F-84f Thunderstreak

By Michael Hammer

The real F-84f Thunderstreak

The Republic F-84F Thunderstreak was an American swept-wing turbojet fighter-bomber. While an evolutionary development of the straight-wing F-84 Thunderjet, the F-84F was a new design. It first flew in June 1950 and entered service in May 1954. The aircraft served with the United States Air Force, as well as other air forces in Belgium, Germany, and the Netherlands. A total of 3,428 aircraft were built.

Specifications
Aircraft Type: F-84F, S/N 51-1714, Thunderstreak, Republic
Mission: Fighter-Interceptor, Fighter-Bomber, and fighter escort.
Powerplant: One Wright 765-W-3 turbojet, 7,800 lbs. thrust
Weight: Empty 13,800 lbs., Loaded 28,000 lbs.
Dimensions: Wingspan 33'7", Length 41'9", Height 14'.
Performance: Maximum speed 695 MPH, Cruising speed 490 MPH, Service ceiling 46,000 feet.

The F-84f semi scale model

The 3D printed F-84f is designed to look and fly like the full size Thunderstreak. The lines and proportions of the model match the real Jet with its swept back wings and all moving tail plane.

The optimized edf duct ensures great performance without the use of cheater holes. Designed to be powered by a 50mm FMS electric ducted fan (3S version) and a 3S2200mAh Lipo battery, the model has great performance and flight times from 6-8 minutes. The model is designed to be printed from regular PLA or PolyAir 1.0

An innovative RDS (Rotary Drive System) is included for the ailerons. The rotary movement of the servo will be translated directly to control surface movement with no visible linkages to the control surfaces. No more broken control horns or visible control rods to spoil the scale looks. Files for tradional ailerons with control horns are also included.

The Edf is easily installed without the use of screws or glue. The edf is secured by the detachable front fuselage and held in place by magnets.

The F-84f is designed with an optional catapult hook for safe and consistent bungee assisted launch. The model can be hand launched but it is recommended to use a catapult or bungee with 6kg pulling force for a safe launch of the model.

Optional scale Drop Tanks can be fitted for that classic Thunderstreak look.

All parts are designed to be easily aligned and glued with medium cyano glue.

Model specifications

Wingspan: 730mm

Length: 860mm

Wing Area: 12,3dm^2

Wing Loading: 81g/dm^2

Airfoil: Eppler E180 modified

Ready to fly Weight (3S2200mAh): 1000g

FMS EDF max thrust: 650 g

Thrust to weight ratio: 0,65

Bill of Materials

1mm pianowire, 500mm
2xmm square carbon rod, brass rod or aluminium rod
5x3mm magnets, 12 pieces
2mm brass or aluminium tube (RDS activated aileron version)
Cyano hinges or similar
Medium thickness cyano glue and accelerator spray.
3 x HTX900 servoes
EDF: FMS 50mm 3S edition available at www.FMSModel.com
Receiver: 4-6 ch
Servos: 3 x 9g HXT900
ESC: 40A
Battery: 3S2200mAh 25C or higher
Velcro straps

3D Printer Requirements:

Recommended Prusa MK3S : 250 x 210 x 200 mm, minimum diagonal for wing chord is 295 mm
Nozzle: 0,4mm
Filament: PLA or PolyAir 1.0
Slicing software: Simplify3D

Print settings

All parts are designed to be printed with 0,4mm nozzle, 0,25mm layer height and 1 perimeter (wall) except fuselage section 7 and the bungee hook which should be printed with 2 perimeters.

All parts should be printed with a 1-2 layer skirt with a 10mm offset from the part unless the table indicates that the part should be printed with a 6-10 mm brim.

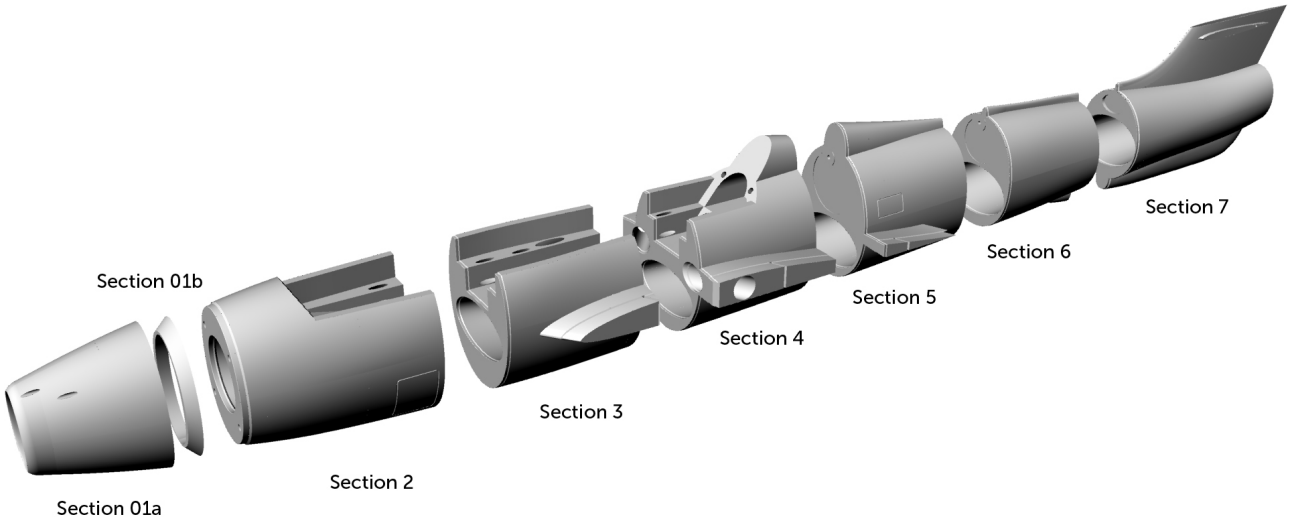
Fuselage sections except section 01a and 01b should be printed using Simplify 3Ds advanced function with multiple processes dependent on the z-axis height. The correct settings for the processes for each fuselage section is listed in the table.

If using a Slicer which can not handle multiple processes, just print the part with bottom layers and no top layers. A hot knife or Dremel can be used to remove any unwanted part when the print is finished.

Part	Top layers	Bottom layers	Brim	Infill
Aileron_Left_01	3	3	Yes	
Aileron_Right_01	3	3	Yes	
Aileron_Left_02	3	3	Yes	
Aileron_Right_02	3	3	Yes	
Aileron_Left_RDS	3	3	Yes	
Aileron_Right_RDS	3	3	Yes	
Bungee_Hook	3	3		30,00%
Elevator_Actuator	3	3		100,00%
Hood_01	2	0	Yes	
Hood_02	2	2		
Fuselage section 01a	1	2	Yes	
Fuselage section 01b	2	2		10,00%
Fuselage section 2 (0-75mm)	2	2		
Fuselage section 2 (75mm-end)	0	0		
Fuselage section 3 (0-0,7mm)	0	2		
Fuselage section 3 (0,7mm-end)	0	0		
Fuselage section 4 (0-0,7mm)	0	3		
Fuselage section 4 (0,7mm-end)	0	0		
Fuselage section 5 (0-0,7mm)	0	3		
Fuselage section 5 (0,7mm-end)	0	0		
Fuselage section 6 (0-0,7mm)	0	3		
Fuselage section 6 (0,7mm-end)	0	0		
Fuselage section 7 (0-0,7mm)	0	3		
Fuselage section 7 (0,7mm-end)	2	0		
Wing Left 01	0	2		
Wing Left 02	0	2		
Wing Left 03	0	0	Yes	
Wing Right 01	0	2		
Wing Right 02	0	2		
Wing Right 03	0	0	Yes	

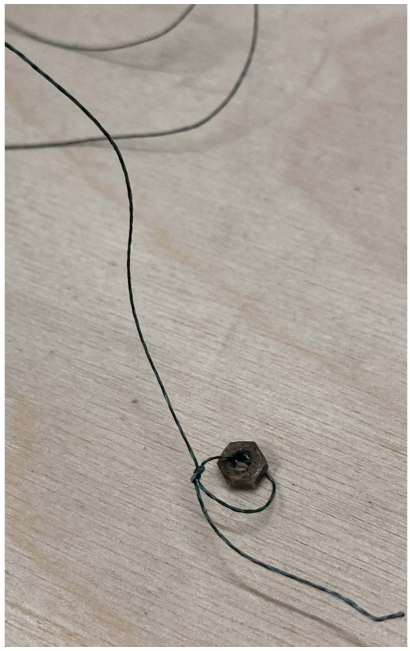
Wing Tip Right	2	2		
Wing Tip Left	2	2		
Servo Cover	1	1		100,00%
Wing Anhedral Gauge	2	2		10,00%
Horizontal Stabilizer	2	0	Yes	
Vertical Stabilizer	2	0	Yes	
RDS set	2	2	Yes	100,00%

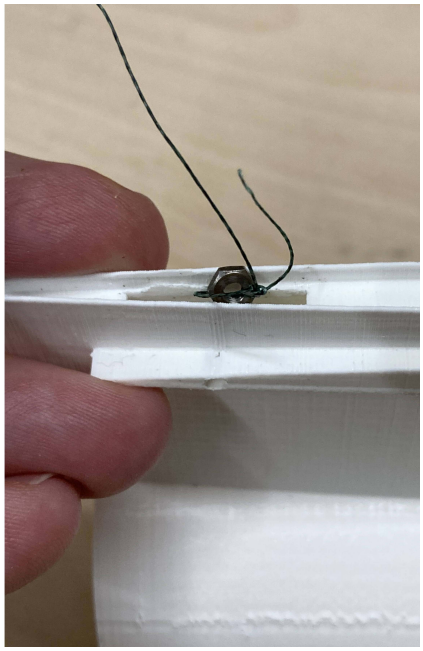
Fuselage Assembly



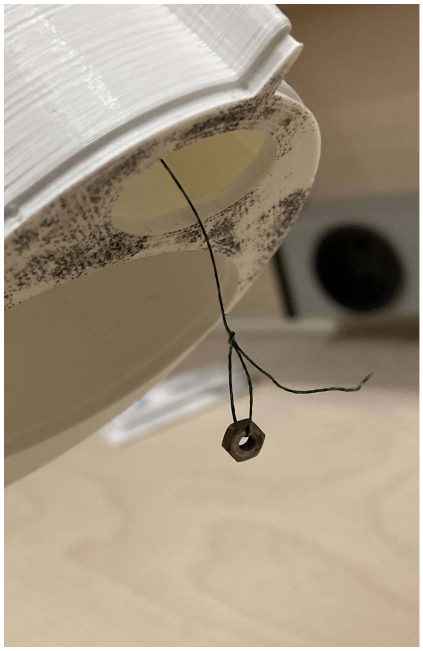
The fuselage is divided into 7 main section.

Start with the last section, section 7. Drill the two holes for the square carbon rod using a 2mm drill bit. Use a small round file to increase the size of the hole until the carbon rod can rotate with just a bit of resistance. Cut a slot for the elevator control arm as shown in the photo. Use a hotknife or a dremel with a cutting disc. Tie a small nut to a piece of string. Insert the nut into the slot and let it drop down into section 7.

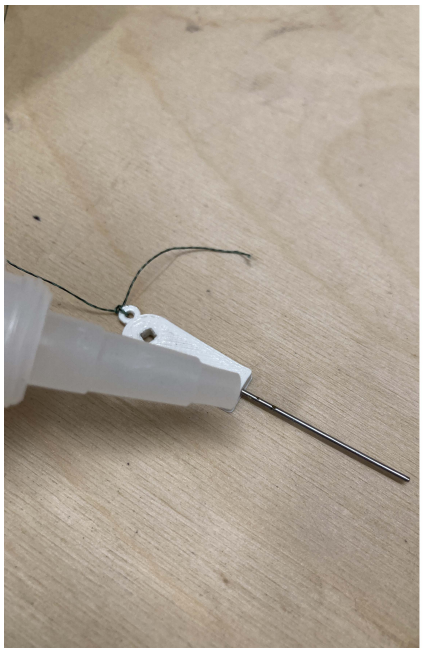
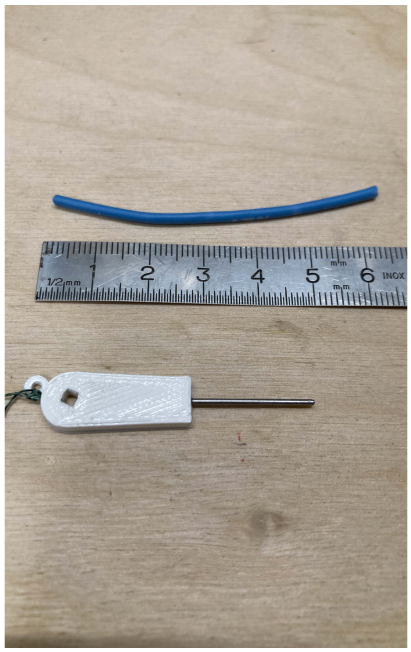
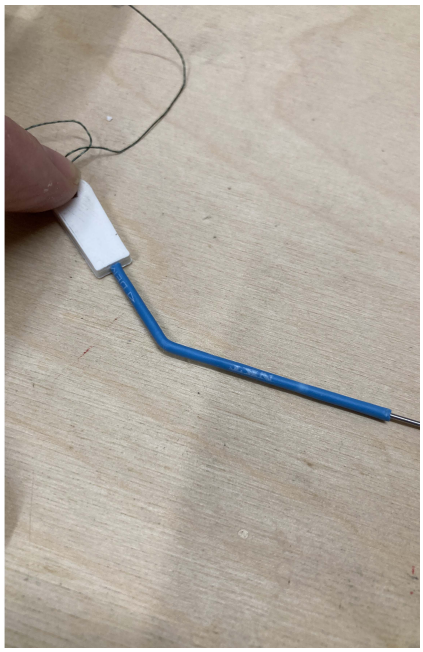




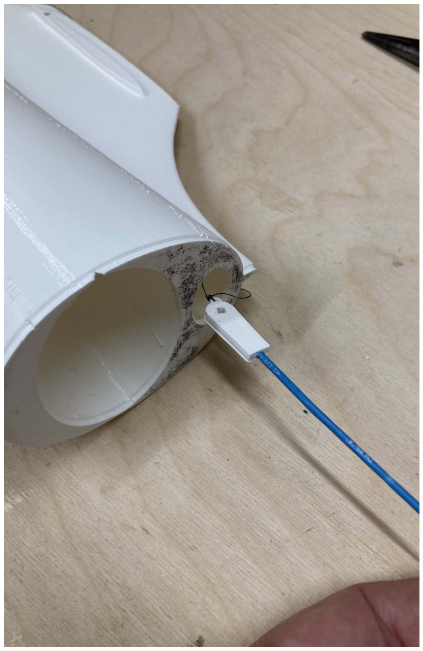
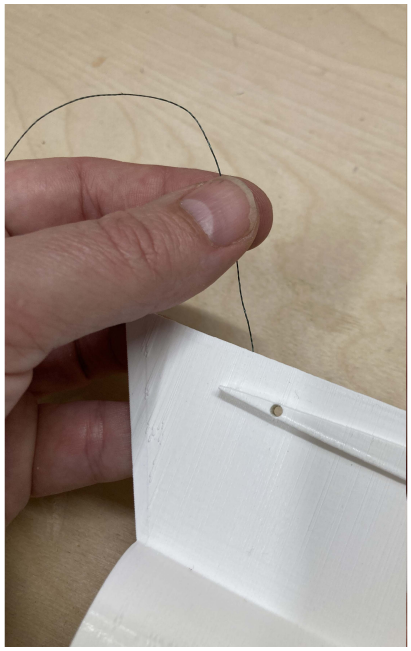
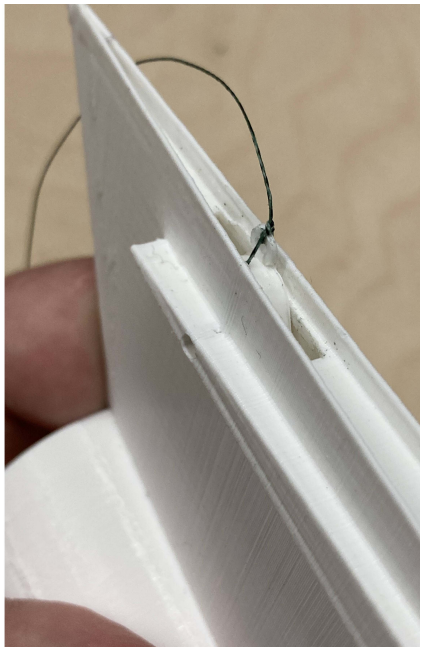
Wiggle the part in order to navigate the nut to exit the hole above the edf duct. Pull the string through and remove the nut. Tie the string to the elevator control arm using the small eyelet on the part. Cut a 35mm long piece of 1mm piano wire and make some notches at the end for better glue adhesion. You can also use sandpaper to roughen up the wire.



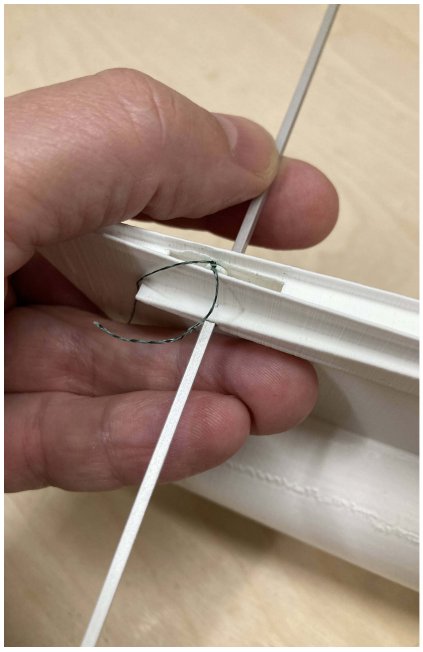
Add cyano or epoxy glue to the piano wire and insert into the elevator control arm. Cut a 60mm long piece of electrical wire insulation. Do NOT use silicone wire insulation. The piano wire should fit tightly into the electrical wire insulation. Cut a 450mm long piece of 1mm piano wire. Make sure the ends of the piano wire is rounded and has no sharp edges. Insert the control horn piano wire into the insulation. Then insert the 800mm long piano wire into the insulation and push it all the way in until it meets the other piano wire. Make sure you can pivot the control arm by pushing and pulling the long piano wire.

Insert the control arm back into section 7 by carefully pulling the string and pushing the long piano wire. Pull it all the way to the top and partly through the slot. Make sure the eyelet is positioned to the left side of the tail as seen in the photo.

Align the square hole in the elevator control arm with the round hole in the vertical stabilizer. Now carefully insert the 100mm long 2x2mm square carbon rod from the side into the hole, through the square hole of the control arm and out the other side of the stabilizer. Bevel the end of the carbon rod to help pushing the rod through. It is very important that the carbon rod fit the elevator control arm firmly. If this is not the case then push the carbon rod to one side and add a bit of thin cyano glue to the center of the rod on all the four sides. When the glue is completely dry, push the rod back to its center position. If it is still loose, then repeat the process. If the rod is too hard to push back to its center position, use a bit of 400 grit sand paper to remove some of the cyano glue. When the carbon rod is centered and fits the elevator control arm tightly, the rod should should rotate slop free when the elevator piano wire is moved back and forth.



Use a another piece of carbon rod to make sure it can be inserted into the square channel of the all moving tailplanes. Push the two tailplanes onto the carbon rod leaving a small gap between the and fuselage section 7. Test that the tailplanes move in sync and slop free when the elevator piano wire is moved back and forth. Pull the tailplanes out again and add a small amount of 15 minute epoxy to the carbon rod. Push the tailplanes back in while making sure that no excess glue will touch section 7.

Use small clamps or clothespins to keep both tailplanes aligned with section 7 while the epoxy cures.

Before the rest of the fuselage sections are glued together it is very important to prepare the sections so they will slide easily into the neighboring part. Use a piece of sandpaper to bevel the edges of the parts. It can be a bit tricky to get both the outer wall and the EDF duct to line up, but with nicely sanded edges the parts should fit together nicely.

Push the elevator pianowire from section 7 through the guide hole in fuselage section 6. Line up the two parts and join them together to test the fit. If satisfied with the fit of the parts, pull the parts from each other and apply medium cyano glue. Join the parts together again. Wipe excess glue from the joint. When satisfied with the fit of the parts, spray with accelerator. Repeat the above process with fuselage sections 5 to 2.



Fuselage section 01a and 01b secures the EDF in its position with the help of 5x3mm magnets. Glue 4 magnets into the holes in section 01b using cyano glue. The magnets should be flush with the surface of section 01b. Add 4 new magnets on top of the magnets that were glued into section 01b. Mark the magnets with a permanet marker in order to keep track of its polarisation. Glue the 4 magnets into section 2 making sure to keep the marked face of the magnets pointing backwards. When all magnets are glued and sprayed with accelerator, section 01b should click onto section 2. Add cyano glue to the inside of section 01a and push it onto section 2. When satisfied with the fit of the parts, spray with accelerator.

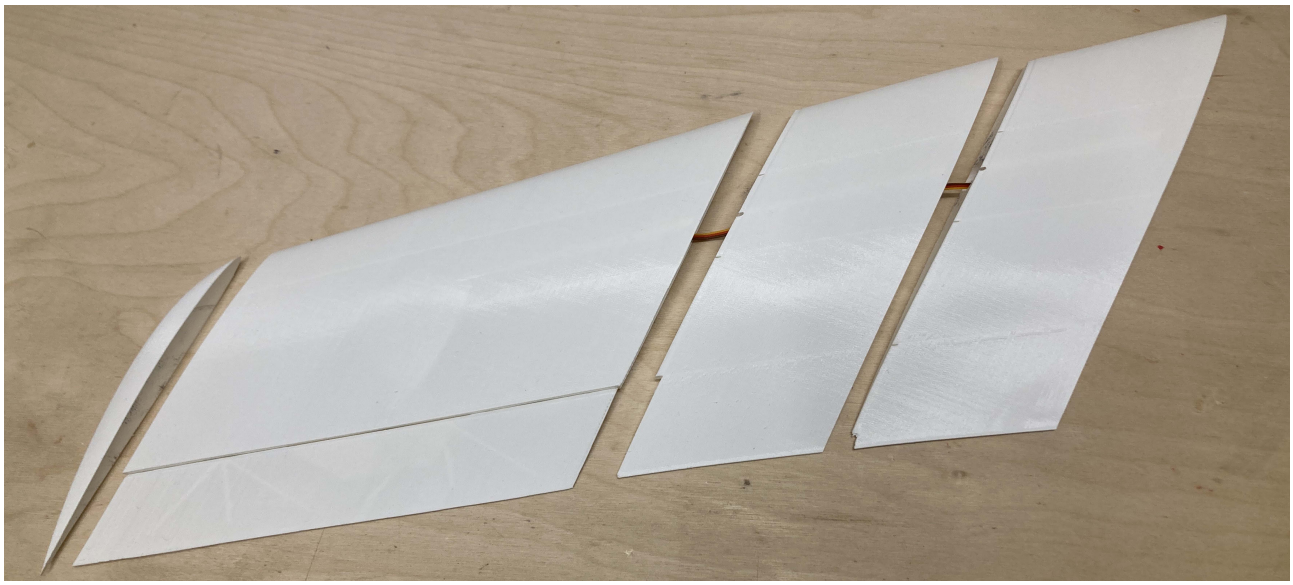
Glue the 2 cockpit section together and add magnets in the same way as with section 1b and section 2. Finally finish the fuselage assembly by gluing the fin on top of section 7.

If you plan to launch your F-84f with a Catapult or a bungee, glue the bungee hook into the slot in the bottom of Section 2.

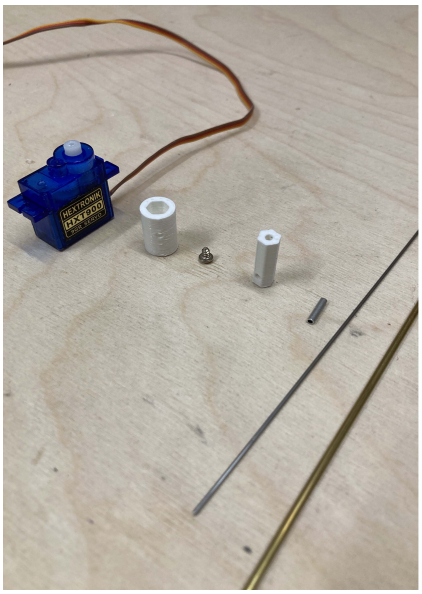
Your F-84-f fuselage should now look like the pixture above. Time to move onto the next part of the build, the wings.

Wing Assembly

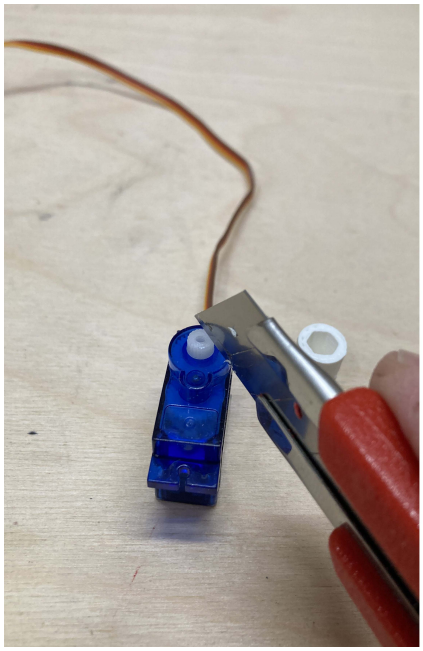
The wings each consists of 3 main parts, wingtip and aileron. The 3 main parts should be glued together on a flat surface protected by plastic film. Make sure the parts fit together before gluing. Use sandpaper og a sharp knife to remove anything obstructing a nice fit. Pull a servo extension lead through the round channel of wing parts 1 and 2. Add cyano to part 1 and fit part 2 to part 1. Whipe excess cyano of with a cloth. Place the parts on the table, make sure everything fits, press the parts lightly against the table surface and spray with accelerator. Repeat the process with part 3. Align the wingtip to the wing and glue.

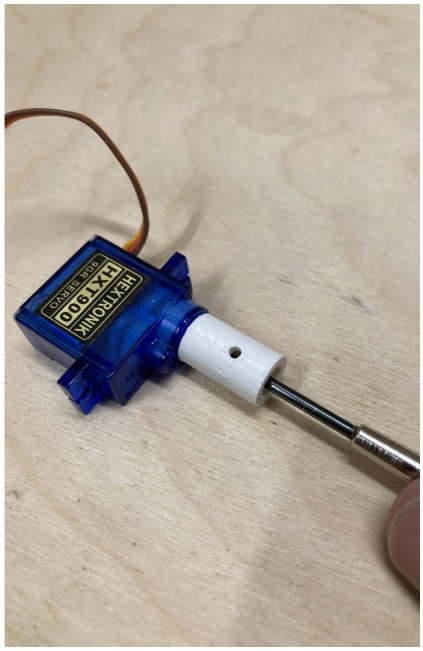


Cut the mounting flanges of the HXT900 servo.



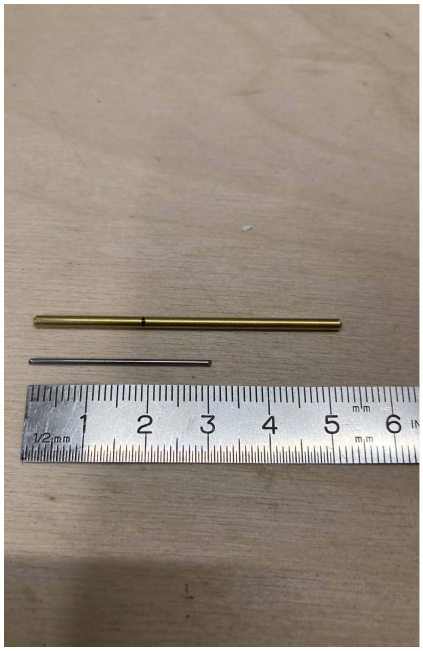
Cut the splined servo axel with a sharp knife to produce a flat surface matching the flat surface of the RDS part. A nice tight fit between the servo and the RDS part is required. Secure the RDS part to the servo with the screw supplied with the servo. An optional hole can be drilled from the side of the RDS part and into the splined servo axel and a pin from 1mm piano wire inserted and locked with a bit of cyano. Cut of piano wire flush with the surface.





Insert the hexagonal RDS Part into the part connected to the servo. Lock in place with a bit of 2mm brass tube. Wrap the servo with painters tape or sand the surface with coarse sand paper.

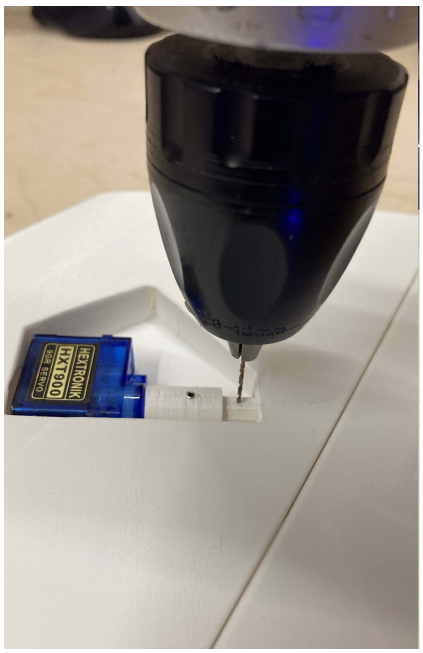
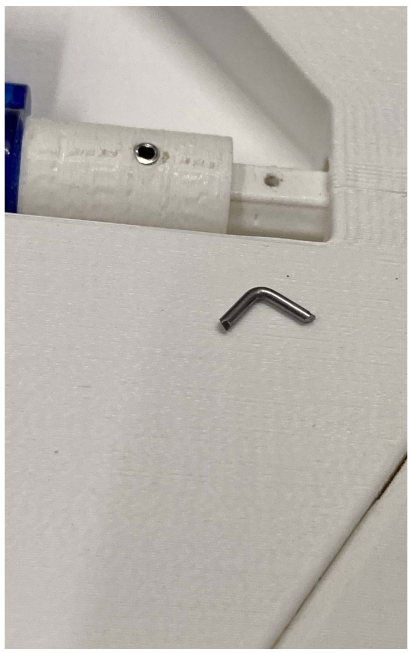
Cut a 55mm long 2mm brass tube and a 30mm long 1mm piano wire. Mark the brass tube at 20mm from one end. Insert the piano wire into the brass tube from the end the 20mm mark was measured. Place the brass tube with the piano wire in a vice and make a 50-60 degree bend at the 20mm mark.



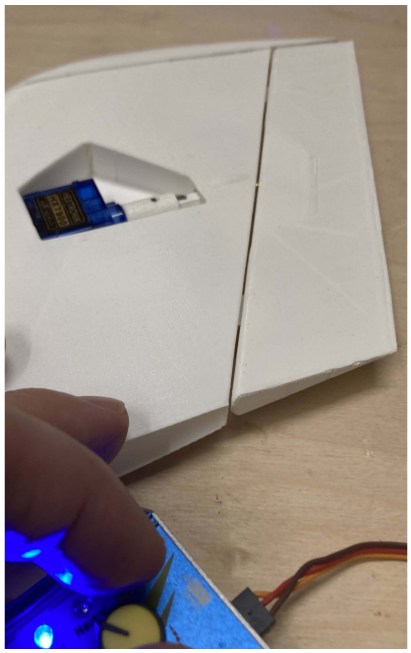
Trial fit the servo and the angled brass tube as shown in the photos. Make sure the servo is in its neutral position. Trial fit the aileron with cyano hinges cut to a size that fits the hinge pockets in the wing and the aileron. The angled brass tube should point inward at the fuselage and move inside the pocket in the aileron. Test aileron can move up and down while the angled brass tube moves in the pocket and rotates in the hexagonal RDS Part. When satisfied with the fit of all components remove aileron, servo and brass tube. Apply a bit of 15 minute epoxy to the inside of the hexagonal RDS Part. Fit the servo back in the wing and insert the brass tube. Lift the servo up a bit and squeze some medium thickness cyano underneath it. Hold in place and spray with accelerator. Mount the aileron again and use a clothespin to keep it in neutral. Wait for the epoxy to cure. When epoxy is fully cured test with a servo tester that the servo will rotate the angled brass tube and move the aileron.



Drill a hole with a 1mm drill bit all the way through the hexagonal RDS part and the brass tube. Make a little L-shaped pin from 1mm piano wire and insert it in the hole and fix it with a drop of cyano.


Glue the aileron hinges with cyano. The final step is to glue the servo lid to the wing with cyano.

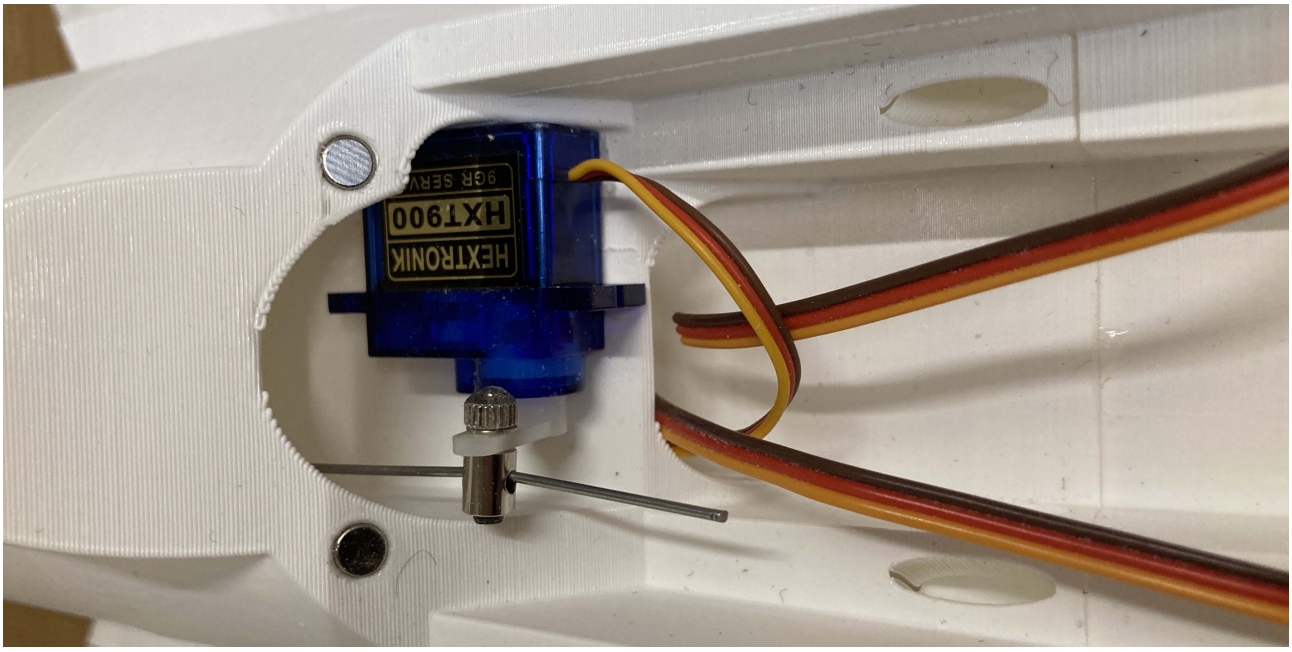


The real F-84f had anhedral wings meaning downward inclination of the aircraft's wing. The model has the scale anhedral designed into it.

To help getting the angle of the wings just right, a jig is supplied with the files. Print two of them. Push the aileron servo extention wire through the channel in the fuselage. Test the fit of the wings to the fuselage. Place the whole model on a flat surface like a floor and place the jigs under the wings where the wingtip meets the wing. Check that the fuselage is positioned with the vertical stabilizer pointing straight up and the wings are symetrical to the fuselage.

When satisfied that everything lines up perfectly, pull one of the wings away from the fuselage and add medium cyano glue to the gluing surface of the fuselage. Be careful to add glue into the slots where the wing spars slide in. Fit the wing again and check that everything lines up and looks symetrical. When satisfied spray with accelerator. Repeat the process for the other wing.

Glue elevator servo and connect with elevator push rod.



Control surface throws

Aileron: up 8mm, down 15mm
Elevator (measured at the leading edge of the tailplane) up 7mm, down 7mm

Center of Gravity

Before first flight make sure the model will balance at the Center of Gravity, CG which is indicated underneath the wings close to the fuselage. If you lift the ready to fly model it should balance at the CG marks. If the model does not balance at the CG marks move the battery forward or backwards until the model balances at the CG mark.

First flight

Always remember: It is the airflow across the wings that creates lift. Keep the airspeed up at all times.

The F-84f Thunderstreak model flies much like a real jetfighter. Speed should be kept up at all times and flying is all about energy management. Energy will bleed quickly if for example very tight turns are performed resulting in slow speed and in worst cases, a stall. If the Thunderstreak model is flown in a scale like manner with gentle maneuvers and enough speed, the model will fly "Like on Rails" with no bad habbits at

all. Make sure your place of flying has plenty of open space as the Thunderstreak will cover a lot of distance in a short period of time.

It is highly recommended to use a catapult/bungee system to launch the F-84f Thunderstreak model. A catapult/bungee system will launch the model in a predictable way with plenty airspeed at a nice angle. And it will do it again and again. Check out this Youtube video about building a simple yet very reliable catapult systém:
The F-84f should be launched with a pull of 6 kg and at a 5-10 degree upward angle.

The F-84f Thunderstreak can be hand launched but the succes depends on the person throwing it. Never try to throw and control the model yourself. Get someone with experience in hand launching to throw the model. Do not run with the model before the throw. It never adds any extra speed and most of the times it messes up the throw. Stand still and throw the model hard and straight ahead at a gentle upward angle like 5-10 degrees. Do not throw it upwards at a high angle. Add full power to the EDF just before the launch. After the launch keep the wings level and fly straight until speed builds up. Do not begin a climb out straight after the launch. Get airflow across the wings before any maneuvering.

Landings should be performed on a grass strip with short cut grass. Bring the model in low over the end of the grass strip but with enough speed to avoid any stall situation. At very low height over the grass keep dialing in elevator until the model settles on the grass at almost stall speed.

I wish you many successful flights with the F-84f Thunderstreak

Michael Hammer