

# **F4F Wildcat**

## **Ryan Aircraft**

### **Revision 3.0**

## **INTRODUCTION:**

In the dark early days of WWII, before world-class carrier fighters like the Grumman Hellcat and Chance Vought Corsair entered service, hard-pressed US naval aviators depended on the obsolescent Grumman F4F Wildcat to parry the attacks of the Imperial Japanese Navy. Although their mounts were inferior to the renowned Mitsubishi A6M2 "Zero" in most respects, the Navy pilots used superior combat tactics and realistic gunnery training to take the measure of their combat-hardened Japanese opponents.

In the first year of the war, Navy and Marine F4F squadrons confronted the best air crews of the Japanese Navy in four major carrier battles and the grinding battle of attrition on and around Guadalcanal. These battles cost the Japanese many of their most experienced aviators, with the end result being that by the time the Corsair and Hellcat entered service in 1943, the tide of war had already turned.

US Navy fighters are among my favorites, and having built models of the Hellcat, Bearcat and Corsair, the time seemed ripe to round out my collection of classic WWII Navy fighters. For the Wildcat I stuck with my tried and true formula, scaling the airframe to 170 square inches of wing area and aiming for an all-up weight of 18 ounces. At this size, the F4F has a proportionally fatter fuselage than any of my efforts to date, so weight control is important. With the mid-wing configuration of the F4F, I also had to pay special attention to the structure around the wing saddle. Given the shape of the fuselage, my favored practice of crutch-built construction worked especially well. The Wildcat has lived up to all my expectations and is one of my favorite models. So let's get started!

## **WILDCAT KIT PARTS LIST**

### **SUPPLIED PARTS:**

Laser cut parts pack.  
Balsa cowl block (1 1/8" X 4" X 4").  
Vacuum-formed canopy.  
Printed Plans.

### **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 9" balsa sheet.  
1 - 18" sticks of 3/16" square balsa.  
6 - 20" sticks of 3/32" X 3/16" balsa.  
6 - 16" sticks of 3/32" X 3/16" balsa.  
1 - 12" piece of 1/4" triangle stock.

### **OTHER ITEMS NEEDED:**

Foam wing cores, available from  
Eureka Aircraft ([EurekaAircraft.com](http://EurekaAircraft.com)).  
1 inch 6-32 nylon screw.  
1 inch piece 1/8" birch dowel.  
Sig EZ-Hinges.  
Control horns.  
Goldberg "Mini-Snap" clevises.  
Sullivan #512 threaded couplers.  
.045 music wire (elevator joiner).  
.062" music wire (torque rods).  
3/32" brass tubing (torque rods).  
.038" music wire (pushrods).  
Thin CA.  
Thin odorless CA.  
Thick odorless CA.  
1.5 ounce fiberglass cloth joint tape.  
3/4" Adhesive-backed Velcro®.

## CONSTRUCTION NOTES:

The airframe was designed with AutoCAD. The fuselage is a conventional structure using former, stringer and balsa sheet construction, and the wing is foam sheeted with balsa. The weight goal for the finished empty airframe is 7 ounces. I use regular thin CA for nearly all construction and odorless CA for the foam wing.

**Wing:** The foam cores are lightly sanded and cleaned with a shop vac or tack rag. The 1/16" sub-leading edges are cut from sheet stock, installed with thick odorless CA and planed flush. The wing skins are glued up from 1/32" balsa and block sanded smooth. *NOTE: See my how-to for gluing up balsa wing skins at [ManzanoLaser.com](http://ManzanoLaser.com) or at [RyanAircraft.net](http://RyanAircraft.net).*

After sanding and dusting the skins, attach them with your favorite epoxy or contact adhesive. *NOTE: 3M Super 77 contact adhesive now contains acetone and is not suitable for use on foam wing cores. Refer to my website for notes on using ProBond Polyurethane. I have had very good results with this adhesive system.* Trim the wing skins flush with the sub-leading edges and then install the 1/8" leading edge caps. Trim the roots and tips flush with the cores and then trim the trailing edge to the size shown on the plans. Finally, the 1/2" balsa wing tips are installed and sanded to shape.

Cut the ailerons from the wing panels as shown on the plan view and apply 1/8" balsa strips to the exposed TE. Trim 1/4" from the LEs of the ailerons and install their 1/8" balsa LEs. If you wish, you can trim the ailerons shorter and face their ends with 1/32" balsa.

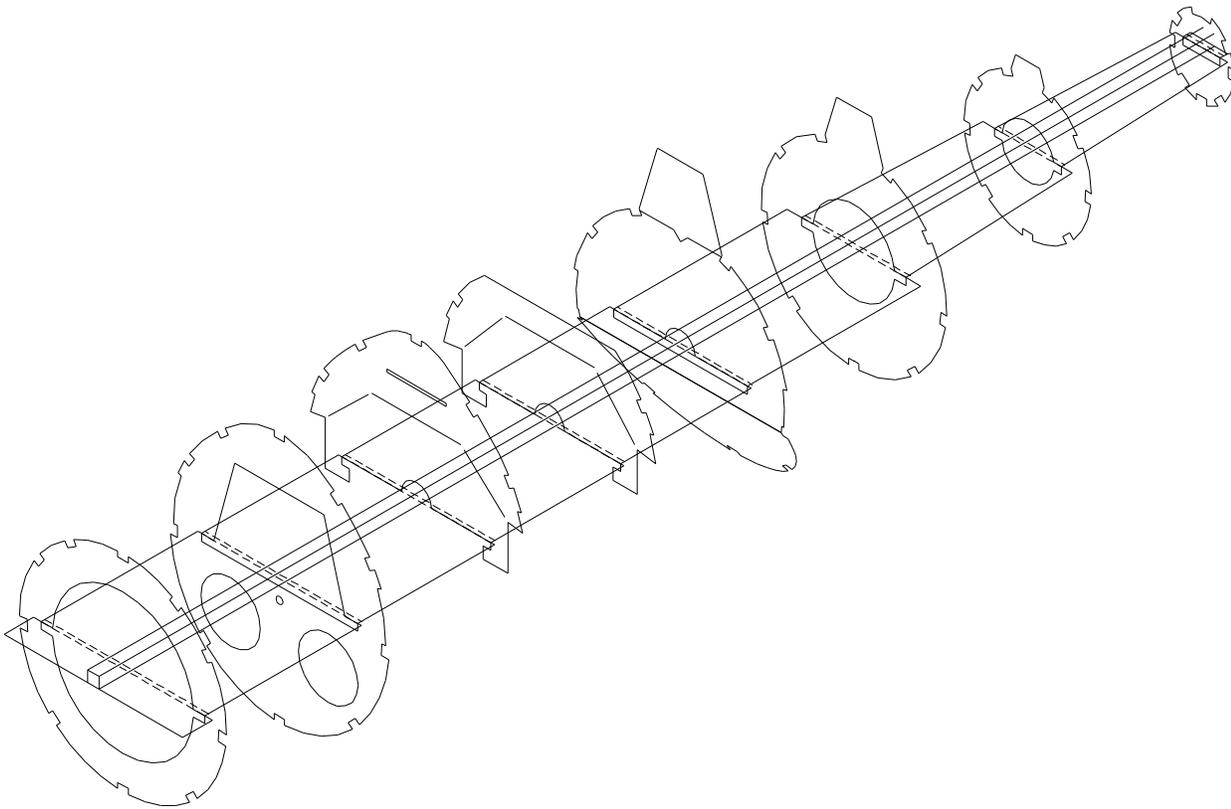
Before joining the wing panels, you need to bevel the roots to the proper angle. Align the root of the wing panel with the edge of your work bench, and block up the wing tip 1". Use a sanding block to bevel the root. Repeat with the other panel. Then, again blocking each wing tip up 1", join the wing panels with thick odorless CA or epoxy. Apply 1.5 ounce glass reinforcement tape to the joint with thin odorless CA.

Next, install the aileron torque rods. These are fabricated from 1/16" music wire and 3/32" brass tubing. Note that the torque rods mate with the ailerons at the very end, forming the inboard hinge for the surface. The easiest way to install the torque rods is to cut through the bottom sheeting, remove the underlying foam and then install the torque rods with thick odorless CA or epoxy, *being careful not to get any glue inside the brass tubes.* Next, fill in the slot with 1/8" balsa and block sand it flush. Cut the hinge slots and dry mount the ailerons. I recommend installing the 1/16" ply aileron servo mount *after* finishing the wing.

**Fuselage:** The fuselage is built over a crutch which is indexed for each former location. Before beginning fuselage construction, glue the 3/16" square hard balsa spine down the center of the crutch to make it more rigid. 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!*

Before beginning assembly of the fuselage framework, assemble F-6, F-6A and F-6B. Note F-6 and F-6B must be beveled and joined at the proper 30° angle with the angle gussets to allow removal of the wing. Also glue the reinforcement strips and extension stringers onto the wing saddle doublers. Note the partial cut-outs in the "crutch grips" of F-4 and F-5. These sections will be removed after the fuselage is completed.

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 and wing saddle doubler assemblies into place, and after making absolutely sure each former is exactly perpendicular to the crutch, glue the stringers to the formers with thin CA. Note that the stringers that are part of the wing saddle assembly extend past F-9 by about 2".



Assemble the F-10, F-11 and F-12 cockpit formers and glue them in place on formers F-4, F-5 and F-6. Glue the F-13 sub-turtledeck in place atop formers F-12, F-6, F-7 and F-8. Note that the pointed rear tip of the turtledeck seats between the top two stringers just ahead of F-9. You should now have a light and straight framework.

Glue the lower edge of the fuselage side panels to the side stringers with thin CA. Note that it's best to install each pair of panels simultaneously so that stresses aren't induced into the assembly. Make sure that the side panels overlap exactly half of the side stringers; I find it helps to make a light pencil mark at the center of the side stringers at each former.

If necessary, dampen the fuselage panels so that they'll bend readily, then carefully push them into place and glue with thin CA. Glue the upper fuse panels into place edge to edge with the fuselage sides. It's best to start at the middle of the panels and work toward the ends. Continue adding the rest of the fuselage panels.

Once all fuselage panels are in place, glue the bottom tail block in place and carve it to shape. Plane or block sand the turtledeck panels flush with the sub-turtledeck, and add the turtledeck cap, which is laminated from two layers of 1/8 balsa. You can now remove the construction crutch. By now, the assembly should be very stiff. Remove the crutch grips from F-4 and F-5 by cutting through the remaining tabs. 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-3, and then 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 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.

**Cowl Block:** The cowl is a block of end-grain balsa that's carved to shape. Note that the block is bored for the motor opening. Draw datum lines on the front of the block and use them as a guide for installing F-1, which is really just a sanding guide. The block is then glued in place onto F-2 and is carved and sanded to final shape. I recommend waiting until the model is covered to install the 1/16" ply motor mount.

**Empennage:** In order to have the necessary strength at the stabilizer mounting, the vertical fin is made from 3/16 balsa. To reduce weight and improve the appearance, the fin is block sanded to taper from 3/16 at the stab slot to 1/8 or less at the tip. It should also be sanded to a symmetrical airfoil section. The stabilizer and elevator halves are 1/8 sheet stock. With the pieces trial fit together, it's time to fit the empennage assembly to the fuselage.

Assemble the wing to the fuse. Pin the vertical fin in place so that it's 90° to the wing and aligned with the axis of the fuselage. Glue the tail fillet blocks (made from 1/2" balsa stock) into place on either side of the vertical fin, but be careful *not* to glue them to the vertical fin at this time. Remove the vertical fin and replace it with a spacer made from scrap 3/16 balsa. Carve and sand the turtledeck cap and tail fillets to shape. Remove the spacers and slip the vertical fin back into place, again making sure it's 90° to the wing. Dry fit the stabilizer in place, and check that it's at 0° incidence relative to the bottom of the wing. When you're satisfied with the alignment, glue the vertical fin in place with thin CA, but leave the stabilizer loose for the moment. You can use filler to make a small radius fillet at the joint between the turtledeck/vertical fin and the fuselage.

Cut the elevator hinge slots and test fit them. Install the 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 stabilizer *after* covering.

**Belly Pan:** With the wing mounted on 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; note that the center stringer is laminated from two layers of 3/32 X 3/16 balsa. You may wish to add a "keeper box" to hold the wing screw in place in the wing.

Install the 1/16" belly pan sheeting. *Note: Given the depth of the belly pan, it's recommended that you pre-trim the panels and then glue them in place while the wing is mated to the fuselage. This will help prevent distorting the belly pan, assuring a better fit.* Drill a 1/8" access hole over the wing hold-down screw. Sand the joint between the belly pan and fuselage sheeting flush, being careful not to sand through the sheeting.

**Last details:** Install the servo mounts with thin CA. Cut the battery mounting plate from 1/16" balsa and install it on F-3 and F-4, using 1/4" triangle stock to reinforce the joints. Apply a strip of Velcro® to the mounting plate so that the battery pack can be secured. I use .038" music wire for the 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 Wildcat 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 enamel paints. It's a replica of the F4F-3 that LT "Butch" O'Hare flew when he earned the Medal of Honor on February 20 of 1942.

The canopy framing can be painted 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 Wildcat should fly just fine. 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 begin a shallow climb. Landings are made with a straight-in approach, and the model is simply held just off the ground until it settles in. With the wash-out in the wing, the Wildcat has very forgiving stall characteristics.