

How to Make a Fanfold Flanker – by Tom Nelson

These construction notes loosely follow the ezonemag.com thread entitled; [Make Your Own Fanfold Flanker](#) found [here](#). These are not to be mistaken for “step-by-step instructions”. My intent is to provide experienced RC flyers and scratch-builders with the templates to make your own Su-27 Flanker out of fanfold, and construction *guidelines*. The pictures, for the most part, are of the second and third fanfold Flankers I built. I hope you enjoy building and flying airplane as much as I have ... Tom Nelson

Design Synopsis

Among the design objectives I set for this project were:

1. Looks: I definitely wanted to capture the cool lines of the full scale bird. Note that I was not interested in a “glass” finish, and the associated weight gain.
2. Performance: The model was to emulate the scale maneuvering capabilities of the full-scale Flanker at a typical air show. Especially the excessive thrust-to-weight of the scale bird.
3. Durable. This really means “repairable”, not “tough”. The airframe is very light, and not all that strong. But scuffs and dings are easily repaired. Don’t crash it, though!
4. Bang-for Buck: To be sure, top end performance would cost money. But I wanted to ensure that the most disposable part of the project – the airframe - was NOT expensive. To that end, you will spend some \$15.00 USD on the bare airframe. And less than 30 hours to get in the air.
5. Size: I wanted a plane that was small enough to transport easily, with no pre-flight assembly required. But I also wanted a plane large enough to handle a bid of wind.
6. Wing Loading & Power: I wanted a plane suitable for hand-launch – no need for the extra time and ‘real estate’ of a bungee launcher.
7. Draggy Airframe: I wanted a plane that was relatively easy to land, and easy to slow down.
8. Pusher Design: This approach protects the motor & prop, and maintains the appearance of the nose. Plus it easily meets design objective #2
9. Well Sorted-Out Propulsion System: No trial and error required in order to get “scale” results.

I’m happy to say that this bird meets the essence of all of these objectives.

Yes, but ...

There are a couple of matters that prospective builders need to be aware of, seeing how I am making some assumptions with these instructions:

- I used Blue fanfold that was nearly 3/8” thick. I’ve tried to draw attention to places where different thicknesses will have an impact, but I’d suggest trying to find 3/8” thick fanfold. And you will definitely want Blue fanfold. Pink is not suitable for the forming processes depicted.
- You’ll need light, strong adhesives. If you are uncertain what to use, then may I suggest the following:
 - Probond polyurethane glue as a primary adhesive.
 - Thick CA and Accelerator (foam safe, naturally) for tacking purposes, and adhering non-structural parts. I also use this for the stabilator tubes.
 - 3M-77 (old formula) spray adhesive for laminating layers of foam together.

- You'll need a scale plastic model if you hope to capture some of the more subtle lines of the Su-27's. 1:72 is a good size. Also a good idea to download commonly available pictures from the internet.
- While the plane is actually very easy to fly, it is by no means suitable for a novice. You should be a capable RC pilot. If you can handle a TwinJet, you are up to the task of flying this bird. But if you find smooth landings are far and few between, you may wish to reconsider.
- You'll need good eyesight. Being a small airframe, you'll need to be concentrating all the time. Even though it is capable of flying slowly, it can also get to a point where orientation is difficult in the blink of an eye.
- You'll want to have already scratch-built a couple of planes, some of fanfold. You should know how to build with a view to lightness and strength. You should have a source of- and know how to work with - carbon fiber laminate and tube. You should have a variety of tools common to scratch-builders, including sanding blocks, files, rasps, razor saws, box cutters, tube cutters etc.
- You need to be familiar with electric propulsion systems. This should NOT be your first electric plane.
- You should know how to program your computer transmitter. Differential and elevon subroutines are required.
- Finally, I want to make the point that there are lots of ways to build this bird, not just "my" way. Meaning, as you go through this build, you might end up with questions or suggestions. Rather than trying to contact me directly, I would ask that you post your questions on the ezone thread dedicated to this build, thereby enabling the "community" to respond. Further, this means that your problems (and solutions) will end up added to the archive - to the benefit of the next builder to come along. *But please check* the ezone thread before posting your question ... I'd like to think that most questions have already been addressed by the brave souls that worked from the beta drawings posted there. You will notice that both the ezone thread and these instructions follow essentially the same sequence, so you shouldn't need to do much reading to determine if your question has already been addressed.

Credit where credit is due

I also feel compelled to offer credit to those who helped along the way. I sincerely hope prospective builders take a moment to read this short list and recognize those folks too; they deserve it:

- The kind folks at Ezonemag.com provided the forum that propelled me down this path, without which I doubt I'd have been motivated to even start this project. Authors of posts too numerous to list all freely published their experiences and thoughts on Ezone, and deserve more appreciation than I can offer here.
- Fiddlersgreen.com provided the spark that got me thinking about forming thin foam into 3D shapes. Their paper airplane Su-27 formed the basis for the templates that eventually became this bird. I'm grateful to Chip Fyn for his kind permission to modify and post these templates.
- Howard Metcalf, for his rubber powered free-flight "Sukhoi Su-27" article in May/June 2000 issue of Flying Scale Models. In particular, the canopy template was a stroke of genius.
- Flat Plate Tectonics article in the August 2001 Flying Models magazine by Brian Steele, in collaboration with Keith Shaw.

- Rcjetpilot, Tom in Cincy, and Rmesnik – all of Ezone – for volunteering your assistance with the CAD drawings. Roberto, your tireless enthusiasm was refreshing to work with, and ultimately made the drawings a reality.
- Ralph, Barry and Jack for being willing to work with the beta drawings I initially offered, and helping me to identify weaknesses in both my drawings and instructions.

So what's it fly like ...

Here are some links to movies:

- **4S1P 2100 mah ThunderPower cells, Castle Creations Phoenix 45 ESC, Mega 16/15/5 and Graupner CAM 5.5 x 4.3 prop.** Thrust to weight exceeds 1 at 18.5 ounces AUW. 14 minutes with throttle management. I highly recommend this setup.
- **9 KAN 950 Cells, Castle Creations Phoenix 25 ESC, Mega 16/15/5 and APC 7x5 E prop.** Thrust to weight exceeds 1 at 18.5 ounces AUW. 7.5 minutes with throttle management.

If you already have the free FMS flight simulator, **here is a flyable demo of my Su-27**, tweaked to emulate the performance you can expect from the LiPo version. The closest you can get to “fly before you build”.



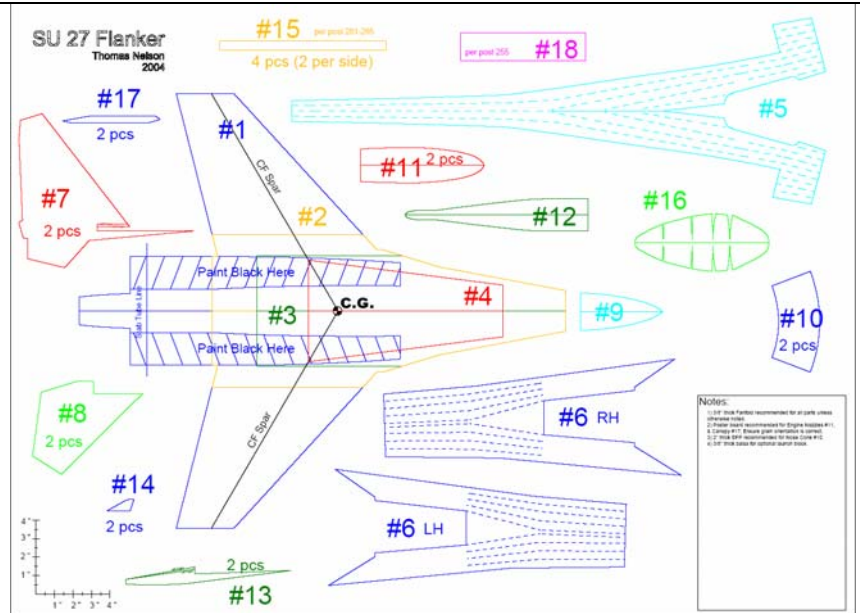
So let's get started already!

Step 1

The drawings for this project are available in three file formats:

- Adobe (.pdf) tiled for printout on 8.5" x 11" sheets of paper. You'll need to spend some time cutting and taping together.
- Adobe (.pdf) untiled. You will need to take this file to a print shop (like Kinko's) and get them to print it on a single sheet of 36" x 48" paper. There will be "processing fee" each time, so you may wish to print several copies and only pay the processing fee once.
- AutoCAD DXF. This is really only offered for those who wish to manipulate the drawing.

So step 1 is to get your copy & cut out all the templates. I suggest you put a copy up on the wall, too.



Step 2

Cut out all the fanfold pieces. Note: the following pieces are not made from fanfold:

- 9, 10, 16
- All remaining pieces ARE made from fanfold. I like to spray 3M-77 LIGHTLY on the back of the paper templates, stick them down and then cut the part. If you spray lightly enough, you can peel off and reuse the templates for those pieces that need multiple copies.

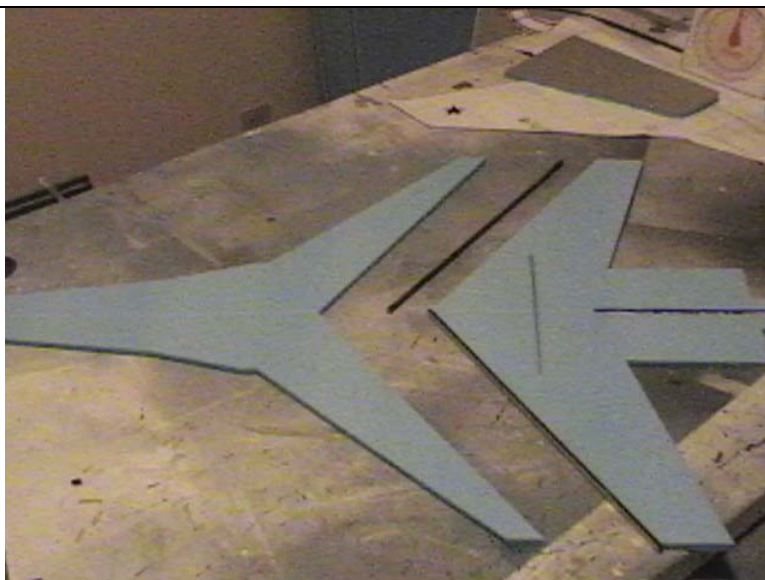
A note regarding fanfold and "grain orientation"; While fanfold doesn't have a grain per-se, it does have "ripples" that affect its appearance. I personally have never found a need to worry about this. But others have had problems with laminating parts 1-4. You may wish to cut these four parts such that the layers "align" with each other when properly positioned. In other words, the high points of each ripple in one layer nestle into the low points of each ripple in the next layer. Finally, if your fanfold has severe ripples, you may wish to align these on the rudders.

Some might wonder about the film common to fanfold. Eventually, all the film will be removed, but for now leave it on.

Step 3

Cut apart Part 1 at the spar location shown on the template, remove the film and insert a spar design of your choosing. Also insert reinforcement for the motor mount, also shown. Feel free to rely on your experience and judgment. I made a CF spar with balsa shear web for the loads the wing would see. And I used a CF tube as a support for the motor. Don't skimp on your motor support; between the weight of a motor and the loads seen while landing (prop strikes), you want this area to be solid.

A word on the location of the wing spar: This wing WILL bend torsionally. If it is allowed to bend such that wash-in is introduced - say when pulling out of a dive - you're in for a nasty tip stall. I tried to locate the spar such that under positive G's the rear of the wing will deflect more than the front. Resulting in washout. Proof's in the puddin' ... none of my Flankers have had problems with tip stalls.

**Step 4**

Remove the film from parts 2-4, and glue them as shown. Use a spray-on adhesive that sands easily, like old formula 3M-77. Ensure that the layers adhere WELL to each other. If your fanfold has excess "rippling" you may find it necessary to weigh things down.



Step 5

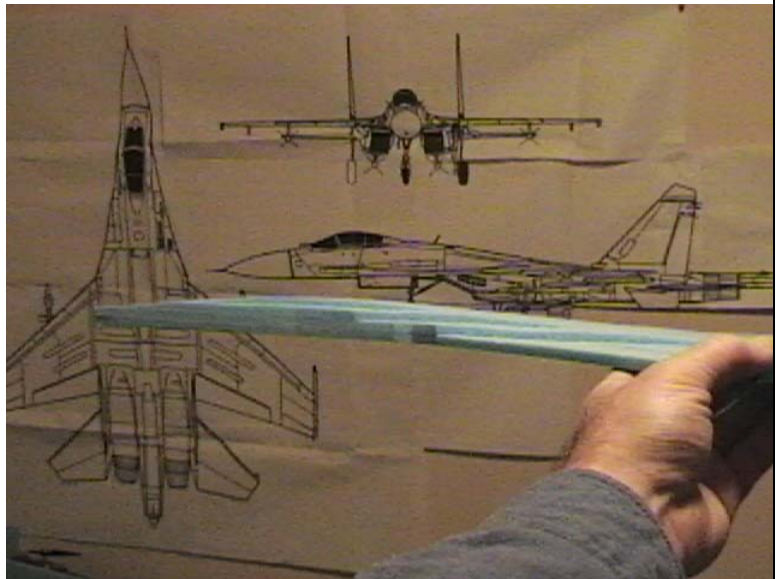
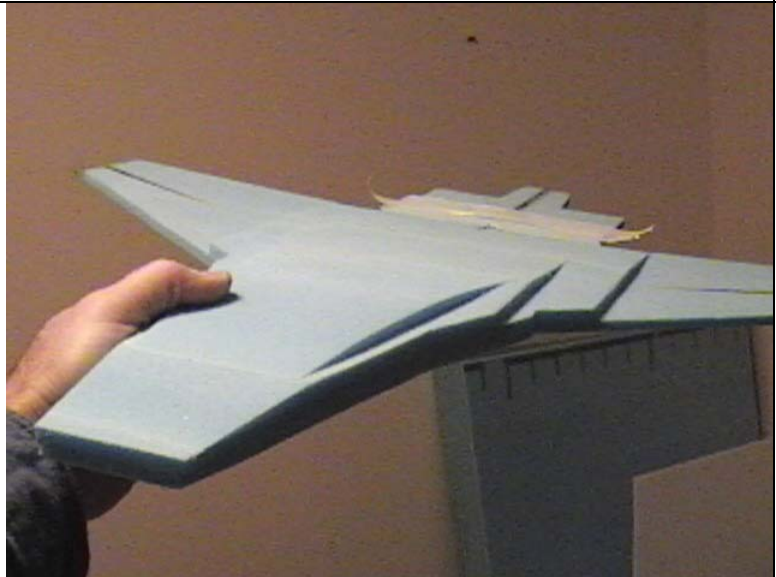
Now you can begin shaping the fuse-to-wing filet. This is done in two parts;

1. The profile. In essence, you are sanding a flat-bottomed airfoil into these layers. You can do this now.
2. The concave portion, which you'll tackle in Step 9. I mention it now so you know where we're headed. But we'll get to this a little later.

For now, concentrate on sanding away the 4 layers such that you are left with an "airfoil" shape.

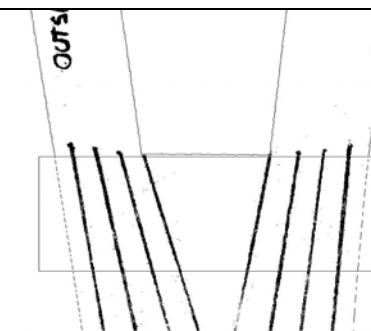
This step (1) is not particularly critical. Might seem so, but it isn't. The turtledeck will conform to whatever shape you end up with. So once you've got the gist of the shape in your mind, grab a sanding block and have at it.

It will help if you place masking tape directly adjacent to where you are sanding. At the wing roots and tail, for instance. This will prevent errant sanding strokes from scuffing those areas.

**Step 6**


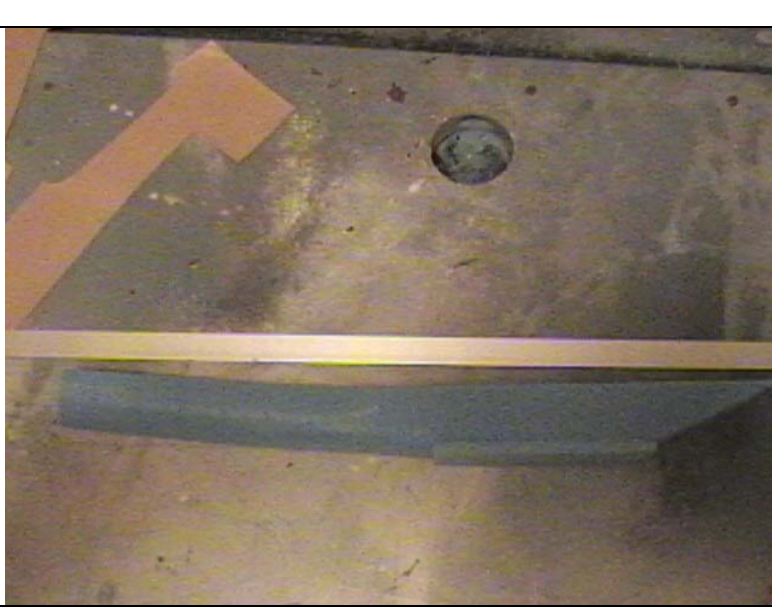
Set aside the layers for now, It's time to make the engine nacelles (LH & RH copies of part 6).

- 6.1. Remove the film on what will be the inside of the nacelle. Do NOT remove the film from the outside surface.
- 6.2. Score as shown on the template. **Here is a movie that shows the scoring process.**



The rectangle represents tape needed to prevent the corners from splitting.



<p>6.3. Add a single piece tape over top of the film on the outside (pictured) The fanfold will try to split at the "corners", which is also where you are trying to bend the sharpest. The film alone is insufficient. The best tape I've found for this is Fiber Reinforced ... it does NOT stretch.</p> <p>6.4. Fill sink/bathtub with HOT water and put on thick rubber gloves.</p> <p>6.5. Move lengthwise along the piece and form the piece into a "U" shape, as shown in the previous post and video. The shape you are trying to achieve is rectangular at the front; triangular in the middle and semicircular at the rear. Here is a movie showing the forming-rolling process.</p>	
<p>6.6. Now you need to straighten it. The forming process will leave it in a 'hunched' state (pictured). You need to put it back under HOT water, don the gloves and bend it such that it rests flat. Be careful! The top portion of the nacelle is stretching - let the hot water relax the foam ... don't rush or it'll split.</p> <p>6.7. Sand the outside. Get rid of all the ridges and irregularities inherent in fanfold. Don't be afraid to remove material; it's plenty strong and can stand to be thinned a little.</p> <p>6.8. Paint the inside flat black.</p> <p>6.9. Make another. Don't make two "lefts" or two "rights"!</p>	
<p>A couple of comments regarding the use of Probond adhesive, which I'll be referencing from this point forward;</p> <p>When using this adhesive, I usually apply the glue to one side, then dip my finger in water and wet the other side, and then press the two pieces together. Exactly per the instructions on the bottle. The water aids with the cure, and causes the glue to foam. The foaming action creates a very good bond with the textured surface of the fanfold. But you need to control the foaming, or it will (1) gradually force its way out of the joint onto the surface, and/or (2) gradually force the two pieces apart. I find that I can get a Very Tight joint by using tape, and that same tape prevents the foam from expanding out of the joint. You really don't want this to happen, as it eventually turns yellow, it takes paint differently than does fanfold, and is harder than fanfold and thus sands differently.</p>	

Step 7

Time to make the forward fuse-turtledeck (part 5).

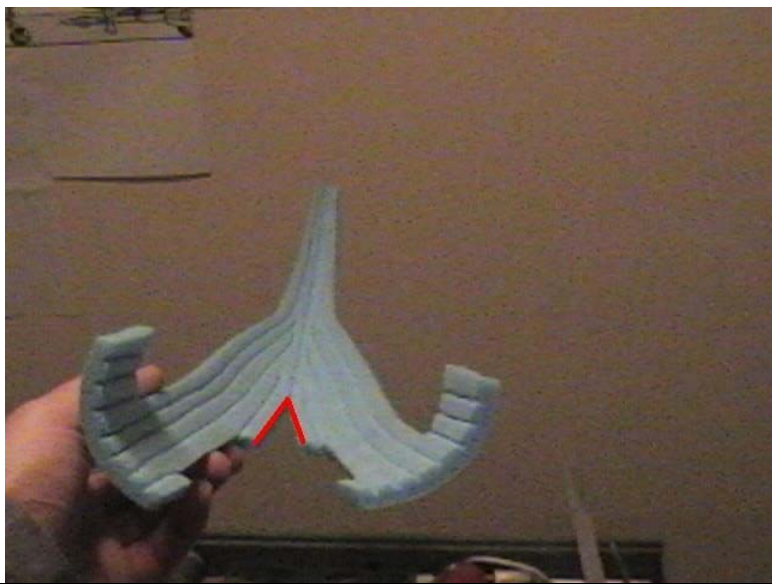
7.1. Remove the film from the surface that will become the inside.

7.2. Score the piece along the lines.

7.3. Heat-form the piece into a semi-tube. Work slowly, moving back and forth from one end to the other, gradually decreasing the radius. I use my bathtub for this.

7.4. You CAN'T roll it too tight to work, but recognize that there are limits to the film, beyond which it will split. This pic shows the minimum roll that will still work. The "spine" portion of part 5 should be rolled VERY tightly, no larger than the diameter of the motor you intend to use. For a better picture of what this should look like, check out the picture of the ESC blister in step 23 ... the spine of part 5 should look the same when you're done.

7.5. Close this triangular area. Use Probond and hold things together with tape on the outside - right over the film. This will cause the whole piece to "hunch". Let the glue cure thoroughly.



7.6. Close up the top of the forward fuselage. Again, use Probond and tape.

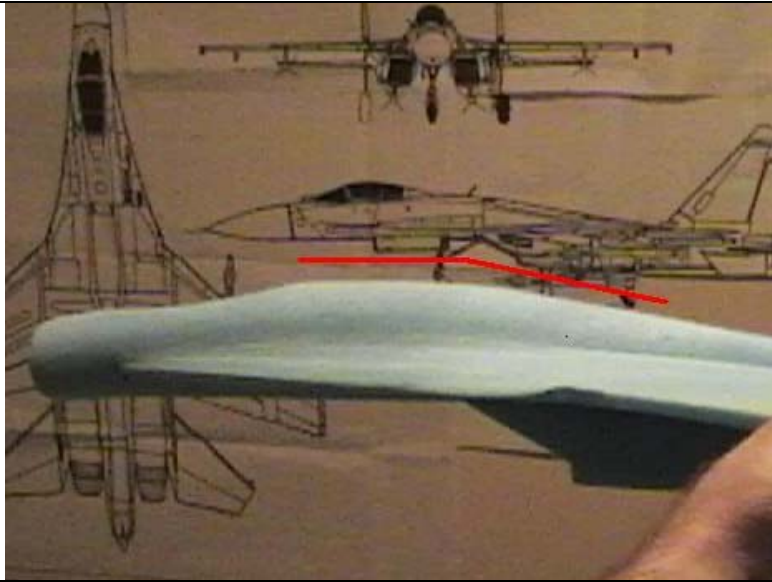
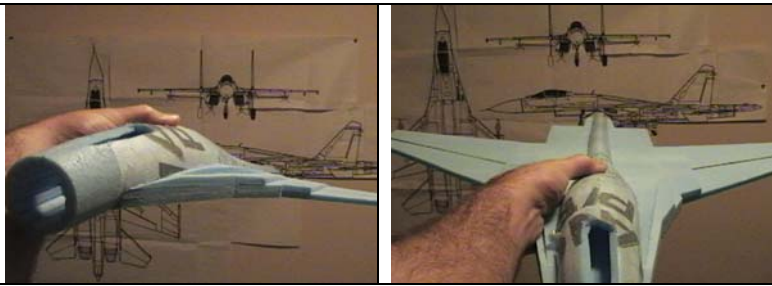

7.7. Finally, close up the bottom of the forward fuselage.

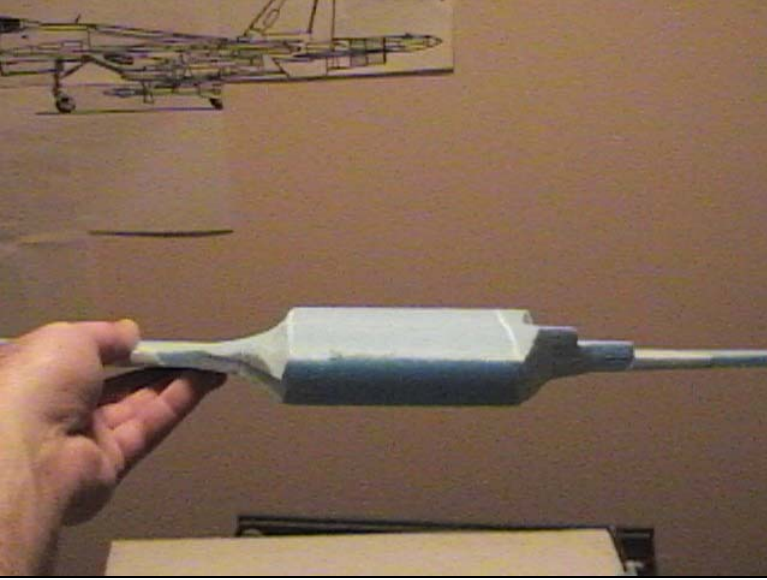
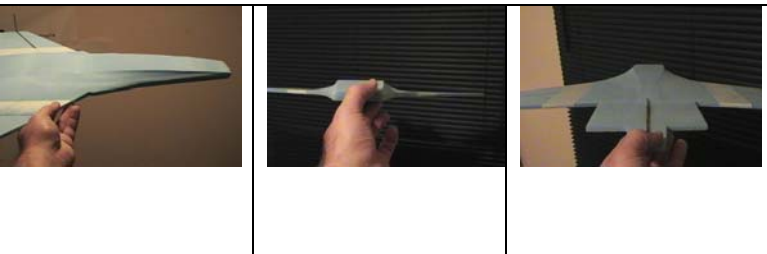
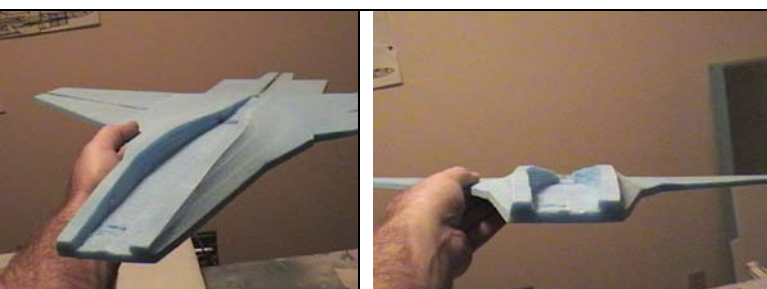



7.8. Don't worry if the cockpit opening ends up a little lopsided. You'll be opening it up and making it symmetrical later.

7.9. Remove the film from the outside of the fuse.



<p>7.9. You'll need to sand the "hump" a bit – otherwise it will appear rather flat. This picture is out of sequence, but clearly shows where and why you'll need to sand in order to get the right shape.</p>	
<p>Step 8</p> <p>Now lay the forward fuse-turtledeck (part 5) on top of the 4 layers. Don't glue it yet! Notice how it conforms to the "airfoil" shape you sanded in. Play with the width of the part until you feel it looks scale. You'll need to sand the bottom of the upper fuse so that it rests flat on the layered portion. Use a sanding block for this.</p>	
<p>In the two pictures above I'm just holding the upper fuse on, getting a feel for how to blend the concave parts into the upper fuse. The tools needed to do this blending are pictured below. Foam sanding blocks – very abrasive ones – are very handy. The more abrasive the sanding block, the less force you should apply to it. I also highly recommend that little spring steel tool, which has a surface roughness of (say) 100 grit. It is great for sanding high spots off of concave portions.</p>	
	

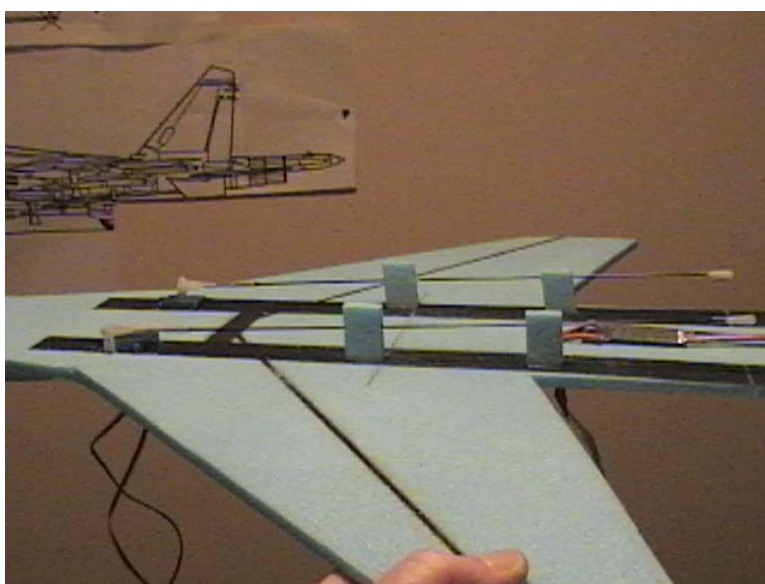
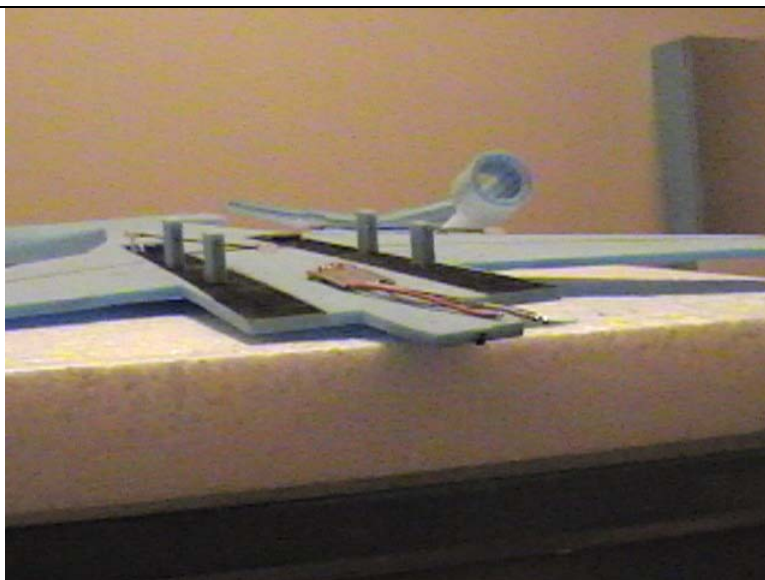
<p>Step 9</p> <p>Once satisfied that you have the curvature of the upper fuse figured out, grab a white water based marker and trace around the upper fuse. Now grab the sponges, dowels and whathaveyou and sand a concave section into the layers. This is a picture of the front, with the left side about half finished, and the right side unstarted ("left" and "right" meaning as-pictured). Check a model or pictures often. This little step will challenge your creative side!</p> <p>Oh - I use a white marker because it doesn't show through the paint that will come later.</p>	
<p>These pictures show where you are headed. Note the tape on either side of the fillet, protecting the wings from errant sanding strokes. The spray adhesive between each layer will leave a slight "line" which you can use to assist with ensuring symmetry. See this movie for a better "3D" look at what you're trying to accomplish.</p>	
<p>Step 10</p> <p>When satisfied, cut away the insides like this. Simply slice through layers 2, 3 & 4, and then pry up on each layer in turn. The 3M-77 will give way.</p> <p>Don't cut into your spar!</p>	
<p>Step 11</p> <p>Paint the bottom of part 1 as shown on the template, attach your ESC with double-sided tape and run your wires. Also a good time to paint your nacelles.</p>	

Step 12

Mount your servos. I dug out a pocket (1 layer deep) in the bottom of part 1 such that the servos were mostly recessed. HS-55's shown.

Install your pushrods. I used CF rods which needed support to prevent bending under compressive loads. I used fanfold for the supports, and custom fit these to the inside of each nacelle. Plastic bushings were buried in the fanfold. Please don't feel compelled to copy my approach ... definitely consider using your favorite pushrod system if you have one.

Note that the height of the clevis at the back is even with the inside of the engine nacelle. For smooth operation, you will need to gouge out a bit of foam from inside the nacelle. You'll see how this works later on.

**Step 13**

Glue your nacelles on. Use plenty of T-Pins. Ensure that the outside edge is parallel to the axis of the plane FROM THE BACK OF THE WING REARWARD. This will ensure that your rudders are parallel when you install them later on. However, the nacelles actually AREN'T parallel from the rear of the wing forward. They're sort of pigeon-toed. You may need a model to see what I mean. If you look at the nacelle on the right, you should see what I mean.



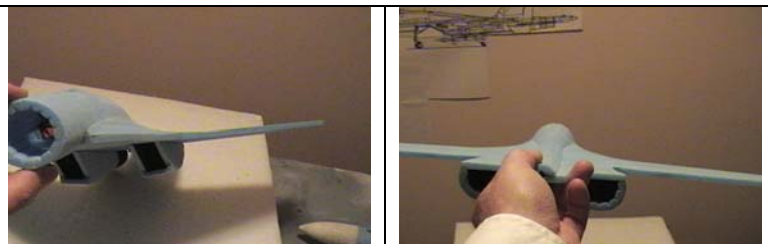
Step 14

Remove the film from the outside surface of the forward fuse-turtle deck and glue to the layers using Probond. Use lots of pins. T-Pins are pretty much necessary, since you'll need to twist them to get them out.

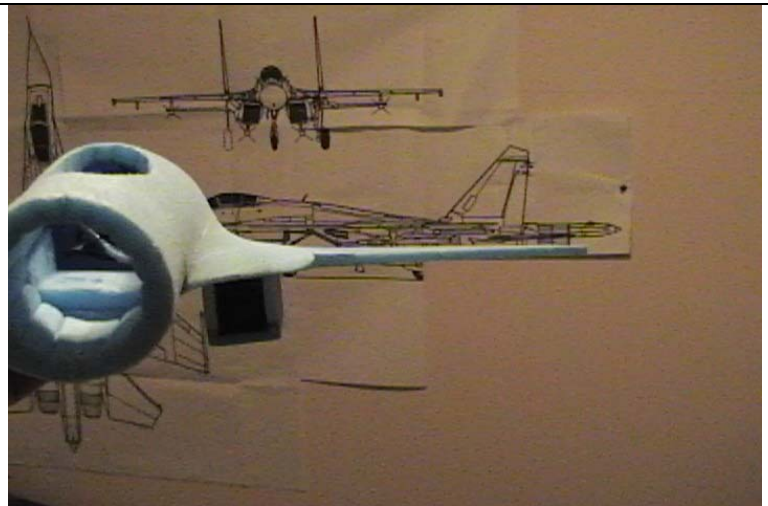
You may also wish to use "dots" of foam safe CA and accelerator to tack part 5 down. Just be sure that these "dots" of glue don't get on any exposed surfaces, or you'll have high spots when it's time to final sand your bird.



A couple of other views.

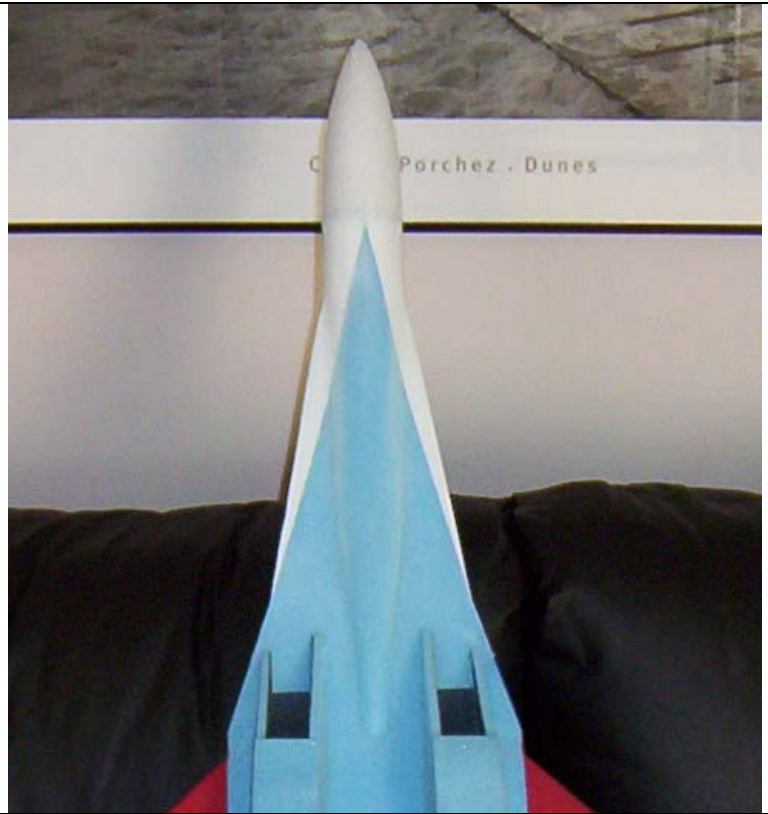


A little more sanding and it should look like this.



Step 14.1

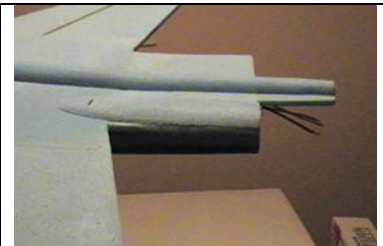
Sand the fuse under portion (part 12) to profile and glue in place with 3M-77. You will need to blend this piece into layer 1. Here's the final look you are aiming for.

**Step 15**

15.1. Next, you need to study [this picture](#). Note how the engines transition to the rudders. You are now going to approximate this transition using parts 11 and 13. The engine covers (11) are deliberately oversized ... you will need to narrow them such that they match the width of your engines. And you'll need to remove the film from both sides of these parts!

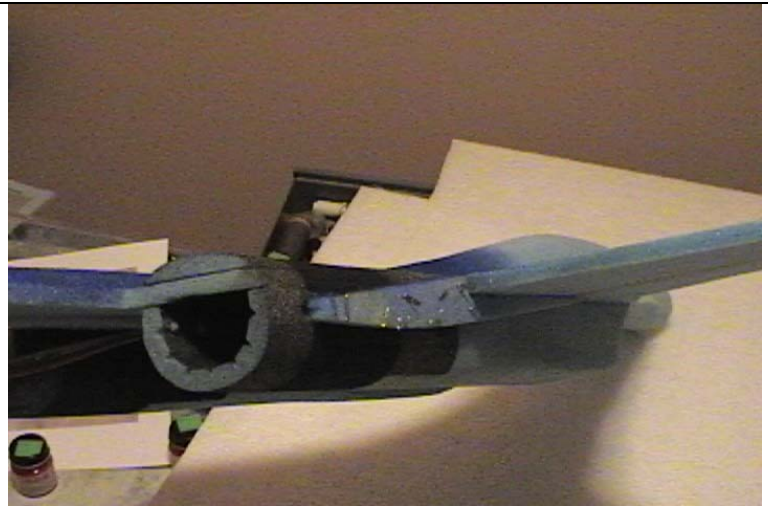


15.2. Plus you will need to sand the engine covers (part 11) to a round profile, such that they complete the shape of the engines. In both pictures, part 11 is only pinned in place while sanding progresses. You will also need to place part 13 against the side of the nacelle in order to properly sand the side of part 1, and some of the side of the nacelle.



15.3 When satisfied, pin and glue part 13 with Probond. Be sure to use your plastic model to assist with this step.

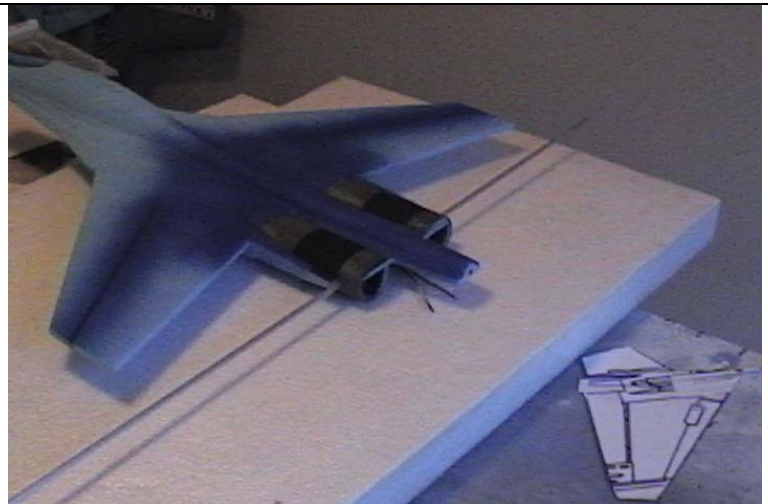
15.4 This is also a good time to paint this area, as it is much more difficult to mask when the rudders are added.



Step 16

Part 13 is partially responsible for the alignment of the stabilizers. But extra precision is necessary for smooth operation of these control surfaces. This picture shows how to accurately align your stabilizers. The extra long tube ($3/16$ " diameter) makes eyeballing the stab pivot point very easy. Ensure your stabilator pivots are parallel to the wing and perpendicular to the datum line.

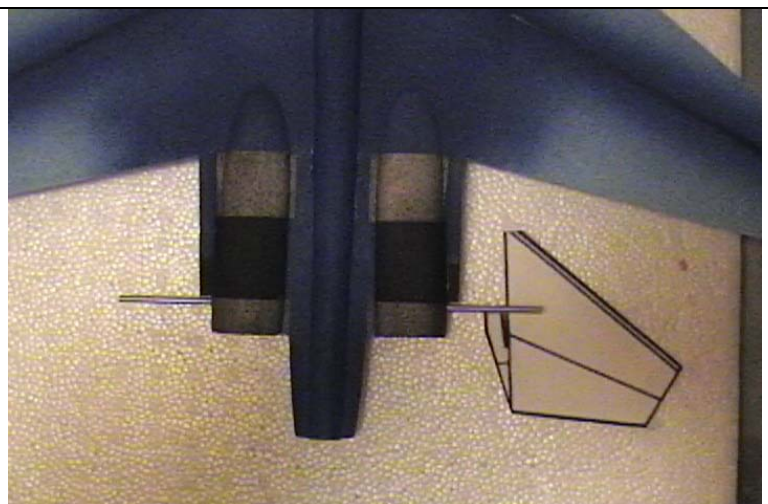
[Click here for stabilator actuator video](#)



I used short lengths of the same ($3/16$ " diameter) aluminum tubing for the bushings. Each bushing (4 in total) was JUST longer than the fanfold was thick, or $3/8$ " long in my case. And the next size down was embedded in my stabs, and served as the pivot. More than adequate strength.

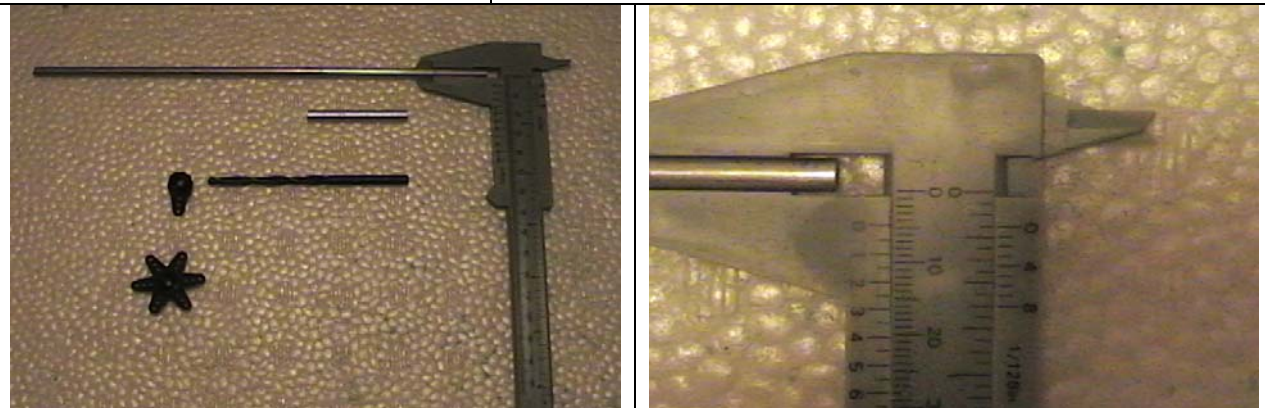
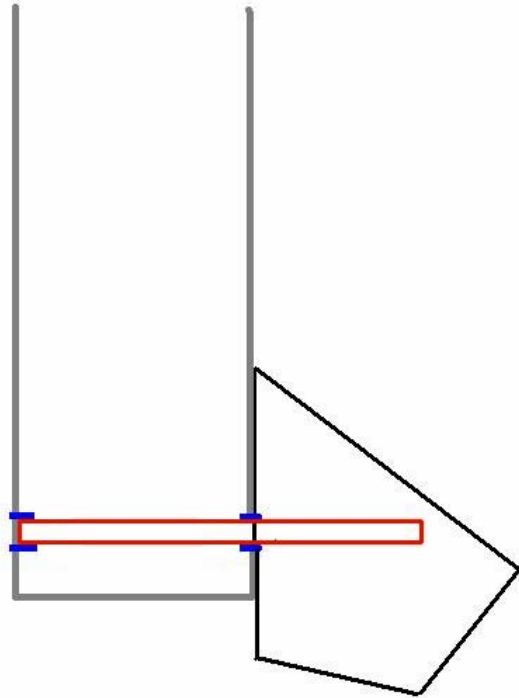
But for now, all you need to do is get the bushings in the nacelles. I used CA. No other reinforcement needed. As mentioned, each bushing is slightly longer than the fanfold is thick. This extra length protrudes into the inside of the nacelle.

What you see here is the aluminum tube that will eventually end up inside the stabilator. You can't see 'em, but the bushings are already in there.



Cheesy drawing showing the essence of the stabilator mechanism.

The blue represents the bushings, and the red is the stab tube



Here are the bits 'n pieces I used. Long tube gets buried in the stabs. Short (3/16" diameter) tube gets cut into 4 bushings. Also pictured is the servo output arm that I cut down and drilled out to accept the pivot tube.

Let me restate:

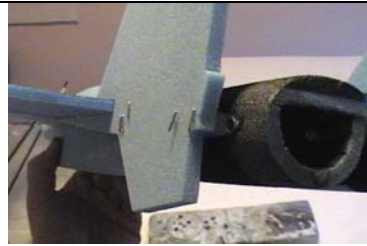
- The aluminum tube in the caliper is what will eventually end up cut in half. You'll glue one piece in each stabilator as explained above.
- The larger diameter (shorter) tube below it is what will be cut into 3/8" long bushings. 4 of them. Two of these will be glued into each nacelle.
- And you see two servo output arms. The top one has had all but one arm cut off, and the hole you would normally use to screw into the servo has been enlarged to accept the top aluminum tube. The other output arm is awaiting its turn.

The drill bit is what I used to make the holes in the output arms.

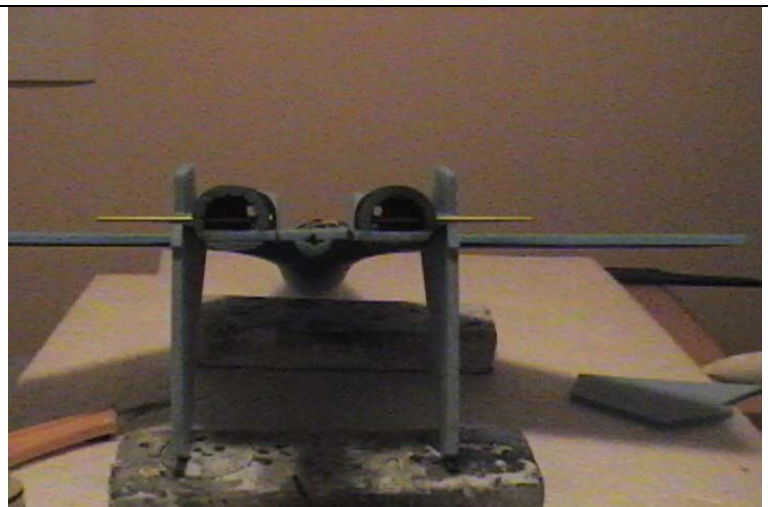
Next pic might help some too.

**Step 17**

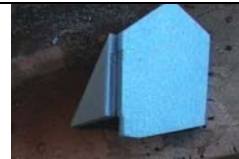
Remove the film from both sides and glue on your rudders with Probond. Use T-pins on an angle to ensure a close, tight fit to part 13. Take your time and make SURE they are aligned. Use a straight edge along the side of each rudder to verify that they are parallel to the datum line.

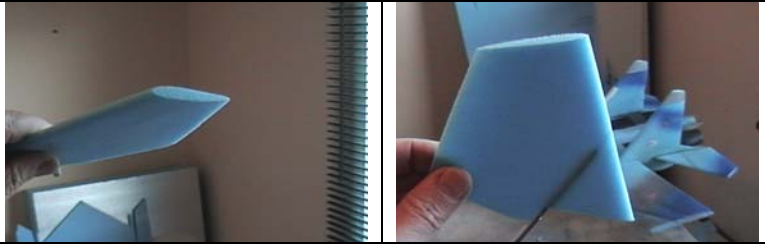

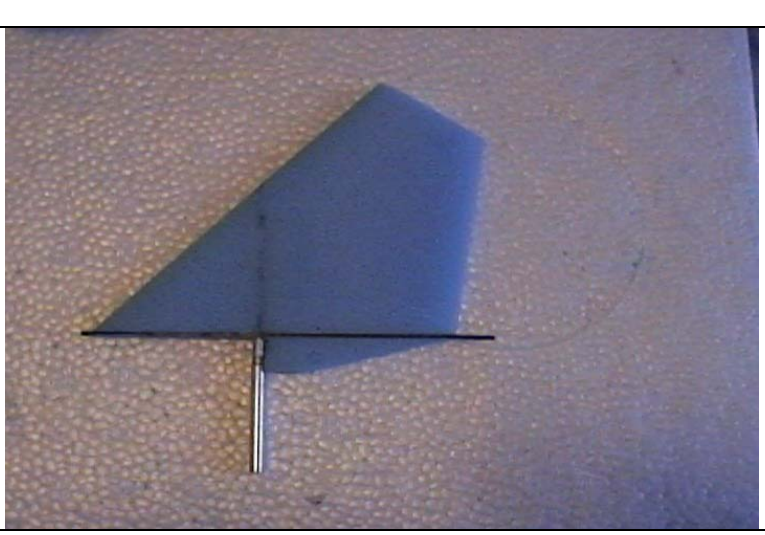



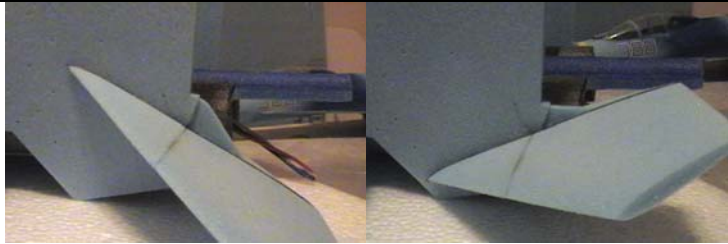


Here is another view of how things should align.

**Step 18**

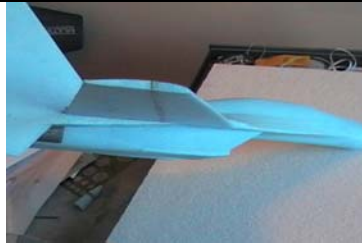
Remove the film from your stabilators. Use the pivot tube to score a pocket in each stab. Then glue using CA. I am in the habit of sanding aluminum whenever I glue to it ... I like the idea of getting through the oxidized layer.



<p>Sand the root and tip of each stabilator to profile.</p>	
<p>Make sure you're happy with the action. These are the only control surfaces on your plane ... make SURE they work smoothly!</p>	
<p>Step 19</p> <p>CA a 0.007" thick CF laminate top and bottom at the root. You only need 1/16" wide strips.</p>	
<p>Step 20</p> <p>Make a pocket in the rudder for the faux actuator fairing (#14):</p> <ol style="list-style-type: none"> 1. Take your exacto knife and slice straight into the rudder. Run it deep and ensure that you've addressed the full range of motion 	

<p>that the stab will go through.</p> <p>2. Take a sharp object (I used a round needle-file) and pick out the foam. Keep trying the fairing, testing how well it moves into and out of the pocket.</p> <p>You will need to sand #14 a little thinner in order for it to fit in the pocket. When satisfied, glue in place on top of the stabilator.</p>		
<p>20.1 Control Throws – I mention this now 'because step 20 directly affects the range of motion you'll need. But don't permanently attach your stabs until just before gluing your exhaust nozzles on ... they are likely to get damaged.</p> <p>Neutral: This plane needs minimal down force from the stabs. Align each stabilator parallel to the bottom of part 13 – this is your starting point ... you'll want to trim the pitch up or down to suit your flying style and speed. Another way to put this, the tail needs to be pushed down, but only very slightly.</p> <p>Throws: All throws are measured from the front point of each stabilator. I like to poke a pin into the fanfold at the appropriate points. These holes are nearly invisible, but can be seen well enough when setting the stab throws.</p> <ul style="list-style-type: none"> • Neutral: Depends upon your CG ... see above. • Pitch: +/- 11/16" • Roll: 11/16" and 13/16" is a good starting point. This set up uses Negative Differential. Meaning (for roll inputs) the front of the stabilator raises higher than the opposing stab lowers. This effectively pitches the nose down very slightly when rolling, eliminating the 'barrel roll'. The net effect is that rolls in the vertical plane do not require pitch correction. <p>Just to clarify: Full UP means the front of each stab will be 11/16" lower than neutral. And Full Left means the front of the left stab will be 11/16" lower than neutral, while the front of the right stab will be 13/16" higher than neutral.</p> <p>Special Note: One of the challenges with all-moving surfaces is ensuring that they are in trim when you are about to launch. I strongly recommend putting marks on the side of the rudder that identify neutral, as well as full-throw deflections. Simple dots (or pin holes) that identify the position of the LE of the stab are all that is needed. A quick check prior to launch gives peace of mind</p>		
<p>Step 21</p> <p>Carve and sand the airfoil into the wing. I start with a box cutter (1" wide blade) and carved the majority of offending fanfold away. Then I move to sanding blocks. The trailing edge on my plane is 1/16". Don't round the trailing TE at all - leave it "blunt" as shown.</p> <p>This might seem 'crazy-thin', but it handles</p>		

flight loads fine. I was amazed at the flexibility of the TwinJets control surfaces, too. From my RC sailplane experience, it seemed like flutter would be a problem, but this simply wasn't the case so I experimented with the Flanker. One caveat, though ... I haven't tried a full power dive and wouldn't suggest it. Maybe someone braver than I will test the airframe to failure!

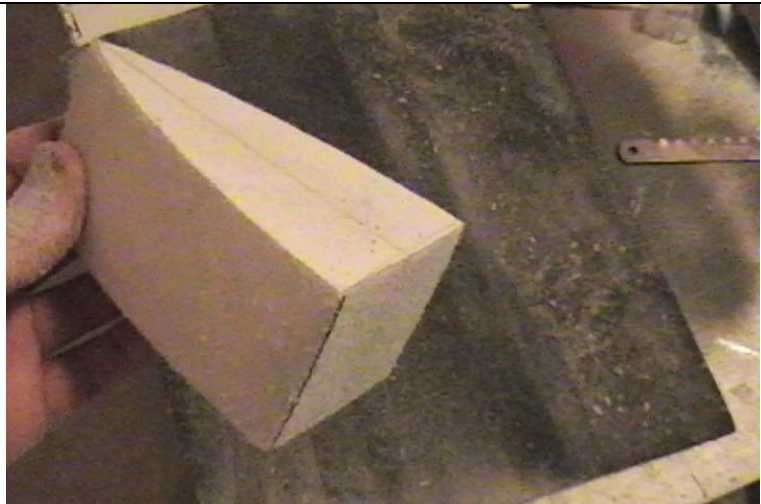


Step 22

Take the nose cone template (part 9) and stick it on a foam chunk. I used solid EPP. I found that I could use a Sharp knife and whittle a very close approximation, and then sand the remainder. Do this for both faces of the cone – the intermediate result is a pyramid shape.

Once I was close, I drilled a hole smack dab in the middle of the back, and glued a brass rod into the hole. I used Probond for the gluing operation. I mixed it thoroughly 60/40 with water and poured it around the rod and into the hole so I had a good bond between the foam (which is porous - especially after drilling) and the brass rod. The idea is to have enough rod sticking out the back that I can use my drill as a poor-man's lathe. So the rod has to be perfectly centered and perpendicular to the X & Y axis. I let the glue cure completely - it'll foam like crazy and keep the rod nice and secure. I then spun it against my belt sander until I was happy with the shape. If anything, you want the cone just a tad smaller than the front of the fuse.

To get the rod out, I heated the end of the rod with a mini-torch just until the glue softened and then pulled it out. The brass rod conducted heat very well - no foam was hurt in the manufacture of this nose cone.



Glue the cone on the fuse with Probond and plenty of T-pins. It is round, so you'll need to squish the (hopefully close-to-round) fuse into compliance. The T-pins help keep things aligned.



Step 23

I made a little blister to fair in my ESC. It's simply a fanfold semi-tube, rolled very tightly – see part 18. Hopefully the pics explain it all.



Step 24

Now that you are basically finished flipping the plane over (and over, and over, and over ...), it is a good time to sand the airfoil into the rudders and ventrals. I used a thin, spring-steel sanding tool for this.

Step 25

I made the canopy from posterboard – without the paper, of course. All you need to do is form it into a tube, then glue all the slits together with CA.

I used a CF rod as the hold-down mechanism. Slide it under the lip at the back of the turtledeck, push the front of the rod under the front lip and slide it into position.

Feel free to use your favorite canopy hold-down method.

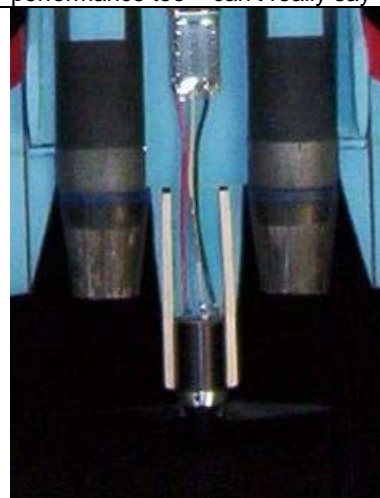







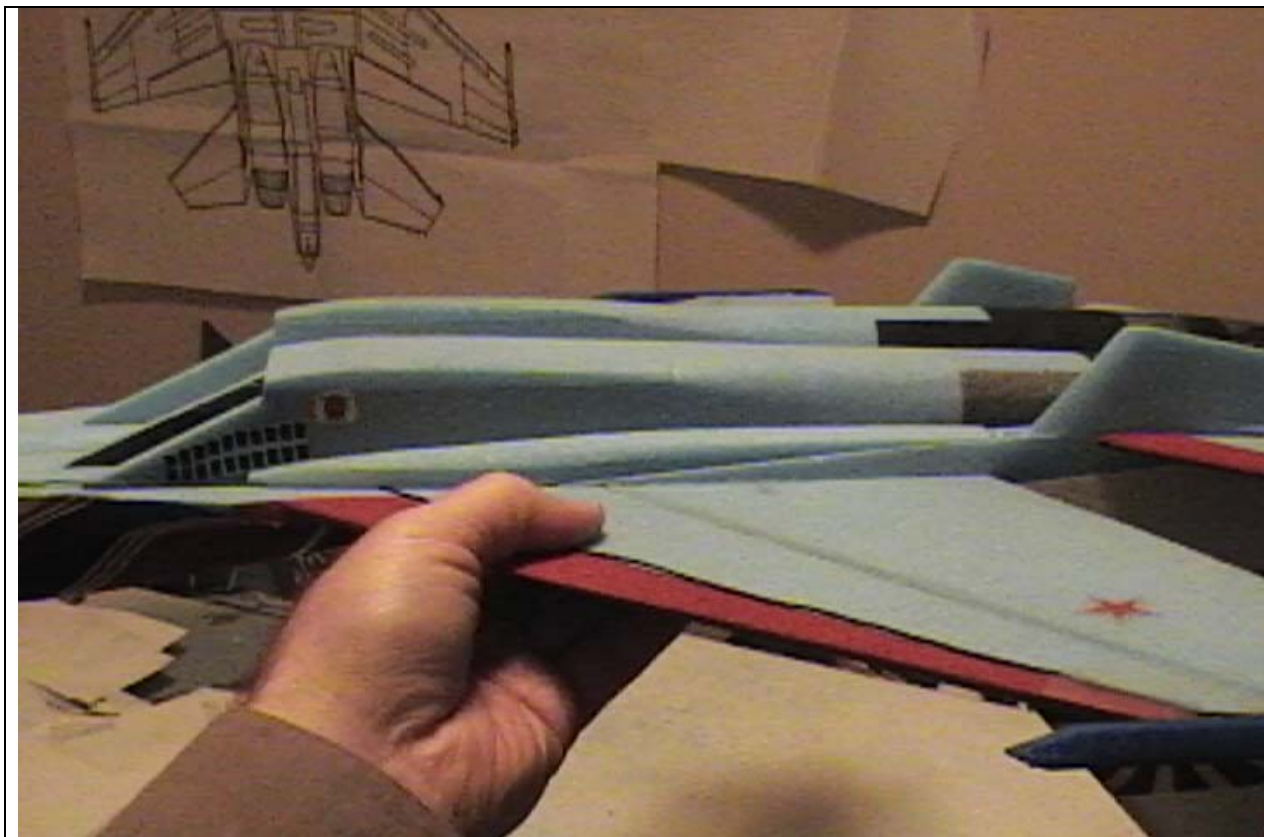
Step 26

The motor mount I used involved two strips of hard balsa glued directly to the motor sides, and then to the foam along each side of the CF spine-support.

The motor needs to be set to Zero left/right thrust, and Zero up/down thrust. Find a long brass or aluminum tube that fits tightly over the motor shaft. The point is to extend the shaft sufficiently to make eyeballing this “zero-zero” measurement easy. You might wonder just what Zero up/down thrust looks like – especially since the nose of the Flanker droops below the thrust line. Simply align the motor parallel with the bottom of your flat-bottomed wing – I use a straight edge to extend the bottom of the wing, and compare this with the extension on the motor shaft. I’ve experimented some with aligning the motor such that it pushes the tail UP slightly. This results in acceptable performance too – can’t really say which approach I prefer.



	
<p>Step 27</p> <p>If you are sure that your control throws are set per step 20, you can now add the exhaust nozzles (part 10). As noted, I made these from poster board. The diameter at the big end is deliberately oversized. To trim them to fit properly DON'T make them shorter. Just trim the seam.</p> <p>You'll find them easier to paint before they're permanently attached. I used water-based felt markers to simulate the turkey feathers.</p> <p>I use a three dots of CA to hold them on ... easy to break free if I need access to the stab mechanism later on.</p>	
<p>Step 28</p> <p>The landing gear blisters are made from part 15. You'll need a double-thickness for each side, hence 4 pieces.</p>	

**Step 29**

I cut the missile rails from a single layer of fanfold. Then I used fiber-reinforced tape along each side to strengthen them. Finally, I used double-sided tape to adhere them to the wingtips. This ensures that they pull away cleanly if caught by grass.

The rails have no discernable effect on how the Flanker flies.



Step 30

The battery you use should be easy to position such that no additional weight is needed to achieve the CG. This is already a conservative CG, by the way ... so there is no need to move it forward. This picture shows 4S1P Thunderpower 2100 mah Lithium Polymer cells; you'll note that there is plenty of room for lighter cells to be positioned further forward.

**Step 31**

Some find the Flanker awkward to launch. I am among that crowd. The nacelles are a bit too wide to grasp in one hand, but holding just one nacelle seems awkward. So, I glued a balsa launch block approximately 3/8" x 3/8" x 3" directly under the CG. This allows a very strong and consistent launch.

Make yours prettier than this one, ok?

**Time to fly!**

For the first toss, use a throttle setting that equates to about 10 ounces of thrust in order to minimize torque roll. I like to throw upwards at about 30 degrees, with the wings banked 30-40 degrees to the right – opposite to the torque-induced roll. My goal is to have the plane torque-roll to wings-level, climbing at about 10-20 degrees by the time my hand is on the stick. The plane requires Zero time to get on step – you can “fly” it immediately. Be sure to use your index finger to give it a good flick and you’ll be fine. **Again, the video includes footage of just such a launch.**

Landing in tall grass: With the motor off, the plane comes down quickly and is easy to spot-land. Maintain a nose-down attitude until a couple of feet high, and THEN flare. Once you pull the nose above the horizontal, speed decays rapidly, and you’ll run out of elevator, so save your flare maneuver until the last moment, or you may find your nose dropping at the last moment. Landings can be very slow in tall grass, owing to a virtual stall just before touchdown. Landing in short grass: just slide it in nose high. Again, flair late or you’ll run out of elevator.

And a final word about pusher props, hand-launched airplanes and missing fingers ... 100+ launches on two ‘27’s and I’ve NEVER had my fingers nicked by the prop ... just in case you were wondering!