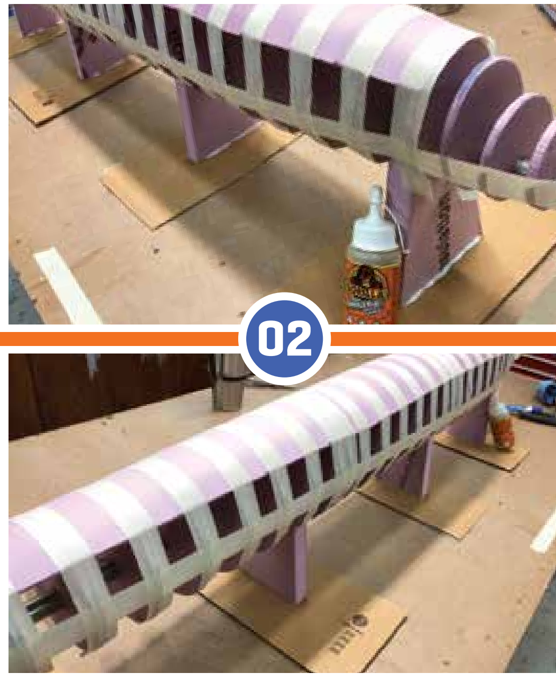
The Lockheed Constellation quickly took on the name "Connie," even in its C-69 military form. Its dolphin-shaped fuselage, the enlarged P-38 Lightning wing, and its triple-fin arrangement gave the aircraft an unmistakable profile on the world's flightlines.

The Constellation has been credited with being the first civilian air transport with a pressurized cabin. This allowed passengers to fly safely and comfortably during bad weather, something that the airlines desperately needed. Three of the 856 Connies that were built carried US presidents and flew missions for the Berlin Airlift. Because it was an airplane on my bucket list, I went to work.





01. A 3/4-inch Forstner drill bit will accurately cut holes in the formers for a snug fit on the electric conduit build fixture. The cardboard bases for the stands allow weights to be applied and hold the build fixture firmly in place while the skin is applied. After roughly 2/3 of the fuselage skin is applied, the conduit and work stands are removed.

02. The masking tape that was applied horizontally keeps the formers aligned as the fuselage skin bonds. The vertical tape provides pressure at each former. Slow-curing brown Gorilla Glue was used for this step.

Fuselage Construction

The Connie's construction closely resembles the methods used to construct balsa models, but without the high cost and weight. The numerous fuselage formers make capturing the unusual shape of the Constellation easy.

Construction starts with a full sheet of 1-inch thick Styrofoam. A hot wire is used to cut the sheet into 1/4-inch sheets. The plans have instructions and illustrations for cutting the material. This approach to slicing foam is easy and it is worth the time to learn. You will soon find that you have an unlimited supply of building material in any thickness you want.

Roughly a quarter of the sheet is cut to 1/2-inch thick to make the tail feathers and motor mounts. The fuselage formers were cut from the 1/4-inch sliced foam. The centerline and waterlines were transferred to the formers, as were their assigned numbers.

I used a scribe to mark the exact center of the hole that the build fixture (3/4-inch electrical conduit) will be threaded through. I used a 3/4-inch foster bit to accurately drill holes in the formers. This drill bit will cut a clean hole in the foam and give you a snug fit.

Some of the formers will require that portions of their centers be removed later. To make the job easier, I precut the formers. This means that the dashed lines on the formers will need to be cut as perforations; doing so will guide your hobby knife to complete the cuts later.

The build fixture is placed on the plans and the fuselage former positions are transferred to the pipe. The formers can then slide into their positions on the build fixture.

Align the centerlines and waterlines that are marked on the formers then measure the waterlines from the build surface to make sure that they are properly clocked. To hold them in place and keep them from rotating, I used long strips of masking tape loosely applied from nose to tail.

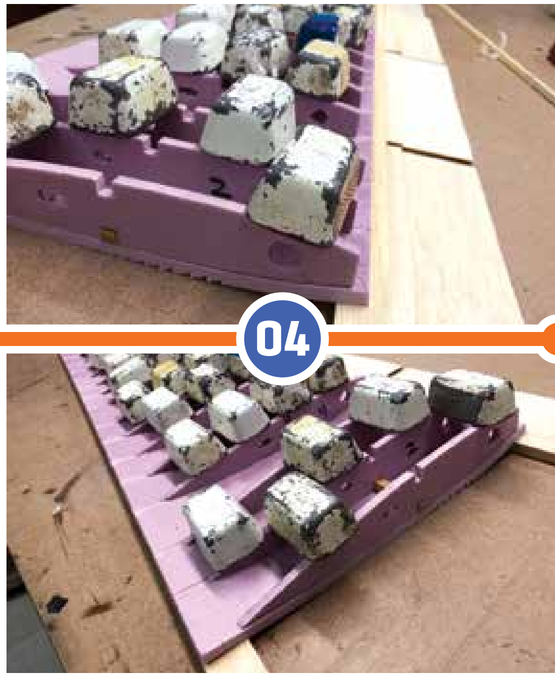
I experimented with using PVC tubing to preshape the sheeting with which to cover the fuselage and found that it was as easy to shape the panels by hand. Using my hands for shaping actually worked better because I could curl the ends tighter than the middle for a better fit.

For the first few panels, I was a little greedy on the size. This took considerable shaping and edge-to-edge adjustments. I was trying to avoid seams that turned out not to be that hard to deal with.

To install the panels, I started with test-fitting the foam sheet panels in place with a few strips of masking tape and marked the edges of the formers so that I would know where to stop applying the glue.

Only apply enough glue to make the edge of the formers glossy. To bond the panels, I put the panel in place and used masking tape to attach it, starting in the middle and working outward. I held the tape strip over the panel and used the ends to pull down the panel sides, then attached the tape ends to the edge of the former.

After roughly 2/3 of the fuselage was sheeted, I removed the building fixture pipe and stands. From this point, the fuselage was worked while sitting on a padded surface, such as foam rubber or a blanket, to avoid dents. Removing the center portions of the formers has to be done at this point (as mentioned earlier), as well as adding the 3/4-inch thick formers that make up the wing saddle.



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03. Sanding the seams is best done with a sandpaper strip to maintain the fuselage's round shape. A blanket and weights work well to hold the fragile foam in place. The next step is to apply fiberglass to avoid damaging your work.

04. The wing is assembled on the bottom sheeting, using the spar for rib alignment. Wood strips are used at the LEs and TEs to form the curve of the bottom sheeting. The amount of weights shown are excessive; strips of wood across the ribs with a few weights would be as effective.

The ends of the fuselage have compound curves that are too sharp for sheeting, so shaped foam blocks were used (sectional construction). This simply involved using the patterns to cut 3/4-inch thick discs of foam and bonding them to the fuselage ends. Rough-sanding the edges off of the discs left me ready to sand the fuselage.

With a 1/4-inch skin thickness, there is plenty of room to sand the seams flush without impacting the skin's strength. The trick is to use a long strip of 120-grit sandpaper while holding it taught and pulling it over the fuselage with light downward force. If you can't find a roll of sandpaper, a cut sanding belt will work.

To prevent damage, I used a blanket with weights around the edges to form a gentle clamp arrangement. To apply the 3/4-ounce fiberglass and Z-Poxy finishing resin, I bonded a foam block to the fuselage bottom where the wing will mount as a stand.

The Wing

Because the wing is assembled directly on the bottom sheeting, a method called pouncing is used to do the layout work. The plans are placed over the wing sheeting and holes are poked through the plans at every intersection of the ribs, spars, and the wing's outer edges. A sandbag will keep the paper from shifting.

The leading edges (LEs) and trailing edges (TEs) of the wing skin should be 3/4-inch oversized. The material will be trimmed off later. Drawing guidelines between the marks in the foam is all that remains. Flipping the plans sheet over and using the holes in the paper will lay out the opposite wing panel. The wing ribs are laid out with the same method as the wing panels and cut while stacked to make the chore easier.

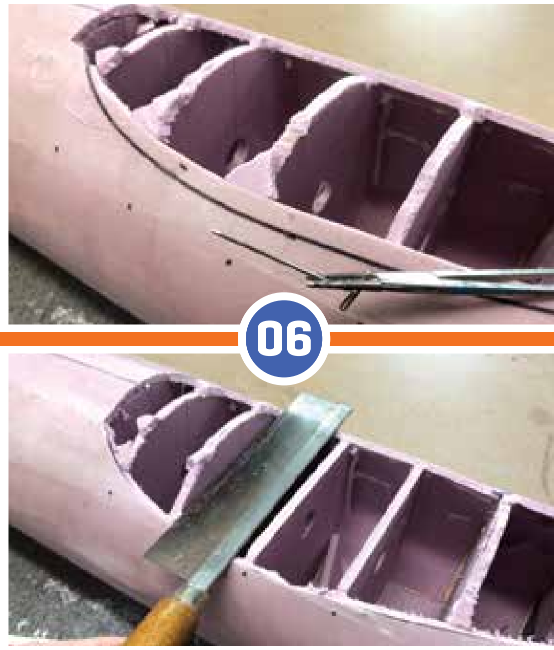
I bonded the spar in place on the left and right wing panels first to keep the ribs aligned and then used weights for clamp pressure. Sliding shims underneath the sheeting at the LE formed the bottom airfoil curve. To join the outer wing panels, the center wing panel is assembled between them using the same method as the outer panels. This step will require the ribs to be cut to allow for the spar joiners and for the outer panel tips to be elevated to 2-3/4 inches.

Before the top wing sheeting can be added, there are a few support structures to add. Solid blocks for the wing attach pins and wing screw were cut using the R1 rib as a pattern. The plywood motor mount supports and the landing gear mount pads went in next. The wiring harnesses for the motor power, ESC, and aileron servos thread through the holes in the ribs with the ends coiled and taped in place to be retrieved later.

To prevent the TE from being too thick, the bottom sheeting must be tapered. I used weights to hold the wing panel's TE along the edge of the work surface and used a long strip of masking tape to protect the ribs while I sanded the foam sheet edge.

In order to locate the landing gear, aileron servo wires, and motor mount bays, I poked small holes through the bottom sheeting for later reference. The first sheet that was applied to the top of the wing was the center panel. This offers an edge to mate to the outer wing panels.

To prevent introducing a twist in the wing, I cut foam wedges to support it from the bottom then double-checked the measurements to the work surface.



05. With foam wedges installed, the wing is ready for the top sheeting installation. The wires can be seen waiting to be retrieved.

06. After rough-cutting the wing saddle area, a straight pin is used to transfer the wing saddle lines marked on the formers to the fuselage skin. Leaving roughly 1/8 inch of extra material for adjusting will make you feel better about cutting into the project. Sandpaper and several test-fits will make for a great fit.

Using slow-curing Gorilla Glue (brown in color) will buy you extra time to apply weights for clamp pressure.

After the LE foam block has been added and the wing has been sanded smooth, I cut free the portion of the wing that makes up the ailerons. The aileron bay was then lined with balsa, as well as the edges of the ailerons.

The wing can be fiberglassed with the ailerons installed if you are careful not to get resin in the gaps. I prefer this method because it makes the finishing steps easier. To mate the wing to the fuselage, I rough-cut the fuselage belly skin to expose the formers. The lines drawn on the formers are used to guide a straight pin through the skin to mark the wing saddle trim line.

I cut to the inside of the trim line until a test-fit could be accomplished. I used a sheet of foam to form the base of the wing fairing. In hindsight, a thin strip of plywood or card stock would make a better base.

The fairing base is bonded to the fuselage skin and formers, using the wing to ensure that the proper shape was copied. After the LE dowel pins and wing attach screw were installed, I cut the foam blocks that make up the fairing. Each piece is slightly different than the previous one, so test-fits and small adjustments were necessary. The sanding/shaping step went quickly and little filler was needed to complete the fairing.

Tail Feathers

The triple fin arrangement on the Constellation posed a rudder construction challenge. I managed to get all five of them to work. The plans have detailed illustrations, and there is a more in-depth look on the RCGroups build thread. In hindsight, I think a single larger-than-scale rudder will prevent a "weathervane" takeoff during a crosswind.

The tail feather construction starts with transferring the patterns to a sheet of 1/2-inch thick foam and cutting them. The control surfaces are cut free from the fins and stabilizer, and the balsa hinge lines are added to the foam. All of the parts have a centerline applied to their edges, and the V shape is sanded on the control surfaces' LE. After the hinges are installed, I marked the parts with colored markers to help with assembly later.

Sanding the surfaces into shape with a sanding bar is easier if you apply masking tape to the back along the hinge lines to keep them from moving. Looking at the parts from their edge frequently helps to make them symmetrical.

The elevator is actuated through a metal wire fork and soldered on a brass bellcrank—fairly standard stuff. The rudders are slightly more complex. A bellcrank is attached to the center rudder through bent piano wire. An aluminum tube is attached to this wire and acts as a tie-rod to move the outboard rudders. There are many moving parts and freedom-of-movement tests to make, but they are worth it in the end.

Battery Hatch

To make the battery hatch, I removed the fuselage skin, stopping away from the balsa hatch supports, then sanding the foam flush with them. I used a razor to remove the fuselage former material to make room for the light plywood battery floor. The edges of the hatch hole were lined with balsa strips for edge protection, and a solid block of foam was cut to fit the hole.

The portion of the block above the fuselage was sanded to shape and fiberglassed separately. I used

07. The tail feathers are made from 1/2-inch thick foam sheets that are sanded to shape after the balsa has been added to the hinge lines. The balsa is used for hinge strength and the convenience of not having to protect the foam from paint with a fiberglass coating. Note the use of colored markers to keep the parts paired.

08. The formed plastic cowling and nacelles make this repetitive step easier and are available on the Park Flyer Plastics website. The cowling is assembled with model cement and held in place with small screws for access to the motors and ESCs. The nacelles are bonded to the wing with Gorilla Glue. On the table is one of the motors waiting to be installed.

magnets to hold it in place and a plastic simulated VHF antenna as a handle to open the hatch.

Motor Mounting

I removed the wing skin from the motor mount bays, being careful not to nick the wires that were waiting for me. The motor mounts are made with 1/2-inch thick foam panel boxes. My plan was to cut away the LE balsa, but working around them allowed me to retain their strength.

The horizontal panels were first to be installed flush with the top of the wing and level with each other. The vertical panels stiffen the mounts but not enough to please me. Adding a radius to the top of the mount made applying fiberglass cloth to the mount easier later and made a big difference in strength. To set the 1° downthrust, I supported the wing on the table with 1° LE up then sanded the front of the mounts 90° to the work surface. Bonding plywood to the mounts with epoxy and fiberglassing the foam box completed the task.

The formed plastic nacelles and cowling are supported by a 1/2-inch foam ring that fits around the motor mount at the wing's LE. After I bonded the rings in place, I carefully trimmed the plastic nacelles to fit the wing profile while resting on the rings. The cowling is formed with a male-to-female fit to ease assembly. To ensure a tight fit to the nacelle, the cowling was temporarily assembled with tape on the model then bonded with plastic model cement.

I used Hextronik DT750 motors that I had on hand in the shop. At full power, they produce 383 watts of power at 41 amps. At half power, the model will maintain altitude with only 211 watts drawing 21 amps.

My point is that smaller motors will fly this model with a weight and cost savings. Your only firm requirement is needing 8-inch propellers for ground clearance. There is ample space in the battery compartment to set the center of gravity (CG), so experimenting with different battery sizes is not a problem.

Flying

The Constellation has such long moments from the CG that flight inputs make for a gentle-flying model. When I saw how predictable the takeoff rotation went, I was already looking forward to the landing flair. I didn't notice a difference in air speed with the gear retracted, although I'm sure there was some.

While looking for a more scalelike air speed, I found that at half throttle I could maintain altitude even in the turns. My real surprise came during the flybys. I expected an airplane this light to buffet around and need frequent corrections, but it flew straight and true. I believe this is because the Connie has such a clean shape that wind penetration is not a problem.

09. The author chose a U.S. Air Force scheme; however, the Connie can also be completed as a civilian aircraft.

SOURCES:

Park Flyer Plastics
(817) 233-1215
parkflyerplastics.com

HobbyKing
www.hobbyking.com

Gorilla Glue
(800) 966-3458
www.gorillatough.com

RCGroups
www.rcgroups.com