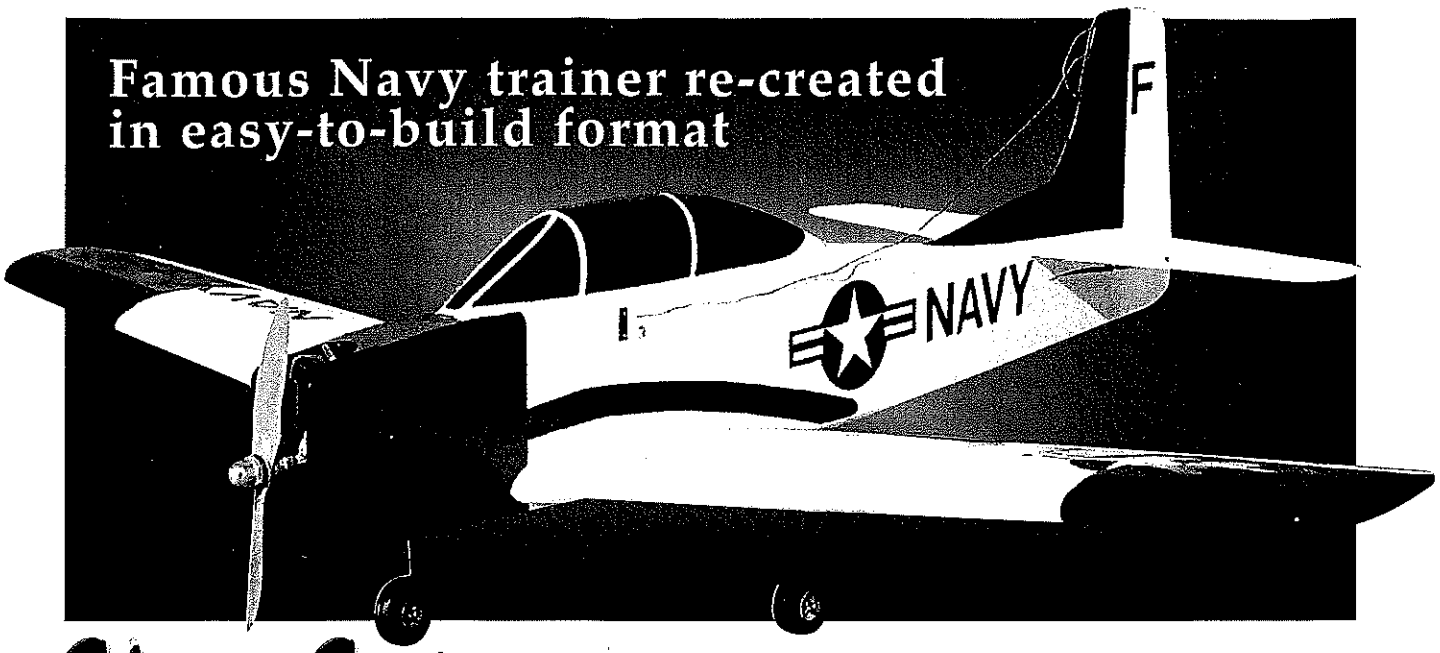
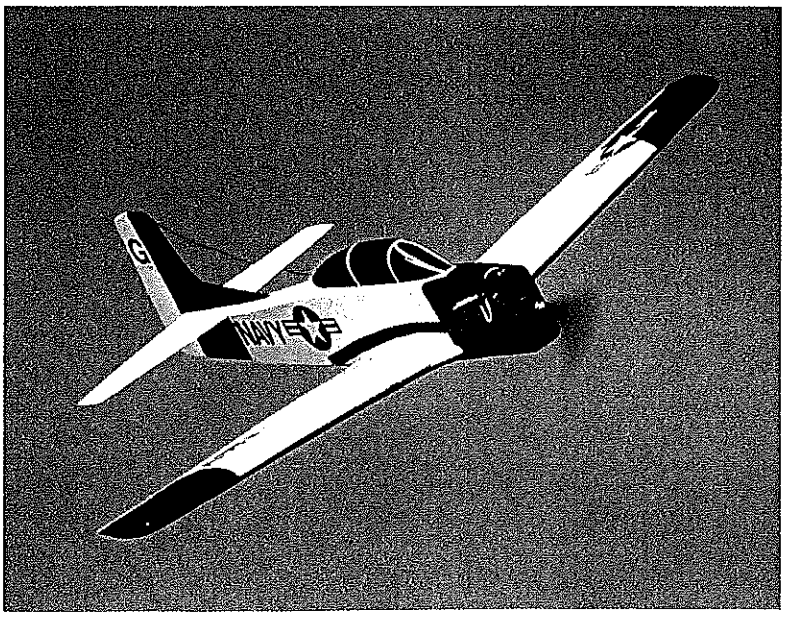


Famous Navy trainer re-created in easy-to-build format

Skinny Scale

by Gary Fuller

North American T-28 Trojan



The T-28 is highly visible in the air, thanks to the bright Navy paint scheme. The retractable landing gear aids in achieving a scale effect.

FOLLOWING WORLD War II, the Air Force needed a trainer that would make it simple for the beginner pilots to transition to the new jet fighters that were just then in production. North American Aviation came up with the T-28 design, and it proved to be such a good trainer that the Navy decided it would use a version of the aircraft to train its pilots.

The Air Force retired its T-28s from the trainer role in the late 1950s, but the airplane saw service as a light attack aircraft for many years thereafter. The T-28 lived on in the Navy as a trainer until the early 1980s. Many are flown today in civilian hands as an economical warbird.

The Model: While out at the flying field, my friend Mark told me he was thinking about building a model of a T-28 using a profile fuselage. After talking it over with him, I convinced Mark that I could design a T-28 model with a fuselage that would be wide enough to fit the engine (and hide it), and it would only be slightly more difficult to build than the trainer with which he was learning to fly. To further convince him, I told him it would even be able to fit a set of retractable landing gear.

To make the model easy to build, I used flat sides on

the fuselage, as are used on a trainer. The top and bottom sheeting is thick, and combined with the ¼ balsa triangle stock in the corners, you can almost sand the fuselage to an oval shape. The top sheeting of the fuselage over the engine is cut away to allow easy access to the engine, as in a trainer.

To make the T-28 easy to fly, I used a thick semisymmetrical airfoil with a great deal of dihedral, as the full-scale T-28 has. To make the model as economical as possible, I designed it with the .40-size engine in mind, with which most trainers are equipped. Therefore, you should be able to use the engine that was in your primary trainer.

The T-28 should appeal to a wide range of modelers, from those who are moving up from a trainer to those who are more experienced and looking for a nice-flying semiscale Sunday flier.

I generally believe that if a full-scale airplane has retractable landing gear, a model of the aircraft won't look right tooling around with its gear hanging in the breeze; I designed my T-28 with this in mind. But I do realize that the expense and trouble associated with retracts don't appeal to everyone, so the plans do show the provisions for fixed gear.

I tried to design the T-28 with the novice builder in mind, but do get some help from an experienced builder if you have never built a radio-controlled airplane.

CONSTRUCTION

Fuselage: The fuselage is fairly simple and straightforward. Lay both fuselage sides on your worktable so that they are positioned top to top. Doing this will keep you from building two left or two right sides.

Glue the ⅛ balsa fuselage doublers to the fuselage sides. Make sure the shorter of the two doublers is glued to the inside of the right fuselage side; this is so the engine will have 2° of right thrust.

Glue the ¼ balsa triangle stock in place on the sides as shown on the plans. Glue the ¼ square balsa to the sides aft of the wing as shown on the plans. Drill the holes in F1 for the engine mount, throttle cable, and fuel lines. Glue bulkheads F2A, F2B, and F3 in place on the right side only. Ensure that the bulkheads are 90° to the side.

Install the left side to the bulkheads. I did this by leaving the right side on the workbench and placing the left side on the bulkheads. I made sure the sides were aligned to each other by using a carpenter's square to check at various places on the top and bottom of the fuselage sides.

Install the firewall F1. Glue in the ¼ plywood nose-wheel retract mount plate, the 1/16 plywood fuel-tank compartment floor, and the ¼ plywood wing-mount plate. Glue the ¼-inch balsa triangle to F1, F2B, the nose-wheel retract mount plate, and the wing-mount plate as shown on the plans.

If you don't plan to use retractable landing gear, you can forego installing the ¼ plywood nose-gear mounting plate. Use a steerable nose-gear mount attached directly to the firewall, or use an engine mount that has provisions for mounting a nose-wheel assembly.

Flip the fuselage up on its bottom and join the sides at the tail. You will need to trim the ¼-inch balsa triangle to do this. Make sure the fuselage is not twisted or crooked as you perform this step.

Glue on the 3/16 balsa top sheeting with the grain running side to side. Flip the fuselage over and glue the 3/16 balsa bottom sheeting to the fuselage, aft of the wing, with the grain running side to side. *Don't glue on the bottom sheeting forward of the wing until later.* Install the nose-wheel retract unit on its mounting plate.

Put the fuselage off to the side and out of the way, and start the wing.

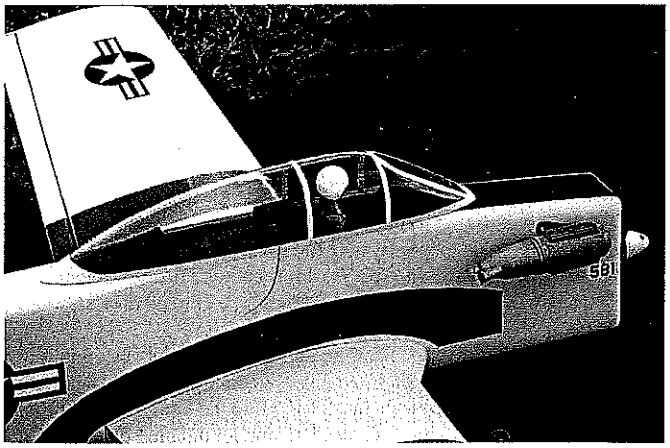
Wing: The wing is slightly more difficult to build than a trainer's, but it is a fairly straightforward design, and you should not have any difficulties. Cut the ⅜ balsa LE from medium to hard balsa. Cut the LE so that it is approximately 3/16-inch wider than each rib's LE. This will be approximately 1 inch at R3, tapering down to roughly 1 3/16 inch at R12. The inboard LE will taper from approximately 1 1/16 inch to 1 inch at R3. You may want to add a bit more to be on the safe side.

Cut the R1 and R2 rib template from the plans, and glue it to a piece of cardboard or scrap balsa for later use. I used a ⅜-inch-diameter sharpened brass tube to cut the holes in R2 and R3 for the retract air lines.

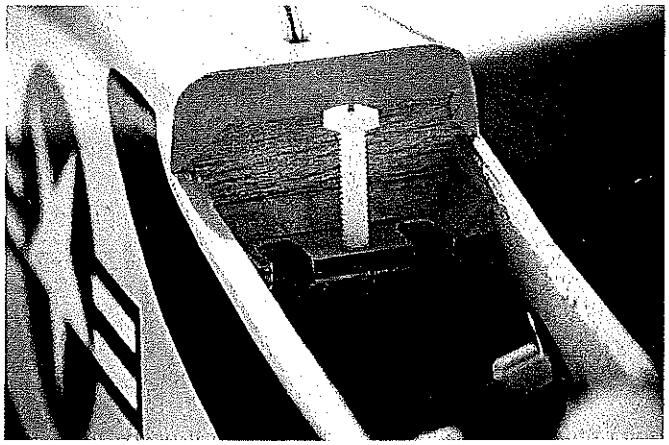
Start constructing the wing by building one side first, pinning the outer lower main spar in place over the plans. Pin the lower forward inboard spar in place over the plans. Place the lower aft inboard spar on the plans, but do not pin it; it will need to be lifted up into place after the

Photos by the author

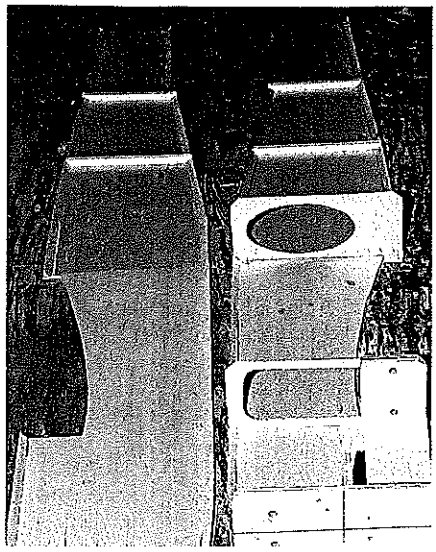
Tim Neal's Thunder Tiger .40-powered T-28 built from Gary's plans is covered with MonoKote in an alternate Navy scheme.



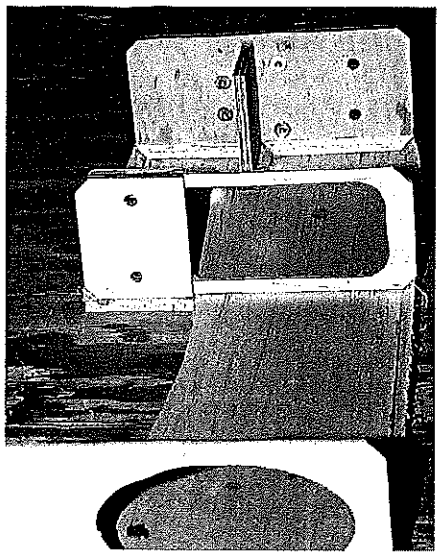
Tim used a clear canopy and installed a pilot in his version of the T-28 to enhance its scale appearance.



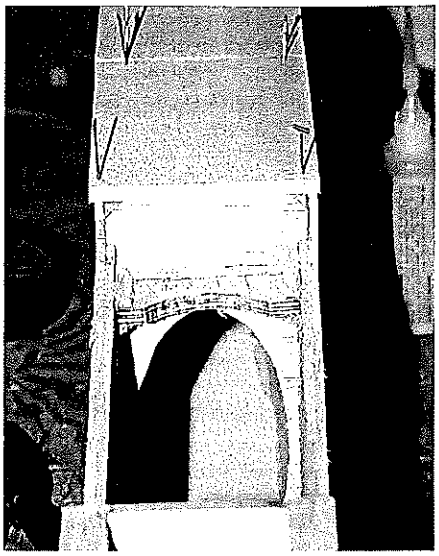
Alternate wing-mounting method uses a single ¼-20 nylon bolt. Cutouts in the mount plate are for aileron torque rods.



The Trojan's fuselage sides are ready to be joined. The right fuselage side has all the formers glued to it.

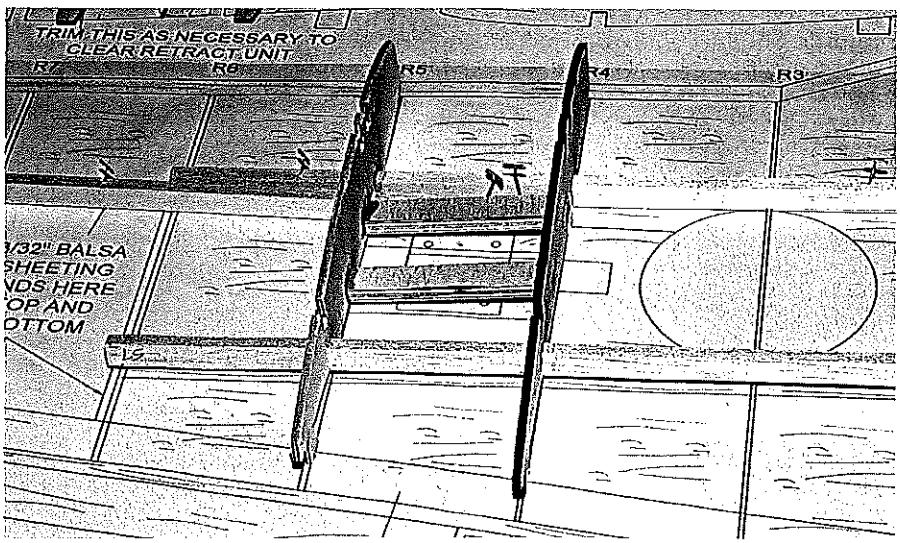


The firewall is drilled for the engine mount, the fuel tubing, and the throttle linkage before it is installed.



Shown is the bottom of the fuselage looking aft. "T" pins hold the bottom sheeting in place as the glue dries.

Rubber bands hold two full gallon cans to fuselage to hold it in place while the top is sanded to shape. Use a strip of sandpaper and the "shoe-shine" method.



Don't pin lower aft spar to plans surface; it needs to be above surface when it is glued to ribs. Install ¼ x ½-inch plywood landing-gear mounts to ribs R4 and R5, and make sure that R4 and R5 will set at 90° to work surface before you glue landing-gear mounts to ribs and ribs to spars.

ribs are in place and glued to the main spar and the forward spar.

Glue all the ribs in place on the main spar and the forward spar, keeping them at 90° to the work surface. Do not glue in ribs R1 and R2 at this time because they need to be glued at an angle later.

Put the upper spars in place over the ribs, and glue them to all the ribs except R1 and R2. Pull the lower aft inboard spar up into the slot cut for it in each rib and glue in place except for ribs R1 and R2. Glue the ¼ balsa TE in place on all the ribs except R1 and R2. Glue the outboard ⅜ balsa LE in place on all the ribs, and sand it flush with R3.

Using the R1 and R2 angle template, glue R2 in place on all the spars, and then do the same for R1. Glue the inboard LE to R3 and R2, and make sure R2 is still at the correct angle using the R1 and R2 angle template.

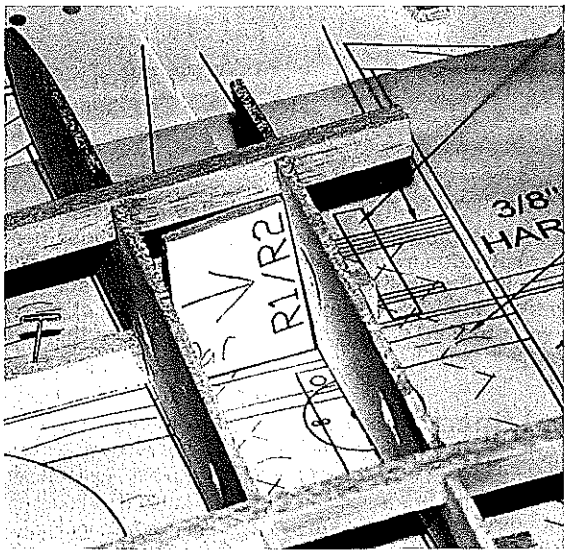
For retractable landing gear, glue the ½ x ⅜-inch hardwood landing-gear mounts in place in R4 and R5. If you plan to use fixed landing gear, glue the 1 x ½-inch grooved hardwood landing-gear block to R4 and R5.

At R4, glue an additional 1 x ½ x ½-inch grooved hardwood block on top of the landing-gear block with the groove running vertical and against R4, and then drill a 5/32-inch-diameter hole down through the landing-gear block using the groove in the top 1 x ½ x ½-inch block as a guide.

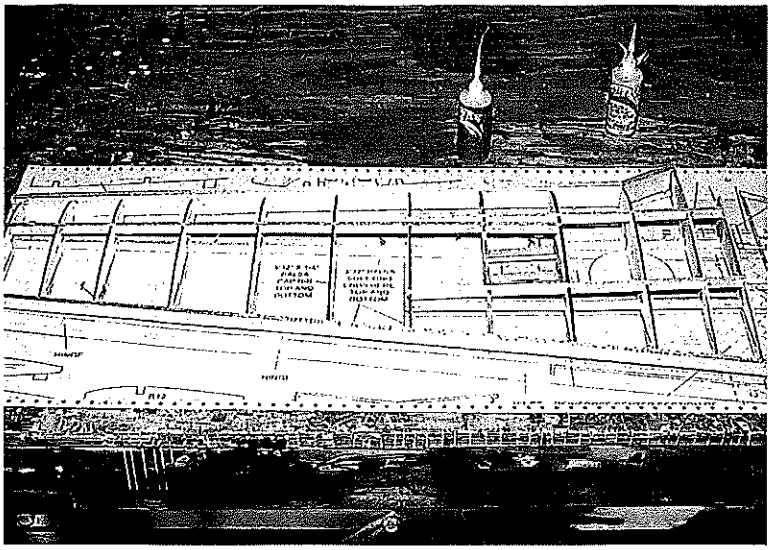
Glue the 1/16 balsa shear webbing in place to the top and bottom spars, as shown on the plans, with the grain running vertical. Sand the ¼ balsa TE flush with the top of the ribs, and then glue the 3/32 x 1-inch balsa TE sheeting in place.

Sand an angle in the LE top sheeting to match the angle where the sheeting will meet the ⅜ balsa LE. Glue the top LE sheeting to the ⅜ balsa LE, and let the glue dry without gluing the LE sheeting to the ribs.

After the glue has dried, adhere the top LE sheeting to the ribs. Wetting the outer surface

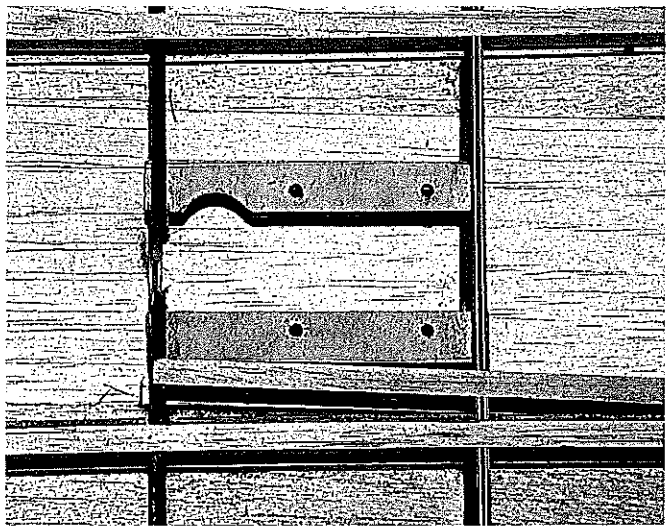


Cut R1/R2 angle template from plans; glue to scrap wood. Use it to glue R1/R2 to spars at correct angle for dihedral.

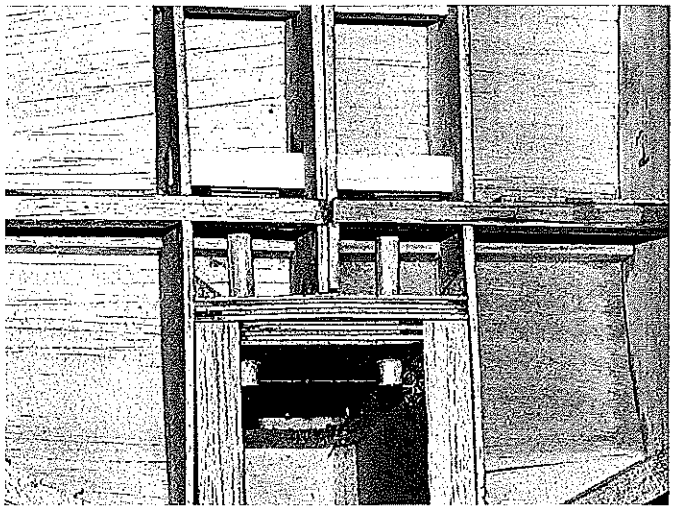


Left wing is ready for 1/16 balsa shear webbing to be installed on spars. Rib R2 needs to be mounted at an angle so that it will mate correctly with fuselage.

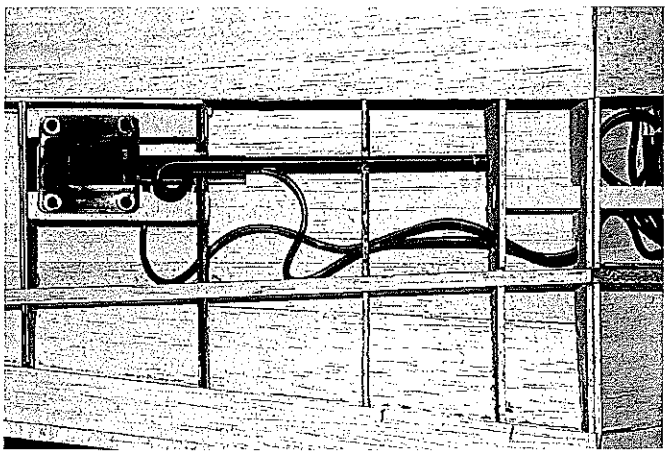
The 1/16 balsa shear webbing has been installed on the spars. Webbing is installed between the spars on the aft spars.



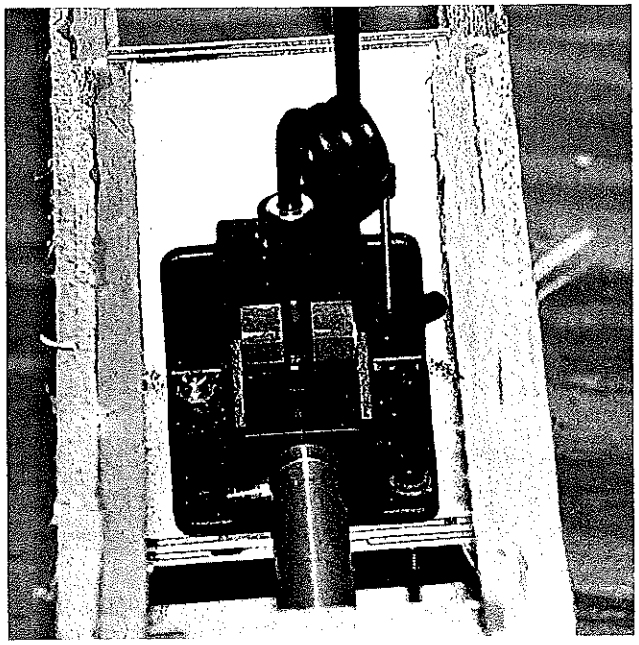
Main landing-gear retract mounts need to have some wood removed so retract units will fit. Retracts are secured to mount with 4-40 bolts with blind nuts.

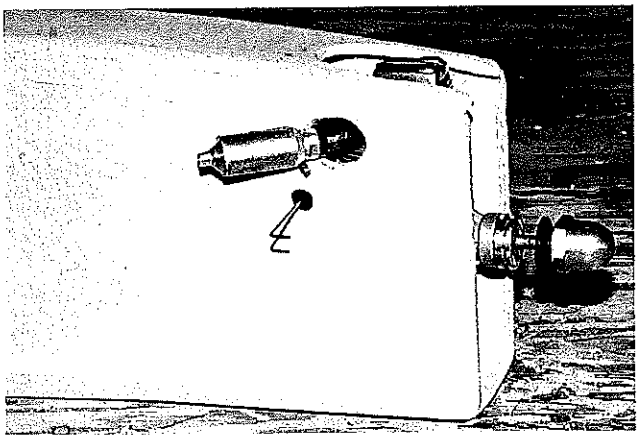


Forward part of wing is held to fuselage with 1/4-inch hardwood dowels. Install dowels before bottom of wing is sheeted.

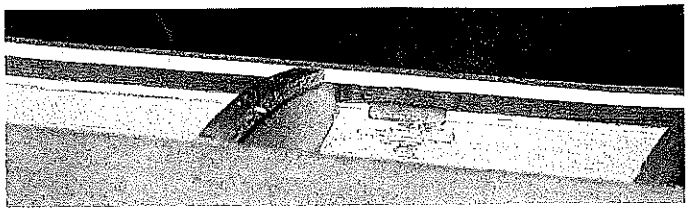


Before fully sheeting the bottom of the wing, install main landing-gear retract units and the air lines to supply them.





Fuselage sides in engine-compartment area will need small holes cut in them for such items as engine muffler and needle-valve extension.



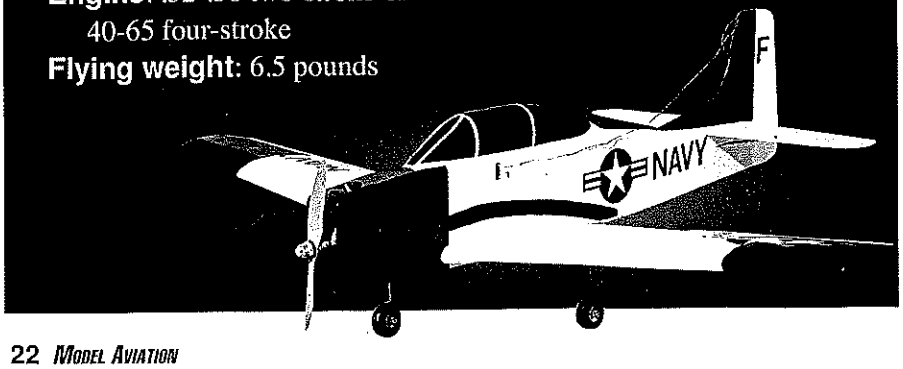
Left: Before sheeting forward bottom of fuselage, fit nose-gear retract unit to ¼ plywood mount. Lower bolts for engine mount will need to be cut flush with back of firewall to clear retract unit. Above: Before covering wing, author likes to put blob of epoxy from inside wing to hold aileron hinges in place where they are accessible.

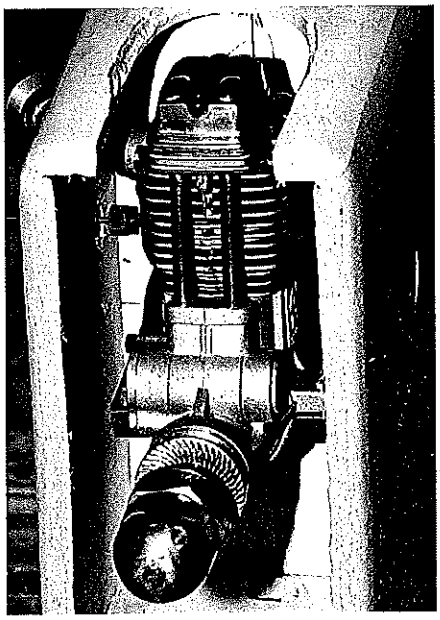
Additional Specifications:

Wing chord: 8¾ inches (average)
Wing area: 524 square inches
Wing location: Lower fuselage
Airfoil: Semisymmetrical
Wing planform: Double tapered
Dihedral (each tip): 3 inches
Fuselage length: 46¼ inches
Radio compartment size: 10 7/32 (L) x 2½ (W) x 8¾ (H) inches
Stabilizer span: 24 11/32 inches
Stabilizer chord: 5¼ inches (average)
Stabilizer area: 126 square inches
Stabilizer airfoil: Flat
Stabilizer location: Top of fuselage
Vertical fin height: 8¾ inches (includes rudder)
Vertical fin width: 7 inches (average)
Vertical fin area: 74 square inches (includes rudder)
Recommended engine size: .32-.50 two-stroke or 40-65 four-stroke
Fuel tank size: 8-10 ounces
Landing gear: tricycle/retractable
Recommended number of channels: Five
Control functions: Rudder, elevator, aileron, throttle, retractable gear
CG (from LE): 4⅞ inches
Elevator throws: ⅝ inch up; ⅝ inch down
Aileron throws: 5/16 inch up; 5/16 inch down
Rudder throw: 1 inch left; 1 inch right
Downthrust: 0°
Side thrust: 2° right

North American T-28 Trojan

Type: RC "Skinny Scale" (semiscale)
Wingspan: 60 inches
Engine: .32-.50 two-stroke or 40-65 four-stroke
Flying weight: 6.5 pounds
Construction: Balsa and plywood
Covering/finish: MonoKote





The engine area is a bit tight. Top sheeting has been cut to clear rocker arm cover and allow cooling for engine.

of the sheeting with water will help it conform to the ribs. Glue the rest of the top sheeting in place. Glue the ¼ x 3/32-inch balsa rib caps in place.

Unpin this side from the plans, and prop up the wingtip at R12 using a 6-inch-high block that is longer than R12 and has sides that are 6 inches parallel to each other so that the wing will not have any twist at the wingtip. Glue the ⅜-inch square hardwood aileron servo mounts to R1 and R2. Build the other wing half the same way you built the first, but go ahead and glue R1 to the other R1 without using the R1 and R2 rib template.

Unpin the wing from the building board. Glue the ¼ plywood center wing mount to R1 and R2 as shown on the plans. Fit the wing to the fuselage, and drill the holes in the ¼ plywood F2B in the fuselage using the center wing mount as a guide. Remove the wing from the fuselage.

Place the ¼-inch hardwood dowels in the holes to hold the wing to the fuselage. Place the ⅛ plywood dowel supports on the dowels, and then glue the supports to the forward inboard top and bottom spars so that the ¼-inch dowels are 90° to the ¼-inch wing-mount block and parallel to each other. Glue the ¼-inch dowels to the ¼ plywood wing mount and to the ⅛ plywood dowel supports.

Begin sheeting the bottom of half of the wing by gluing the LE sheeting to the ⅜-inch LE, as you did for the top LE sheeting. When the glue has dried, use slow-drying cyanoacrylate to glue the sheeting to the ribs. If you wet the sheeting, place the wing on the building board and weight it down until the sheeting has dried. Prop up the other half of the wing with the 6-inch block while the sheeting dries.

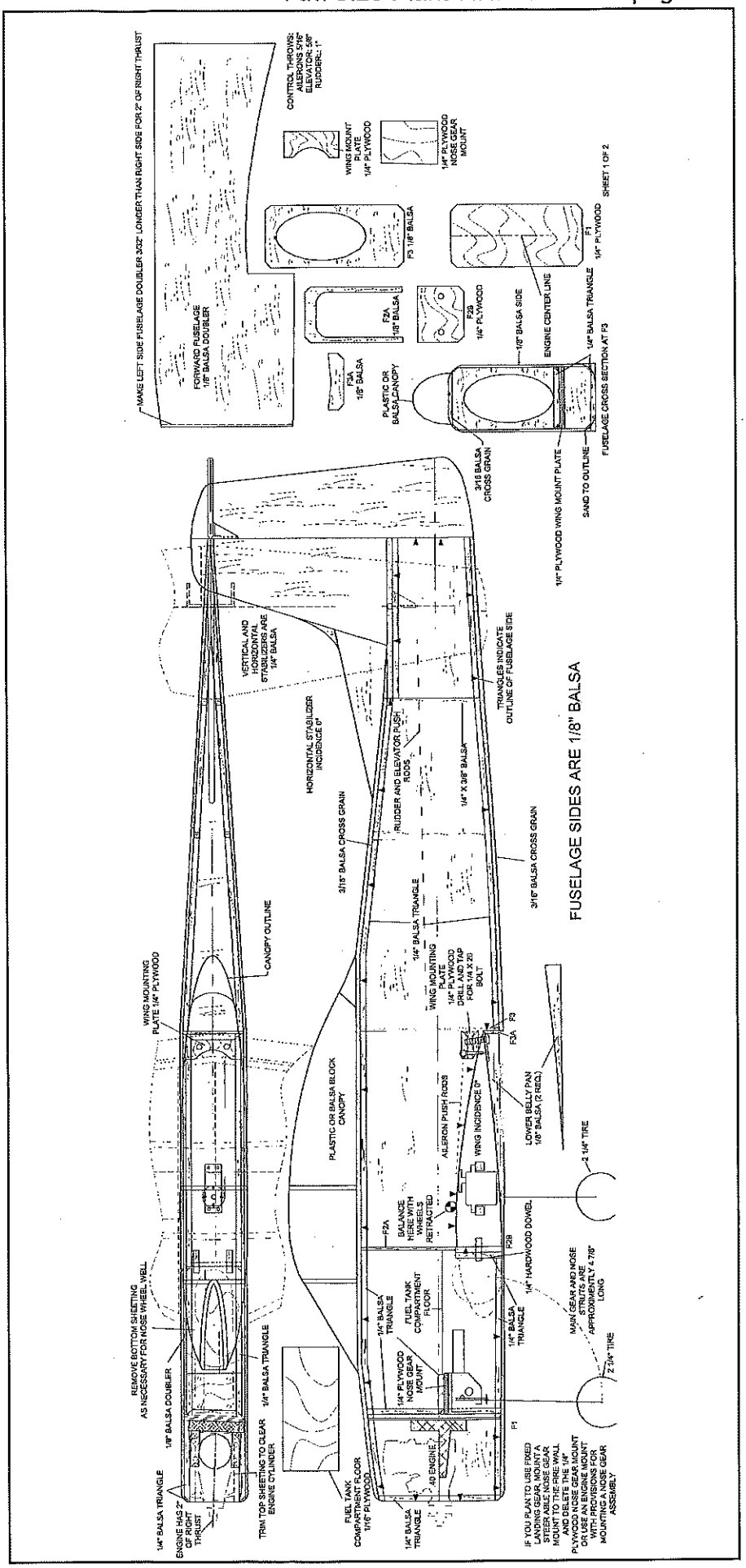
Glue the LE sheeting on the other wing half using this same method. After the LE sheeting has dried, remove the building tabs from the bottom of the ribs, sand the ¼-inch TE flush with the ribs, and then glue the 1 x 3/32-inch balsa TE sheeting in place.

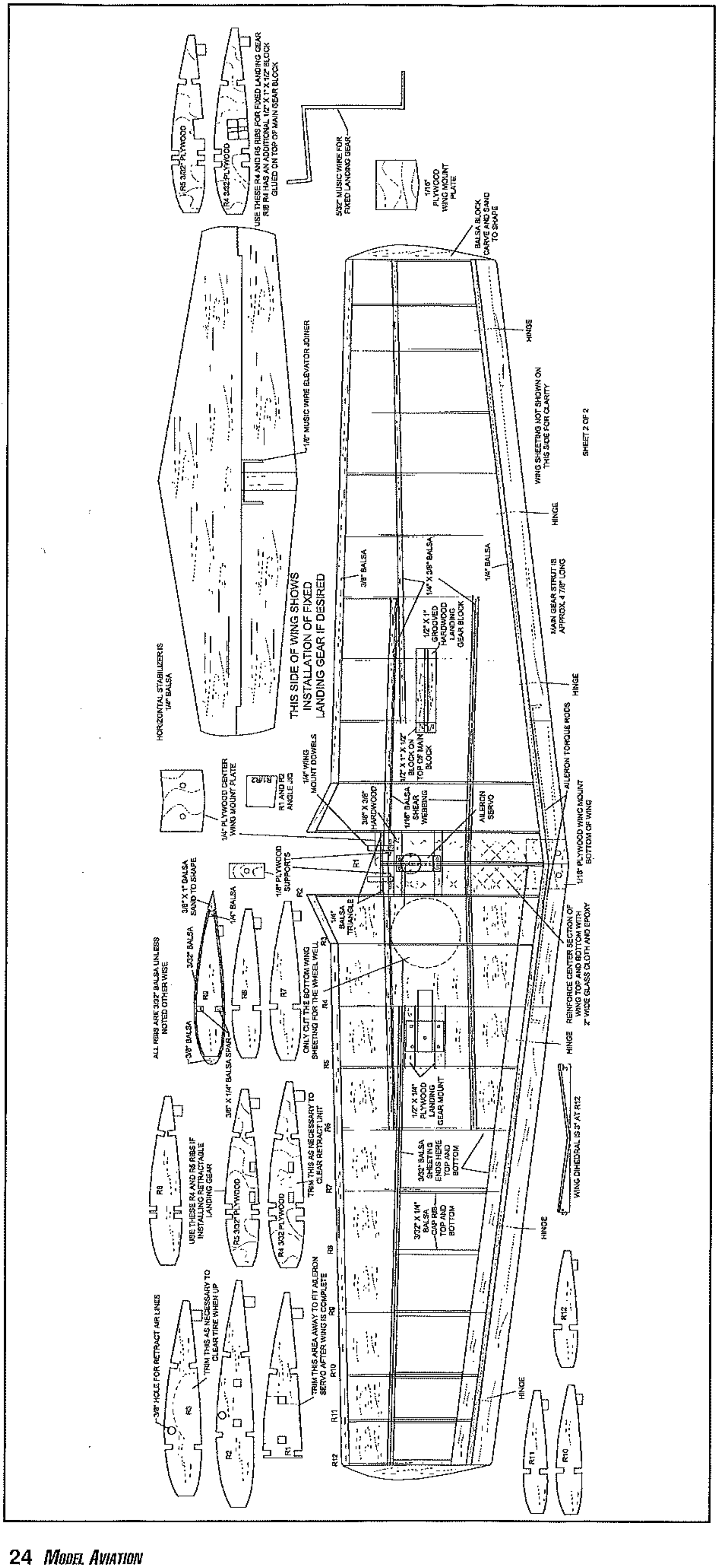
Before the rest of the bottom sheeting is installed, fit the main landing-gear retracts in place and run the air lines to the center of the wing. Trim ribs R3 and R4 as necessary to fit the retract units and wheels when the wheels are in the up position. Glue the rest of the bottom sheeting in place along with the ¼ x 3/32-inch rib caps.

Cut the slots for the aileron hinges in the wing's TE. Install the hinges in the wing, and then temporarily tack-glue the ¼ x 1-inch balsa TE to the wing. Sand the ¼ x 1-inch TE to match the wing airfoil's contour.

Remove the TE from the wing, and cut the aileron from the inboard section of the TE. Cut a groove in the TE to accept the aileron torque rods. Lubricate the torque rods' bearings with Vaseline or such so that the glue will not cause the rods to stick to the bearing, and then glue the torque-rod bearings to the TEs. Make sure they can rotate freely, and then glue the TE to the wing.

Score the 1/16 plywood wing-mount plate down its centerline so that it can be "cracked" and bent so it will conform to the dihedral. Glue the plate to the TE as shown on the





plans. Glue the wingtip blocks to the wingtip, and then sand them to shape. Sand the LE to match the airfoil as shown on the plans.

Reinforce the center-section of the wing on the top and bottom with 2-inch-wide, 6-ounce fiberglass cloth. Cut the opening in the center-section of the wing for the aileron servo, and trim rib R1 to fit the servo. Cut a small opening for the retract air lines.

Place the fuselage upside down on your workbench, and secure it so it won't move. Install the wing on the fuselage. You may need to trim the holes in the F2B plate for the ¼-inch dowels so that the wing will fit to the fuselage properly.

Once you are satisfied with the fit of the wing to the fuselage, align the wing so that it is square to the fuselage, and then drill the wing-bolt holes in the wing and wing-mount plate. To do this, place weights on the wing so that it is held securely to the fuselage while you measure from the center of the fuselage to where the rudder mounts to the wing TE at the tips. (I use the place where the tip blocks join the wing at the TE.) Adjust the wing so that these measurements are the same.

Once you are satisfied that the wing is aligned correctly, drill a 13/64-inch hole through the 1/16 plywood wing-bolt reinforcement and the ¼-inch wing-mount plate in the fuselage. Remove the wing from the fuselage, and then tap the wing-mount plate in the fuselage with a ¼-20 tap. You can use some thin cyanoacrylate-type glue to strengthen the threads in the plywood.

Use a ¼-inch drill bit to enlarge the hole in the wing plate so that a ¼-20 nylon bolt will fit through it. Bolt the wing to the fuselage, recheck the alignment, and then drill the hole for the other bolt the same way you drilled the first hole.

Keep the wing mounted to the fuselage, and cut the landing-gear struts to the correct length. I did this using the following method and utilizing adjustable axles. On the nose-gear retract unit I installed the strut for the nose wheel. I cut the strut a little long for the axle so that when the wheel is up, there is a slight gap between the wheel and the forward wing-mounting plate.

With the axle and wheel mounted to the strut, I retracted the nose wheel into the fuselage to check the clearance. I adjusted the axle on the strut to the correct location for the wheel clearance and tightened the axle on the strut. I extended the wheel and removed it from the axle. I cut the strut flush with the axle and soldered the axle to the strut. After that, I reinstalled the nose wheel so I could move on to the main gear.

I installed the struts on the main landing-gear retract units and installed the axles and wheels. I flipped the airplane over and set it on the bench on the landing gear. (You may need to put some weight on the front of the fuselage so it won't sit on the tail.)

I adjusted the position of the main gear axles so that the fuselage sat in a level position fore and aft and side to side, and I tightened the axles on the struts. Make sure the wheels are aligned so the model will roll straight ahead. I removed the wheels and cut the struts flush with the axles, and

then I soldered the axles to the struts.

Now is a good time to glue the ⅛-inch balsa belly pan sides to the wing along with the F3A bulkhead and the 3/16-inch belly pan bottom sheeting.

Remove the wing from the fuselage, and cut the bottom sheeting for the main wheels to retract into. You accomplish this by mounting the wheels to the axle and then actuating the retract unit by hand so that the main wheel is lying against the sheeting.

Mark the sheeting around the wheel and strut. Move the wheels to the down position, and cut the sheeting where you marked it for the wheels and strut. Move the wheel to the up position, and trim the hole and ribs R3 and R4 so the wheel and strut fits into the wing.

You need to trim the sheeting so that there is roughly ¼ inch of clearance around the wheel and strut. This is necessary for those not-so-pretty landings that may bend the struts. If you want, you can line the openings with 1/16 balsa now, but this is not shown on the plans.

Sheet the bottom of the forward fuselage, and cut the bottom sheeting for the nose-wheel opening as you did for the main wheels.

Glue all the pieces together for the vertical stabilizer. Hinge the rudder to the vertical stabilizer, but don't glue the hinges in place. Hinge the elevators to the horizontal stabilizer, but don't glue those hinges either.

Glue the piece that separates the elevators to the horizontal stabilizer. Cut a groove in the bottom of the center of the horizontal stabilizer for the music-wire elevator joiner. Mark the elevators for the location on the joiner, and drill the hole and cut a groove for it in each elevator. Remove the elevators and the rudder from the stabilizers. Set them aside.

Refit the wing to the fuselage, and mount the horizontal and vertical stabilizers. To do this, place the fuselage on the workbench, right side up, and secure it so it won't move. Adjust the fuselage position to get the wing sitting level fore and aft by measuring at the center of the LE of the wing and the TE of the wing to the workbench, and then adjust the position of the fuselage so these are the same distance from the workbench. You do this so you can set the wing a stabilizer incidence.

Pin the horizontal stabilizer in place on the back of the fuselage. Get a few feet out in front of the fuselage and sight down along the fuselage toward the horizontal stabilizer. Compare the position of the stabilizer to the wing, and look to see if it is tipped to one side or the other. Sand the high side of the horizontal stabilizer mounting area if necessary so that the stabilizer is not tilted.

Measure the distance from the LE and the TE of the stabilizer to the workbench surface. These need to be the same so that the incidence angle between the horizontal stabilizer and the wing are 0° to each other. Sand the horizontal stabilizer mounting area if necessary to achieve this. Double-check the horizontal stabilizer to make sure it is not tipped to the side compared to the wing.

Measure from the wing TE at the tip to the horizontal stabilizer TE at the tip on both sides of the fuselage, and adjust the horizontal stabilizer so these are the same. When you are satisfied with the stabilizer's alignment, glue it in place on the fuselage. Make sure the elevator joiner is installed in the horizontal stabilizer center when the horizontal stabilizer is glued in place.

Pin the vertical stabilizer in place while the fuselage is still mounted on the bench. Sight down the front of the fuselage toward the tail, and align the stabilizer with the centerline of the fuselage. When you are satisfied with this, glue the vertical stabilizer to the fuselage, making sure it is 90° to the horizontal stabilizer.

Finish: Most of the airplane is finished now, and all it lacks are the finishing touches and the radio installation. I haven't discussed the canopy yet because if you plan to use a plastic type, it needs to be mounted after you cover the fuselage. If you plan to carve and sand a balsa-block canopy, you could mount it before you cover the fuselage. It is a good idea to hollow out the balsa canopy; it makes an ideal place to mount the retract air tank.

Finish-sand the T-28 to the cross-sections shown on the plans. Bevel the hinged part of the control surfaces while you are finish-sanding. The more time you spend here, the better looking the finished model will be.

Temporarily mount the rudder, elevators,

and ailerons, and then mount the servos and build up the pushrods. Do the same for the engine. Run the nose-wheel steering cable to the nose-wheel retract unit, hook it up, and adjust it for smooth operation. I recommend that you use pneumatic retracts for your T-28 and route the air lines for the main gear through the wing before you cover it.

Decide where you want to mount the retract air tank. If you don't plan to use a clear canopy with a little cockpit dressing, I recommend that you mount the air tank under the canopy. If you use a clear canopy and dress up the cockpit, mount the air tank behind the wing on the bottom sheeting inside the fuselage. Glue the tank to the bottom sheeting using RTV. Make sure the air tank doesn't interfere with the elevator and rudder pushrods.

I covered my T-28 with MonoKote, but use whatever brand you want. Once you have your model covered, cut away the covering where the canopy belongs and dress up the cockpit to suit your fancy. Glue the canopy to the fuselage using formula 560-type glue. If you use a cyanoacrylate-type glue for this operation, you run the risk of permanently fogging the canopy.

Permanently mount the rudder, elevators, and ailerons. Hook up the servos to the control surfaces, and check to make sure they all operate in the correct direction and have the recommended throw.

Install the engine and fuel tank. Install the retract air valve and retract servo in a convenient location. Install the radio on/off switch and the retract air fill valve on the side opposite the engine exhaust. Install your receiver, but hold off on installing the battery so you can move it around to adjust the balance point.

Assemble the wing to the fuselage, and check the balance point. Figure out where you need to place the battery to achieve the correct balance point. I placed the battery as far forward as I could, and I still ended up adding a lot of nose weight to get the proper CG.

Remove the wing from the fuselage, and install the battery in the location you determined for the balance point. Reassemble the wing to the fuselage, pressurize the retract air system, and make sure the retracts work the way they are supposed to. Check to make sure they don't leak air excessively. Check your wing for warps, and correct any you find.

Flying: My first flight with the T-28 was a near disaster. The O.S. 40 four-stroke wasn't putting out anywhere near full power because of a bad glow plug, but I didn't realize that until I rotated and my T-28 staggered into the air. It was barely able to climb higher than approximately 10 feet.

So after getting roughly 200 feet away from the runway, I decided to chop the throttle and land the airplane in the bean field to the north of the runway. As I walked out to retrieve it, I thought about the one good thing to come out of this short flight: the airplane seemed to have excellent low-speed handling.

When I retrieved my model, I found that it had not sustained any damage. After changing the glow plug and readjusting the high-speed needle on the engine, the next flight went off much better.

Once I got the airplane to a safe altitude, I was able to confirm that the slow-speed handling was very good. It will slow down quite a bit before it starts to wallow around and then stall and drop a wing. Despite the small chord of the ailerons, the roll rate is respectable and the ailerons feel solid.

Vertical performance with the O.S. 40 four-stoke is nothing to write home about, but it is more than adequate for scalelike flight. Landings with the T-28 are a breeze. As it gets near the runway, hold the airplane off with up-elevator as you bleed off the airspeed, and you will be rewarded with a beautiful touchdown on the mains. On pavement you will be able to hold the nose wheel off the runway until the T-28 is nearly stopped.

This has turned out to be a thoroughly enjoyable airplane. The simple construction technique, pleasant flight characteristics, and semiscale looks have given me many hours of satisfaction.

If you're a beginner or an advanced flier who is looking for something that is simple to build and doesn't look like the ordinary model, this may be the airplane for you. MA

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