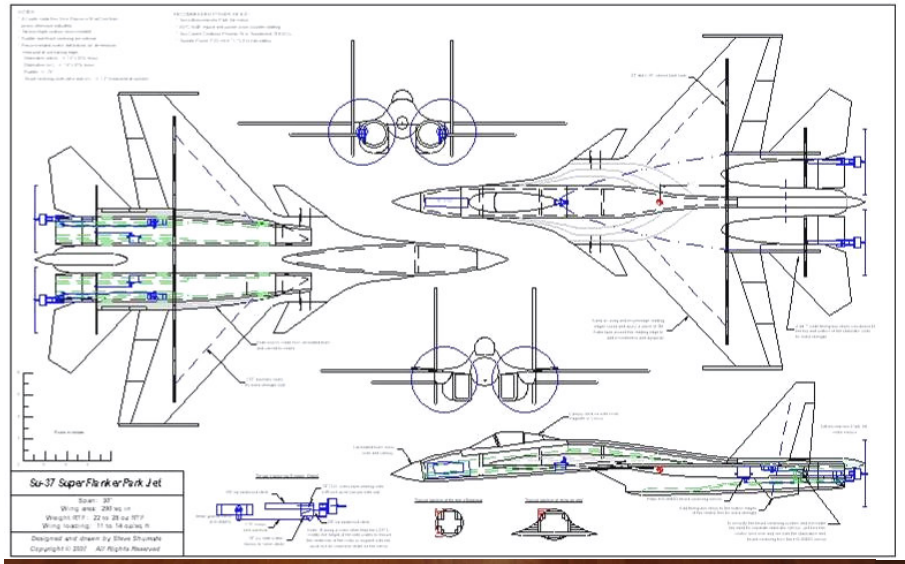
Construction Guide for the Su-37 Super Flanker Park Jet

By Steve Shumate



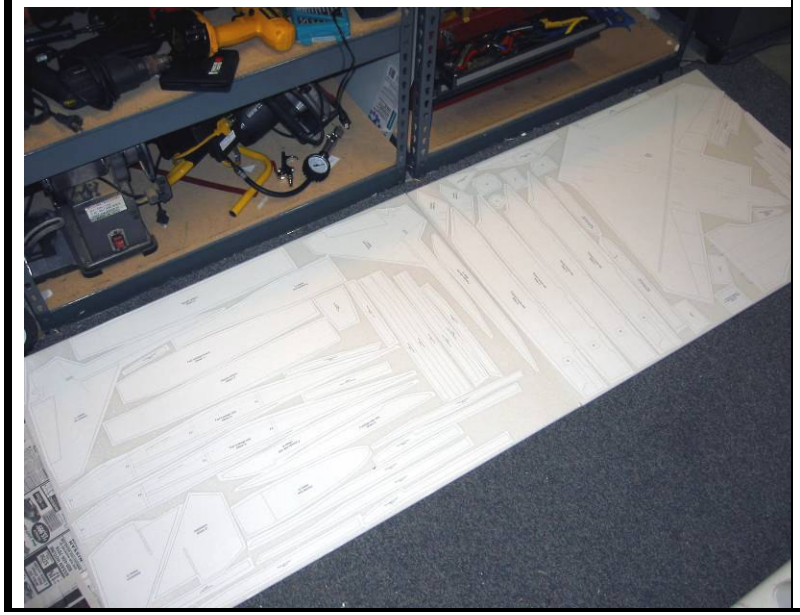
Introduction

Welcome to the Su-37 park jet! This model was designed for twin Littlescreamers Park Jet (LSPJ) motors and features a working 3-axis thrust vectoring (TV) system, just like the real Su-37. With the TV system off, this model handles extremely well in the air and is very predictable, maneuverable, and easy to fly. But with the TV system on, it can do wingtip flips, incredibly tight turns, and wild tumbling maneuvers just like the real Su-37. The TV system also provides excellent controllability at ultra low airspeeds and high alpha. With the twin LSPJs, the top speed of this model is in the neighborhood of 80 mph and the thrust-to-weight ratio is between 1.4 and 1.7, providing unlimited vertical. Amazing performance for an electric model! The counter-rotating propellers also result in no prop torque, which provides very smooth launches and more jet-like handling qualities.

The 3-axis thrust vectoring system provides roll, pitch, and yaw—both motors gimbal up/down together for pitch, opposite for roll, and differential throttles provides yaw. The prototype model used separate servos for the tailerons and the thrust vectoring, for 4 servos total. This allows turning the TV system on and off at will (via a switch on the transmitter) and also allows easily adjusting the trims and rates of the TV system separately from the stabilators. However, this model was also designed so that the builder can eliminate the two stabilator servos and just slave the stabilators and TV together mechanically. This eliminates the cost and weight of the extra pair of servos and also greatly simplifies the transmitter programming. To do this, just run a pushrod from each servo to the stabilator control horn (note the control must be installed pointing down instead of up as shown on the plans), and then run a second pushrod from the control horn to the TV mechanism. Note this simplified TV setup will require a lot of manual adjustments in the linkages to ensure the stabilators and TV are properly aligned, especially once the airplane is trimmed.

Note there are many options for how this model can be built, including:

- **With or without canard** – The plans show all the modifications required to convert this Su-37 to one of the original non-canard Su-27 or Su-30 variants. All that's required is to delete the canard, modify the strake contours, and modify the vertical tail outline. The changes required to do this are shown in red on the plans.
- **Twin motors or single motor** – This design can be easily adapted for a single centerline motor, which could be done with or without thrust vectoring (in this case it would be single-axis or pitch only). Note the upcoming Littlescreamers Super Park Jet Special motor would be an excellent match for a single-motor version. The changes required to do this are also shown on the plans.
- **With or without thrust vectoring** – The TV system provides amazing maneuverability on this model but also adds quite a bit of weight, cost and complexity. For those that want a simpler version, this model can be built without the TV system and will still be a great-flying park jet. Another option is to go with the simplified TV system described above.
- **Flight control options** – There are a wide range of flight control options on this model. To actuate everything (stabilators, flaperons, rudders, canard, thrust vectoring, throttles) would require 9 channels and up to 8 servos! But on the other hand, this model could also be flown just fine using tailerons and throttle only—3 channels and 2 servos. The setup used on the prototype model (and described in this manual) is in between these extremes, utilizing tailerons, rudder, thrust vectoring, and twin throttles, for 7 channels and 5 servos.



Building Tips

This model can be built using the following types of adhesives:

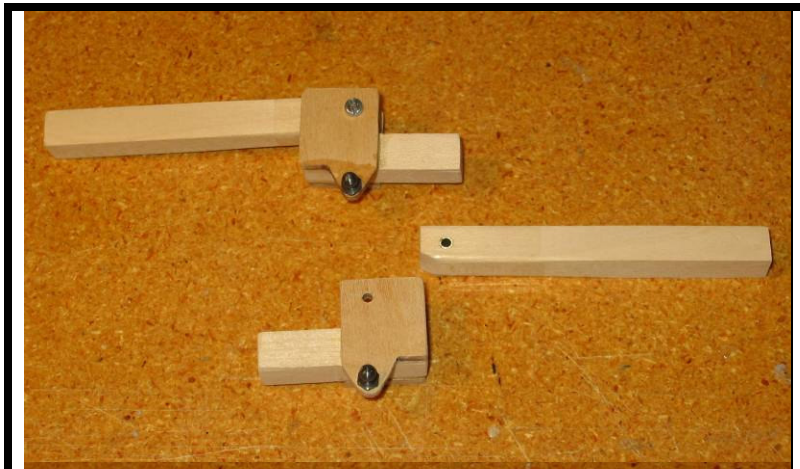
- Epoxy (with or without microballons)
- Odorless cyanoacrylate (CA) with accelerator
- UHU Creativ for Styrofoam (or UHU POR)
- 3M 77 spray adhesive
- Hot glue gun
- ProBond (or Gorilla Glue)

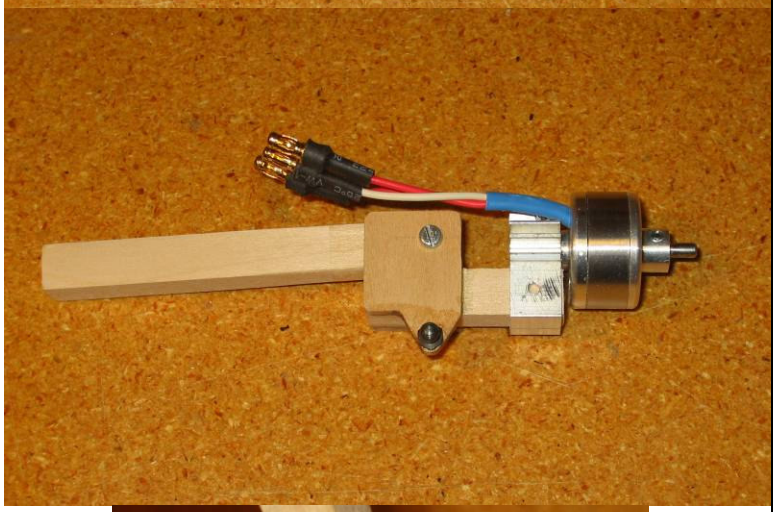
To minimize weight, try to use as little epoxy as possible on this model, saving it for only critical joints such as wing spars and motor mounts. You can also mix microballons into the epoxy to reduce weight considerably and help it fill gaps better. The majority of construction should use a lightweight and quick-drying adhesive such as foam-safe CA, UHU Creativ, or 3M 77. I personally use 3M 77 and UHU Creativ (pictured at left) for the majority of construction since they are strong, dry very quickly, and sand well.

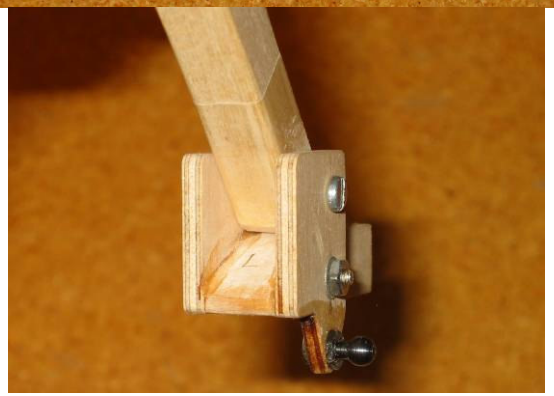
You'll notice that 3M Satin tape is called out several times in these instructions, since it works very well for hinges, leading edge protection, and general strengthening. When purchasing, make sure to get 3M Satin tape (sometimes called 3M Gift tape), which is sold in the purple container. The common 3M Scotch tape sold in a green container doesn't work nearly as well, nor does common packing tape.

Begin construction by cutting out all of the paper parts templates with scissors, trimming them to within approximately 1/8" of the lines. Then test fit all of the templates onto the foam sheet, trying to minimize wasted foam as much as possible. Once you're satisfied with the arrangement, remove each template individually and spray the back of the template LIGHTLY with 3M 77 spray adhesive. Then replace the template onto the same spot on the foam sheet. Repeat for every template.

After all the templates are tacked onto the foam, cut out all the pieces by cutting on the lines with a SHARP hobby knife. To help keep track of the parts, keep the paper templates on each piece until you're ready to use it.







1. Begin by assembling the thrust vectoring motor mounts. This step is optional—you may choose to install straight motor sticks if you don't want to incorporate thrust vectoring. If so, just cut the hardwood motor mount to the length you need and skip the rest of this step.

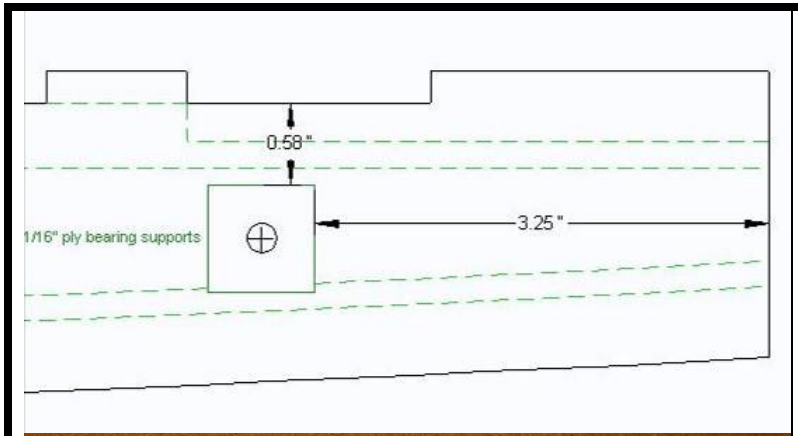
Cut the 3/8" square hardwood motor mount stick into two lengths—a 3 3/8" main stick and a 1 1/2" movable portion. Drill a 1/8" dia. hole in the main stick to fit the 1/8" O.D. brass bearing tube (top photo), and then glue the tube in place with thin CA. Cut a small chamfer in the lower edge as shown. Then wrap the aft end of this stick with a layer of packing tape to ensure a smooth low friction surface.

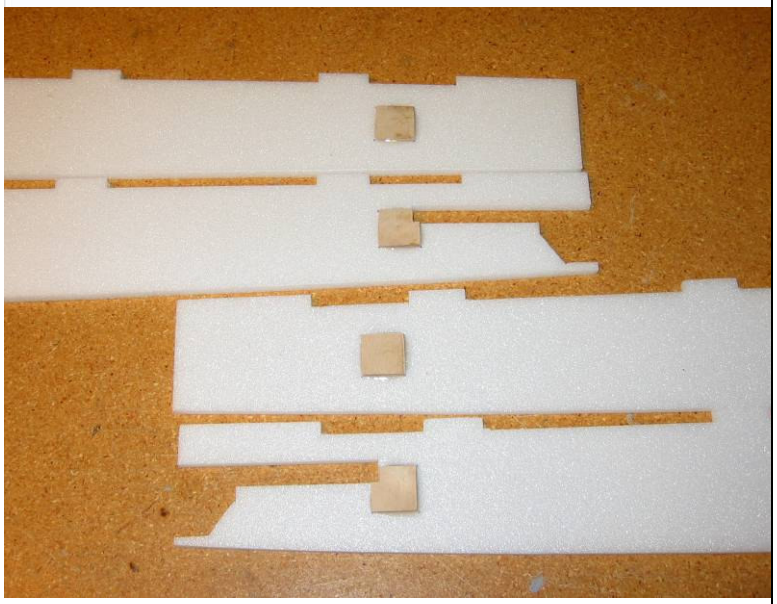
Sand the inside surface of the two 1/8" plywood side plates to make them as smooth as possible. Trim the aft edge of the movable motor mount stick as shown on the plans, and then glue on both side plates using epoxy or CA. After the glue is dry, drill the pivot hole through the top of both side plates at the same time, making sure it is exactly perpendicular to the plates (using a drill press is highly recommended).

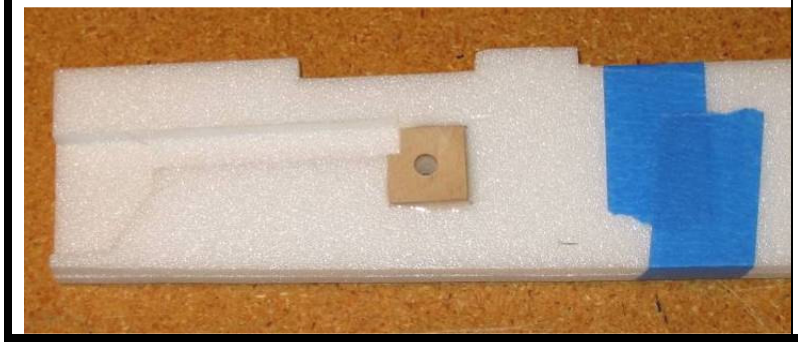
The assembled motor mount is shown in the middle photo. The movable portion pivots around a 3-48 bolt, and the system is actuated via a pushrod and Dubro micro ball link on the bottom. Make sure the system pivots smoothly, and sand or trim as required. For extra strength and security, install a small bolt and nut across the lower side plates and movable mount stick (bottom photo).

Repeat for the second motor mount, making it a mirror-image of the first.

IMPORTANT NOTE: It is important that the thrust line of the motor runs directly through the pivot pin. This will minimize strain on the thrust vectoring servo and also prevent pitch trim changes with throttle setting. The parts provided were designed specifically for the Littlescreamers Park Jet Special motor with the stock 3/8" stick mount. If you use a different motor and mount, you may need to make new custom side plates out of 1/8" plywood that raise or lower the movable motor mount stick to realign the thrust line with the pivot pin. If so, this won't be difficult since the design of these plates is very simple--just trim or extend the square upper edge as required.

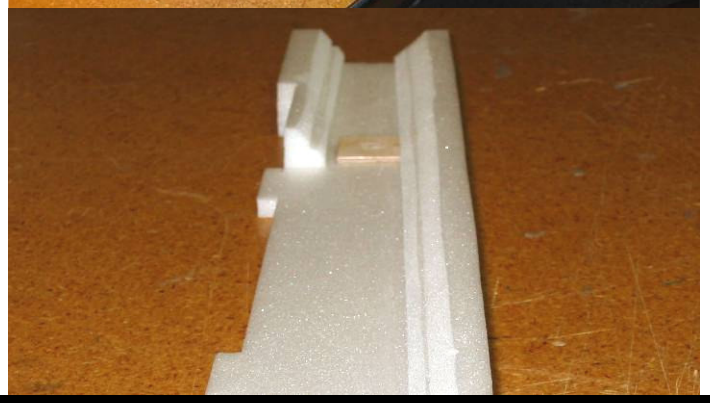






2. Now begin assembly of the nacelle sides. Start by gluing the 3/4" square 1/16" plywood stabilizer bearing supports in place on each nacelle side using epoxy, at the location shown in the top picture at left. Note you'll need to cut a small notch in the top corner to clear the motor mount stick on the two outboard nacelle sides. Make sure to make mirror-image left and right side pieces (middle photo).

Next carefully align the left and right sides of each nacelle and tape them together back to back (with the plywood squares on the outsides). Then drill a clearance hole for the stabilizer pivot rods through both support plates at the same time (bottom photo). Use a drill press if at all possible to ensure the hole is perfectly perpendicular. The stabilizer pivot rods should be able to turn freely in these holes, but with as little play as possible.

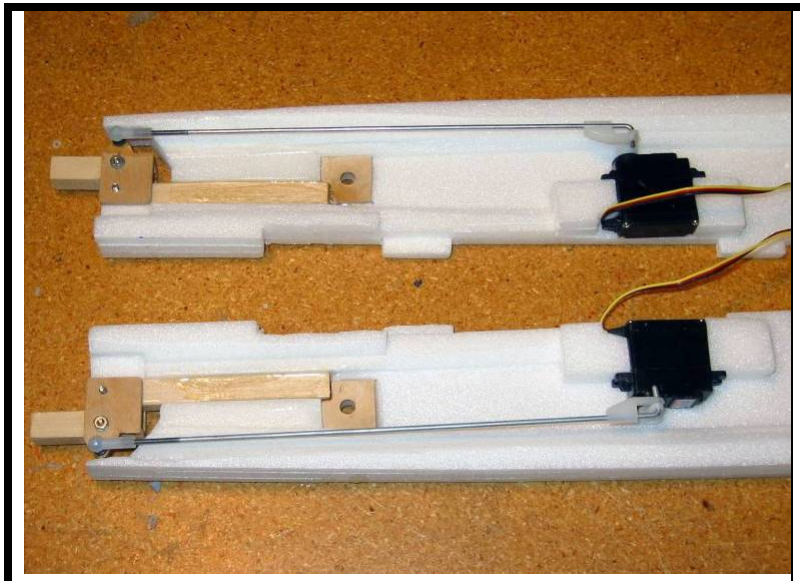


3. Glue the nacelle side doublers to the inboard nacelle sides at the locations shown on the plans (top photo). 3M77 spray works very well for this. Note there are two layers of doublers, which will allow sanding these corners down to a very large radius once the model is assembled. Make sure to make left- and right-side pieces.

Glue the nacelle side doublers to the outboard nacelle sides at the locations shown on the plans, using the same procedure as before (middle photo).

Glue the main motor mount sticks in place on the outboard nacelle sides using epoxy. Make sure the chamfered edge is on bottom when installing.

Optional: For less drag and a cleaner appearance, use a sharp hobby knife to cut a 45 angle on the inside edges of all the nacelle side doublers (bottom photo).

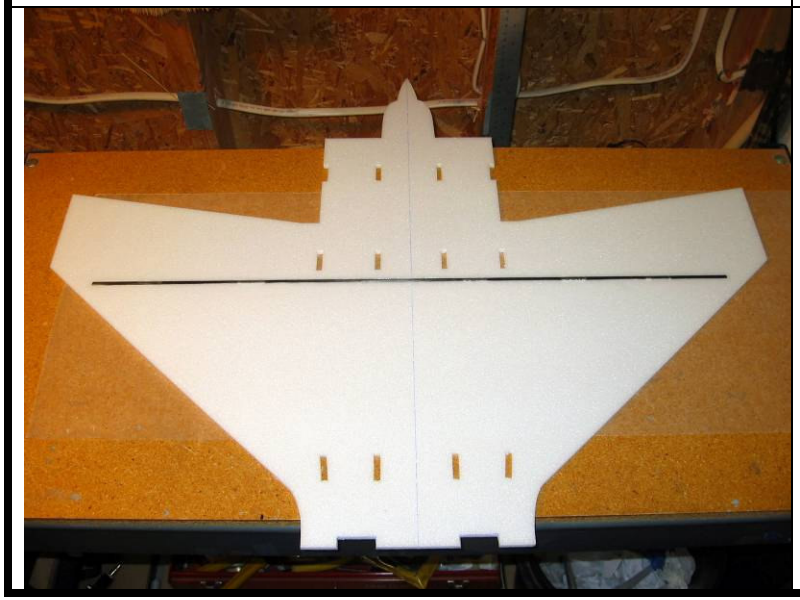


4. Test fit the movable section of the motor mounts and ensure they swing freely. Trim and sand if required.

Install the thrust vectoring servos. A strong (40+ oz/in torque) metal-geared servo is required since a plastic-geared servo could get stripped if the prop hits the ground during landings. The prototype used a Hitec HS-85MG servo, which worked very well. Use double-sided tape to attach the servo to the nacelle sides, and then glue in scraps of foam all around the servo to hold it securely and eliminate play. Lastly use thick CA and accelerator to glue the servo firmly in place.

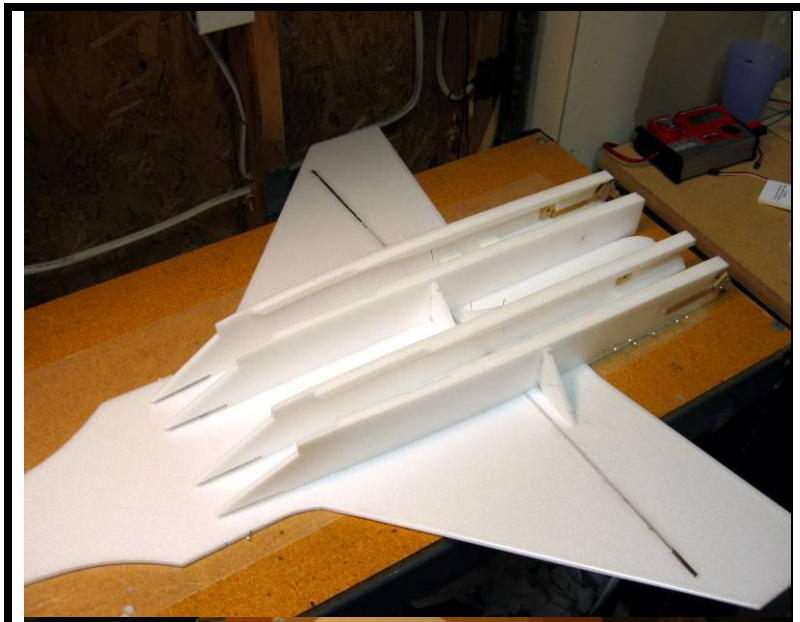
Cut the pushrods to length and install.

Plug the servos into a receiver and test the thrust vectoring mechanisms to ensure they work properly. Set the throws up so that the motor mounts deflect about 30 degrees up and down.

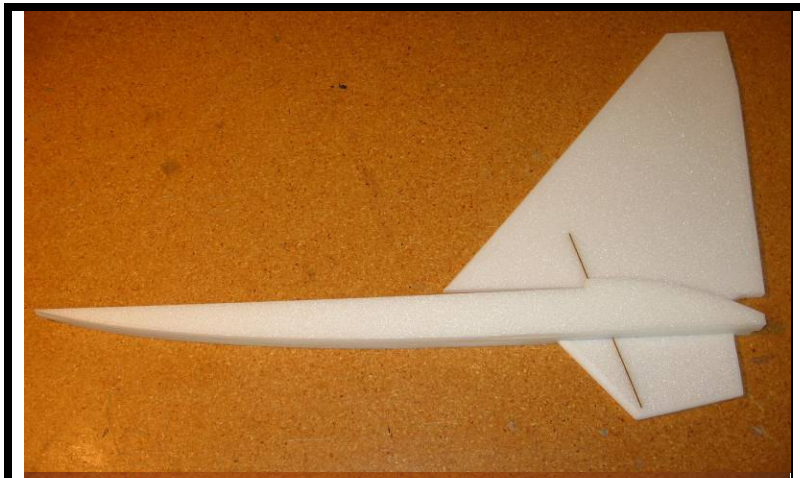


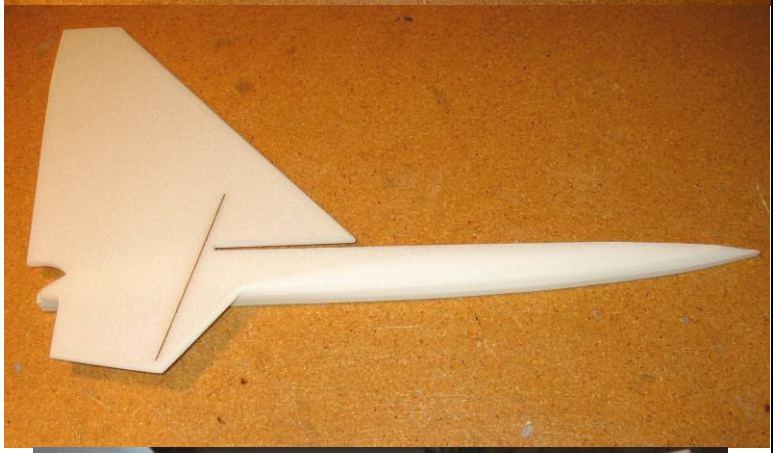
5. Next build the wing. Lay the wing down over wax paper on a flat surface and use 30 minute epoxy to glue in the carbon tube wing spar. Mixing some microballons into the epoxy is recommended to reduce weight and help the glue fill gaps better (ProBond also works well). Place wax paper and some heavy books on top of the wing to hold it perfectly flat as the glue cures.

After the glue has cured, sand the leading to a well-rounded shape and the trailing edge to a tapered shape. Apply a strip of 3M Satin tape around the entire leading edge for smoothness and improved durability.



6. Place the wing on a flat surface, and then glue the nacelle sides in place as shown, fitting the tabs in the nacelles to the pre-cut slots in the wing. Note the outboard nacelle sides are bent slightly inboard to form a gentle curve (though no heat-forming is required). Use four temporary 90 degree angle pieces of scrap foam to hold the nacelle sides perpendicular as the glue dries. Also note pins can be used to hold everything together while the glues dries. A gap-filling glue such as epoxy with microballons or ProBond is recommended for this step.





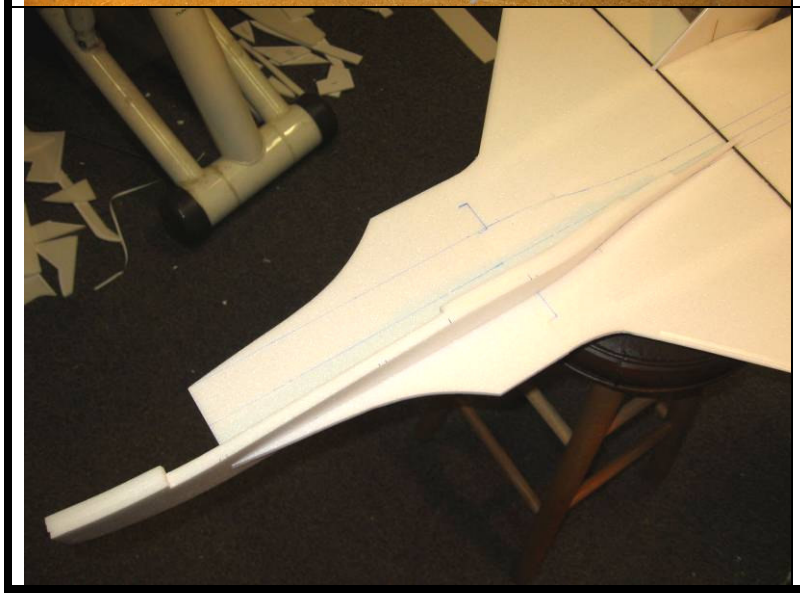
7. Next build and install the vertical tail and side rails. Begin by sanding the leading edge of the vertical tails to a well-rounded shape, and the trailing edge to a tapered shape. Apply a strip of 3M Satin tape to the leading edge for smoothness and durability

Cut a slot in the vertical tail for the 1/32" plywood spar (note the location shown on the plans is different from the photo shown at left—one of the lessons learned after building the prototype model!). Place the vertical tail over wax paper on a flat surface and the glue the aux spar in place using epoxy.

Laminate the two fuselage side rails together using 3M77 (two pieces together for each side). Then glue the laminated side rails to the vertical tail piece as shown (top photo). Once the glue is dry, sand the side rails to a scale tapered and rounded shape (middle photo). See photos of the real Su-27/Su-37 for guidance on how these are shaped.

Glue the completed vertical tail/side rail pieces to each side of the aft fuselage with epoxy (bottom photo). Use temporary 90 degree triangle scraps of foam on top of the wing (not shown here) to ensure the vertical tail is perpendicular to the wing. Note the rounded aft end of the side rails sits flush with the holes for the stabilator pivot rods.

8. Now begin the forward fuselage assembly. Glue the forward fuselage doublers to the forward fuselage sides using 3M 77. Make sure to make left- and right-side pieces. Note that double thickness doublers are used throughout to allow sanding the forward fuselage to a very rounded shape after assembly.



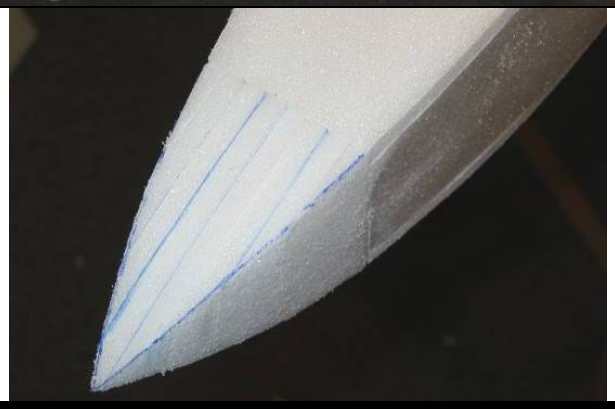
9. Using a heat gun, gently heat and bend the forward fuselage sides to the shape shown in the photo at left and on the plans. For guidance in shaping this piece, use the turtledeck top piece to trace an outline on the top of the wing with a Sharpie marker (shown in the photo at left). Then simply bend the fuselage sides to match that outline. Drawing a centerline on the wing will also help keep the fuselage properly aligned.

10. Next install the forward fuselage onto the wing, including the sides and four bulkheads (you can install all of these parts at once). Use epoxy with microballons (or ProBond) and use pins and masking tape to keep everything aligned and in place. Glue the forward fuselage sides to the TOP of the wing first, then let the glue dry.

11. Now glue the forward fuselage sides to the bottom of the wing. It will help to draw an outline on the bottom of the wing first (simply trace the forward fuselage bottom piece) to provide guidance on how much to bend these parts in.

12. Glue on the forward fuselage top and turtledeck tops (top photo). I found it easier to NOT laminate the turtledeck tops before installing—just glue the first one, let the glue dry, and then glue the second one on top of the first).

Glue on the forward fuselage bottom piece (bottom photo).



13. Laminate the nosecone pieces together using 3M 77 adhesive. Then glue the nosecone block to the front of the fuselage.

Once the glue has dried, sand the nosecone to shape. Start by tracing the top outline of the nosecone onto the foam (using the provided template) and cut it to shape with a long knife or saw. Begin with coarse sandpaper (100 grit) to rough out the basic shape, then move to a finer sandpaper (220 grit) to do the final shaping. End with 320 grit sandpaper to do the final polish sanding and provide a very smooth surface.

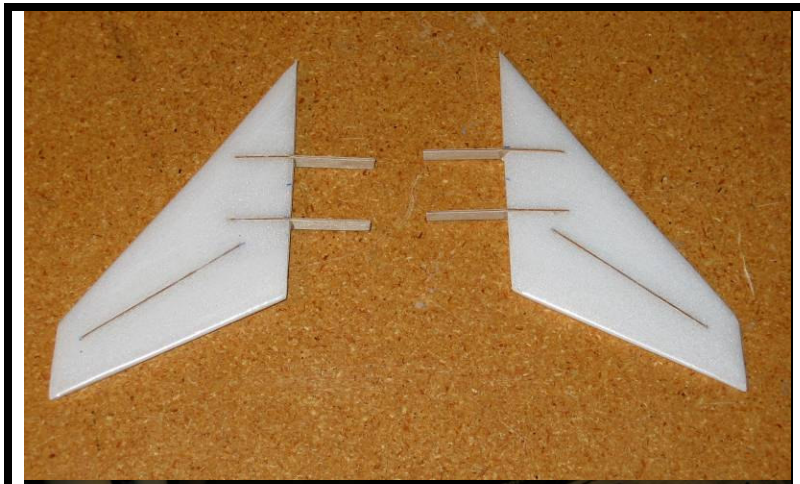
14. Laminate all of the canopy pieces together using 3M 77 adhesive. Note how the two sill pieces are attached to the outside edges of the block.

Once the glue has dried, sand the canopy to shape. Start by tracing the top outline of the canopy onto the foam (using the provided template) and use that to guide the shaping. Begin with coarse sandpaper (100 grit) to rough out the basic shape, then move to a finer sandpaper (220 grit) to do the final shaping. End with 320 grit sandpaper to do the final polish sanding and provide a very smooth surface.

Note that custom-molded clear canopies are also available from www.6mmflyrc.com.

15. Next make and install the wing fillets. Begin by laminating the three fillet pieces together using 3M77. Then rough sand the fillets to a smooth concave shape using a rounded sander (I simply wrapped sandpaper around an epoxy bottle as shown in the middle photo). Start with coarse sandpaper and work your way to finer grits.

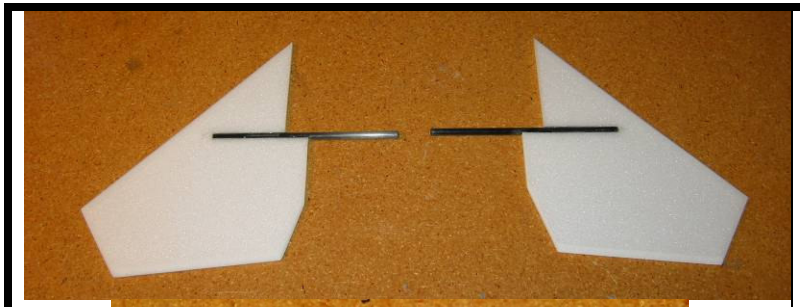
Once the fillets are roughed to shape, glue them to the wing/fuselage. Then apply generous amounts of lightweight spackling compound all around the fillets and sand to a smooth well-blended shape. See photos of the real Su-27/Su-37 for guidance in shaping these. It takes quite a bit of time to properly shape these fillets, but take your time to do it right—they are a very integral and recognizable feature of the Su-27/Su-37 airplanes!



16. Next make and install the canards. Bare foam canards will not be strong enough and must be strengthened. There are several ways this could be done, including installing hard balsa around all edges of the canard, fiberglassing the entire canard, or installing 1/32" plywood spars and covering with Satin tape (as shown in the top photo). Chose the method you prefer.

Begin by sanding the canard pieces to a symmetrical airfoil shape. Then add the strengthening using your selected method. Next cut slots in the canards for the plywood dihedral braces and then glue them in place with epoxy as shown.

Cut matching slots in the wing for the plywood dihedral braces and then glue the completed canards in place with epoxy as shown.



17. Next install the stabilators. Sand the leading edge of the stabilators to a well-rounded shape, and the trailing edge to a tapered shape. Apply a strip of 3M Satin tape to the leading edge for smoothness and durability.

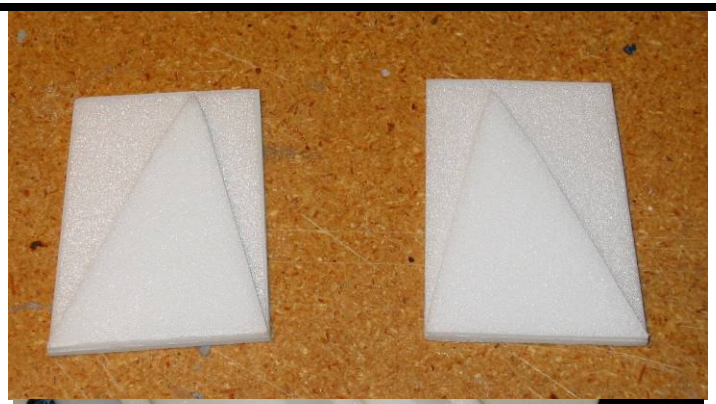
Lay the stabilators over wax paper on a flat surface and glue the carbon tube pivots into place using epoxy (top photo).

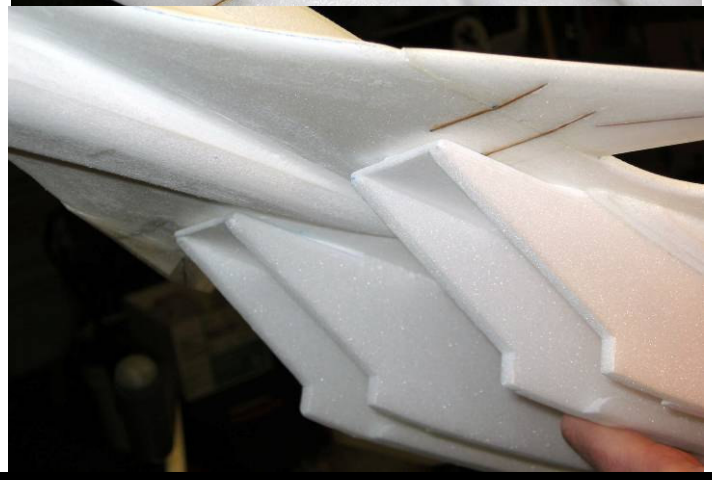
Note the hardware required for the stabilators (second photo from top). The carbon tubes pivot inside the plywood supports in the nacelle sides. Two plywood end stops butt up against each support to keep the pivot tube from sliding left/right. A plywood control arm is installed to allow a pushrod connection to the servo. Putting a small piece of packing tape over the plywood supports in the nacelles to minimize friction with the end stop bearings is recommended.

Slide the carbon pivot tube through the outboard ply support, and then slide on an end stop, control horn, and the other end stop (third photo from top). Push the pivot rod through to the inboard ply support. Once everything is in place and aligned, glue the end stops into place with epoxy or thick CA, but don't glue the control horn yet.

Install the stabilator servos using a similar procedure as the thrust vectoring servos (double-sided tape, foam block supports, thick CA reinforcement). Then install the pushrods. Once everything is aligned properly, glue the plywood control horn to the carbon tube using epoxy or CA.

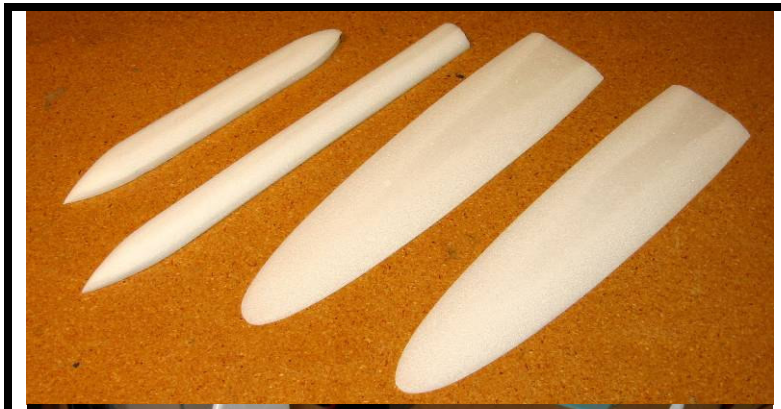
Repeat for the other stabilator.

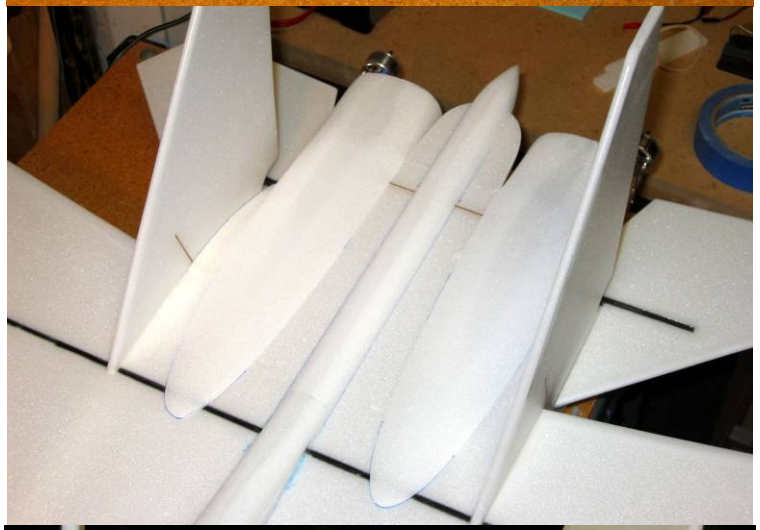


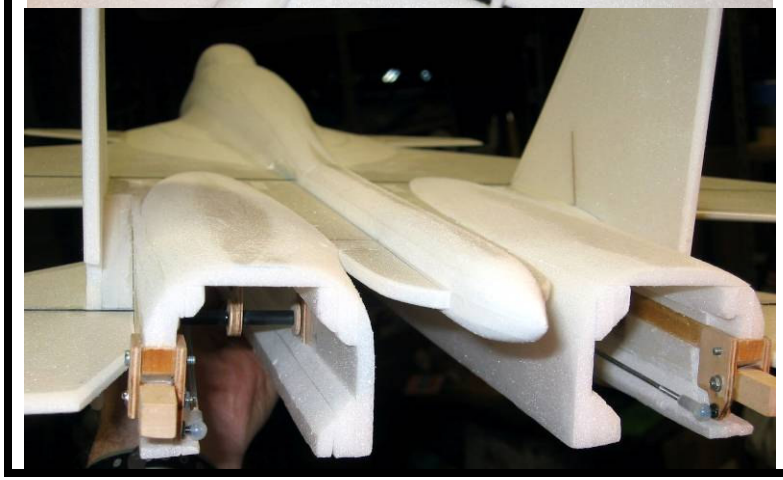


18. Next install the inlet diverter pieces. Glue the 3mm Depron triangular inlet diverter center pieces to the 3mm Depron inlet diverter top pieces (top photo). Make sure to make left and right hand pieces.

Glue the above assembly into place at the front of the inlets (bottom two photos). Then glue the 6mm Depron internal inlet top piece in place directly behind the diverter pieces .



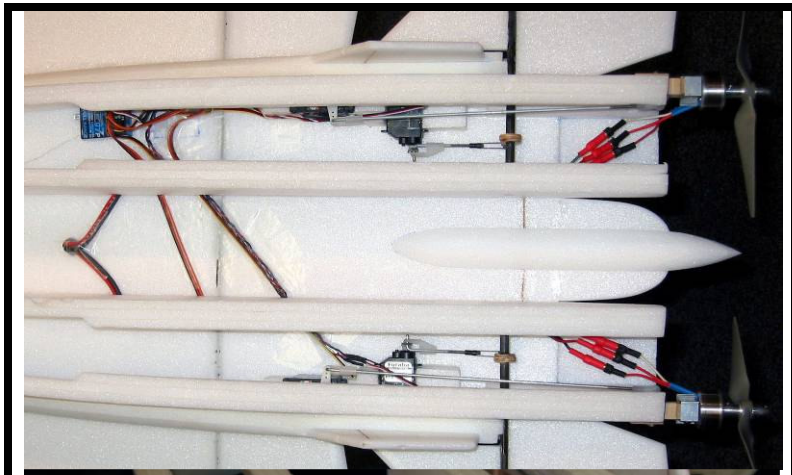


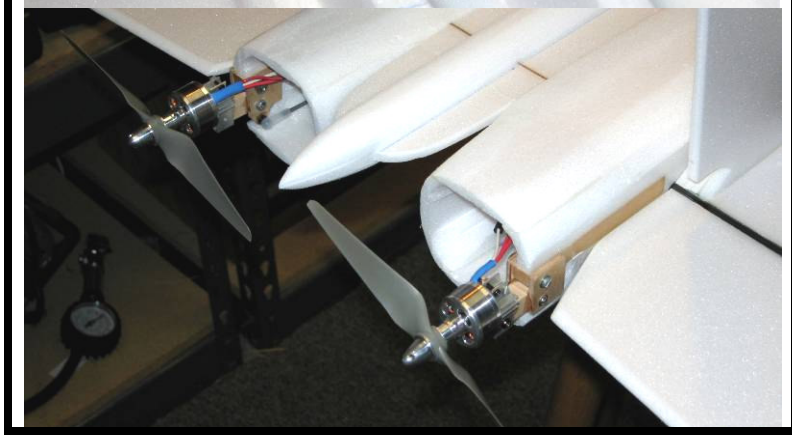


19. Laminate the aft fuselage top and bottom spine pieces using 3M 77. Then sand to a well rounded shape, and taper the back end to a spike (top photo).

Sand the decorative nacelle top pieces to a rounded shape with feathered edges (top photo).

Glue the top spine, bottom spine, and nacelle tops to the aft fuselage (middle and bottom photos).





20. Install the receiver, speed controls, and wiring. There are many ways you could do this, but I chose to install the receiver in the forward left nacelle (top photo), and one speed control in each nacelle flush with the inboard nacelle sides (bottom photo). Try to locate everything as far forward as possible since this model tends to be tail-heavy. Twist all the ESC wires together to help reduce electromagnetic interference, and tape all wiring down flat against the foam to keep them from flopping around in flight. To connect the components on opposite sides of the airplane, I simply ran the wiring across the bottom of the wing and then taped them down flat to the wing. Although these wires will be visible externally, you can paint over them later to help hide them.

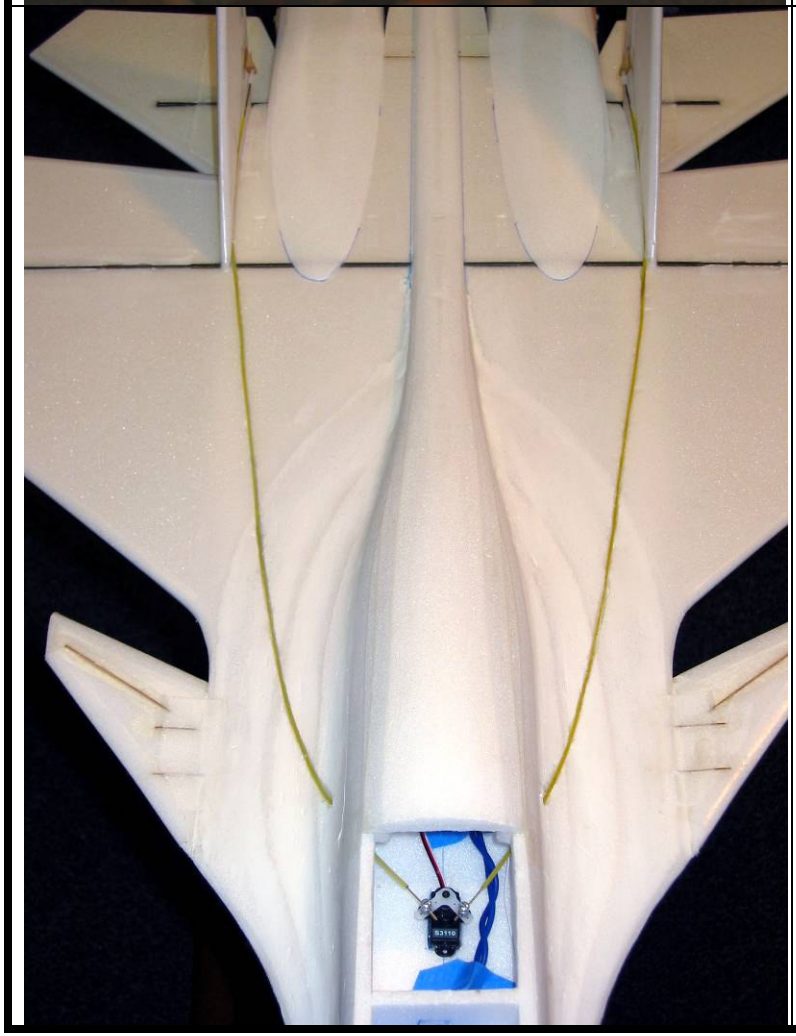
Note the battery extension wires must branch off in a Y to connect to each speed control. Use 16 ga minimum for the battery to ESC extensions, and you can use either 16 ga or 18 ga for the ESC to motor extensions.

Make sure all of the electronics work properly before proceeding to the next step, since once the nacelle bottoms are glued on you'll have to cut into the model to gain access.

NOTE: Make sure to install the speed controls so that they get PLENTY of airflow for cooling. Mounting them inside the nacelles as shown is ideal. I even cut away some of the plastic shrink wrap to promote even better cooling. Cooling is important not just because of the heat generated by the motor controller, but even more so for the integrated BEC circuitry since this model requires 4 servos (and most speed controls are only rated for 3 or 4 servos). Providing ample cooling to the BEC will allow it operate the servos safely and help prevent premature shutdowns due to overheating. Note you could use a separate and more powerful BEC component instead, but that would add weight and cost.

21. Sand the bottom of the nacelles flush with a long sander. Then glue on the nacelle bottoms. Sand the nacelle lower edges to a well-rounded shape.

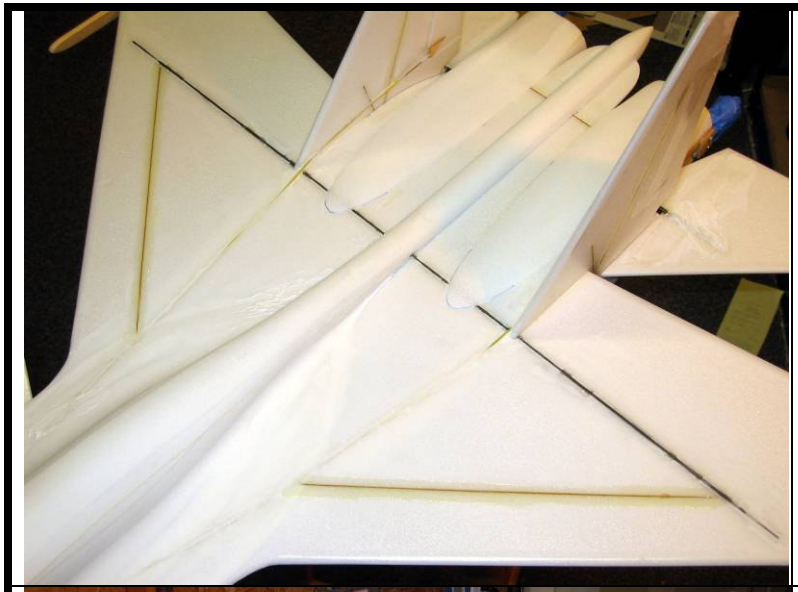
22. Sand the balsa wing tip missile rails to shape and glue to the wing tips.



23. If incorporating rudders, install the rudder control hardware now. Rudders are not required and this model flies fine without them, but they are helpful for improved control at high alpha and for better aerobatics.

Mount the servo in a slot in the wing on the centerline under the canopy. Use Sullivan micro flexible cable pushrods, with small pieces of 1/32" music wire soldered onto the rudder end. Make a small hole in the fuselage sides for the pushrod to exit, and then cut a slit in the top of the wing as shown and push the pushrod down into that slit. Then glue the pushrod in using thin CA and accelerator. Filler can be added before painting to help hide these pushrods.

I used Dubro micro pushrod keepers on the rudder horn and Dubro micro EZ connectors on the servo end. Use a 90 degree servo arm and make sure the pushrods connect to the servo arm at a 90 degree angle at neutral (to ensure the rudders deflect equally).



24. Optional step – If you plan to fly this model aggressively (either high speed, high weight, or aggressive aerobatics or tumbling), it is highly recommend to install a 1/32" plywood auxiliary spar in each wing as shown on the plans and in the photo at left. This spar will significantly strengthen the front of the wing and prevent it from flexing. Just cut a slot with a sharp knife into the wing and then glue the spar in with epoxy.

It is also highly recommended that the stabilators be strengthened chordwise. Just run a 1" wide strip of fiberglass cloth chordwise at the root from front to back and on top and bottom, and adhere the cloth with either water-based polyurethane or epoxy.

25. CONGRATULATIONS! Your model is now complete.

The model can be flown as is or can be painted using a variety of paints (see the next step for painting advice). I actually recommend test flying the airplane before painting it to allow making the maiden flight at the lowest possible weight and to allow you to more easily fix any internal problems that might arise.

PAINTING TIPS - This model can be painted with a wide variety of paints, just make sure to test compatibility with the foam first. The prototype was painted with standard acrylic craft paint (available at most craft stores), which can be applied with either a brush or airbrush. Here are a few painting tips:

- Wipe the entire model with rubbing alcohol before painting to remove all grease and dirt.
- Rough areas should be filled with lightweight wall spackling compound thinned with water, which fills the holes and can be sanded to a very smooth finish with minimal weight gain.
- Primer isn't required over Depron, but applying a coat of water-based polyurethane (WBPU) will help seal the foam and provide a smoother finish. Mixing some microballons or baby powder in with the WBPU will help fill holes even better and improves the finish further.
- When thinning acrylic paint for use in an airbrush, thin roughly 50/50 with windshield wiper fluid. The wiper fluid will allow the paint to dry faster (relative to thinning with water), which reduces the chance of runs. It will not affect the finish.
- Decals can be made on a computer and printed onto standard label paper using an inkjet or color laser printer.

Good luck, and I hope you enjoy this model as much as I have!

Additional Photos For Reference

Flight Setup

1. Below is a chart that summarizes all of the channel assignments and mixes used on the prototype model (utilizing a Futaba 9C transmitter). Note that if you don't have a programmable or 7 channel transmitter, you can just build the mechanically slaved TV version. That eliminates the need for all of the custom mixes and 2 additional channels.

Channel Assignments					
1	Taileron 1	Micro servo			
2	Taileron 2	Micro servo			
3	Throttle 1	ESC			
4	Rudder/Yaw TV	Micro servo			
5	Throttle 2	ESC			
6	TV 1	Mini MG servo			
7	TV 2	Mini MG servo			
Standard Mixes Required					
1,2	Elevon mixing				
Custom Mixes Required					
	Function	Master	Slave	Switch	Mix Rate
1	Dual throttle	3	5	None	100% mix rate
2	TV 1 pitch	1	6	A	100% mix rate
3	TV 2 pitch	1	7	A	100% mix rate
4	TV 1 roll	2	6	A	100% mix rate
5	TV 2 roll	2	7	A	100% mix rate
6	TV 1 yaw	4	3	B	+30% mix rate
7	TV 2 yaw	4	5	B	-30% mix rate

2. Adjust the flight controls to provide the following recommended deflections (all measured at the root trailing edge):

   Stabilators (pitch): +/- 1.5" (-30% expo)
   Stabilators (roll): +/- 1.5" (-30% expo)
   Rudder: +/- 0.75"
   Thrust vectoring: +/- 30 degrees (mixed with elevator)

3. Start with the CG at 6.1” ahead of the centerline of the carbon tube wing spar (see the plans). Depending on how your model is set up, some ballast may be required in the nose to achieve this CG (the prototype required 1.25 oz ballast on the final painted model). This is a relatively conservative forward CG location, great for making first flights. You can move the CG aft for more

maneuverability later as desired.

4. To hand launch this model, grip the airplane on one of the nacelles just behind the CG, apply about 75% throttle, and throw it overhand moderately hard, straight ahead, and slightly nose up. Make sure to keep your hand away from the prop as you throw it! With twin LSPJ motors this model has a lot of power, and full throttle launches aren't required (plus launching at a somewhat lower power setting will give you more time to react after you've released the model).

5. You'll find this model is surprisingly docile and predictable in the air and has no bad habits. But with the TV on it is capable of amazing aerobatics!

6. Belly landings are easy to do with this model, but remember to ALWAYS release the elevator control right before touchdown to prevent the forward stabilator tips from digging into to the grass or ground—which can significantly damage the model and/or stabilator servo! Also remember to pull the throttle back to zero just before touchdown so that the propeller and/or motor mount is not damaged on landing.

7. For much more information about this model, check out the online discussion thread on RCGroups at the link below:

   http://www.rcgroups.com/forums/showthread.php?t=666686

Specifications

Wing area: 290 sq in
Span: 30.0”
Length: 36.3”
Weight RTF: 22 to 29 oz
Wing loading: 11 to 14 oz/sq ft
Flight controls: Tailerons, rudder (optional), thrust vectoring (optional)

Recommended equipment:

Motor: Two Littlescreamers Park Jet (LSPJ)
Battery: One Thunder Power 2100 mAh 11.1V Prolite
Prop: APC 6x4 regular and pusher (counter-rotating props)
Speed control: Two Castle Creations Thunderbird 18 or Phoenix 25
Receiver: Castle Creations Berg 7P
Servos: Futaba S3110 on all flight controls, Hitec HS-85MG on thrust vectoring