

P-47 Thunderbolt

Ryan Aircraft
Revision 2.0

INTRODUCTION:

The P-47 Thunderbolt was one of the immortal fighters of WWII. With its 2,000HP R-2800 radial engine, its heavy armor protection and its awesome armament of eight .50 caliber machineguns, the "Jug" was the antithesis of lightweight British and German fighters like the Spitfire and Bf-109.

When first deployed as an escort fighter in the Eighth Air Force, the P-47 suffered at the hands of lighter German opponents flown by veteran pilots, but as P-47 pilots gained experience with their powerful mounts and as fighter leaders like the great "Hub" Zemke formulated better doctrine and tactics, the balance swung inexorably to the Allied side. The P-47 eventually amassed an impressive record as an escort fighter, and as P-47 groups shifted to a ground attack and close air support role, the Jug gained a reputation as a fearsome gunnery platform whose tough construction brought its pilots home mission after mission.

Having designed a series of small electric models of US Navy fighters, the time was ripe to try a model of the radial engine masterpiece Alexander Kartveli designed for the US Army Air Force. For these models, I shoot for 170 square inches of wing area and an all-up weight of 18 ounces. The P-47's fuselage is proportionally larger in relation to its wing area than on my previous subjects, but I was still able to meet my weight goal. Since the Thunderbolt has a semi-elliptical planform, I opted for a built-up wing instead of my usual foam construction, and this worked out well. The fuse was the same jig-built semi-monocoque structure that I've used on previous designs. The Jug has proved to be an outstanding flyer that looks beautiful in the air. As Republic president Alexander de Seversky said, "It was a dinosaur, but a dinosaur vit good proportions." So let's build a Jug!

P-47 KIT PARTS LIST

SUPPLIED PARTS:

Laser-Cut Parts Pack.
Balsa cowl block (15/16" X 4" X 4").
2 - Vacuum-formed canopies.
Plans.
Construction notes.

Balsa Required:

1 - 1/16" X 3" X 18" balsa sheet.
10 - 1/32" X 3" X 18" sheets for wing skins.
1 - 1/8" X 2" X 18" balsa sheet.
1 - 1/2" X 2" X 12" balsa sheet.
1 - 18" stick of 3/16" square balsa.
5 - 36" sticks of 3/32" X 3/16" balsa.
1 - 12" piece of 1/4" triangle stock.

OTHER ITEMS NEEDED:

1 inch 6-32 nylon screw.
1 inch piece 1/8" birch dowel.
Sig EZ-Hinges.
Control horns.
.045 music wire (elevator joiner).
.038" music wire (pushrods).
Sullivan Super-Flex Cable Pushrods
Thin CA.
Thick CA.
1.5 ounce fiberglass cloth joint tape.
3/4" Adhesive-backed Velcro®.

Construction Notes:

The airframe was designed in AutoCAD. The fuselage is a balsa semi-monocoque structure, and the wing is conventional built-up construction. The weight goal for the finished empty airframe is 7 ounces. I use regular thin CA for nearly all construction. Throughout the construction notes, I list the adhesives I used, but you're free to make substitutions based on your own preference.

Wing: The wing skins are glued up and block sanded. Pre-cut the bottom and top skins to shape as shown on the plans. Mark the spar and rib locations on the bottom skins, and bevel the trailing edges.

Pin the left bottom wing skin to your building board. Pin the spar in its proper location and CA it in place. Add each of the wing ribs, and CA them to the bottom skin from the spar to the trailing edge (note that W1 is angled to allow for the dihedral). Cut the 1/16" balsa sub-leading edge from the supplied sheet, glue to the front ends of the wing ribs and trim as needed. Now remove the marked sections of W7, 8 and 9 to provide a gap for the 1/4" balsa aileron leading edge stock. Cut the aileron LE stock to rough size (note that the top edge is convex; it's *not* a straight taper). Install and trim flush with the tops of the ribs.

If you're going to be using a single aileron servo, now is the time to route the tube for the Sullivan #507 Super-Flex cable. I do not recommend heavier flex cable, as it won't be able to make the tight bend required without excessive binding. If you prefer to use individual sub-micro servos in the wings, make provision for routing their leads.

Now un-pin the wing structure from the building board and position the washout shim *under* the trailing edge before once again pinning the wing to the building board. This will impart the needed washout. Press the bottom skin forward of the spar into place and CA it to the wing ribs and sub-leading edge.

Note: Do NOT cut the ailerons free from the wing panels before installing the upper wing skins. Doing so will make it very difficult to build in the necessary washout.

Check the fit of the upper wing skin, insuring that it matches the wing and that the trailing edge is beveled to make a clean joint. Glue the upper wing skin into place. I like to use thick CA on the ribs and pin the skin into place overnight. I glue the skin at the leading and trailing edge with thin CA. After the glue has cured, trim the skin flush with the sub-leading edge, tip and root. Add the 1/8" balsa leading edge cap and laminated balsa tip blocks and carve them to shape.

Repeat these steps for the right wing panel. With both panels completed, block them up to the correct 1" per panel dihedral angle and glue them together with thick CA. No dihedral brace is needed if you wrap the joint with a strip of 1-1/2 ounce glass cloth.

Now cut the ailerons free from the wing panels and shape their leading edges. Cut the hinge slots and dry mount the ailerons. This completes the basic wing structure.

Fuselage: The fuselage is built over a crutch which is indexed for each former location. Before beginning fuselage construction, glue the 3/16" balsa spine down the center of the crutch to make it stiffer. Make sure that the crutch is absolutely flat and straight. Note that the crutch is to be removed when the fuselage is complete. **IMPORTANT!** *Do not glue any of the formers to the crutch!*

By now you should have determined whether you're building the Bubbletop or Razorback version. Note that the turtledeck and cockpit assemblies are slightly different, but all other construction is the same.

Before beginning assembly of the fuselage framework, assemble F-7 and F-7B. Note they must be beveled and joined with the 30° angle gussets to allow removal of the wing.

Slide each of the formers over the crutch into their indexed positions. *Note: Be especially careful to keep F-2 square to the crutch and not induce any warpage while adding the stringers; this former determines the*

thrust line of the motor. Dry fit the 3/32 x 3/16 stringers into place, and after making absolutely sure each former is exactly perpendicular to the crutch, glue the stringers to the formers with thin CA.

If building the Razorback, take the slotted turtledeck spine (F-12) and bevel its aft upper edge as shown on the plan. Fit the turtledeck spine in place and add the cockpit floor (F-13) and the other turtledeck formers (F-14, -15 and -16). Bevel the edge of the cockpit floor to match the formers. You should now have a light and straight framework.

Secure the lower fuselage side panels to the side stringers with thin CA. Make sure that the sides overlap exactly half of the side stringers; the stringers will make it easier to glue the upper fuse sides to the lower sides.

If necessary, wet the fuselage panels slightly so that they'll bend readily, then carefully glue them into place with thin CA. Glue the upper fuse side panels into place edge to edge with the lower sides. It's best to start at the middle of the panels and work toward the ends. Form the panels into place and secure to the formers and stringers with thin CA. Any slight gaps at the ends of the panels can be filled with slender triangular slivers of 1/16" balsa.

Next add the top fuselage panels, again being careful to join them tightly to the upper fuse sides. Laminate the wing saddle doublers onto the lower fuselage sides as shown on the plans.

Add the bottom fuse panels to complete the planking. Making certain they're straight, glue the tail pieces together. Cut the lower tail block from 1/2" balsa. Tack glue it in place with thin CA and carve it to shape. Then, remove it and hollow it out before gluing it back in place permanently.

You can now remove the construction crutch. By now, the assembly should be very stiff. The main fuse structure is now complete.

Wing Installation: Block sand the leading edge of the wing at the root so that it will have a flat face against F-4, and if needed, trim the trailing edge at the root so that it will fit into the wing saddle. Tap the 1/16" ply wing mount for a 6-32 nylon screw, glue the mount in place in the fuselage and reinforce the joint with 1/4" balsa triangle stock. Drill the screw hole through the wing, add the 1/64" ply reinforcement plate and install the 6-32 nylon wing screw. Square the wing with the tail of the fuselage, pinning it in place in the proper position. Drill the leading edge of the wing to accept the 1/8" locator dowel and dry fit the dowel in place.

Wing Fillets: The wing fillets are optional, but to me these are an important part of the character and beauty of the Jug. The wing fillet bases are 1/64" ply. Remove the wing, install the dowel and re-install the wing with a sheet of wax paper sandwiched between the wing and fuselage. Sandwich the fillet bases between the fuse and wing and then glue the bases to the fuse (*be careful not to glue the fuse to the wing*). Install the 1/64" ply fillet trailing edges. Once the glue has dried, remove the wing and apply fillets of light spackle. Let the spackle dry thoroughly (at least overnight) and then sand it to final shape. Glass the fillets with 1½ ounce or 2 ounce glass cloth and finishing epoxy.

Belly Pan: With the fillets completed, again assemble the wing to the fuselage. Install the belly pan formers on the bottom of the wing, being careful not to glue them to the fuselage. Dry fit the 3 belly pan stringers in place. I suggest you add a "keeper box" to hold the wing screw in place in the wing.

Note: If you're using a single aileron servo in the location shown on the plan, it's easiest to install its mount on the bottom wing surface before planking the belly pan.

Remove the wing from the fuselage, *leaving the screw in place in the wing*, and install the 1/16" belly pan sheeting. Trim and sand the front and rear edges flush with the formers. Drill a 1/8" access hole over the wing hold-down screw and re-install the wing on the fuselage. Sand the joint between the belly pan and fuselage sheeting flush, being careful not to sand through the sheeting.

Empennage: Fit the triangular stab base into place between the fuse sides and secure it with thin CA. Assemble the wing to the fuse and trial fit the stab on the stab base. Make certain the stab is parallel to the wing, and if necessary, sand the base or add shims to correct any error. Remove the stab and glue the tail fillet blocks (made from 1/2" balsa) into place using a T-shaped 1/8" balsa spacer as a guide (be careful *not* to glue the spacer in place). Carve and sand the tail fillets to shape with the spacer supporting the fillets.

Cut the elevator and (optional) rudder hinge slots and test fit them. The balsa spacer is now removed from the tail fillet. If you've been careful with the glue, it should slide right out. Dry fit the vertical fin and stabilizer and test install a music wire elevator joiner (you can use a 1/8" dowel joiner if you prefer). I found it easiest to wait and permanently install the vertical fin and stabilizer *after* covering.

Cowl Block: The cowl is a block of end-grain balsa that is carved to shape. Draw datum lines on the front and back of the block and use them as a guide for installing F-1, which is really just a sanding guide. Cut the hole through the center of the block using a scroll saw or similar. The block is then glued in place on the front of the fuselage (using the datum lines as a guide) and carved and sanded to final shape. I recommend waiting until the model is covered to install the 1/16" ply motor mount.

Last details: Install the servo mounts with thin CA. I elected to add a rudder servo for full 4-channel control, but this isn't necessary. Cut the battery mounting plate from 1/16" balsa and install it on F-3, -4 and -5, using 1/4" triangle stock to reinforce the joints. Apply a strip of Velcro® to the mounting plate so that the battery can be secured. I use .038" music wire for the elevator and rudder pushrods to keep weight to a minimum. On a model this small, I prefer to make my control horns from 1/32 ply, mortised into the surfaces for added strength.

Finishing: While the P-47 is suitable for film covering, I like to finish my warbirds with fiberglass and paint. Tissue and dope also works well. I covered the prototype with .56 ounce glass cloth and painted it with Testor's Model Master enamel paints. It's a replica of the P-47D-15RE that 56th Fighter Group CO Colonel "Hub" Zemke flew in the early months of 1944.

The canopy framing can be painted easily using the frisket masks shown on the plans. Make sure you protect the inside surface of the canopy with masking tape; overspray gets *everywhere*. After painting the framing, remove the masks and glue the canopy in place with Formula-560 or equivalent canopy glue. Install the hardware, and you're ready to go fly.

FLIGHT TESTING: Be careful checking the CG. I suggest you start with the CG 2" behind the LE of the wing where it exits the fuse and adjust it to suit your tastes. If you keep the weight to around 18 ounces, the Jug should fly just fine.

Takeoff and Landing: I recommend getting a capable assistant to hand-launch the model on the first flights. The model needs to be thrown straight and level. Hold the wings level and let it climb as the speed builds up. Landings are made with a straight-in approach, and the model is simply held just off the ground until it settles in. With the built-in wash-out, the Jug has very forgiving stall characteristics.

Flight Characteristics: I've been very pleased with the performance and handling of this model. The Jug will do huge loops and Cuban 8s, and the roll rate is surprisingly fast. Inverted flight is very solid. With active rudder control, stall turns, Hammerheads and spins are added to your repertoire. I hope you enjoy your Jug as much as I've enjoyed mine.