Redshift F3f Competition Model Sailplane - Building Guide.

Redshift: ˈred.ʃɪft - From the Cambridge English Dictionary.
“A change in the way that light reaches the earth from star and other objects in space because they are moving away from the earth.” The Cambridge English Dictionary.
Redshift: ˈredˈSHift - From Oxford English dictionary.
“The displacement of spectral lines toward longer wavelengths (the red end of the spectrum) in radiation from distant galaxies and celestial objects. This is interpreted as a Doppler shift that is proportional to the velocity of recession and thus to distance.”
Redshift: ˈRED.ʃɪft - From the Doc Hammond Dictionary.
“If its shifted to red, then it’s going to be heading away from you at one hell of a speed…So TURN!”

The Perp, with the toy.

Technical specs:

- Span: 3.0M (118”)
- Length: 1.395M (55.8”)
- Wing area: 48Dm/2 (744” Sq)
- Tail area: 5.8Dm/2 (89.9” Sq)
- Total area: 53.8 Dm/2 (833.9” Sq)
- Wing Loading at 4Kg (8,8 Lb) AUW 74.39g/Dm/2
- Aspect ratio: 19:1
- Wing aerofoils: JH3580, JH3575, JH3570
- Tailplane aerofoils: JH10SYM
- Controls: Ailerons, Flaps, Elevator, Rudder
- Servos: 10mm (Fuselage/Flaps) 8mm (Ailerons)
- CG 90~95mm depending on preference.
- Brass Ballast (Fuselage) 1 x 20mm square tube @ 350mm long = 2238g
- Brass Ballast (wings) 4 x 20mm x 10mm @ 250mm long = 1750g

Total ballast possible Vs wing area:

2238g (Fuse) + 1750g (Wings) = 3988g divided by 53.8Dm (Wing area)

= <u>74.126g/Dm2</u>

Building notes:

First, a sincere note of thanks from me:

Hello discerning flyer, and now owner of a Redshift F3f Model sailplane.
I'd like to thank you for choosing the Redshift. A lot of thought, much testing, a whole slew of theory and calculation, but most of all a heck of a lot of experience went into its design. It's different, certainly not a "me too" and I have to say I am really happy with the way it came out.

I believe that your Redshift will reward you by making you giggle insanely, while grinning so hard your head might be at risk of falling in your mouth – which event, is actually a good thing. But most of all I hope it brings you much joy and real fun.

What's in the box?

Before you start:

PLEASE Read me!

PLEASE do read through this instruction document carefully, and identify all of the parts needed and the work to be done. Make sure you thoroughly understand it, and if there is anything you are not completely sure of - then ASK ME! I'm always happy to help.

Working surfaces:

YOUR model has a nice high polish, and unfortunately its quite easy to get scratched by sharp tools, abrasive paper, your wife's fingernails – when she finds out he much you paid for it - or even a slightly gritty surface. So, always use a cradle or at least a soft surface to lay your parts on when working – anything might do – an old blanket, just as long as it won't scratch your lovely baby

Glues not to use:

THERE is no place on this airframe for 5-minute epoxy or hot glue. Please don't use these. Yes, they may save time but I can assure you that you'll spend a lot more time repairing the plane if they fail, and at worst you won't be able to.

Glues to use:

SLOW Epoxy, or failing that, slow epoxy, or as an alternative, slow epoxy.
Cyanoacrylate – "Zap" good quality and used in very small gaps, or for "tacking" components in place before securing with Epoxy.
I have heard good things about Gorilla glue but I have never used it, so I can't recommend it.

Preparation:

ALWAYS try to keep the surfaces to be secured clean and especially free of dust or any form of oil – ESPECIALLY - silicon oil or wax.
Always prepare the surfaces to be bonded by light abrasion, and then by degreasing with good alcohol or acetone etc.
Always make sure that the components to be secured fit well, with gaps as small as you can manage.

The fuselage installation:

1. Ballast tube

THERE is not that much to do here, but what is done is best done carefully:
Please measure twice and cut once.

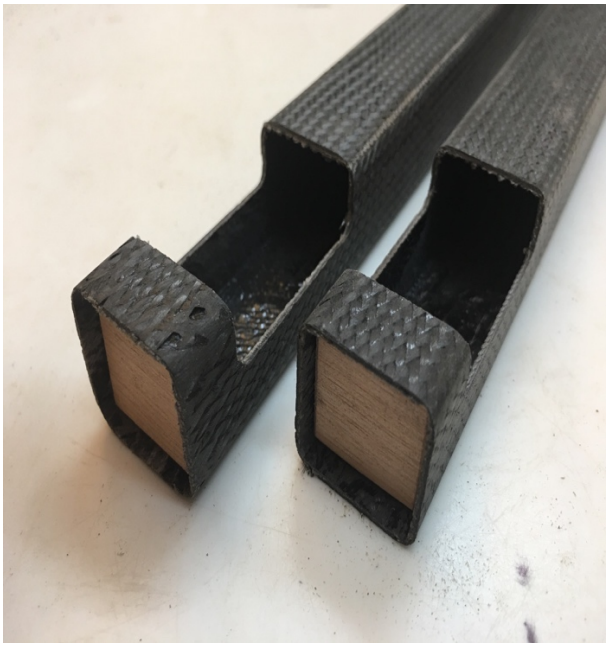
THE START of fuselage installation should begin with the 20mm x 20 mm ballast tube. As this is a member of considerable strength in its own right, I like to use is to add strength to the fuselage rather than just as a place to add weight.

NOTE that the carbon/glass tube supplied can use USA standard ¾" x ¾": (19mm) Brass, Lead in square brass tubes, Refined Osmium, or active Uranium ballast slugs, as well as the metric 20mm x 20mm versions.

So, let's go!

FIRST THING to do is to cut two 20mm x 20mm x 6mm ply end plates. Trim/sand to fit snugly inside the ballast tube.

NEXT, cut the opening for the slugs to be inserted or removed which should be slightly longer than a slug and about half way down the tube, so that you can grab them if needed. Remember to leave the ends intact for the ply end plates:



THEN, decide how long you want you ballast tube. Normally this will be as long as possible, but there are three things to remember:

1. The length of your slugs – I use 35mm (1, 3/8”)
2. The system you will use to keep the slugs in the tube. I use Depron or other hard foam.
3. The Centre of gravity, which is 90 to 100mm (3.54” to 3.93”)

THUMBNAIL FORMULA: Length of slugs (35mm) x 10 = 350mm PLUS two x ply end plates = 362mm, PLUS one slug length for insertion and removal. Total length should therefore be around 397mm or 400mm to be as near as dammit. This will hold ten slugs for 1.22 Kg. (2.7 lbs.) of brass. If you are using radioactive materials it may be more.

NOW roughen and degrease the insides of the ballast tube at both ends and epoxy the end plates in. Try not to get too much epoxy inside the tube as this might cause the slugs to bind and there’s nothing worse than a slug stuck inside your tube – as the actress said to the bishop.

MARK THE MIDDLE OF THE SLUG MAGAZINE. That’s the space between the front of the rear ply plate and the BACK of the cut-out section at the front where all the ballast will be stored. In other words, all of the useable contained ballast space. You’ll need to know where this is when bonding-in the ballast tube to make sure the ballast is always around the CG.

OK, when that’s all cured it’s time to add the rails – note that you do not absolutely HAVE to do this but it makes several things easier, and adds a lot of strength to the fuse. I cut two nice straight grain spruce rails, 10mm x 5mm x 630mm (3/8” x 3/16” x 23”) and then plane them so that one side of the rectangle is reduced to 3mm to account for the curvature of the fuselage. Then I epoxy them to the sides of the ballast tube with about 220mm (8.6”) sticking out beyond the front of the tube, and the tops about halfway down. The front extensions will provide rails for the radio tray to sit on later.

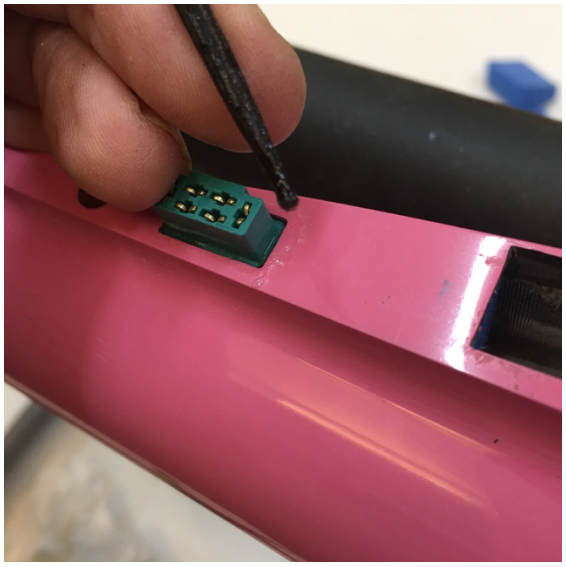
AFTER that's all hard, it's time to trial fit the assembly into the fuselage. This is where you have to make sure that you know the centre of the ballast mass and the CG of the plane. Trim, phiddle and phart with the assembly until its fits nicely inside the fuselage, while making sure the CG position and the centre of ballast mass are the same! That done, remove a portion of the rail just behind the ballast tube opening on both to run the wing servo wires down. You need this to allow the wires to pass the end of the ballast tube and go into the radio compartment.
NOW glue the assembly inside the fuselage, after checking ad infinitum that the damn thing is in the correct place.

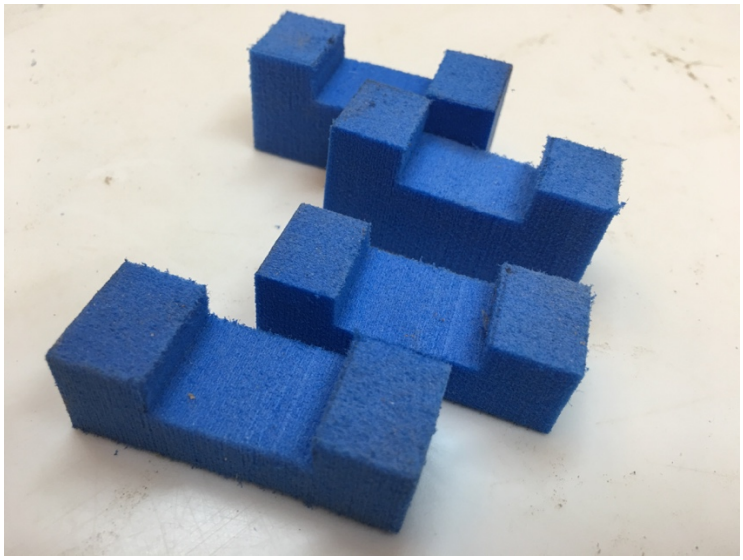
FINALLY, after all is cured and hard as a diamond, make sure there are no obstructions, protrusions, debris, dead mice or any other mummified remains inside and route the wing wiring harness. The wires should fit into the "trenches" either side of the ballast tube and then run down through the removed rail portion into the radio compartment. And if you have done it right, you can reward yourself with a goodly swig of your favorite falling down water.

2. RADIO TRAY:

CHECK that the battery, receiver and servos all fit the tray and trim to suit if needed (The radio tray, NOT the battery, servos and receiver). Then check to see that the tray fits inside the fuselage on top of the spruce rails. If all is good, then epoxy it in, but try not to get any epoxy on the wires. I sometimes put a bit of shrink wrap or suitable plastic tube on the wires (but don't shrink it.) to provide a little protection.

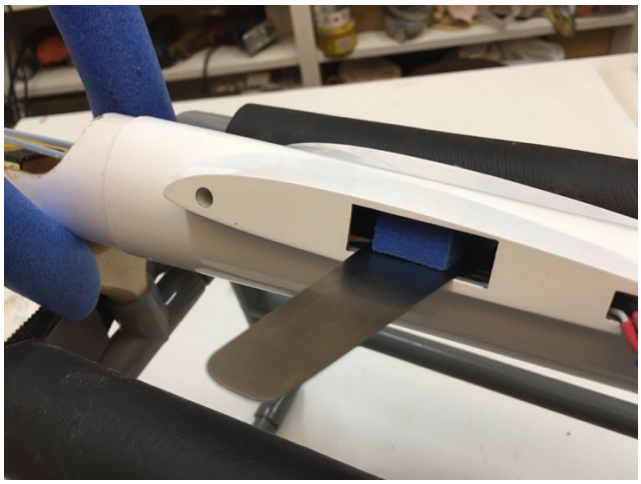
THAT done, it's time to secure the connectors into the wing holes. What I do is to drip a little bit of cyanoacrylate glue into a discarded pop/soda bottle cap, and then use a toothpick or sharpened stick to get the tiniest drip of Cyanoacrylate and run it between the connector and the wing stub hole. Damn stuff is hard to control if you try to use the bottle nozzle, and the little nylon capillary tubes that come with the glue never last long.





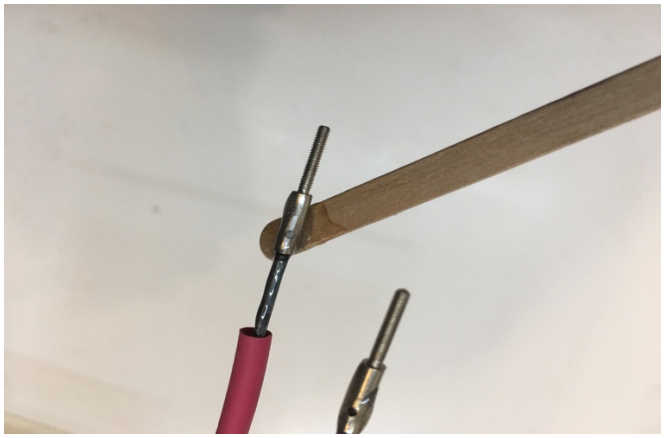
NEXT I usually make some Depron or other foamy type connector wire keepers to bung inside the fuselage wing stubs to prevent the wires and pushrods from obscuring the wing joiner orifice. Note that these are about 20% larger than the space they have to go into, both are different sizes, and they have channels cut so that each side holds down the wires, etc. well. In this case (see above – I made 2 sets while I was at it) it was bit of blue packing foam.

FIRST MAKE SURE that the Teflon control rod tubes are ON TOP of the wire bunches, then use something thin and flat to hold down the wires and pushrod tubes, and then slide/push the keepers into place each side front and back – a bit farther than the orifice. I used a stainless-steel spatula, but a steel rule works well. Bingo! wires and tubes now firm and secure and not obstructing the ingress of the wing joiner.



NOW it's time to get the control rods sorted out. After many years of using carbon rods and plated brass clevis/ball joint leaders, I have come upon the method that works the best for me: First abrade all the surfaces lightly - until they don't shine is enough. Then degrease the rod and the leader with alcohol or acetone etc., before using Cyanoacrylate glue to secure the leaders to the rods. After that, thread an appropriate sized piece of heat shrink tubing on to the rod and get it back out of the way. Next thoroughly mix up a very small amount of 30-minute at least, (24 hour is better) epoxy and dab a bit round each rod. NOT TOO MUCH!

THEN slide the heat shrink tubing over the assembly and heat it gently with a heat gun (not a flipping cigarette lighter or a blooming blowtorch!) and shrink it until its tight. It's a good idea to have a piece of tissue or a rag to dab away any escaping epoxy – and there will be some. Neat huh?



This is how I do all my control rods so I won't bother to repeat this elsewhere in the instructions.

3. V-Tails:

YOU will notice that the model comes to you with the V-Tails secured by the 5mm joiner rod and the 3mm location pins inserted through the tailplane stubs on the fuselage. While this works fine - there is quite a bit of bearing area inside the fuselage tail stubs – it's probably better to add a bit of security.

This can be done in three ways:

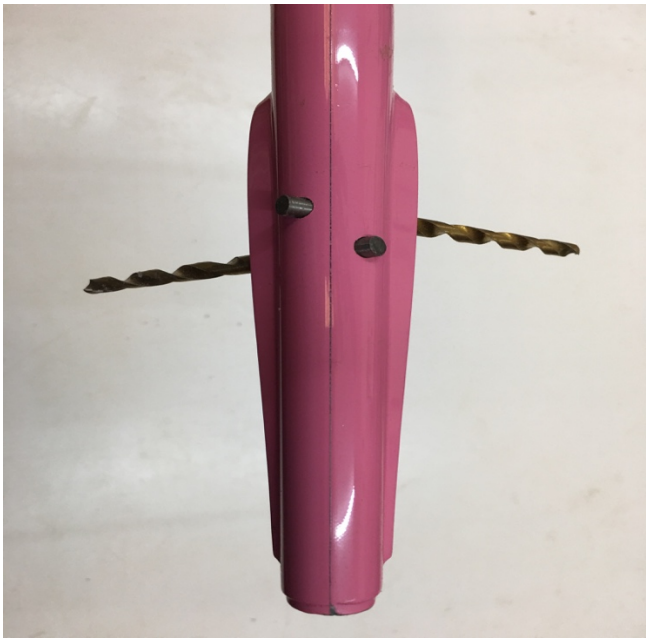
1. By continuing the 5mm hole through the fuselage sides, and bonding the 5mm rods through the fuselage. Problem there is that if you break the rods – which is highly unlikely – then they won't be that easy to remove and replace.
2. By adding a bit of "splooge" (epoxy and filler) around the ends of the 5mm rods where they touch the bottom of the fuselage. Again, unless you wax the ends of the rods or use substitute ground steel dowels prior to adding the splooge, then this again presents a "permanent" solution.

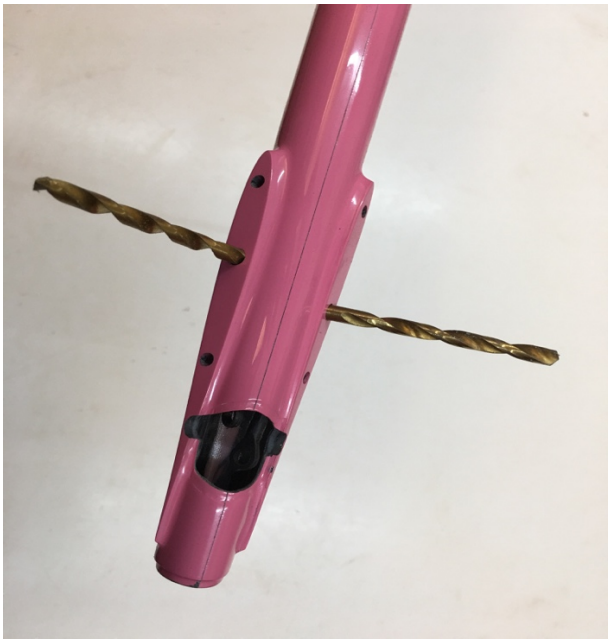
3. Belt and braces - combining 1, and 2:

PUT some tape over the underside of the fuselage where you expect a hole to appear, as this will help to make a crisp hole without too much chipping at the edges.
Remember that the tail stubs and the Tailplanes are not 90 at degrees to the 5mm rods, but ARE at 90 degrees to the fuselage centre line. Extend the holes carefully, using a very slow drill speed and a gently pushed 5mm bit to ease through the fuselage. To make a more secure alignment, I wax the ends of the 5mm joiner rods and insert them so that they can protrude through the bottom of the fuselage. Then I pull them out again, and add splooge through the new holes on the underside of the fuselage.

Then push them back and twist them to distribute the splooge inside. Be careful to remove any epoxy that gets pushed out. When cured you can knock the rods out and shape the ends of the joiner rods to the fuselage contour by carefully sanding.

Note: Using the chuck end of 5mm drill bits, or even better, using 5mm ground steel dowels is better than using the carbon Rods.





LAST, it's time to tidy everything up, fit the servos, and connect the receiver and battery etc. By the way I rarely use switches of any kind. I prefer to leave a connector between the receiver and battery etc., and use a model finder alarm to remind me to disconnect – but it's entirely up to you.
I normally attach the cute little end cap - don't you just love it? - at this stage. You can tape it, Zap it or epoxy it – as you wish.

4. Wings:

Preparation:

PLEASE DO remember to make up your wings on a soft surface. The paint used for the model is actually hard 2-part car paint so it's pretty resilient, but we use a lot of hard tools, mini-grinders, and abrasive paper - not to forget the vengeful wife's nails - all of which can be harmful to the nicely polished wings.

Design notes:

THE WINGS for the Redshift have a very advanced planform that is designed to give a good elliptical "type" lift distribution while minimizing the boundary layer departure problems often associated with the ellipse type wing configuration. Added to that and to make thing even more weird, you will notice that the aerofoil sections are double cusped – that is, as a friend once put it – they have undercamber AND "overcamber". This is a high control response section that is designed to give good reaction to control inputs, so you get more effect for less angle of deflection. Or to make it easier to understand, less drag per given control input/control response.

If you want to know more about this, please contact me.

AS USUAL, all this means penalties, as there is no free lunch. The aerofoils are 8% thick, and have just under 2% camber with the high point at about 25% of the chord – which leaves the rear of the airfoil a bit thinner than "normal".

The end result of this means that for the ailerons, the new 8mm (5/16”) thick wing servos are easiest to install – and these are in fact what the wing is designed to use. 10mm Servos will fit, but end up being a bit fiddly to install. Here I have illustrated the “worst case” by using 10mm servos in the aileron pockets.

Note: For flaps, 10mm thick servos will be no problem.

Flaps


Ailerons

Start by spotting the servo mounting holes on the servo frames – either the ones supplied, or any you wish to use. The drill the correct sized holes through the frames and trial fit the servos, checking to make sure that the mounting screws do not protrude through the bottom of the fames. If they do then just file them off. Sometimes I have found I necessary to file a small clearance on the side of the frames to let the servo wires fit freely.

Note: If you are using 10mm servos you will need to trim the servo hatch mounting area to allow enough room to get the servos and frames in.

TRIAL FIT everything! Make sure the whole assembly fits where it should, and that the servo arms will line up with the control horns. If anything needs to be fettled, adjusted, or modified – now is the time to do it. Also, please don't forget to roughen the undersurfaces of the servo trays to provide good adhesion.

NOW it's a matter of degreasing the pocket insides and the servo trays then bonding in the trays with epoxy. I find its best to do them one by one even if it does take longer as this part is important.

SERVO HATCHED supplied are too large to fit the servo pocket recesses, so you will have to sand them down to fit. I normally save a little time by snipping off the sides to within a couple of millimeters of the correct size and going from there.

LAST, PLEASE thread the servo connector harness through and connect the servos. To keep things tidy and not too loose I put some Depron "keepers" where I can to hold it in position. Ever since I was a baby I have hated rattles. Don't be tempted to glue the connector into the wing. It's hard to get correctly aligned and really not necessary.

Done, your model should look like this:

Redshift F3f Controls etc.:

1. Dimensions in millimeters
2. Angles in degrees

Parameter:	**Position (up)**	**Position (down)**
CG	98mm from LE	
Controls:		
Ailerons	+18	-12
Elevator	+5	-5
Rudder	+10	+10
Flaps		-80º
Snap flap		-5
Butterfly/Crow:		
Flap		-80 º
Ailerons	+5	
Elevator		-4

Happy flying!

James Hammond. January 29th 2018