

# F6F-5 Hellcat

Ryan Aircraft

Revision 3<sup>M</sup>

## INTRODUCTION:

The goal of this design was for an unusual warbird for Speed 400 power. Most models in this class are of subjects with in-line engines and low frontal area. With it's blunt nose and stubby fuselage, the Hellcat would be sure to stand out in a crowd. As it turns out, the blunt nose is no problem at all, and all the examples I've built have excellent flight characteristics. Be aware that weight control is critical on a model this size.

The thinned Clark Y foil section reduces drag and imparts gentle stall characteristics at the low Reynolds Numbers of this small model.

This is a short kit, including laser cut parts, canopy, etc. The builder supplies balsa sheet stock and sticks. Because tastes in hardware vary so much, none is included. The construction notes describe the way I set up my Hellcat, but you're free to substitute as you see fit. Good luck!

Jim Ryan

## HELLCAT PARTS LIST

### SUPPLIED PARTS:

Laser-Cut Parts Pack.  
Balsa cowl block (1 7/16" X 3 1/2" X 4 1/8").  
Vacuum-formed canopy.  
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 9" balsa sheet.  
1 - 3/16" X 1" X 9-1/2" balsa sheet.  
3 - 18" sticks of 3/16" square balsa.  
2 - 18" 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).  
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 construction of the Hellcat adheres to my belief that simple models can be light models. I tried to keep the part count as low as possible. A quick note on adhesives: I use regular thin CA for most construction, but this adhesive will attack foam. For all wing construction, I recommend foam-friendly odorless CA or an aliphatic adhesive. Throughout the construction notes, I list the adhesives I used, but you're free to make substitutions based on your own experience.:

**Wing:** The foam cores are lightly sanded and cleaned with a shop vac or tack cloth. The 1/16" sub leading edges are cut from the supplied sheet stock, installed with thick odorless CA and trimmed flush. The wing skins are glued up from the supplied 1/32" balsa. *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 the skins, attach them with contact adhesive or Gorilla Gue. Trim the skins flush with the sub-leading edges, roots and tips, and then trim the TE as shown on the plans (the skins should extend about 1/8" behind the foam cores' TE). Then the leading edge caps (cut from supplied 1/8" sheet stock) and wing tips (cut from supplied 1/2" stock) are installed and sanded to shape.

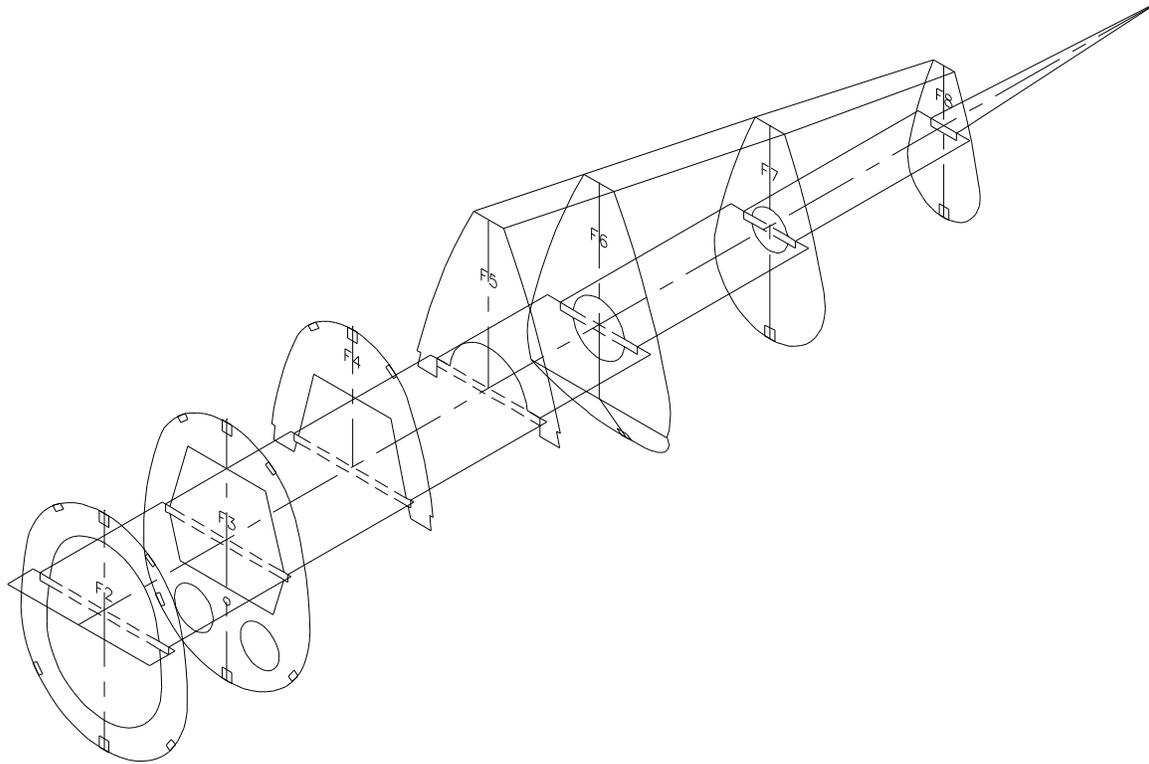
The original F6F featured a flat center section, with the polyhedral joints at the wing folding joints. The wing panels should be cut apart at the polyhedral joints with a razor saw and then beveled with a sanding block so they'll join at the correct angle. Align the root of the outer wing panel with the edge of your work bench, and block up the wing tip 1 3/8". Use a sanding block to bevel the root. Repeat with the other outer panel.

Cut the ailerons from the outer wing panels and glue 1/8" balsa to the exposed TE with thick odorless CA. 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. Blocking up the wingtip 1 3/8", join the outer wing panels to the inner with thick odorless CA, then apply 1.5 ounce glass reinforcement tape with thin odorless CA. Use the same technique to join the wing halves on a flat surface. 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 other hinges are spaced farther out so that the aileron doesn't bind at the polyhedral joint. 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. *Be careful not to get any glue inside the brass tubes.* Next, fill in the slot with 1/8" balsa and sand it flush. Cut the hinge slots and dry mount the ailerons. I recommend installing the 1/16" ply aileron servo mount after covering the wing.

**Fuselage:** The fuselage is built over a crutch, which makes it easier to ensure a light and straight assembly. The laser-cut crutch should be marked for each former location as shown on the plans, and you should glue a 3/16" square balsa strip in place on it as a stiffener. 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, you must assemble F-6 and F-6A. Note they must be beveled and joined at the proper 30° angle to allow removal of the wing, using the laser-cut 30° angle braces. You'll also need to trim the slot in F-6A for the 3/16" stringer to seat properly.

Slide each of the laser-cut formers over the crutch into their correct 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 3/16" square top stringer into place on formers F-2, F-3 and F-4, and after making sure each former is exactly perpendicular to the crutch, glue the stringer in place with thin CA. Repeat for the laser-cut 1/16" sub-turtledeck, which fits atop F-5, F-6, F-7 and F-8, the 3/32" X 3/16" nose stringers and the 3/16" square bottom stringer, again making sure the formers are square to the crutch. There is no bottom stringer from F-3 to F-6; that will be part of the belly pan that you build later. You should now have a light and straight framework.



Position the lower fuse sides on the frame so that their edge aligns with the notches in the formers and tack glue in place with thin CA. The forward edge of the wing-saddle cut-out should be flush with F-3.

If needed, wet the lower fuselage sides so that they'll bend readily, then carefully trim them so that they'll join tightly over the 3/16" keel stinger. Apply thick CA to the formers and push the fuselage sides into place, running a bead of thin CA down the seam.

Laminate the wing saddle doublers onto the lower fuselage sides as shown on the plans. Trim or block sand the edges of the lower fuse sides flush with the formers around the wing saddle, being careful not to change the shape of the wing saddle.

Making certain they're straight (the pointed tail of the crutch helps here), glue the tail pieces together. Cut the balsa 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.

Install 1/4" triangle stock to the joint between the wind saddle doubler and F-3 at the leading edge of the wing. This will help to reinforce this high stress area.

Edge-glide the upper fuse sides to the lower fuse sides, being careful to get a good straight seam. Once the lower edge seam has cured, push the upper fuse sides into place and secure with thin CA. Fit the nose planking pieces in place, trimming as needed, and secure with thin CA.

The 3/16" turtledeck cap is glued on after the upper fuselage sheeting is planed or block sanded flush with the sub-turtledeck. The tail fillets are cut from 1/2" balsa and glued in place using a T-shaped 1/8" balsa spacer as a guide (be careful *not* to glue the spacer in place). The turtledeck and tail fillets are now carved and sanded to shape. Note that the rear of the stab support will need to be trimmed to match the downward angle of the rear of the vertical fin.

**Empennage:** The tail feathers are simple 1/8" balsa sheet stock. Glue the vertical fin pieces together and leave them to dry. Cut the elevator hinge slots and test fit them. The balsa spacer is now removed from the tail fillet. Dry fit the vertical fin and stabilizer and test install a 1/16" music wire elevator joiner (you can use a 1/8" dowel joiner if you prefer). Glue 1/8" filler pieces at the rear of the tail fillets, leaving room for the stab and joiner. I found it easiest to wait and permanently install the vertical fin just prior to finishing and the stabilizer *after* finishing.

**Wing Installation and Belly Pan:** Tap the 1/16" ply wing mount for the supplied 6-32 nylon screw, glue the mount in place in the fuselage and reinforce the joint with 1/4" balsa triangle stock. Drill 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. Remove the wing, install the dowel and re-install the wing with a sheet of wax paper sandwiched between the wing and fuselage. When gluing the belly pan formers in place on the bottom of the wing, be careful not to glue them to the fuselage. Glue the front and back formers (F-3A and F-6A) in place first and then dry fit the keel stringer in place. Then trim the middle two formers (F-4A and F-5A) until they can fit in place without bowing the keel stringer upward; this makes the belly pan much easier to plank.

Remove the wing from the fuselage, and install the 1/16" belly pan sheeting. Carefully trim the sheets so that they join tightly over the 3/16" keel stringer. Trim and sand the front and rear edges flush with the formers. Drill a 1/8" access hole over the wing hold-down screw (this will keep the screw trapped in place) 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.

**Cowl Block:** The cowl is a block of end-grain balsa that is carved to shape. Note that the block is bored for the motor opening and counter-bored to provide a shoulder for positioning the motor mount. Draw datum lines on the front of the block (the face that's counter-bored) and down the sides and use them as a guide for installing F-1. Use F-1 as a guide for cutting out the chin scoop (a scrollsaw works well for this). Using the datum guidelines, glue the cowl block in place onto F-2 and then carve and sand it to final shape. *Wait until the model is complete* to install the 1/16" ply motor mount with thin CA. The fins in the chin scoop (if desired) are scraps of 1/64" ply or card stock.

**Last details:** Install the elevator servo mount with thin CA. Again, I recommend installing the aileron servo mount after covering. 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 joint. Apply a strip of Velcro® to the mounting plate so that the NiCad pack can be secured. Unless you wish to test fly the model before painting it, I'd suggest leaving the installation of the control linkages until the model is finished. I use .038" music wire for the pushrods to keep weight to a minimum. Another option for the elevator is to install Kevlar pull-pull cables. If you opt for music wire, I've found that Sullivan 2-56 brass couplers (part number 512) are perfect for these small models; just solder them in place as usual. On the aileron horns, I like to use Sig SH-659 1/16"/2-56 aileron connectors. I drill and tap a 4-40 hole through the connector, and use a set-screw to secure it to the torque rod. This is light and compact and works very well.

**Finishing:** I like to fiberglass and paint my models, but a Navy fighter like this is also suitable for film covering with Corsair Blue Ultracoat. The national insignia and ID markings can be cut from white film using the patterns on the plans, making a quick and very scale finish.

If you do opt for covering the model with fiberglass or another paintable surface, keep weight to an absolute minimum. Use nothing heavier than .56 ounce cloth, and apply it with a single coat of finishing epoxy thinned 30% with denatured alcohol. Also use a light paint. I've found the Model Master military paints to be nearly ideal for these small electric projects; they're highly opaque and very light.

The canopy framing can be painted easily using the frisket masks shown on the plans. Just stick them onto the canopy as shown. Make sure you mask off the inside surface of the canopy also, because overspray gets *everywhere*. After painting the framing, remove the masks and glue the canopy in place with RC-56 or equivalent canopy glue. Install the hardware, and you're ready to go fly.

**FLIGHT TESTING:** Be very careful checking the CG; this model is short-coupled, and experience has shown that it is *not* tolerant of an aft CG condition. 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 Hellcat 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. Landings are made with a straight-in approach, and the model is simply held just off the ground until it settles in. Thanks in part to the washout, the Hellcat shows little tendency to tip stall.

**Flight Characteristics:** Once the model is up and "on the step", it flies very well, with no tendency to snap. I have the most fun flying it in close and doing low passes down the runway. It flies very well at about 2/3 throttle, but it's crisp and stable throughout the speed range.

**Aerobatics:** The Hellcat has surprised me with its large loops and quick rolls. With a model of this kind, you can't expect to do unlimited aerobatics, but it certainly flies like a Hellcat should. It can do nice Immelmans, split esses and Cuban 8s. Inverted performance is solid and predictable.

Enjoy your Hellcat!