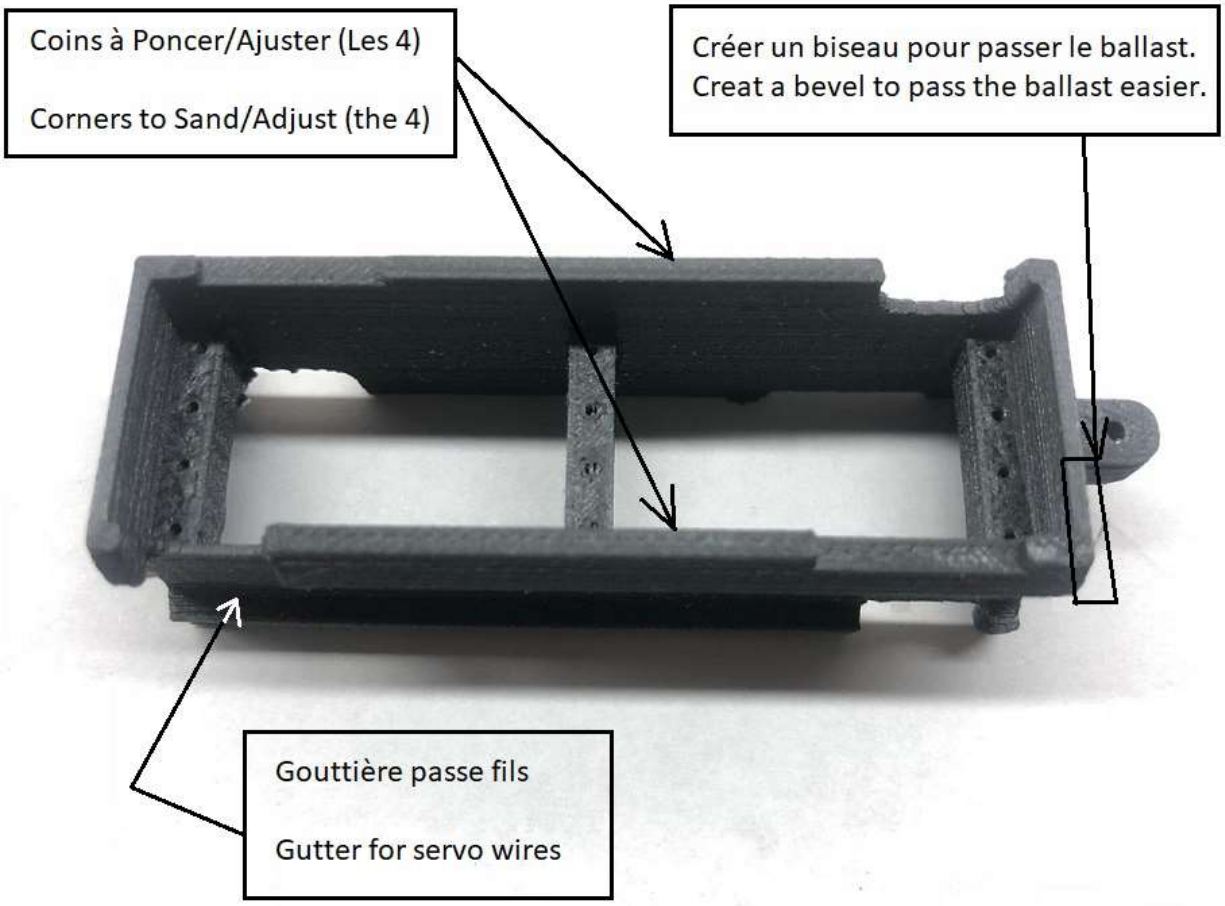
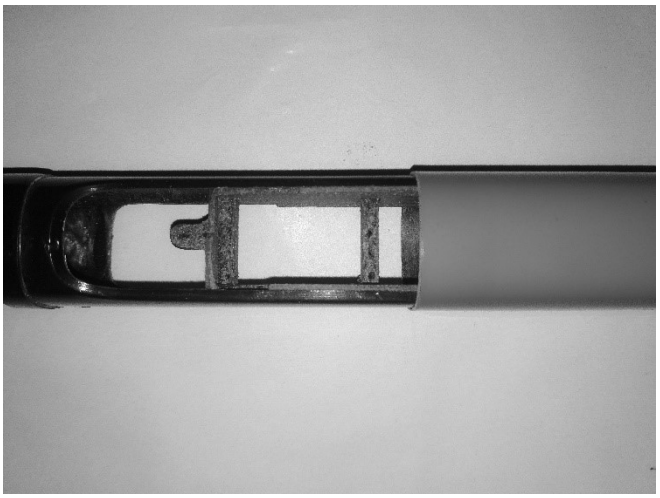
NRJ – Assembly and settings manual

Thank you for the purchase of our glider, we hope that you will enjoy flying it!
Please pay close attention to the following assembly instructions, to have the most reliable machine the NRJ can be.

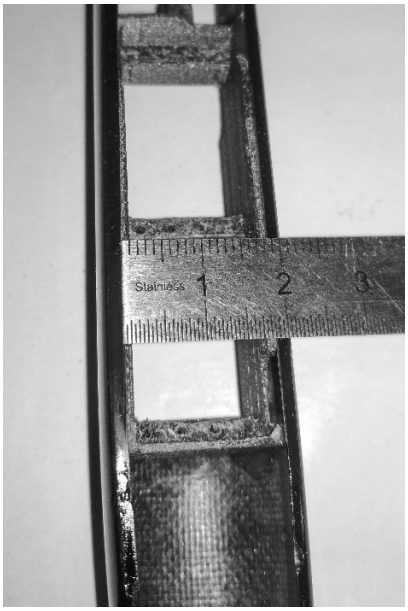
<u>Servo tray preparation.</u>

The servo tray is 3D printed and requires some fine-tuning to sit perfectly in place in the fuselage. Small thickness variations in the fuselage are expected, and as such it is necessary to lightly sand the tray for a perfect mating. The tray should maintain accurate dimensions in the corners and along the length of its contact with the fuselage. It should also let servo wires through freely. Run multiple dry fittings and check that the external nose cone slides without forcing or deformation. An improper placement of the tray may prevent the nose cone from fitting when the servos and servo horns are mounted.

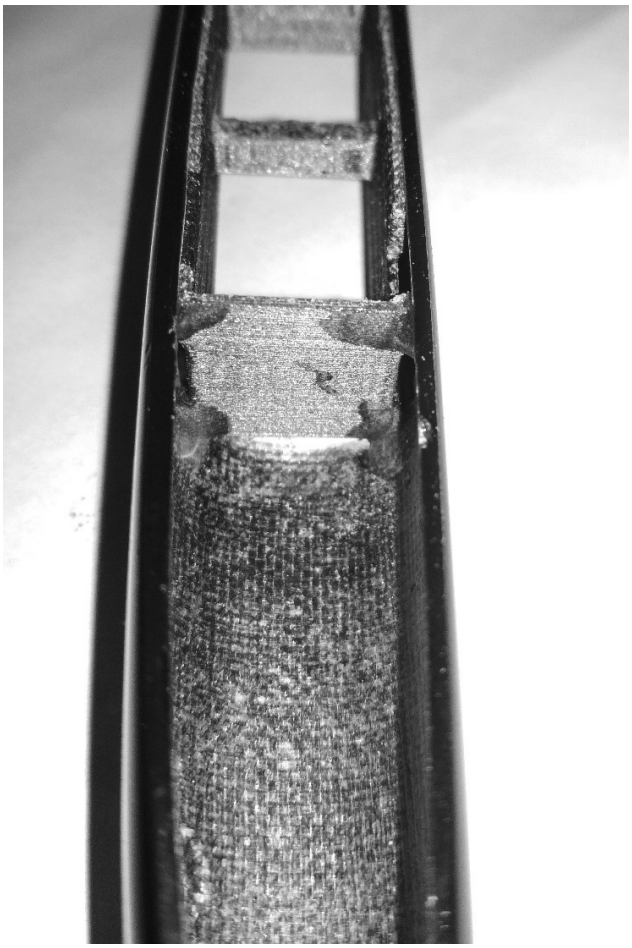


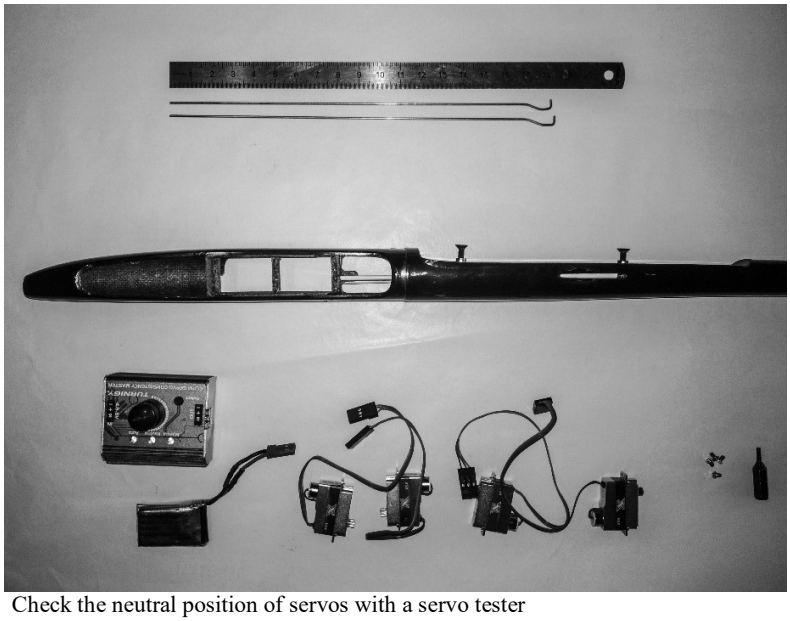


To leave the possibility of ballasting the glider correctly, a distance of around 23 mm between the end of the tray and the central lip of the fuselage opening is necessary.



The tray can be glued with fast (less than 90 minutes) epoxy, whose different properties from the long-curing fuselage epoxy allow an easier removal of the servo tray if required. Glue with 4 mating points on the top and bottom sides of the tray. Be careful to not fill in the cable channels of the tray with glue, meant to allow the servo wires to reach the nose.



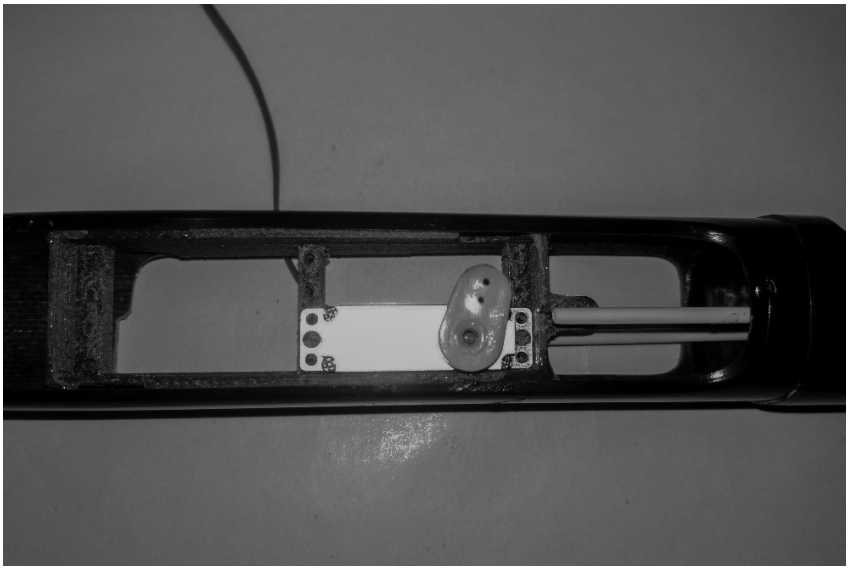


Check the neutral position of servos with a servo tester

An exemple of servo mounting on the tray

Servo mounting: *It is imperative to do so only once the tray has been glued in right place*. Two screws per servo. Check the screw diameter against the tray's pre-drilled hole, the plastic is hard and fragile screws may break while screwing in, which would obviously complicate assembly. (if needed, drill it again with a 1.2mm bit)
3 types of servo trays available:
4 x KST 08 ' , 4 x MKS DS75K ' and 2 x KST 08 + 2 x MKS DS75K '.
You can replace KST08 by Dymond D47 for tails (light versions).In this case, glue a little piece of 4x4mm (pine wood) under the D47 leg , to have the right horn's height position. D47 works in 1S, but it's better to supply it with a 5 to 6 V voltage booster.

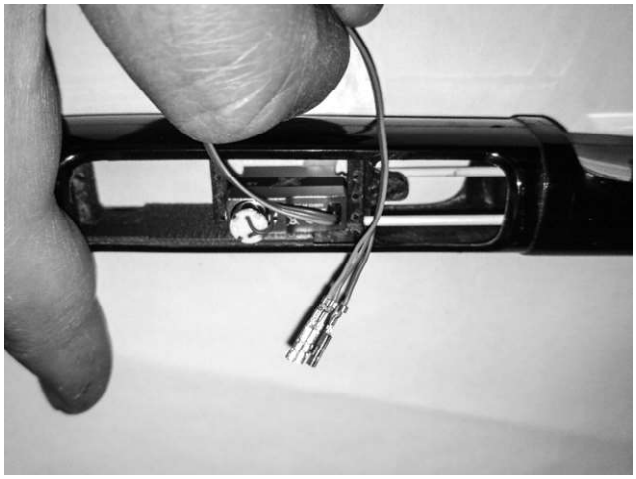
Ailerons servos and linkage system mounting:
Mount the ailerons servos close to the wing and the tails servos on the front of the tray. Ailerons linkages must be as short as possible.



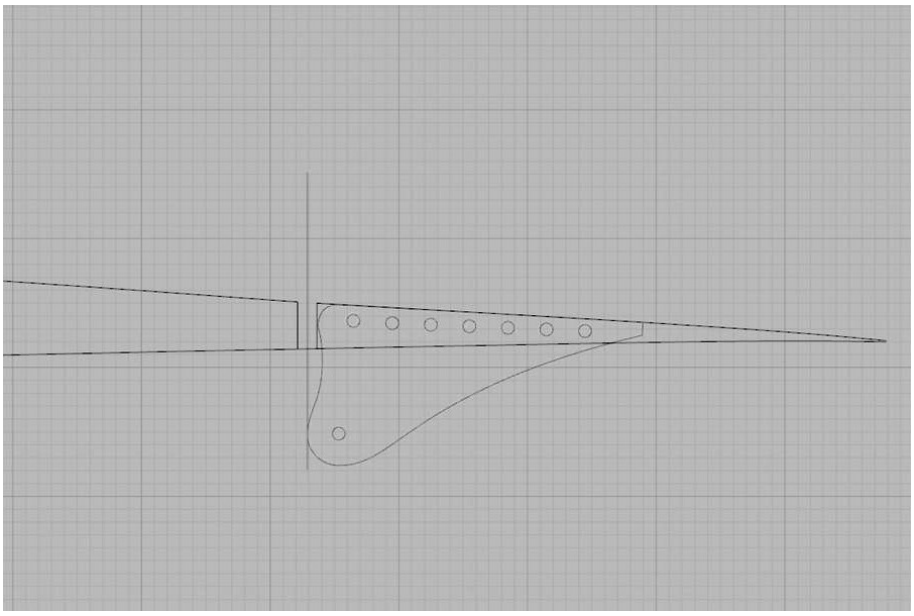
Here, sleeves are only dry mounted to check their possible length.

To insert the servo wires in place, disassemble the servo leads from the plugs while being careful with the order of those leads in the plug. Then use a thin string attached to one or all three leads and pull them through the channel towards the front of the fuselage. If necessary, gently separate the joined wires from each other by pulling the leads apart to have

more play to pass the leads one at a time through the channel. The NRJ's fuselage is very thin and space is thus at a premium, however this is the price of having a significant decrease in drag!

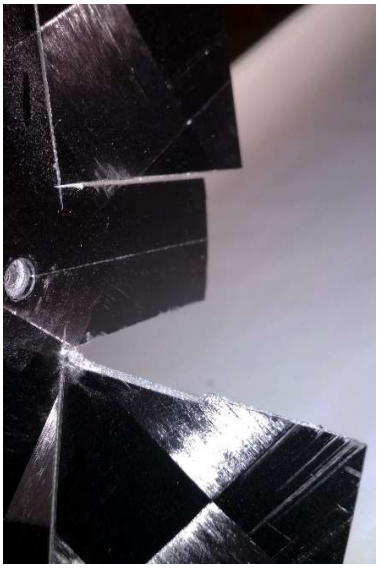


Aileron horn installation



To minimize the "accessory" drag of the ship, the aileron horns must be installed as close as possible to the fuselage. Be careful to keep the installation of horns symmetric and respect the given distances for the best range of motion. Cut a notch of 1.5 mm wide and 25 mm long on the side of aileron root, as close as possible to the hinge. Put a tiny drop of oil on the Kevlar hinge, to prevent CA to enter in it. Glue your horn precisely with CA, adding a 25mm joint between aileron and horn on the bottom side of aileron.

Vertically, the horn's hole is backward offset from hinge to prevent the command rod from bending excessively during full flap extension.

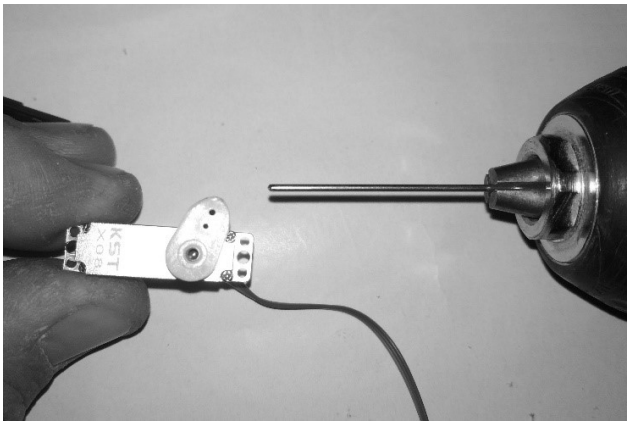


Aileron linkage installation

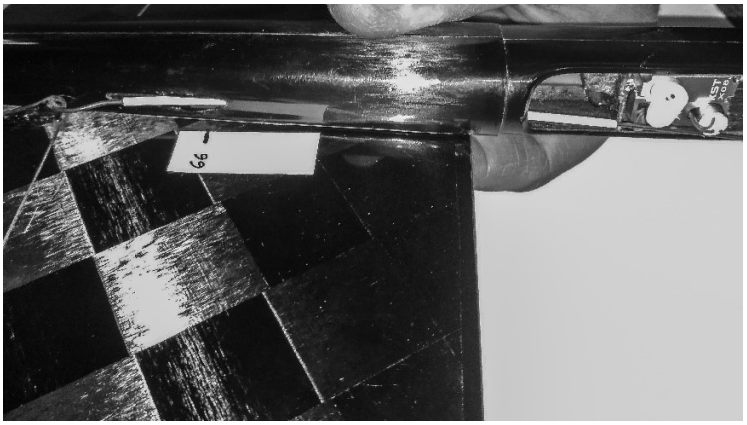
In order to have as little play and as rigid a control rod as possible, it is preferable to use the elements provided in the kit, such as the *plastic sleeves and 1mm control rods* or TFLE *(Teflon) tubes and 1.2mm rods*.
Check the hole diameter of the horns both the servo and control horns for a tight fit. If one of the holes is just a bit loose, using a slightly oblique elbow joint or a CA drop should help remove the residual slop.

Kinematic requirements for ailerons:

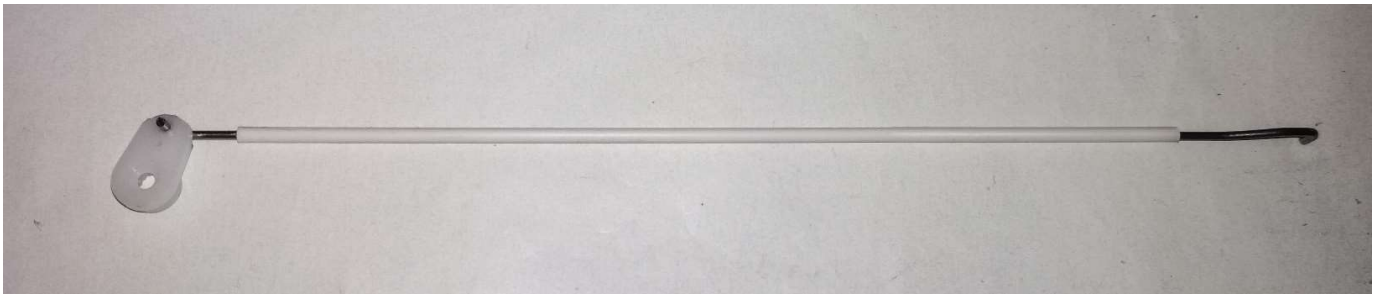
For the optimal range of motion on the ailerons (+35mm of down for full flap, -13mm up) we need a linear range of (+6.5mm, -2.5mm) of the control rod at the aileron horn linkage, with a matching range of motion on the servo horn. The aileron servo horn should normally be a 2 holes horn for KST servo (Axle to 2nd hole: 6.5mm) and 1 hole for MKS servos... (Axle to single hole: 7mm). Keep these ratings for perfect range and precision.
At neutral, the aileron horn servos must be 20-30° backward tilted to the ailerons direction, to fit the servos and ailerons linear ranges better. In total, 9mm of linear range must be managed on both aileron and servo horns. Notice that we must choose the shortest servo horn possible to prevent any instance of flutter, which damages servos over time, caused by the torque and vibration constraints that are transmitted by the aileron linkages. But we must keep enough length in the lever arm to allow for enough linear range. You may be tempted to put quite longer horns to allow for easier ballast passage in the center of the fuselage. Rest assured, the ballast system enters the fuselage perfectly as we designed if all assembly is done per the instructions herein.
Always use the maximum angular travel possible for the servo with full radio travels. This will ensure the trims precision.



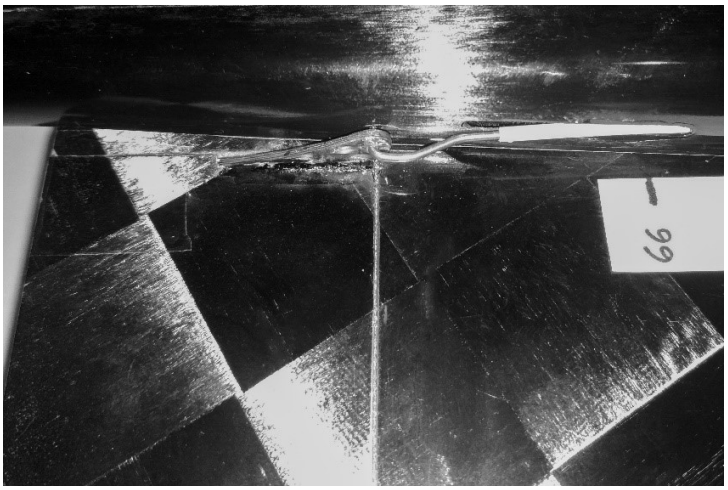
Fit the aileron and servo horns' holes to the rods diameter with a rod piece.



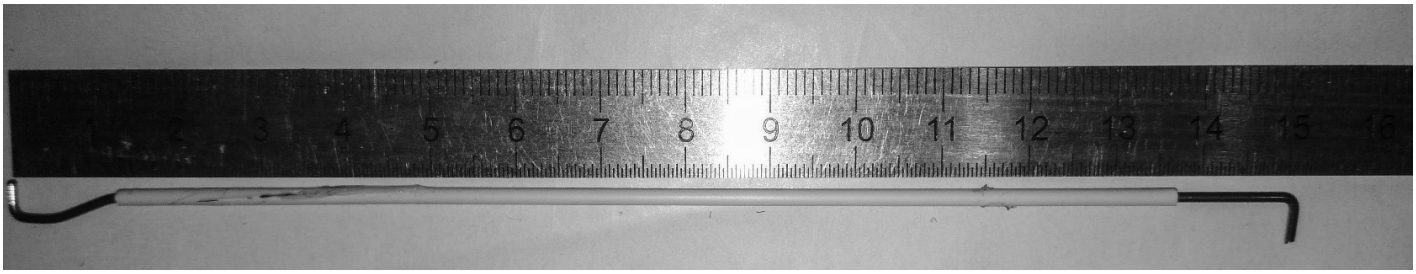
Start the linkage build from ailerons and finish it at the servo horn.



The sleeve must be glued only when the linkage will be entirely cut and ready (elbows and lengths). Don't forget to insert rod in sleeve first.

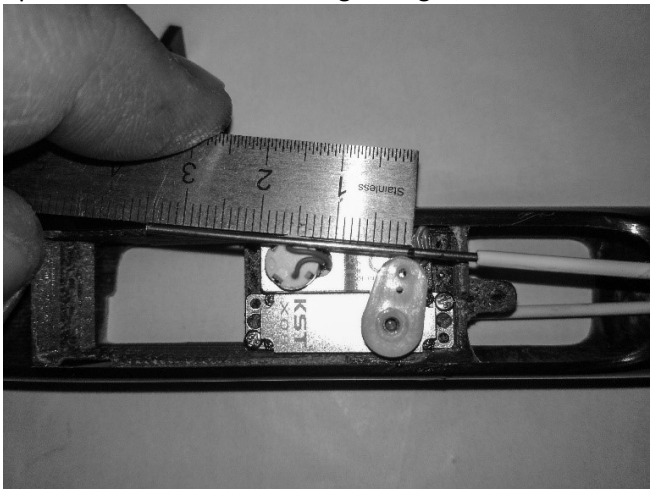


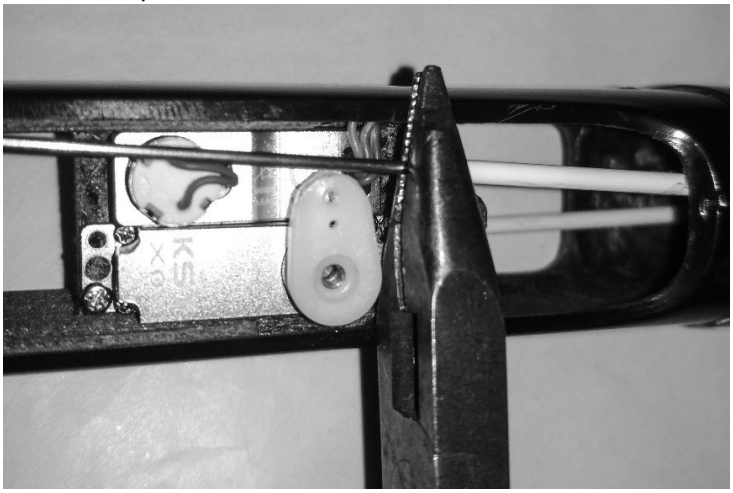
Immobilize the aileron with a piece of tape and mount the wing on the fuselage.

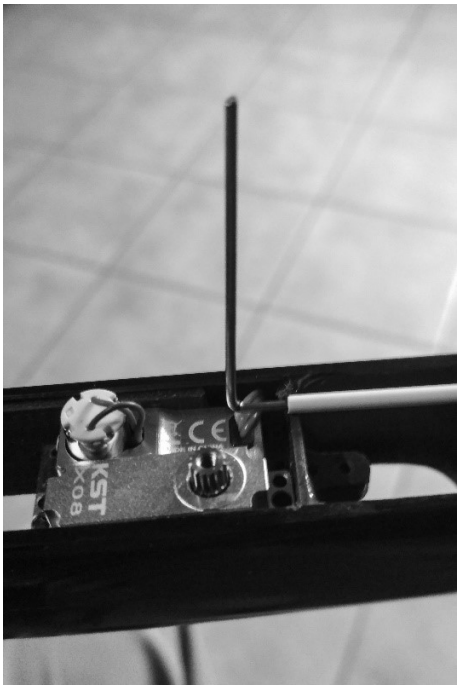


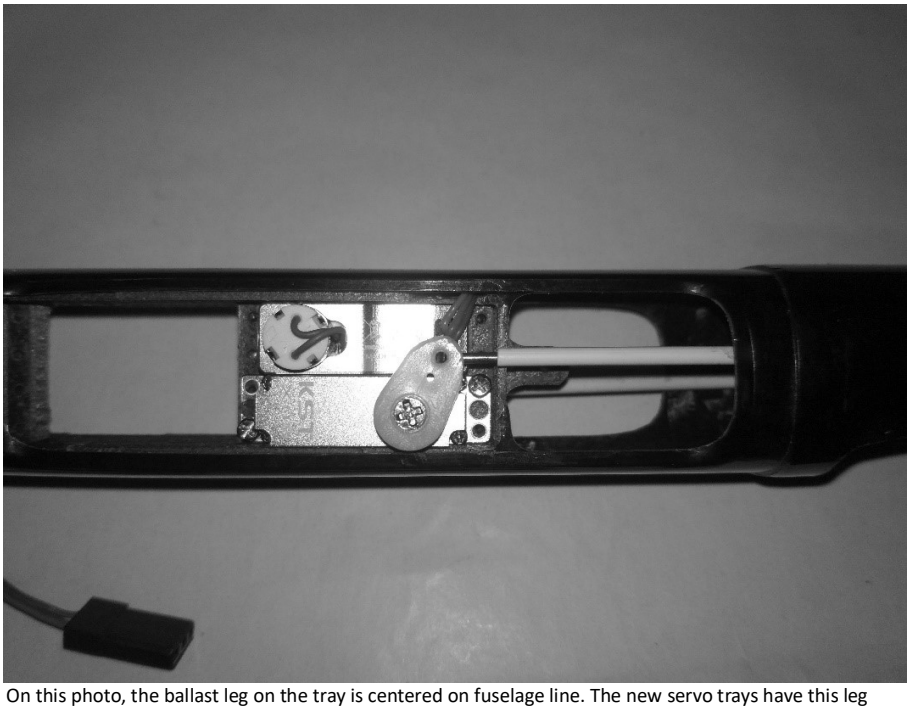
Then prepare the aileron connexion with the right width and shape for an easy mounting/unmounting... The length ***will*** differ for your installation, so do not take this image as a reference for length.

After the aileron bends are prepared, mark with a pen about 1.5 mm before the horn hole. (Again, aileron is secured at neutral and servo at neutral with the definitive tilt!) The difficulty is to bend the rod at the right length, take your time and calculate your gesture. Put your pliers just over the pen mark, edge to edge, the pliers must cover the pen mark. Fold up the rod and cut it at the right height, to let the nosecone slide into position without friction.



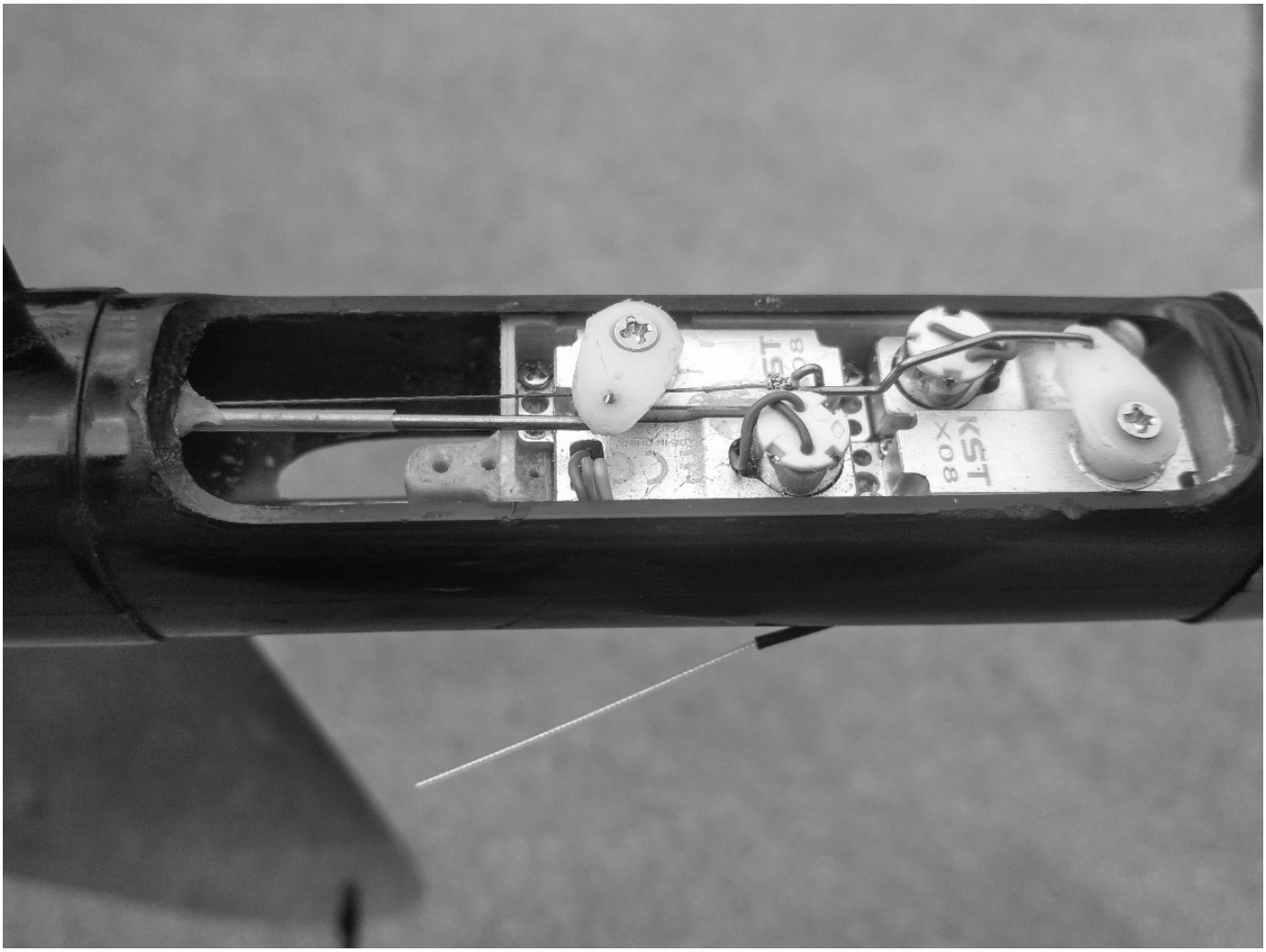






On this photo, the ballast leg on the tray is centered on fuselage line. The new servo trays have this leg brought down a few millimeters… **a better ballast connection is now guaranteed**. ;-)

Glue the sleeves after having slid them with enough linear range near the aileron horn for full flap extension.
Their lengths can be adjusted by cutting even if the extremities of the linkage are done.
For an optimal strength of the linkage, be sure to follow instructions for both inner and outer glue joints, as intermediate mechanical reference points.
The greater the length between the points (horns anchorages and fuselage reference), the more likely the control rods will bow and allow flex in the linkage. (And allow flutter to happen as a consequence…)
Do not under estimate all those said mechanical needs for perfect reliability and precision.



Tail feathers installation

Kinematic requirements:

Elevator
The necessary servo-side control range is **+/- 4mm.** Choose a short servo horn for this servo, which will yield higher precision for the elevator's motion. (In the same way as ailerons...) This will then yield a very high precision of the elevator trim.
The original elevator horn's height should be trimmed down to 10.5mm before being glued to avoid hitting against the tail boom. For even motion the wire must be perpendicular to the hinge with the elevator at the neutral position.

Rudder
The servo control range is **+/- 4.5mm.** (Rudder control's maximum motion range suggested of +/- 14 mm). Using the same servo horn as for the elevator servo will yield a very rigid control, helping retain and transform as much energy as possible during the discus launch and release of the glider

Stab pod preparation.

The stab pod's rear is sanded and prepared in our factory to let the elevator wire through.
But the final slot must be finished with a 2mm bit drilling and a little file. Pay attention, the slot mustn't be extended in the boom structure, to ensure the boom stiffness in launch constraints.

Rudder installation

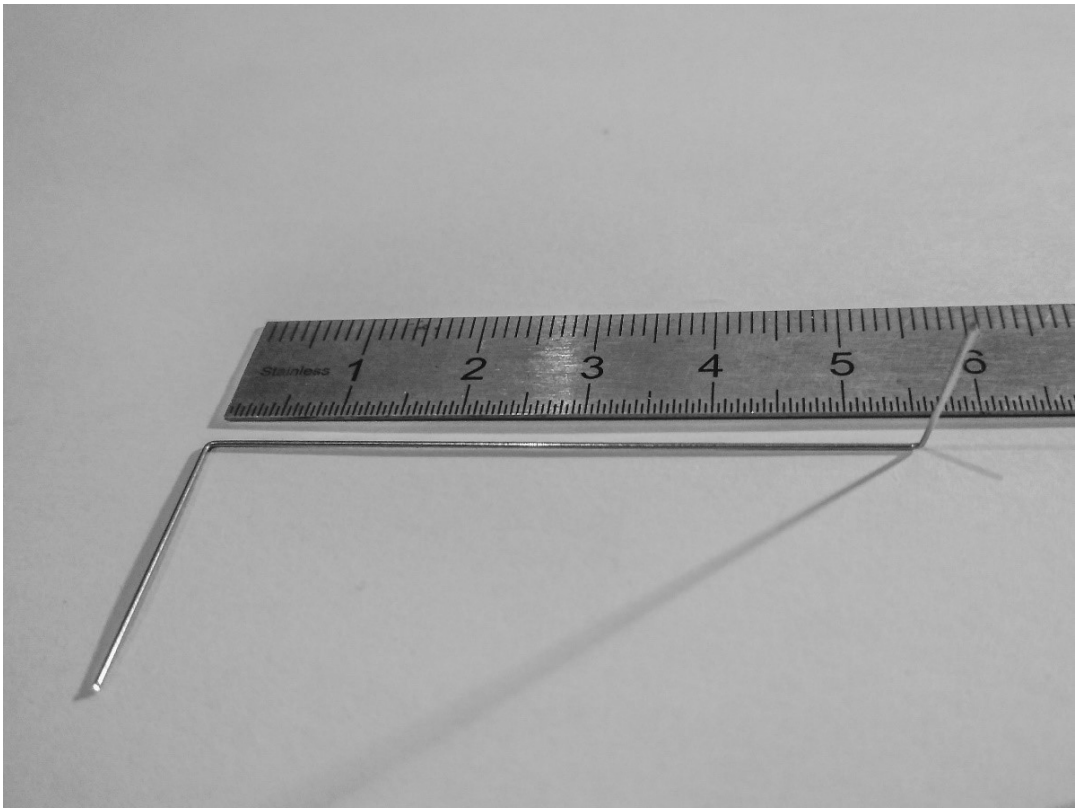
For a right-handed pilot, the peg installs at the tip of the left wing. The rudder has an asymmetrical profile, and in the case of a right handed pilot, the top (domed) surface must face towards the peg. The horn must be glued on the opposite (flatter) side. For a left-handed pilot, as the rudder is symmetrical, just mirror the installation by putting the peg on the right wing tip, curved rudder facing right and rudder horn glued on the left side.

Glue the rudder with slow-curing epoxy to have time to double check that it is installed perfectly square.
AN OTHER WAY is to use CA but then be sure to drill 3 tiny holes on each side of the boom fitting cover of the fin, allowing the glue (medium CA preferably) to fill the space deeply and correctly.
Remember to use as little glue as possible. Weight matters most of all in F3K ships, and especially on the tail where the lever arm is so long every gram makes a huge difference! Avoid any quick operation at all costs, mistakes are so very easily made and hard to fix!

For rudder and elevator horn installation, find the center line during a dry mount and cut out a 0.5mm slot through the top skin and foam core. Put a piece of tape on the other side to prevent CA from leaking out of the bottom skin. For the stab, slide in the horn and make a second dry mount to check the angle and path of the horn in the axle of the stab pod slot. Glue the horn in position with medium CA and be careful to maintain the horn's hole above the hinge line when the control is at neutral, to guarantee a symmetrical motion for the servo.

Tail-feather springs

Using the provided 0.3mm steel rods, bend them in a U with 55 mm in the middle section, and 25mm long tails on each end, with 90 degrees bends. The bends should be separated by around 45° of rotation to guarantee enough strength.
In order to avoid any kind of warping of the control surface, insert first the leg in the control surface as near to the horn as possible, so as close the center line of the elevator or rudder. Then the other, 55mm off-center leg of the spring in the fixed part. You can secure the spring with two tiny drops of CA between elbows and the holes done in the tails..

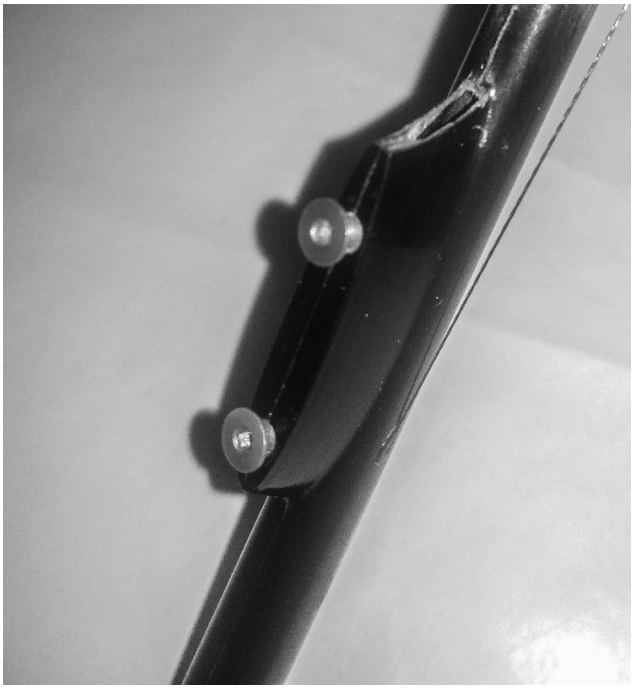


Tail control wires installation:

If you wish to use multi-braid nylon fishing line:
To guarantee it won't deform over time (especially noticeable on the rudder due to the stress during launch), it is recommended to pre-stretch the line using a weight for some hours (suggested to use 1 kg on one end).

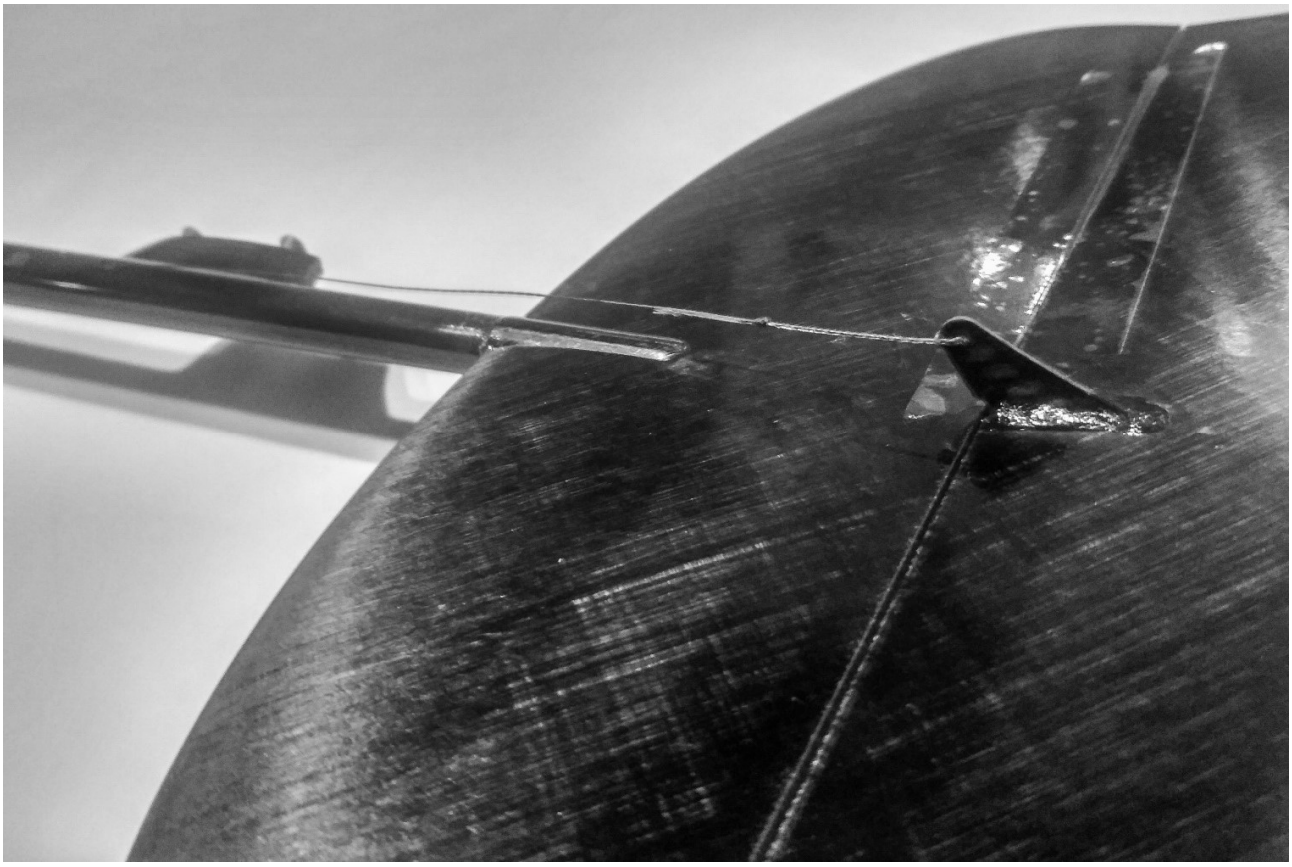
If using braided steel wire:
Be attentive to forcefully bend the loop exactly where needed, with square angles to avoid the wire's springiness introducing slop in the control, leading to a loss of precision during launch and preset mode. Use the providen steel sleeves to crimp the loops.
Knots on steel braid are not suitable!

The wires are threaded in from the back of the fuselage, through the already prepared slot on the elevator's mount for the elevator, and through a hole to be made for the rudder line.
For the rudder line hole, there are two options: either at the end of the boom, through the fitted section of the boom on the rudder, or earlier near the elevator's mount on the side. In this last case, Use a 1.5mm drill bit and make the hole oval by angling the bit to avoid any kind of friction of the cable against the fuselage. Prefer to drill it in the pod length, 5mm behind the pod's leading edge and not in the boom itself.



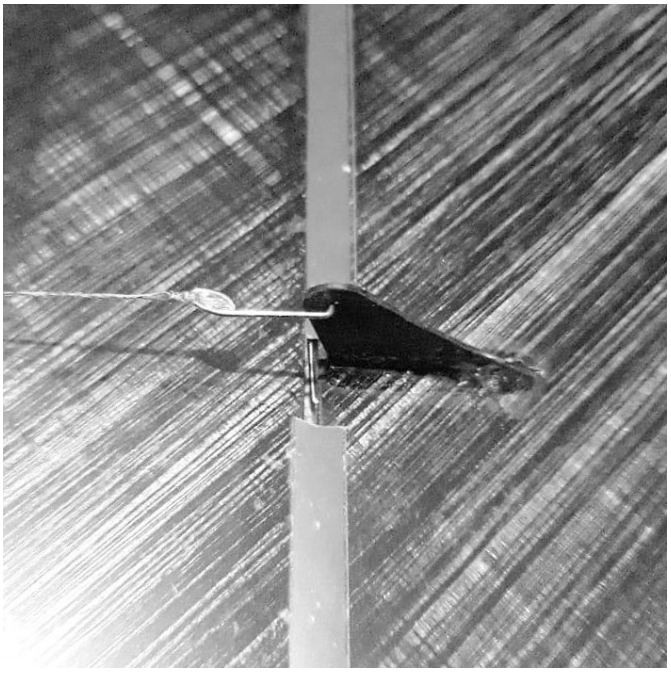
You can secure the hole with thin CA and pass the bit it again to deburr the abrasive carbon fibers, or insert and glue a little piece of electric wire hard insulation to prevent from any hazardous friction (using nylon fishing braid). For the steel braid wire, there's no particular scare to have on this point.

With both servos set to neutral, lock the control surfaces in place with the horn at + 2 mm with tape with the spring installed and under compression.

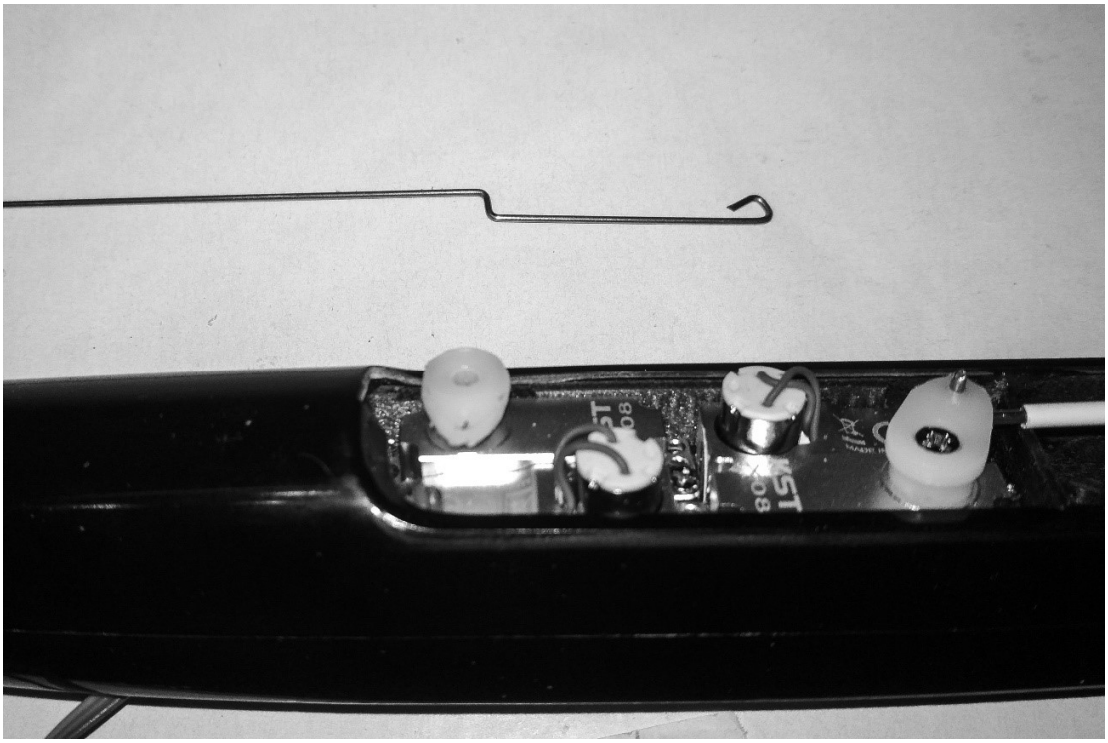


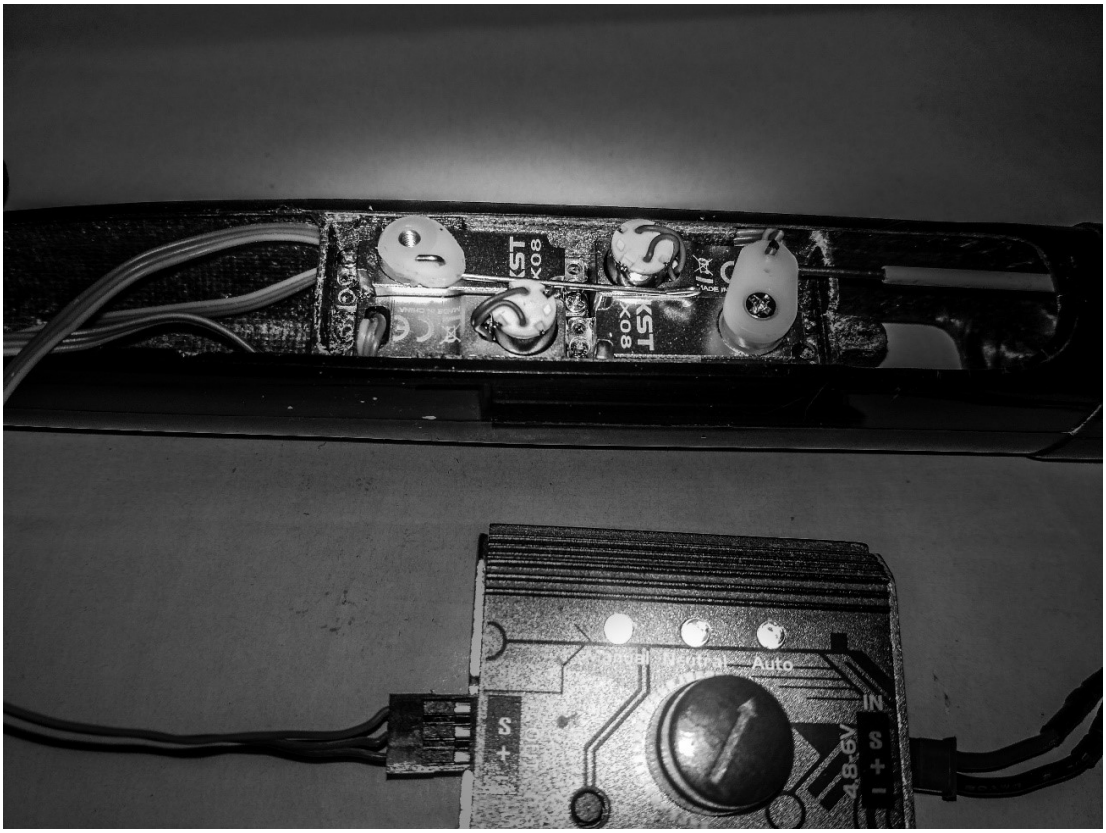
DON'T make a simple knot directly attached to the carbon sharpen horn. Make a little hook in a 0.3mm rod.

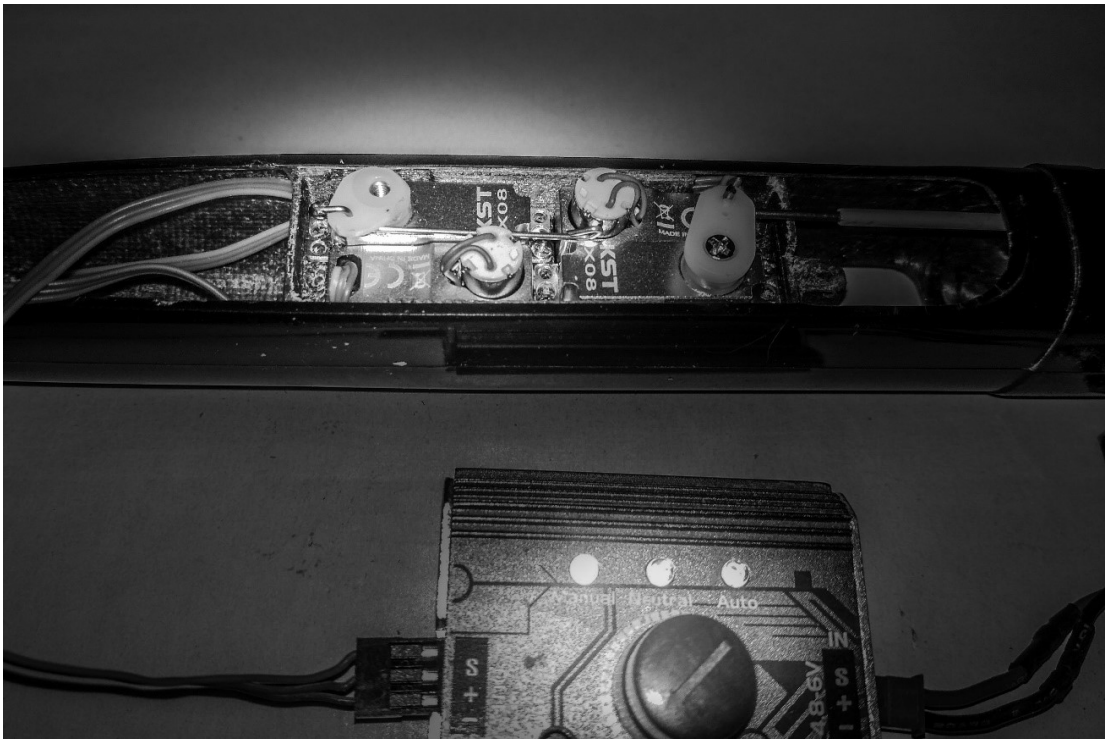
In the case of a fishing braid use, you can make a small hook with a 0.3mm rod, to attach the wire in a permanent fashion on it. This prevents from any wire cutting by friction on the sharpened carbon control horns. (It has often happened in DLG history...!)



Use a drop of CA to attach the other end of the wire to a long thin control rod that you'll then slide in through the fuselage up to the front. Hook up the line to the servo horn using a small part of 0.5 or 0.8mm control rod, to avoid friction and allow for easy unmounting. No knots or glue on the servo horns! This is bad for a clean command.
The length of this piece must be define according to the servo travel, and the free place between the servos.



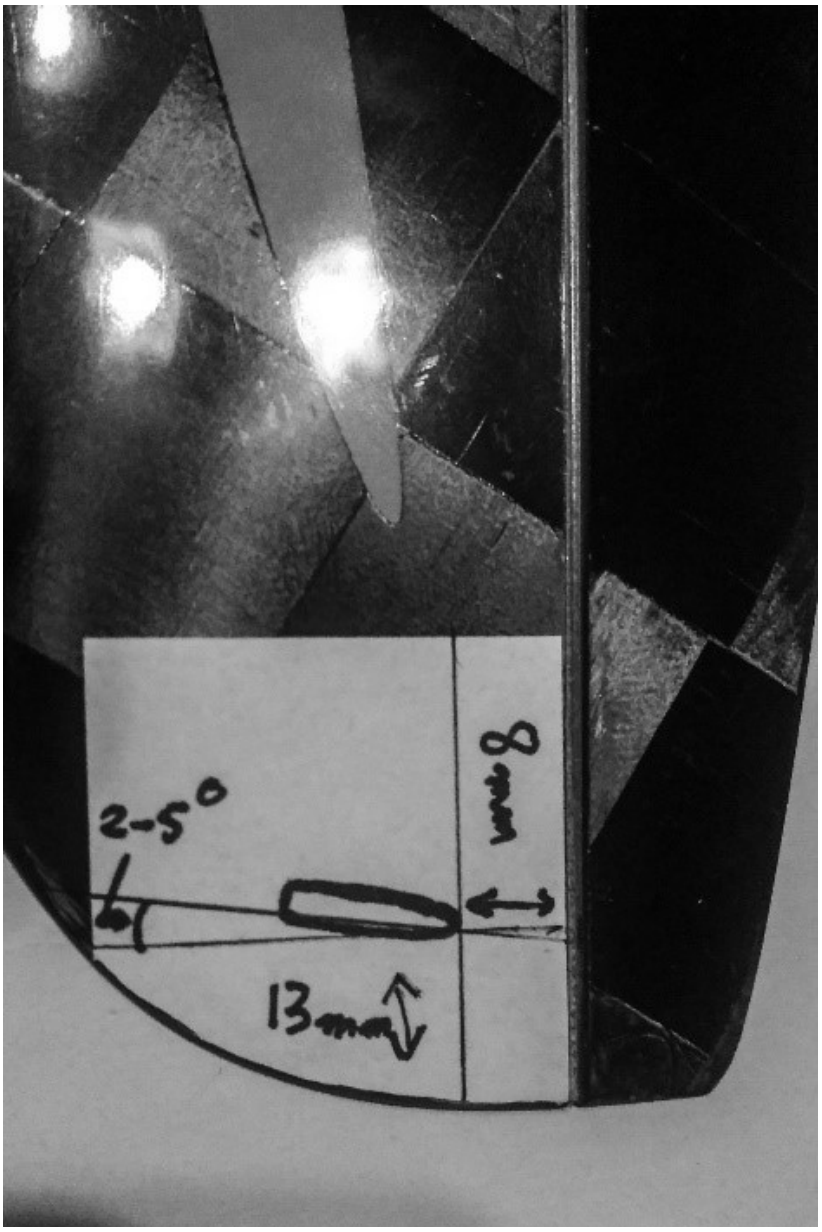




Once the wires are taut and the knots or sleeves locked in place, take away the tape on the control surface and the spring should take out the **2mm slop** built in when taping down the control surface). In general, your control surface should now be perfectly neutral.

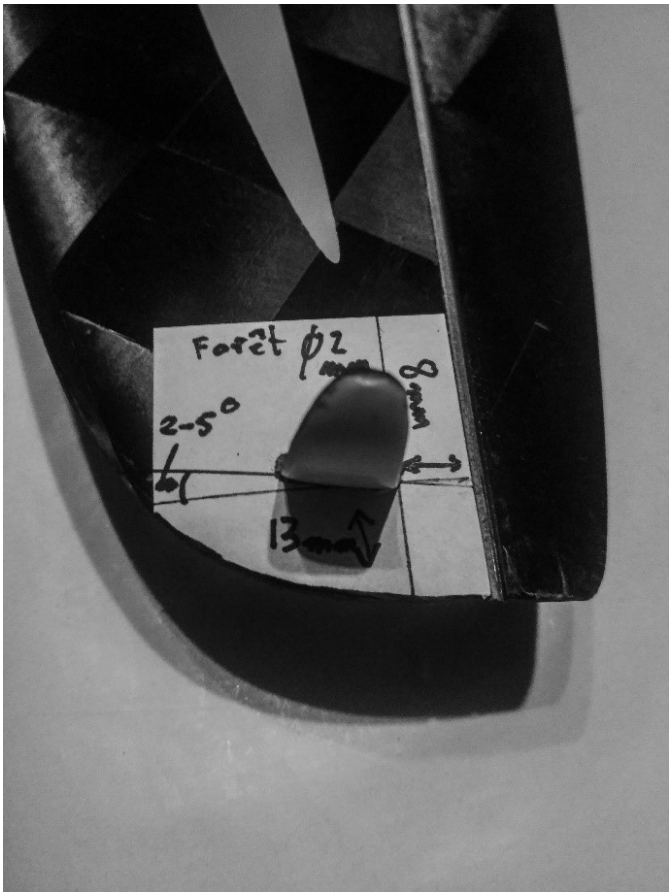
The external top side of the servos horns might need to be sanded to let the nose cone get properly seated.

Peg installation and wing balancing



Do not forget to properly set the tilt angle of the peg, it balances the load transmitted to the ship during launch by the index and middle fingers. This tilt is different for every pilot, due to individual differences in length of the fingers. Make sure to base yourself on the joint position of the last phalanges! A good general indication is somewhere between 5 and 7 degrees. As each half wing has got 7° dihedral angle from the root, your peg can finally look pretty vertical from a final front view.
Also the peg's "yaw" alignment matters. Parallel to the fuselage is generally standard, but opening it up a little bit with the trailing edge to the outside means it will slip away from the finger tips at the end of the launch easier. Recommended range is from 2 to 5 degrees from parallel with the fuselage towards the outside. This angle is obviously set when cutting the peg's slot through the wingtip.

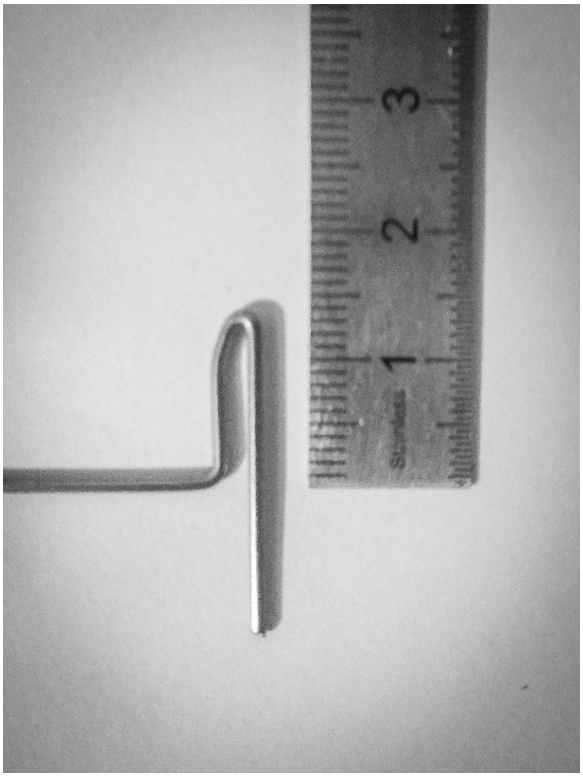
Drill an undercut of the peg's cross-section through the wingtip, with a 2mm bit for edges of the peg section and 3 holes of 3 mm at the center, and finalize the slot size with a small nail file to get a tight fit. Check your desired mounting angles as you do so! Put some tape above and below to prevent from unwanted traces of glue; slide in the peg, and wick medium or thin CA into the joint. Then make a smooth joint on top and bottom, as light as possible.



Balancing the wing is quite necessary, because the peg is very often way too heavy. As a result, the glider may tend to lean towards the peg side, misleading small thermal detection and inducing aileron or rudder trims during launch or flight, which is undesirable.
After having determined the needed weight to balance the wing (usually 1.5 to 2g), lower the outer aileron and in the hinge's opening (wing core) create a pocket for your lead to fit in without impeding the aileron's motion, gluing the weight in place with CA or epoxy. (Grease slightly the Kevlar hinge before!)

Ballast set preparation:

Nothing particularly difficult to do, but prepare the length of the ballast rod to fit the rearmost hole on the tray leg.
In general, keep the same CG while fitting your ballast connection length as for the empty weight CG, but keep the possibility to move your heavy ballasts forward (80 to 100gr) to the first hole for the turbulent situations. You can bend a final handle, a practical wide hook, with an accurate remaining height that can prevent the ballast connection from going out of its hole by threading the nosecone over, close to it. 100gr ballast is quite ok for 8m/s FAI limits conditions with the NRJ, especially if you use the Superstrong, which brings the total weight to 330gr.



Gap sealing hinges of the control surfaces

In order to minimize drag as much as possible, it is advised to gap seal the hinges of all control surfaces. In flight, any audible whistling sound means there is some more drag that can be eliminated.

Take clear or kapton tape about 1cm wide and put it down with half of the width on the edge of a perfectly clean support. Apply white or black powder (talcum powder, micro balloons, etc.) using a brush to the remaining half of the tape's width. One may also consider using old cassette tape or similarly thin and light ribbons instead. Lift the tape off the support and apply to the hinge gap, making sure to stick the edge of the tape to the fixed part of the surface.

Do not forget to double check all control surface ranges and senses, CG, fail safes, flight phase trims etc. before flying!

The hardware and/or instructions may be updated, be sure to check for updates regularly!

Settings:

CG between 64.5 and 66.5mm
For a CG at 66 mm, it can be shifted forward to 64.5mm with the heaviest ballast (100g). Adjust the length of each ballast stick according to its mass depending on your preferences while staying within the recommended CG range.

Speed:	Ailerons 1.2 - 1.5 mm up		
Preset:	Ailerons 0.0 mm	+	Elevator 2.5mm up
Fast cruise:	Ailerons 0.0 mm		
Slow cruise:	Ailerons 2 mm down		
Thermal:	Ailerons 2.0 - 7.0mm down		
snap-flaps:	Ailerons 5 mm down / 3 mm up (5 points curve, to have some kind of inverse Expo with ailerons down)		

Control surface motion ranges:

Ailerons: (differential suitable for thermal slow chase): 13 mm up 19mm down (with classical 3 points curve)
Differential for speed and high cruise modes can be more like +/- 13 mm
Elevator: +/- 8 to 10 mm
Rudder: +/- 12 mm (no need for more, the dihedral is very helpful!)

Some advices about the flight performance:

The NRJ has special gliding characteristics, being able to fly really fast with a good drag in flat foil configuration. But while this is really amazing, you might forget about the consequent sink rate of this flight mode. This is only suitable for quick transitions or returns from downwind explorations with high speed. To obtain the best sink rate, and longer times while floating, you must use one or two camber modes, about 2 to 4-5 mm down, and trim these flight modes to obtain nice, straight and horizontal trajectories, at the respective different cruise speeds.
We have noticed a better handling and performance in thermals detection if the snap flap mix is stated with an inverted expo, (using a 5 points curve..) with the full flap mix rate effective on the first half of the elevator (stick) range. See the upper values for snap-flap details.

HAVE GOOD FLIGHTS!

O.A. Composite TEAM