De Havilland TIGER MOTH

by Pat Tritle

The Tiger Moth can be finished in a wide array of color schemes.

FIRST FLOWN IN 1931, the de Havilland Tiger Moth, a dual-cockpit, dual-controlled biplane, was designed to be a primary trainer. It went on to become one of the most widely used aircraft by flying clubs and auxiliary squadrons around the world.

The Tiger Moth was actually a higher-powered, upgraded version of the Gipsy Moth. The Tiger Moth played a significant role in the British Commonwealth Air Training Plan, and large numbers were built in Canada, equipped with floats, skis, and many with sliding canopies for cold-weather operation.

Not only was the Tiger Moth an excellent trainer, but it also served well for coastal submarine patrols at the beginning of World War II. Many are still flown by private owners today.

Many years ago, a friend who owned a Tiger Moth told me that it was almost the perfect trainer. It was relatively easy to fly, and although it would "amplify" the student's mistakes, it wouldn't "hang him out to dry."

My dad told me the same thing regarding the Piper J-3 Cub. Having built and flown models of both the J-3 and the Tiger Moth in several sizes, I affectionately look at the Tiger Moth as the "Cub of biplanes."

The full-scale Tiger Moth had a wingspan of 28 feet, 4 inches; a length of 23 feet, 11 inches; and was powered by the 130-horsepower Gipsy Major engine with a two-blade wooden propeller. Its top speed was 104 mph, it cruised at 90 mph, and it stalled at 43 mph.

The rate of climb was 673 feet per minute, and the Tiger Moth had a service ceiling of 13,600 feet. Empty weight was 1,115 pounds, and gross weight was 1,825 pounds.

An oversized *RC park flyer* of the *classic trainer*

I designed the model to approximately 1:8 scale and use four-channel RC and brushless power. The idea was to build a large park flyer that was slow enough to fly in smaller venues but big enough to handle less-than-perfect weather conditions. If slow, scale flying is "your bag," the Tiger Moth might be for you!

The model is easy to transport. The wings are removable in pairs, in case the model needs to be disassembled. But it will reassemble at the field in less than a minute.

The Tiger Moth structure looks more like an FF model than a typical RC design but is not a difficult build. The fuselage is stick framed with formers and stringers, and the tail group features bowed outlines, to keep the weight down. Long-tailed, short-nosed models can require a good bit of nose weight to balance if the builder doesn't take care to ensure that the aft end stays light.

The wings feature egg-crate-style construction, to assure ease of assembly, and are plugged into the fuselage and top wing center-section in pairs, to accelerate break-down and reassembly for easy transport. To ease the scratch-building process, a laser-cut parts package and vacuum-formed plastic cowl and oil tank have been developed for the design.

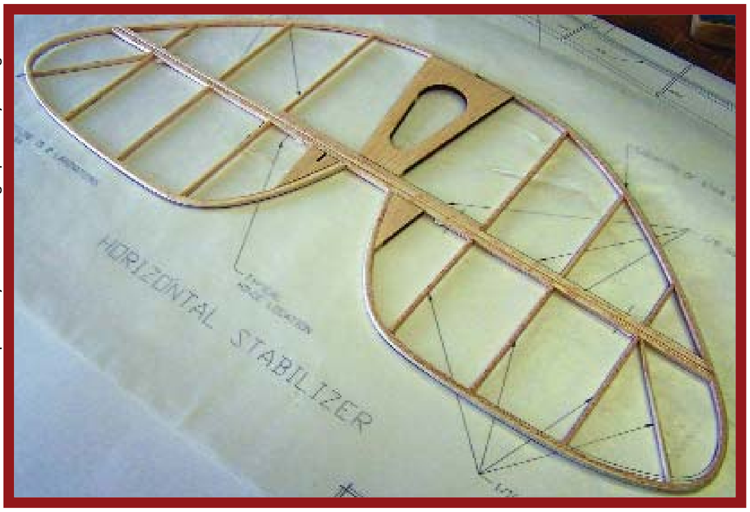
To blend old-technology airframe design with modern electronics, the Tiger Moth is set up for the readily available E-flite Park 400 outrunner brushless power system and mini RC equipment. Therefore, it will be easy to build and set up and will fly excellently.

CONSTRUCTION

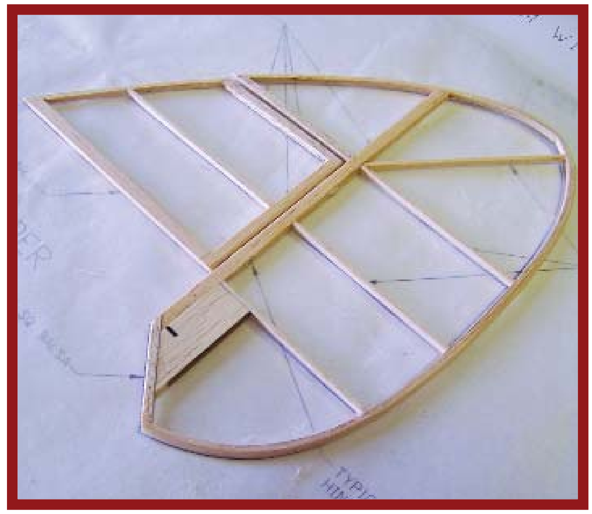
Begin by bowing the rudder, elevator, and wingtip outlines. Bowing patterns are made from $^{3}/_{16}$-inch-thick artist's foam board using the templates provided. Rudder and elevator outlines are formed using two laminations of $^{1}/_{16}$ x $^{1}/_{8}$ balsa. The wingtips are formed using two laminations of $^{1}/_{16}$ x $^{3}/_{16}$ balsa.

The secret to successfully bowing the outlines is sufficiently soaking medium-firm balsa in water, to soften it. Pull the bows

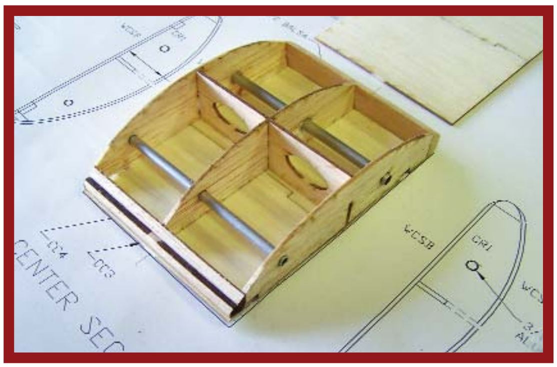
Static photos by the author Flight photos by George Laskar



The horizontal-stabilizer assembly is built directly over the plans. The outline is bowed from two laminations of balsa. Hinges are 1/8-inch-wide strips of CA hinge stock.



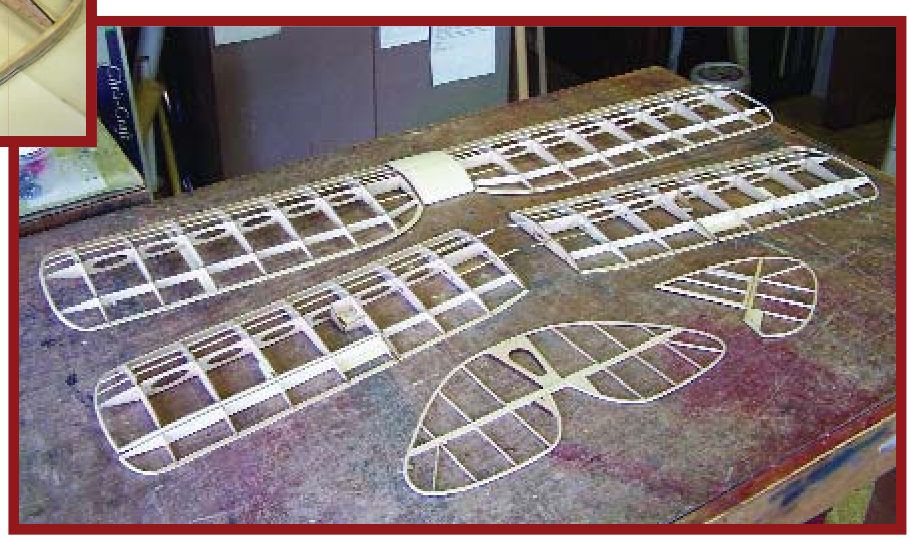
The rudder assembly is built directly over the plans as well. It is hinged, as is the stabilizer. The parameter should be rounded to mimic a steel-tube structure.



The top-wing center-section is built directly over its bottom sheeting, with plug-in wing-receiver tubes glued in place before the top skin is glued in place.

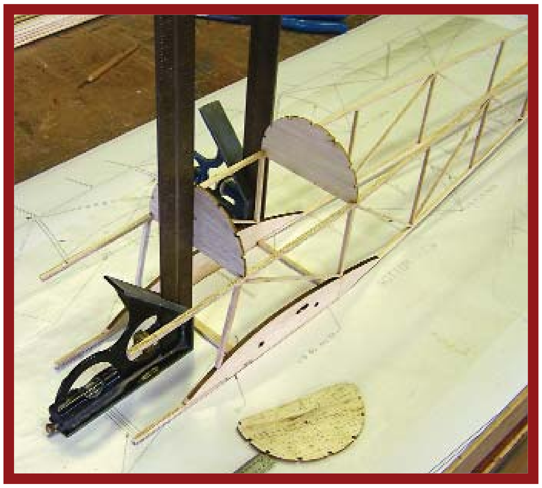
The wing assembly begins with all spars, ribs, and TEs glued together over the plans. Once the basic right wing is framed, the left wing is assembled to the same point.

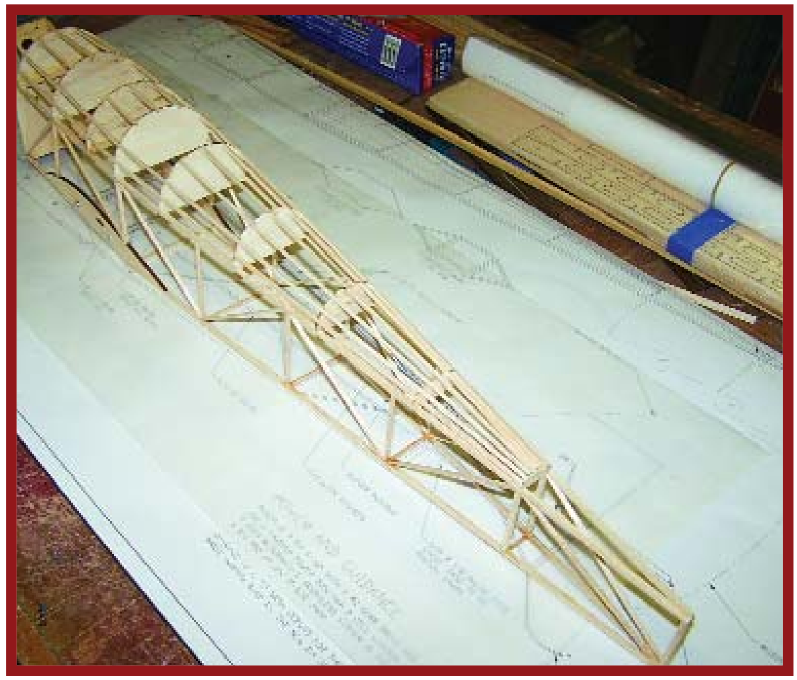
Aileron ribs and front hinge spars are adhered in place directly on the wing assembly while the wing is still pinned to the building board.



The 5/32-inch-OD and 1/8-inch-OD rear aluminum wing-attachment tubes are glued in place on the bottom wing assemblies.

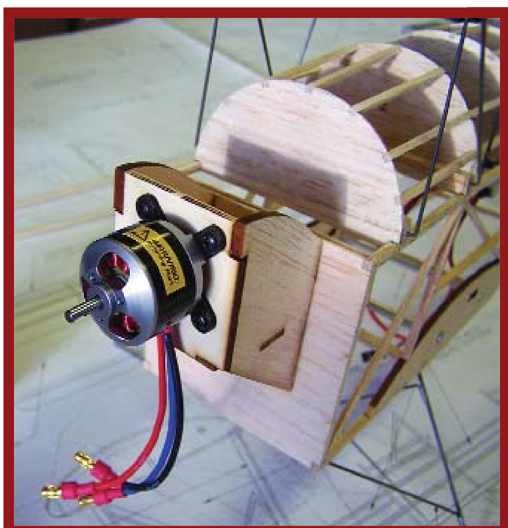
With all framing completed, top and bottom wing assemblies are sanded to final shape. All hinges should be notched and installed, but not glued until after flying surfaces are covered.

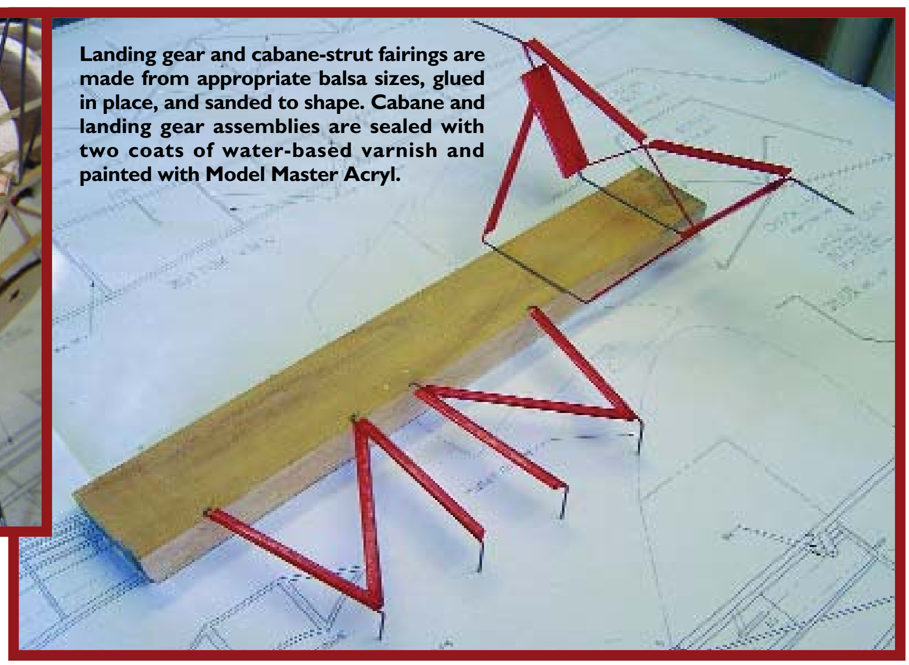




Above: Top formers are glued in place using machinist squares, to ensure that fuselage sides remain vertical and that formers are aligned vertically.

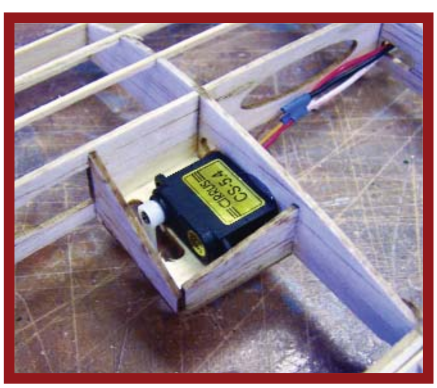
Right: The Tiger Moth's finished fuselage frame is sanded to its final shape, to eliminate irregularities in the completed structure.





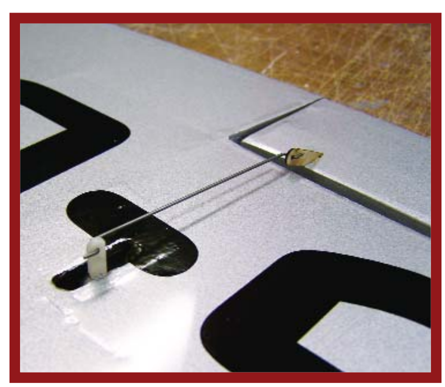
Landing gear and cabane-strut fairings are made from appropriate balsa sizes, glued in place, and sanded to shape. Cabane and landing gear assemblies are sealed with two coats of water-based varnish and painted with Model Master Acryl.

Above: The E-flite Park 400 outrunner motor is screwed in place on the firewall using the provided motor mount and mounting screws.

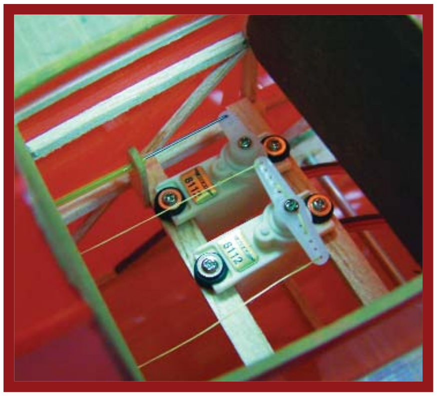


Aileron servos are glued onto the mounts with silicone adhesive. The wires are extended by soldering a section of wire into the lead, to eliminate the need for a separate extension cable.

The top-wing center-section is covered with corrugated foam from Titanic Airlines, sanded to shape, and painted with Model Master Acryl.

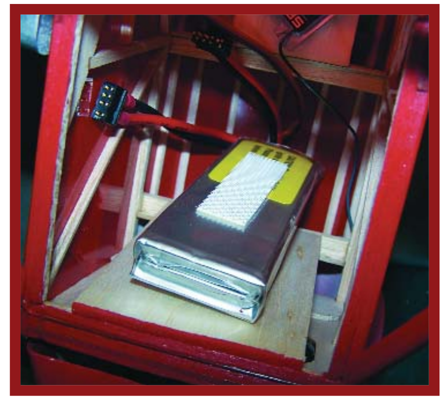


Aileron pushrods are .032 wire. Pushrods are set up with Z bends on both ends, with the final alignment made by positioning the control horn before gluing it in place with a drop of thin CA.



Access to rudder and elevator servos is through the rear cockpit opening. The elevator pushrod has Z bends on both ends. Pull-pull on the rudder is the lightest option.

The vacuum-formed cowl and oil tank are trimmed from their carrier sheets, and their edges are sanded smooth.



The 2100 mAh, two-cell battery is mounted on the tray supported at the firewall and front cabane mount. The battery is secured to the mount with Velcro.

Battery access is through a plastic hatch on the fuselage bottom. Motor cooling air exits the gap at the bottom of the cowl at the firewall.

around the forms and glue them with either white glue or medium CA.

To speed up the forming process, the parts can be dried while still on the forms. Place them in the microwave oven on high for 12-14 seconds.

For the dedicated scratch builder, provided pattern sheets can be transferred directly to $^1/_{16}$ and $^1/_8$ x 4 x 24-inch balsa sheets, to make your own print wood to simplify the parts-cutting process. The other alternative is to use the laser-cut-parts pack.

Framing the Tail Section: The elevator and rudder are built directly over the plans. Pin the shaped parts in place and add the $^1/_8$ square balsa spars, followed by preformed outlines. Add the ribs, using $^1/_{16}$ x $^1/_8$ balsa.

When dry, remove the assemblies from the board and cut the surfaces apart. Sand the borders to a radius and slot for hinges. The hinges are made using the supplied pattern. Don't glue the hinges until after you cover the parts.

Framing the Wings: The top wing's construction begins with the center-section. Join the upper and lower sheets from parts WCST and WCSB. Ribs and spars are assembled directly on the bottom sheeting.

Glue the $^3/_{16}$-inch-OD and $^5/_{32}$-inch-OD x 3.3-inch-long aluminum receiver tubes in place, leaving roughly $^1/_{32}$ inch protruding on both sides. Sand the contour into the LE and TE, and glue the top sheeting in place.

De Havilland Tiger Moth

Type: Semiscale RC park flyer
Skill level: Intermediate pilot and builder
Wingspan: 44 inches
Wing area: 575 square inches
Length: 34.35 inches
Weight: 20 ounces
Motor: E-flite Park 400 (920 Kv) outrunner
Power: 15-amp ESC (15 amps minimum) with BEC (2 amps minimum); APC 11 x 5.5E propeller; 2100 mAh, two-cell Thunder Power Li-Poly battery
Radio: Four channels with four microservos, 72 MHz full-range (or 2.4 GHz digital spread spectrum) receiver
Construction: All balsa; plastic parts, laser-cut parts available
Finish: Nelson LiteFILM recommended

Tiger Moth Materials List

Sticks

Eight 1/16 square x 36 balsa
Six 1/16 x 1/8 x 36 balsa
Three 1/16 x 3/16 x 36 balsa
Four 1/16 x 1/4 x 36 balsa
Nine 3/32 square x 36 balsa
Eight 1/8 square x 36 balsa
One 1/8 x 1/4 x 36 balsa
Four 1/4 x 1/2 x 36 balsa

Sheets (required only if laser-cut parts pack is not used)

Six 1/16 x 4 x 24 balsa
One 1/8 x 4 x 24 balsa
One 1/32 x 1 x 2 plywood
One 1/8 x 2 1/4 x 3 light plywood

Wire

Two .032-inch-diameter x 36-inch steel
Two .046-inch-diameter x 36-inch steel
One .062-inch-diameter x 36-inch steel

Tubing (.014 inch wall)

One 3/16-inch-OD x 12-inch aluminum
Two 5/32-inch-OD x 12-inch aluminum
Two 1/8-inch-OD x 12-inch aluminum

Miscellaneous

Two Sullivan Products pushrod tubes (item S507)
Two 2 1/2-inch light foam wheels
One round toothpick (rudder control horn if pull-pull is used)
4 feet of Kevlar thread (rudder pull-pull cable)
16 feet of 40-pound-test Kevlar fishing line (wing rigging)
Four Nelson Hobby Direct "T"-pin clamps (main wheel retainers)
Two .008 x 1 x 9-inch litho plate (if stall slats are used)
6 inches of Velcro (battery and receiver mounting)
One .010 x 4 x 4-inch styrene plastic (battery hatch)
One .080-inch-diameter x 12-inch styrene plastic (wing rigging)
One .008 x 2 x 10-inch acetate (windshields)
Light CA hinge stock
Double-stick servo tape (aileron servo mounts and stall slat mounts, if used)
Three #2 x 1/2-inch sheet-metal screws (cowl mounting)

Covering and Detailing Components

Two rolls of Nelson LiteFILM (or equivalent)
Model Master Enamels in appropriate colors
Model Master Acryl in appropriate colors
Custom graphics for trimming, as desired

Radio and Drive-System Components

12 inches of light servo wire
Heat-shrink tubing (for extending aileron-servo leads)
One Deans four-pin connector (battery/ESC connection)
One 60-inch servo Y lead *MA*

—Pat Tritle

Remove the center-section from the board and sand to final shape. Add corrugation using your favorite method or the available plastic detail parts.

The top wing panels are assembled over the plans. Pin the 1/4 x 1/2 balsa LE and 1/16 x 1/4 balsa TE in place, followed by A3 and A5. Adhere main spars A1T and A8 in place on A5, and glue ribs R2, R3, and R4 in place.

Use the rib angle gauge to set R1's proper angle and glue it in place. Trim A8A and glue it in place, followed by the 5/32-inch-OD front and 1/8-inch-OD rear by 3.8-inch-long aluminum joiner tubes.

Trim the wingtip bows at the LE and TE. Sand the bottom of the bow to flow into the TE from the main spars and adhere in place. Fit and glue the 1/16 square balsa top spars in place. When dry, remove the wings from the board and sand to shape.

Begin the bottom wing construction by gluing the A2A aileron spar doublers in place on A2 and the R3A rib doublers in place on R3. Pin the LE and TE and A4 in place over the plans, followed by the spar assemblies.

Glue ribs R3, R6, R7, and R8 in place. Align R5 using the rib angle gauge and glue it in place, followed by the 5/32-inch-OD and 1/8-inch-OD x 3.8-inch-long aluminum joiner tubes.

Trim the wingtip bows at the LE and TE. Sand the bottom of the bow to flow into the TE from the main spars and glue in place. Fit and adhere the 1/16 square balsa top spars in place.

Trim aileron servo-mount plate SM1 as needed to fit the servo used. Glue it in place flush with the bottom of R3 and A1B, followed by support gussets SM2 and SM3.

The ailerons are built in place on the wing assembly. Glue inboard rib AR1 to A9. Be sure to get the angle set up correctly. Trim A9 to fit the tip bow, and adhere AR1 to the TE and A9 to the tip. Glue A10 and the AR2 ribs in place to complete the assembly. When dry, remove it from the board and sand to shape.

Cut the aileron from the wing panel and sand to shape. Cut the hinge slots into the aileron spars 1/16 inch below the wing's top surface and angled downward at approximately 30°.

The hinges are made using the provided patterns and should be folded so that the aileron will hold a neutral position when the hinges are installed. Use the Aileron Servo Detail drawing for reference.

Now that the top and bottom wing assemblies are finished, plug the top wing panels into the center-section to check the fit. Since there are no mechanical devices attaching the wing panels into the center-section, an easy way to snug up the connection is to use a pair of needle-nose pliers to gently squeeze the front mounting tubes on the outer panel just enough to cause a slight interference when the wings are plugged in.

The same procedure will be used to retain the bottom wings in the fuselage. I know what you might be thinking, but don't worry! A slight amount of interference is all it takes to keep the wings in position.

The Tiger Moth is covered with Nelson LiteFILM, and trim is applied using sign vinyl. The APC propeller is decorated using a brown Sharpie marker.

Fuselage: Pin B1 in place over the Main Fuselage Frame assembly drawing. Build the frame using the wood sizes shown. When dry, remove the first frame assembly from the board and build the second frame.

The fuselage frames are joined directly over the top/bottom view of the fuselage framing drawing. Cut the rear landing gear-mount beam from 1/8 x 1/4 balsa, and gouge a 1/16-inch-diameter slot down its length. Pin the landing gear mount and the 1/8 square balsa crosspiece at the rear of B1.

Score B1 on the outside edge, and "crack" the side frames to angle the sides into the tail post. Adhere the side frames in place on the mount beam and crosspiece. Use machinist's squares or triangles to ensure that the frames are perpendicular to the building board, followed by top formers 1, 2, 3, and 4 and the 1/4 square balsa cabane-mount beams.

Pull the tail posts together and glue, using the squares to ensure proper alignment, followed by formers 5, 6, 7, 8, and 9 and the 1/16 x 1/8 balsa crosspieces.

The firewall is laminated from FW, FWA, and FWB. Notice the orientation of the slots for the motor mount to accommodate the right-hand offset. Use the Firewall Assembly Detail drawing for reference.

Build the motor-mount assembly and glue it in place on the firewall. Adhere the firewall assembly in place on the fuselage frame using a square to ensure proper alignment.

When dry, remove the frame from the board and glue the 1/16 x 1/8 front diagonal braces and the 3/16-inch-OD front and 5/32-inch-OD x 3.3-inch rear aluminum lower wing-mounting tubes in place. Cut the front landing gear-mount beam from 1/8 x 1/4 balsa, gouge a .047-inch-diameter slot down its length, and glue in place.

Fit and glue all 3/32 square balsa stringers in place on the fuselage top and sides, the 1/8 square balsa hatch rails inside the front bottom longeron between the landing gear mount beams, and the B4 tail-skid support blocks.

Landing Gear and Cabane Struts: Bend the cabane struts from .046-inch-diameter wire and solder them together over the plans. Be sure to make one left- and one right-hand assembly. Drill the cabane-mount beams using a #56 bit. Fit the cabanes into the fuselage assembly.

Main landing gear struts are bent from .062-inch- and .046-inch-diameter wire. Tape the front and rear struts in place on the fuselage frame, and solder together using the Landing Gear Assembly drawing for reference.

Remove the cabane struts and landing gear from the fuselage frame. Add the balsa fairings, sand to shape, and seal with two coats of water-based polyurethane varnish or dope. Lash the landing gear to the mount beams with Kevlar thread, and glue. Bend the tail skid from .046-inch-diameter wire, lash to the tail post with Kevlar thread, and glue.

The last step in framing is to make the battery hatch using .010-inch-thick styrene plastic and 1/8 square balsa.

Radio and Motor Installation: Glue the 1/8 square balsa servo-rail mounts and 1/8 x 1/4 balsa servo rails in place in the rear cockpit. Space the rails to accommodate the servos used, and mount the servos on the rails.

The rudder and elevator pushrods are made from Sullivan Products pushrod tubes and .032-inch-diameter wire pushrods. Glue the B2 and B3 pushrod-tube rear supports in place on their respective sides on the aft fuselage.

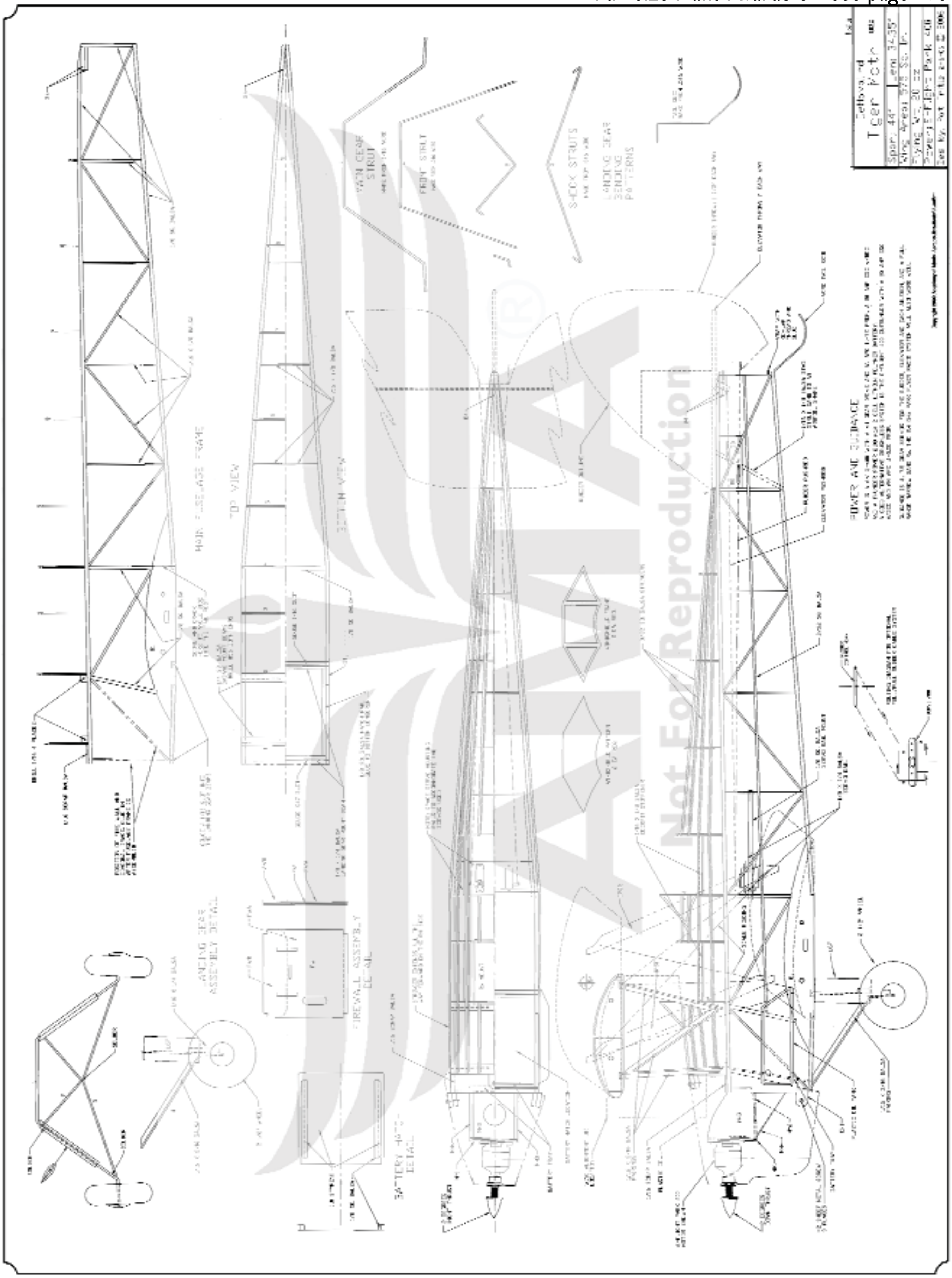
Adhere the pushrod tubes in place at B2 and B3, and glue the provided pushrod supports to secure the tubes at the front, rear, and at least two places in between. Make a Z bend or use a micro easy connector at the front end, and secure it to the servo arm. Cut the wire with 2 inches of excess at the rear, where the aft Z bends will be made during final assembly.

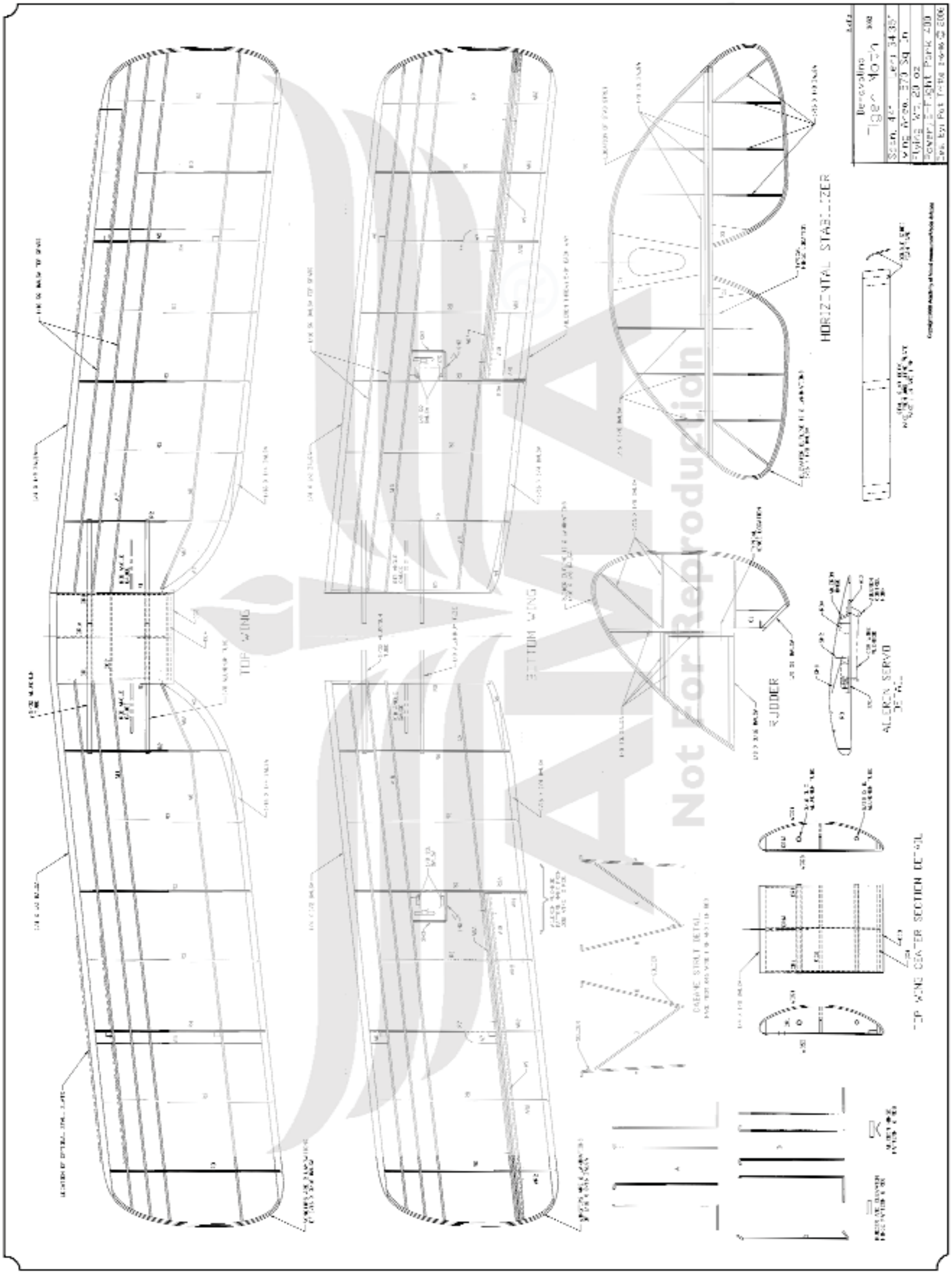
For those of us who prefer a pull-pull system for the rudder, a diagram is provided for setting it up using a cable and a toothpick for the control horn. If you do use the pull-pull system, omit B2 and mount the rudder servo on the fuselage centerline.

Then run the cables in and mark on the plans the exact location where they exit the

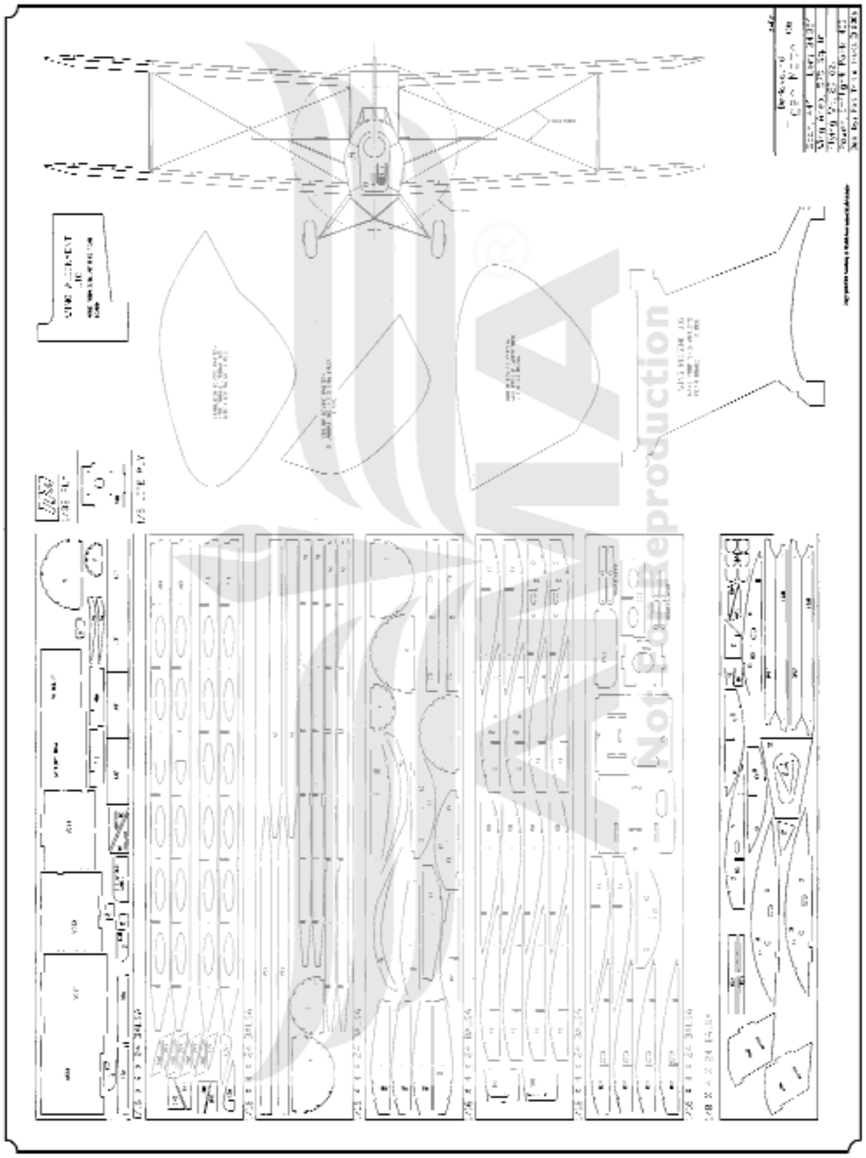
Wing panels plug into center-sections as pairs. Wing tubes are squeezed gently, to create a slight interference fit to retain the panels.

Full-Size Plans Available—see page 175





TOP WING
BOTTOM WING
HORIZONTAL STABILIZER
RUDDER
AILERON SERVO DETAIL
CABANE STRUT DETAIL
TOP WING CENTER SECTION DETAIL
Flying Wt. 20 oz
Not For Reproduction



fuselage, for future reference. The exit points will be used during final assembly, when running the cables out through the cover.

The aileron servos are mounted in the wings using double-stick tape or silicone caulk. Extend the leads to exit the wing root with 2 inches of slack. Make sure the servo arms are centered before you permanently mount the servos.

Mount the motor on the firewall and connect the ESC. Test the system without the propeller for proper operation and make necessary changes now, while the components are still easily accessible.

Glue the receiver mounting tray in place between formers 2 and 3, under the front cockpit, and mount the battery tray as shown, behind the firewall. Mount the battery and ESC to their respective trays using Velcro.

Laminate, shape, and glue the cowl mounting tabs, and adhere them in place on the firewall using the cowl to locate them properly. Trim the cowl and fasten it in place with #2 sheet-metal screws.

Covering: Before you begin, sand the entire structure to remove any remaining bumps or boo-boos. Clean the entire structure with a damp paper towel.

The model can be covered with light silkspan and dope or light Mylar iron-on covering such as Nelson LiteFILM from Nelson Hobby Direct, which is also available under the name Coverite Microlite and Solarfilm. I don't recommend using materials such as MonoKote or UltraCote; they are too heavy, and their extreme shrinking qualities will damage the Moth's light structure.

For best results with whatever material you choose, follow the manufacturer's recommendations for application.

Once all covering is in place, prepare the plastic cowl and oil tank for painting. I airbrushed the plastic parts with Model Master Enamels and brushed the wing center-section, landing gear, and cabane struts with two-coats of Model Master Acryl.

Callie Graphics custom-made the graphics on the prototype. Now is a good time to shape, seal, and paint or stain the interplane struts.

Final Assembly: Glue the aileron, elevator, and rudder hinges in place using Pacer Canopy 560 glue from Frank Tiano Enterprises. I don't use thin CA, because it leaves the hinge too stiff.

Plug the bottom wing into the fuselage, and use it as a reference to align and glue in place the horizontal and vertical stabilizers. Pay attention here, so that the elevator control-horn notch doesn't end up on the wrong side.

Set up the elevator (rudder) and aileron pushrods by centering the servo arms. With the control surface in its neutral position and the control horn dry-fitted in the slot, mark and Z-bend the pushrods. Fit the control horn over the Z bend and glue it in place on its respective control surface.

The aileron pushrods are also set up using a .032-inch-diameter-wire pushrod with a Z bend on each end. A V bend can be added to the pushrods if so desired, but later adjustment won't be necessary if care is taken.

If the rudder is connected using the pull-pull system, mark the location where the cables will exit the fuselage. Reinforce the covering there with a 1/2-inch-square piece of hinge tape, and cut a 1/8-inch slit through which the cable can come. Pull the cables through the fuselage and tie off to the control horn. Secure with a drop of thin CA.

To set up the top wing, make the wing-alignment fixture and two wing-rigging fixtures from 3/16-inch foam artist's board using the provided templates. Pin the alignment fixture in place on the fuselage centerline, and fit the top wing assembly onto the cabanes.

Use the interplane struts and wing-rigging fixtures to set up the lateral alignment, and glue the center-section in place atop the cabanes with five-minute epoxy. A drop of thin CA at each interplane-strut attach point will secure the wings nicely.

The wing rigging is done using 40-pound-test Kevlar fishing line. The rigging extends from the top rear wing-mount tube to the bottom of each interplane strut, from the front bottom wing-mount tube to the top of each interplane strut, and making an "X" between the interplane struts.

By starting and ending at the top rear mounting tube, each side can be completed with a piece of string that is approximately 84 inches long. Where the string comes around the front lower wing-mount tube, wrap it around the tube once. Then the wings can be slid out roughly 1 inch, and the string can be secured with a drop of thin CA.

With the rigging secured in place, use Pacer Canopy glue to adhere the .080-inch-diameter x 3 7/8-inch styrene plastic rigging support "javelins" in place at the crossover junction.

Now it's a matter of adding the last of the details, such as the stabilizer support struts, windshields, wheels, cowl, and oil tank. To retain the wheels, I drilled Nelson T-pin clamps to 1/16-inch-ID tubing, slipped them over the axles on both sides of the wheel, and secured them with a small drop of thin CA.

Make the stall slats from thin aluminum sheet. I used printer's litho plate. The slats are optional, but add them if you like a well-behaved airplane that lands at walking speed;

they *do* make a difference.

With the battery mounted in the model, set up the CG $2^{1}/_{4}$ inches from the LE at the center-section. Set the control throws as shown on the plans.

Double-check to make sure that the propeller will turn and the controls move in the right direction. With that, the Tiger Moth is ready to fly!

Flying: We're at the point we've been anticipating: maiden-flight day. Before you fly your Tiger Moth, mount a freshly charged battery and recheck the CG, the control throws, and direction, and that the propeller is turning the right way. If all of that looks good, it's time to fly.

For the first trim flights, pick a nice, calm day. There's nothing worse than trying to trim a new model in choppy air.

To take off, point the Moth into the breeze, hold slight up-elevator, and advance the throttle to nearly two-thirds power. Use the rudder to track the model straight down the runway. If it doesn't lift off on its own, a touch more up-elevator will be all you need.

Keep the climb shallow and use rudder and ailerons together to make turns. The model will turn okay on rudder or ailerons alone but is slow to react.

Climb the Moth to a safe altitude and trim it for straight and level flight at just more than half throttle. By now, you've probably noticed that it is a slow, smooth, and docile flyer. Try a few turns to get a feel for the necessary rudder/aileron coordination.

Try a stall for fun. When you're nearing stall speed carrying a bit of power, use the rudder for directional control and see how slow you can make the airplane fly. You'll be amazed by how slowly it will fly and how controllable it will be throughout its speed range.

To land, set up the approach carrying a bit of power. Keep the nose down a bit, or the model will get so slow that it will be at the mercy of any moving air. Fly it down to almost a foot of altitude and raise the nose slightly to bleed off the last of the speed. Once in ground effect, the airplane will float down to a nice three-point landing as the power is reduced.

For some serious fun, try a few touch-n-gos. The more you fly the Tiger Moth, the more you will see that it has no vices. And for slow, relaxing park flying, I think you'll find it hard to beat. **MA**

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Sources:

Laser-cut parts pack, vacuum-formed plastic parts:
Pat's Custom Models
(505) 296-4511
patscustommodels@aol.com

Callie Graphics
(505) 293-2922
info@hobbies-n-stuff.com

E-flite
(800) 338-4639
www.horizonhobby.com

Sullivan Products
(410) 732-3500
www.sullivanproducts.com

Nelson Hobby Direct
(877) 263-5766
www.nelsonhobby.com

Frank Tiano Enterprises
(863) 607-6611
www.franktiano.com

Model Master
(800) 962-6654
www.testors.com