

THE T2A

What follows is the recommended construction sequence from back in the day. We suggest that you read all of the way through the instructions before beginning the building process. Make your own decisions on how to accomplish the build.

The T2A MK I kit includes an epoxy-glass fuselage, foam wings and stab, bulkhead drawings, canopy and plans. Because the fuselage is epoxy-glass, epoxy glue should be used when gluing to it. A Dremel tool with carbide bit works well for making the fuselage cutouts.

One part of the assembly to watch carefully is the installation of the firewall and engine mount. The approach outlined will get the engine properly located using the front end of the nose as the reference for the engine alignment and firewall installation. Just follow the building sequence and proper alignment will be ensured.

NOTE: *Do not use the seam line of the fuselage to do any alignment.* Because of how the molds were made, the T2A seam is not always in the center, most notably at the tail. This does not mean your fuse is not straight. It does mean that if you use this line for alignment of wing or stab you will have a crooked airplane. Also, you cannot measure too much. Double and triple check everything before applying epoxy or a Dremel.

T2A CONSTRUCTION SEQUENCE

1. FINISHING THE WING

Each wing and stabilizer half must be first sheeted with 1/16" balsa sheet.

Whatever your wood source, you still need to weigh each piece of wood to make certain you have wood of equal weights on each wing half. Remember a pattern ship is not just balanced on the center of gravity, it is also balanced on its longitudinal axis. You will need to glue these 4" wide sheets together to form 1 large sheet that will cover 1/2 of the wing. If you purchased a full kit with wood pack you have a copy of Bob Noll's Perfect Foam Wing Construction DVD. Follow that for excellent results. You keep the grain of the wood straight with the trailing edge of the wing and take into account the sweep of the leading edge when you measure the amount of wood needed. Join enough wood together to make 1 piece of wood that will be cut in half to cover both sides of one wing half. When you cut the leading edge of one half, the correct angle will be cut in the second piece for the other half. You join these pieces together (after first making certain that they mate correctly with no gaps) with masking tape. You then open up the pieces and run a bead of Elmer's Wood glue down the hinge line. Then place the piece on your FLAT workbench (masking tape side down) and wipe off any excess glue. You could use Cyanoacrylate (Zap, Hot Stuff, etc...) To do this, but you would end up with a very hard to sand glue line. The wood glue takes longer but is much easier to work with. You apply this method to each wing half and each stabilizer half. You should now have 8 pieces of sheeting prepared to cover the top and bottom of each wing and stabilizer half. You next, using a

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1" disposable paint brush, apply a very thin layer of 60 minute epoxy to 1 set of wing sheeting. (A top and bottom of a panel) To apply the thinnest possible layer of epoxy lay down the epoxy with the brush and then use a hair dryer to heat up the epoxy. The epoxy will then take on the appearance of water and will brush into the wood very easily. This makes a little epoxy go a long way. You can then squeegee off any excess epoxy. You then place the bottom sheeting in the foam shuck and place the wing panel in next (aligning the trailing edge with the sheeting). Place the top piece of sheeting in place and then cover with the foam shuck. Place a piece of plywood on top of the sheeted core and place about 75 to 80 pounds of weight evenly over the top of the wing panel. Allow to dry overnight. Trim and sand sheeting flush with the cores. After all sheeting is complete; you then add the leading and trailing edge pieces. Since the wing has been sheeted with 1/16" balsa, 1/4" balsa should be used for L.E. This will also be true for the stab. Shape leading edge to a smooth rounded contour as shown on plans.

Mark aileron outline as shown on plans. Note that you will be leaving space on the back of the wing and front of the aileron for a balsa cap. This is to give you something to hinge to. If you are using a single aileron servo, you will need to install torque rods. Good quality torque rod sets are available from Goldberg or DuBro. Consider separate servos for each aileron. The flexibility and programming options this will give you are worth the extra work.

Prepare and hinge the ailerons using a minimum of 4 hinges for each one. The outboard hinge should be within 1/2" of the end of the aileron

The wing tips are cut from balsa sheet. Sand the wing skin, tips, leading and trailing edge to shape. The leading edge should be rounded, not sanded to a point. Just around the trailing edge of the ailerons. Do not sand them to a sharp edge or the effectiveness of the ailerons will be reduced.

2. JOINING THE WING PANELS

Before they are joined, draw a centerline down the root of both wing panels. Then transfer these marks to the leading and trailing edge of each wing. These marks will be used both to align the wing panels when they are joined and to get the proper wing incidence later. If you choose to use one servo for each aileron you will need to choose the location and make holes for leads before joining the panels. You will want to mount the servo in a section of the wing deep enough to be able to recess it most of the way. I like a point a bit inboard of midway on the aileron, but this is not really critical.

Once you have your servo position marked or cut out, mark a spot on the wing root for servo leads to exit. Hold the wing panel upright, root up, tip down and use a heated wire 1/8-1/4" diameter to melt a tunnel for your leads. It helps to have a second person that can stand back a little and tell you which way to lean the wire as you are melting the tunnel. A piece of string ran through the tunnel before the panels are joined will allow you to pull your leads through with minimum trouble when you are ready.

The wing panels are joined using the angle already cut into the foam blocks. Work very carefully to ensure that the leading and trailing edge centerlines on both wing panels are properly aligned.

Any good grade of epoxy may be used to join the wings. 5-minute is adequate here. The strength will come from glass added to the center section later.

You may add a 1/16-1/8 ply plate to the bottom center trailing edge of the wing. Fiberglass the wing center section using a five-inch width of 4 to 6 oz. glass cloth. The glass cloth should wrap completely around the wing and overlap the ply plate.

After the resin has hardened, drill the clearance holes for the 1/4-20 nylon bolts through the ply plate. **Note that the holes through the ply plate are angled so the head of the bolt will rest squarely on it.**

3. INSTALLING THE FIREWALL AND ENGINE MOUNT

Use the procedure outlined to insure that the engine mount is properly installed. If this procedure is carefully followed, the engine will be installed with no down or right thrust.

If retract gear is to be used, the blind nuts used to mount the nose gear must be installed before the firewall is glued in place. Mark and drill the nose gear retract mechanism mounting holes. The blind nuts are mounted on the front of the firewall. Because the engine mount lays flat on the firewall when it's installed, it will be necessary to countersink the retract blind nuts so they are flush with the face. In addition, the mounting screws will probably have to be cut so they don't extend beyond the shoulder of the blind nuts.

Drill and tap the engine mount arms for your engine.

Cut out the access hole for the engine and the hole in the front of the nose for the prop shaft. When you cut out the hole in the front of the nose, leave a flange at least 1/4" wide around the outside of the hole for strength.

Now you're ready to install the firewall. Put the engine mount inside the fuselage and mount the engine to it. Tack glue a 1/16" balsa shim to the back of the spinner plate. The shim should be the same diameter as the spinner. With the engine and engine mount inside the nose of the fuselage, put the prop and spinner onto the engine. A 2-112" spinner is recommended.

Hold the fuselage up on its tail so the spinner back plate shim rests flat on the nose. Tape the spinner to the nose to hold it firmly in place. Square the engine so it is upright and tape the cylinder head in place so it won't move. Then put a couple of dabs of 5 minute epoxy or CA onto the back of the engine mount, put the firewall into the fuselage through the wing opening and push it up to the back of the engine mount. Hold the firewall in place carefully while the epoxy sets up. Continue checking the spinner back plate shim to make sure it's flat to the nose of the plane. When the glue has set up, the engine mount is tack glued to the firewall and the firewall is properly located, but not glued in place.

With the engine mount still tack glued to the firewall (and the epoxy hard), remove the engine. Remove firewall and engine mount through wing area. Then, using the holes in the engine mount as a guide, mark the location of the engine mount bolt holes on the firewall. Break the engine mount loose and drill the engine mount bolt holes through the firewall. Install the blind nuts on the back of the firewall using a bit of 5-minute epoxy under the shoulder of each blind nut. If you are using fixed tricycle gear, now is the time to mount your gear blocks on the firewall or drill your engine mount for a nose gear. Mark and drill holes in firewall for steering, throttle cable, and fuel lines. Bolt engine mount and nose gear blocks to firewall and slip assembly back into fuselage through wing saddle. Bolt engine, prop and spinner back into place along with your 1/16 spacer. Check alignment again. If nothing has moved, tape everything in place and get ready to make it permanent.

Apply some 5-minute epoxy to the inside of the fuselage at 4 or 5 locations around the edge of the firewall to glue it in place. After that has set up, apply a liberal amount of 30 minute or longer epoxy around the inside of the fuselage at the fuselage-firewall joint. A scrap piece of balsa may be used to push the adhesive into the joint. Before the glue sets up, add pieces of glass cloth laced with epoxy around the firewall-fuselage joint for added strength. An alternate method that works well is to thicken your epoxy with milled fiber. I find this easier than trying to get pieces of cloth in places I can't see. Tip the fuselage onto its nose while the glue sets up.

5-minute epoxy or 30-minute may be used to seal the front side of the firewall-fuselage joint. Glass cloth can be used in this location as well.

Next you may install the rest of the fuselage bulkheads (F-2, F-3 and F-4). F-2 is forward wing, F-3 is aft wing and F-4 is tail bulkhead. Cut adequate clearance holes in the bulkheads for your choice of fuel tank and your pushrods. It will be easier to drill the holes for your wing hold down dowels before you glue F-2 into place. You may also want to drill holes for nose wheel steering and throttle now. Cut out most of the center of F-4 before installing. The fuse has been reinforced forward of the stab already and F-4 may not really be needed but a little more stiffness in that area will not hurt. You can CA F-4 to a long stick or dowel to push it into place and then just break the stick loose once your glue has cured.

4. INSTALLING THE FUSELAGE WING HOLD-DOWN BLOCKS AND BELLY PAN

The wing saddle built into the fuselage is designed to set the wing zero-zero to the thrust line. It is recommended, however, that the wing incidence be checked with the wing in place in the wing saddle before the hold-down blocks are installed. To do so, put the wing in place on the fuselage and block it up on your workbench so the flat nose is at 90 degrees to the surface. Then, when you measure the distance from the leading edge centerline to the surface and do the same for the trailing edge, the distances will be the same. If not, shim or sand the wing saddle as necessary.

Remove the wing from the fuselage. Using the plans as a guide, install the 1/8" plywood plate to wing leading edge and insert X" dowels. The 1/8" dowel plates are worth the extra trouble in added strength. The X" F-5 (nut plate) piece will have to be sanded to fit before being epoxied in place in the fuselage.

With the blocks installed on the fuselage and the wing prepared, you are now ready to align the wing and drill the holes for the wing bolts through the fuselage hold down blocks. To assure that the wing is properly aligned to the fuselage, you have some measuring to do. Put the fuselage in place on top of the wing on your workbench. Eyeball the wing from the front of the fuselage to make sure it's square to the wing. Measure the distance from each wing tip to the fuselage side. Both distances should be the same. Measure the distance from the trailing edge of each wing at the wing tip to a point on the center of the top of the fin. If the wing is properly aligned, these distances should also be the same. Use a felt tip pen to mark the wing along the wing fairing on both sides of the fuselage as reference marks.

Carefully tape the wing to the fuselage so it won't move. Turn the fuselage and wing upside down. Working very carefully, put the drill bit through each clearance hole in the wing and drill the holes into the fuselage wing hold-down blocks. These holes may either be drilled or tapped for the 1/4-20-nylon hold-down bolts or 1/4-20 blind nuts may be used.

Trim the belly pan to shape and attach to wing with epoxy. Fair in with putty or a micro balloon mix. Cut openings to allow access to wing hold down bolts.

Remove the wing from the fuselage.

Alternate Method:

Rather than dowels at the leading edge, some builders will make a forward hold down plate like F-5 and use (2) 1/4-20 nylon bolts at the leading edge as well as the trailing edge. This allows you to make very fine changes in wing incidence for trimming your airplane.

5. BUILDING THE STAB AND ELEVATOR HALVES

Install the 3/16" leading edge and stab tip and sand to shape shown on plans. Use: 5-minute epoxy to join the stab halves, then wrap the center with 4-6oz glass cloth and resin.

Transfer elevator shape from plans as you did for the ailerons. Cut and trim elevators, add balsa caps and reinforcement for control horns. Drill the holes for the elevator horns on the inboard side of each elevator half. Using an elevator horn on each elevator **half means** that the elevators will be independently adjustable, a feature of great advantage in building contest planes for contest flying.

Another option is to use a dowel or commercial wire type elevator horn and permanently join the elevator halves. If you go this route, make absolutely sure the halves are perfectly aligned or you will forever have trim problems.

Hinge slots may be cut in the stab and elevator halves at this time.

6. BUILDING THE RUDDER

Cut rudder from balsa as shown on plans. Taper to about 1/8" at the rudder trailing edge.

7. INSTALLING THE STAB AND ELEVATOR HALVES

Cut stab opening in fuselage. The opening on one side will have to be larger than the other in order to slide stab through. The right side (from pilot's view) has been extended aft to allow for this. On a flat surface, block up the fuselage with the wing in place. This time though, make sure that the wing is level from tip to tip. Block up the nose or tail as necessary so the wing leading and trailing edges are the same distance to the surface. Then you're ready to install the stab.

Slide stab in place in the fuselage and check the alignment to make sure that: (1) the center of the leading edge and trailing edge on both sides of the stab are the same distance from the surface of the table on which the fuselage rests, (2) the distance from the stab tip to the fuselage is the same for both stab sides, (3) the distance from one stab tip to the wing tip on the same side of the fuselage is the same as the distance from the other stab to the other wing tip. Sand or shim the stab cut-out as necessary. When you can get it properly aligned, use epoxy glue to glue it in place, checking the alignment again while the adhesive sets up.

Install the elevator halves using a minimum of three hinges for each one. The outboard hinge should be within 1/2" of the outboard end of the elevator.

8. INSTALLING THE RUDDER AND RUDDER HORN

Hinge rudder at this time and install a control horn.

9. CUTTING THE PUSHROD EXIT HOLES

Plan how to get the straightest run for your pushrods and cut the minimum size slots in your fuselage for the exits. Take your time and plan it out, since once you cut a slot, it's a pain to fill it in and it will add tail weight, which you almost never need.

10. INSTALLING THE SERVO RAILS AND COCKPIT FLOOR

Hardwood servo rails (not supplied) should be epoxied in the fuselage. For additional strength, glass cloth may be added, though it's not necessary. If you plan to install a cockpit you will need to install the floor before you put in servo rails. Cut cockpit floor and the 2 small bulkheads from balsa using supplied template. Glue in place with CA or epoxy. Hold off installing pilot and canopy till the very last to avoid damage.

11. PREPARING THE PUSHRODS

The rudder and elevator pushrods may be prepared at this time. Since the elevator pushrod must have double ends at the rear, two rods and devices will have to be attached. They are then bent into a "Y" shape to exit the holes in both sides of the fuselage for the elevator horns. If one clevis rod is soldered to the other, be sure to wrap the joint with cleaned wire first, then solder it. Or, the two clevis rods may be mounted directly to the pushrod, with staggered holes on either side of the pushrod. The fiberglass pushrod set from Dave Brown has a special fitting that makes dual outlet pushrods a breeze. I really like the carbon pushrod sets from Central Hobbies but I have not yet figured out a good dual output method. They will make a very light and stiff rudder pushrod. Pull-Pull is a popular alternative.

12. INSTALLING THE MAIN GEAR STRUTS

For fixed gear, simply put the main gear struts in place. Each strut is held in the grooved hardwood with two metal straps screwed in place. Adjust the main gear or the nose gear as necessary so the plane rests in a slightly positive attitude.

To install retract gear first mount the wing onto the fuselage. Bring the nose gear strut down and put a 2-1/4" wheel on it. Block up the plane so it rests in a slightly positive angle. Measure and cut both main gear struts so the plane will be in this position with the wheels down when the 2- 1/4" wheels are installed. Install the struts into the retract gear mechanism to determine where the wheel well is to be cut out. Seal the foam inside the wheel well with some five-minute epoxy or white glue. The aileron servo well can now be cut into the wing and servo rails added

13. FINISHING

All mold release has already been cleaned from the fuselage. It should be well sanded and a primer used. Any imperfections in the fuselage can be filled with micro balloons, auto body putty, etc. and sanded smooth before painting. Trim canopy to shape and epoxy or Zap in place. Tape off around base of canopy and fair it in using micro balloons or a good putty. If you are going to clear your airplane, you can sand the entire canopy. The clear will bring back the gloss and make it transparent again

3/4oz. fiberglass and resin is recommended for all balsa sheeted areas. Resin and micro balloons are recommended for fillet material. However, since resin won't bond to the epoxy-glass fuselage, a thin coat of 5-minute epoxy should be applied to the fillet areas first to act as a bonding agent. One of the epoxy surfacing resins from Bob Smith or Zap can be used with no additional prep over epoxy. We still prefer polyester resin for ease of sanding and better heat resistance.

When covering with Monokote or Ultracote, keep in mind that there is foam underneath the balsa on the wing/stab areas, so do not leave your heat source in one place too long.

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14. LOCATING THE CG

All radio equipment, fuel tank, and the engine can now be installed.

While the specific location of the CG on a contest pattern ship is a matter of personal preference, we recommend locating it as shown on the plans.