Aeroic Firebird 60 Build Instructions

Foreword
This is not a beginners model and was challenging to put together to a standard I was happy with. In flight, it is fast – effortlessly fast. Being fast it will gobble-up sky, and being small it becomes a dot very quickly.

Fuselage
Firstly, you need to decide on the basic layout of the battery, servo's and receiver as this decision affects the ballast tube. If you are building the non-rudder variant then I suspect the ballast tube will not need to be shortened.

Ballast Tube
James kindly provides a 210mm long, 20mm diameter tube in the kit that protrudes into the radio bay by ~40mm. As supplied, this could carry ~650g of lead! Now, if entering the Dark Side and dynamic soaring off the back of a slope, then this ballast really helps and you probably wouldn't have a rudder fuselage so the length isn't an issue. For the rest of us, 500g of lead ballast is more than enough so you can shorten the ballast tube to ~160mm.

Mark out and trim the ballast tube to ~160mm

Make a new end-cap

End-cap in epoxied in place

Note: the tapered end of the ballast tube fits well in the fuselage, so remove material from the opposite end and cap with some 3mm epoxy fibre glass sheet. This has the added benefit of moving the opening forward making ballast additions easier. Remember to make the centre of the ballast tube and align it 80mm from the wing leading edge, and epoxy in position. Check that your chosen control runs pass the tube without interference.

Ballast tube in place. Note the centre of the tube is aligned to 80mm from Wing Leading Edge

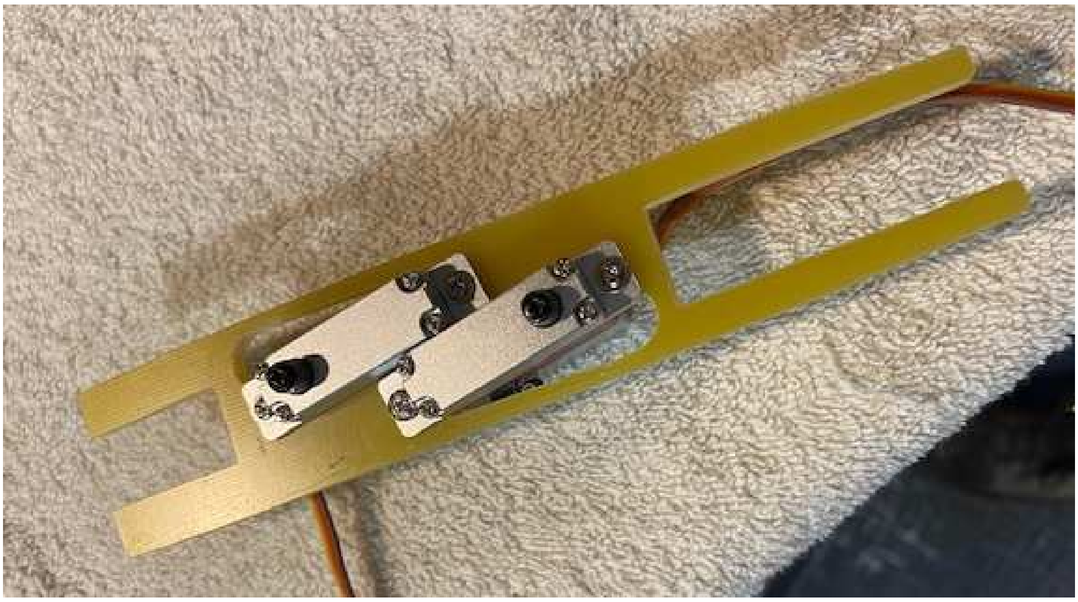
In all honestly, for the majority of us the ballast tube probably isn't needed and does massively improve access and assembly if you have the rudder fuselage.

Servo Tray

In my layout I have Rudder and Elevator servos mounted in the radio bay, a 1300mAh 2S LiPo up front, and a Jeti REX7 RX behind. The tray is made from 3mm epoxy fibre glass sheet and epoxied in place once all the fitting and shaping is complete. Basic design is shown:

Servo tray cut and trimmed to fit

Canting the servos at an angle as shown brings the output shaft close to the centre line and creates clearance for the output arms either side. KST servo wires exit via a tough gromit, so the tray is designed to insert the servo from above, then twist into position before fitting the screws.



Servo tray with servos. Remove servos before fitting

The tray is relieved from the rear for the battery and receiver to be mounted vertically and retained with Velcro. If using a LiPo, removing the battery for storage and charging is very sensible. I also relieved the front of the fuselage and canopy to get the battery as far forward as possible.

I also added shelves for the RX and Battery to sit on, and attached using Velcro:

Plates for RX and rear of battery to sit on, retained with Velcro

Plates and Servo tray epoxied into the fuselage

The radio bay is Kevlar, so the aerials don't need to protrude, but every effort should be made to get 90 degrees between them for signal diversity. However, I simply could not get the right aerial runs, so used fairings and routed them externally.

Aerial fairings in place. Masking tape prevents epoxy going where its not wanted

Tail Surfaces

The elevator is driven by a central 1.5mm diameter rod connected via a ball joint inside the vertical stabiliser. Carefully cut a slot for the rod to pass through and allow +/-8mm of elevator movement.

The supplier ball joint has a 2mm hole and can easily be sleeved using 2mm x .225mm brass tube soldered in place, and trimmed as shown:

Soldered Brass Tube

Trimmed and Elevator Joiner

I chose to drive the Rudder and Elevator using 2.9mm snakes with M2 studding each end for the clevises. As the Elevator is top hinged, it is generally less load and easier on the servo to pull at an angle of around 30 to 45 degrees from vertical. The added benefit is less curve on the snake. A slot for the elevator joiner needs to be made, which is challenging because of the thickness changes in that area. It takes a little fiddling to get it right before applying hot glue where snake outer touches the fuselage. Continually check free movement as you go.

Elevator slot with Rudder and Elevator snakes in position

Snakes held with hot-glue where they touch. Voltage regulator fits forward of the hatch with extended wires to battery and RX

The Rudder horn is pre-fitted (thanks James) and is a simple case of making up the snake and fitting it.

Servos installed and connected with RX in place

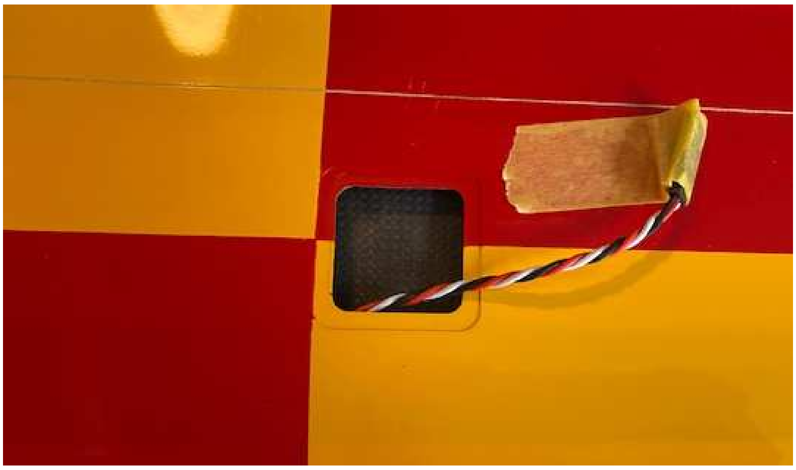
If Dynamic soaring or racing, you can either fit a micro servo in the vertical stabiliser, or use a 3mm carbon push rod. Have fun connecting a push rod as the run is impeded by the ballast tube. I found when setting the balance point, that I needed to move the voltage regulator to the rear to create enough space in the nose for the lead (3 ¼ ounces, 90g). High voltage servos would've helped by negating the need for the regulator – lesson learned.

Once happy, trim the access hatch and fit using Crystal Clear tape.

Wing

Start by threading the wiring harnesses into each wing half. It is likely that the hole in the wing-centre will need to be opened up with a Dremel to get them in:

Wing Harness exit – hole must be enloarged



Retain servo connectors with tape to protect wing

You will need servos that are a maximum of 8mm thick. I used KST X08H Plus, de-lugged to allow positioning forward in the servo bay right next to the sine-spar. I went through I number of ideas to link the servo to the control surface, and settled on a simple bent control rod with an M2 metal clevis with a lock-nut.

2mm diameter control rod with metal clevis and lock-nut

The bay needs relieving for the rod to pass freely, and to clear the output arm. You are aiming for the connected servo to sit flat against the inner wing surface with no load applied; this is important for when the servo is glued in place:

Relieve servo hatch as shown to allow free movement of control rod and output arm. Note that the relief is in-line with the control horn

Before the control rods can be fitted, all four pre-fitted horns will need to holes opening up. Given how close the horns are to the surface, this needs to be done by hand with patience and masking tape to protect the surfaces. I found it best to open the hole from each end without breaking through, then using the pushrod itself to bring the hole to the final, slop free, size.
The slots in the top of the wing may need shaping as they need to be 12mm deep and 6mm wide to be able to fit the control rods. The rigidity of the clevis prevents the control rods slipping out once fitted:

Control horn exit needs to be 12mm long x 6mm wide for smooth operation

The servo needs to be connected to the control rod before it is epoxied in place as there is no chance of fitting it afterwards. I lined the wing with masking tape before I started to protect the surface:

Mask wing to stop epoxy finger prints

Make sure both the inner wing surface and the servo have been lightly roughed-up to create a key.

The control rods need to be 53mm centres to get the servo in the right place.

Set control rod to 53mm long before installation

I found having the servo powered really helped. Sequence:

- Connect control rod to control surface
- Connect servo to clevis and lock nut fitted, but not locking
- Tuck with wires into the wing
    - Trial fit until you are happy
- Apply epoxy to the servo
- Rotate servo into position, checking wires are still ok
- Locate with a blob of hot glue until cured
    - The hot glue is all that is needed if you take time to get the control rod run correct and the servo sits flat against the inner wing surface
- Once cured, tighten lock-nut and secure with a drop of cyano

Before activating the servos, I turned the throws down to 10% and worked my way up to the correct settings to remove the risk of damage to servo or wing.

Completed servo installation. Repeat four times

I found with the servo output arm needed to gain full surface movement, and a clean run between servo and surface, the servo cover blister isn't quite deep enough. Another 3 to 4mm and it would be fine. I therefore modified the covers as shown:

Relieved servo cover

Having 4 whistles in the wing certainly makes an entertaining sound on the fast passes. The covers are secured with crystal tape:

Finished installation

I may add crystal tape fairings to tidy them up later.

Assembly

Assembly is fiddly when trying to get the green connectors into the fuselage. I have opened up the exit hole in the wing centre approximately 30mm long and 10mm wide to allow free movement of the wires in / out of the wing cavity. I have also shortened the RX end of the harnesses to reduce the amount of wire folding in the under-wing bay.

There is a knack to getting the wing and wires sorted each time. Don't rush.

Setup

Centre of Gravity

Start at 80mm from the wing leading edge, and when loading the ballast tube make sure you add evenly front to rear unless fine tuning.

I used made up the nose weight using sheets of 2mm lead cut to a profile to match the inside of the fuselage and wedged them in place, adding / removing weight to fine tune.

I use the vertical dive trimming method to fine tune the CogG on all my models. Gain height, enter a vertical hands-off dive: if she tucks she's tail heavy; if she pulls out she's nose heavy. You are looking for a straight vertical hands off dive without deviation. Be careful, though: this is a thoroughbred racing machine and accelerates alarmingly quickly in a dive if you aren't ready for it – put on plenty of height and be ready with the airbrakes and elevator. A less pure, but effective method is to dive at 45 degrees and look for the same tucking / pulling out behaviour; it works, but the effects are less pronounced.

Control Throws

Control throws (to start) in mm from the roots or closest to the fuselage, as recommended by Dr Hammond, are detailed below. I have developed the Termal setup for light wind days.

Normal:	**Up**	**Down**	
Ailerons:	12	8	
Elevator:	8	6	
Flaperon:	12	12	(optional)
Snap	0	5	

Speed:	**Up**	**Down**
Ailerons:	10	6
Elevator:	6	5
Flaps:	3	3
*Aileron reflex	-1	
Snap	0	3

*Put a ruler along the top of the aerofoil until the top, and the front of the ailerons/flaps and TE all touch.

Thermal:	**Up**	**Down**	
Ailerons:	12	8	
Elevator:	8	6	
Flaps	3		Fixed
Aileron reflex	3		
Snap (N/A)			

Crow braking:	**Up**	**Down**
Ailerons:	17	
Elevator:		6
Flaps		60 to 80 degrees (As much as you can get)
Snap (N/A)		

Normal, Speed and Thermal are on a three-position switch in that order (Speed in the middle), and the crow brakes are on the throttle stick to gain proportional control. I have also set a 1 second transition time between each Flight Mode to keep things smooth.

I have exponential set at 50% aileron, 20% elevator and 10% rudder just to soften things around the centre.

Experiments with ballast continue…

General Flying Notes

The Firebird carries speed into manoeuvres very easily, and the maiden proved it is quite aerobatic. Keep things wide and smooth, like a turbo-jet, and you can't go wrong. The flaps are very effective at slowing things down, but almost totally remove aileron authority when fully deployed, and if you slow too much, may reverse the ailerons. Always retract the flaps just before landing / impact, whichever seems the most inevitable.

Rudder response is remarkable given its size and lack of movement and will command pretty good stall turns. It is most useful in thermal turns for keeping the wings more level; I have a little mix with rudder and aileron in Thermal mode. The rudder is also good for side-slipping when bleeding speed for landing. I would always recommend a full-house setup, even with the additional hassle it caused fitting everything in, as it is an extra dimension of control.

Elevator authority is good, but does need to be reduced in Speed mode. The wing is immensely strong because of the sine-wave-spar, making the weak-point the retaining bolt thread, but no need to risk it by keeping things smooth.

I found launching and landing in Normal mode is best, then use Thermal to gain height when thermals are about, and drop into Speed to come tearing across the slope. Note: it makes very little noise on a fly-by – none of the loud whistling you sometimes here – which is a mark of how clean it is aerodynamically.

If the wind is much less than 15mph fly something else.