Aresti 2M

Thank you for purchasing the Aresti 2M. It is a major step up from the Vector series designed by Dr James Hammond over 20 years ago and this is his new design!

We knew from the very first prototype maiden flight that the Aresti 2m was special and now after thorough testing, with many hours of test flying (and a few changes during its development) it's even better! For instance you may have noticed that the Aresti 2m uses flat wing servo covers for minimal drag and we have worked out the servo geometry for the best torque and least slop. It would be easier to build with blister covers but would defeat the objective. It's all been tested many times and while you may be an experienced builder of moulded model gliders we do encourage you to follow the recommended construction for the best possible performance.

So what's different? The main features are: completely new wing sections, elevator pitch control, and increased side area including a larger rudder! Look inside the servo wells and you will see the wiggly line of the sine-wave sheer web, a revolutionary new spar design for composite gliders.
It makes the wing lighter yet torsionally stiffer than with a conventional spar construction.

The fuselage has a substantial CNC ply tray (+ formers) and ballast tube. The tray makes the build much easier by taking away any positional guesswork as well as adding a great deal of structural strength. Together with other extensive reinforcements this is truly a 'slope-hardy' plane.

Before we start

Servos:

You have a massive choice but ideally maximum of 10mm thick for aileron with up to 13mm for the flaps. We recommend KST DS135MG all round for the wing.
For the elevator it is hard to beat the MKS DS6100 but feel free to use other similar quality 10g or less servos. It is possible to squeeze in a 12mm thick servo but anything heavier will mean more nose weight as the elevator servo is in the fin.
Rudder servo size is less critical and even 15mm wide servo will fit but you will have to adjust the pre cut CNC radio tray to suit.

Wiring loom;

The cut outs are sized for MPX green plugs and you can purchase ready made Aresti 2M looms from your distributor as an optional extra. If you are making your own use 26 swg flat wire for the fuselage. It's easier to use this wire as the loom has to go round the ballast tube and there's not much space. Wing loom wiring can be as thick as you like. For the tail servo, a good quality lightweight wire is ideal. We supply 0.25mm2 German Litze wire with our looms but 26swg will do although a few grams heavier.

Hardware needed:-

10 x M2 clevises.
2 x M2 threaded carbon rod adapters.
2 x M2 pushrods 35mm long
2 x M2 pushrods 30mm long.
M2 ball link
2mm steel tube (ID approx 1.5mm)
M2 pushrod approx 30mm long.

You can purchase Aresti 2m hardware kit with top quality components including stainless steel 303 grade pushrods as an optional extra.
Note: While not really necessary, you can use M3 fittings in the wings.

Battery and switch:

The radio tray is cut for a 2/3 AF Nimh 1600mah 4.8v RX flat battery pack. The nose-weight calculation and rest of the build assumes the use of this battery. However you can fit a variety of different batteries including the latest Lithium Ion cells by adjusting the battery slot in the tray. There's space and so also enough for any type of switch.

Bag set;

An optional extra and sound investment is a bag set tailored to fit the Aresti 2m, comprising of fuselage bag with joiner pocket, wing and tails bags designed to allow the tails to remain plugged in.

Ballast set:

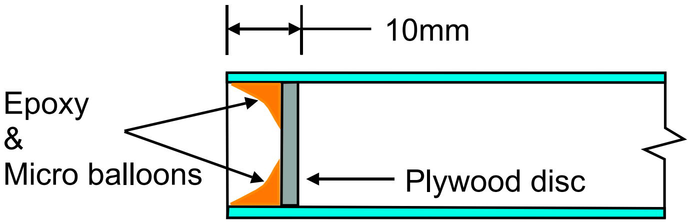
Some pilots like to fly planes like the Aresti 2m without ballast preferring a tight, close in, flight pattern, whatever the conditions.
However most will prefer a more flowing type of flying with lots of energy and big stall turns! Then you will need ballast. The fuselage can carry 8 x 19.5mm D (3/4'' D) x 35mm long brass ballast and the wings 2 x 15mm D x 127mm steel ballast. That totals just over 1kg of ballast!
Ballast sets are an optional extra.

The Build

The following building sequence will help speed up the construction and simplify some of the procedures. The aim is to give you details of how we build the Aresti 2m as good as it can be! As already mentioned, one of the main objectives is to utilise the designed small control surface horns so that servo arms can be under the skins. Longer servo arms will result in excessive servo throws requiring you to rate down at the Tx and so reduce torque and increase slop. If you intend to fit thicker servos there is no problem but you may find that you need blister covers in this case which are not supplied in the kit.

Preparing the ballast tube:

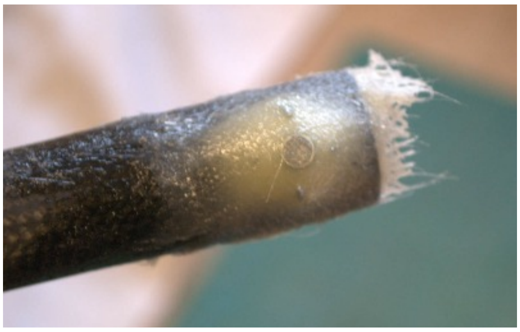
Sand up the inside of the ballast tube at one end just over 1cm in. Spin a disc using a Dremel and have quite a tight fit. Not critical what you use; 1.5 ply or 2mm lite plywood is OK. Use the ballast to ensure a square fit. Then tack with thin cyano run into joint. Back fill with thickened epoxy and allow to cure.

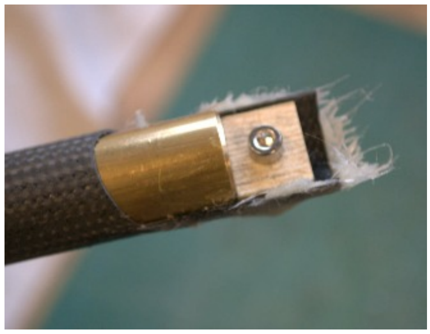


Ballast Tube End

Once cured, put in 8 slugs and 1 wood spacer cut to exactly 15mm long (the tray is not sized for a full 35mm spacer). Cut the tube so that it is flush with the spacer. Thus the centre of the tube is 15 + 4 x 35 = 155mm from the cut face. Mark 95mm on the fuselage wing root and a mark at 155mm towards the nose. This is the position of the front of the ballast tube. The tray cut out for the ballast tube must line up with this mark and of course when the ballast tube is in, position flush with the cut out. The ballast is then centred at 95mm.
Attached pictures below show of how to cap and retain ballast using M4 fittings.

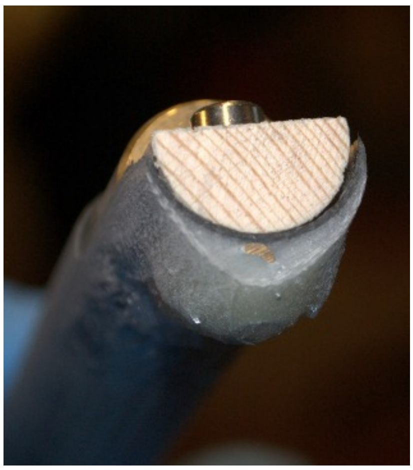
M4 T nut





T Nut epoxied with colloidal silica and then glassed.

It helps to cure with the bolt and ballast in place so no problems with fit. Grease, Vaseline or use release agent on the bolt first. Front of ballast tube cut at approx 30 degree angle and approx 40mm. Once trimmed back to the plug it is 35mm, same length as a ballast slug for easy insertion. The angled cut will help. Plug is 15mm long and 4mm dia hole is centred at 7.5mm. The radio tray has a cut out for the ballast tube and allows for 15mm extra length. This will ensure that you can position the ballast tube with its centre on the CG. Although in reality you have a few mm tolerance either way just means moving the tray fore or aft if you use a slightly different length spacer.



Trimmed and sides flattened.

Wiring loom:

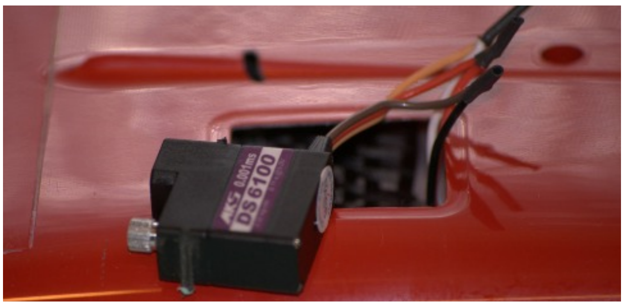
If you've bought the ready made loom you can ignore this next bit otherwise make the fuselage loom using MPX males (with pins and bigger female casing) using 26 swg flat wire (twisted 22 swg is too thick to go down the sides of the ballast tube easily. The length required is 320mm including male servo end. Make up the servo extension for the elevator servo using 26 swg wire. Servo cable can be heavy so avoid 22 swg which will add weight to the back end.
Do the wing loom next. Using the servo wells, measure the lead from the wing servos to the wing root and add 8cm for easy plugging. Try and avoid having too much excess wiring after taking into account wing servo leads I always do the plugs loose on the wing so add some heatshrink to protect the wires from chaffing- about 5cm is enough. I use thinner 1cm heatshrink over each wire and run thick cyano over the back of the plug and heat shrunk wires before applying the 5cm sleeve over the whole lot. It's a quick way to add some mechanical strength as you will be pulling and pushing the plug and makes it a bit more reliable. Test the loom to ensure that it works properly.

Nose weight:

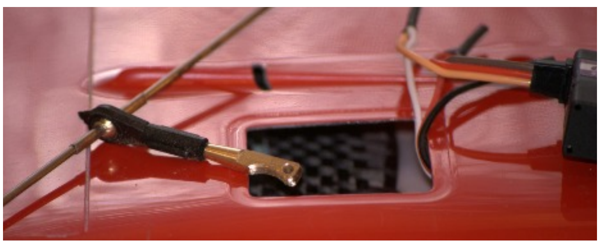
You will need approx 130g of lead to roughly balance the model if using the recommended 2/3AF Nimh battery. If not adjust accordingly. To cast a lead block (which is preferable method as it uses the least volume) tightly wrap some aluminium foil around the nose cone and insert it into some damp sand (held in a small plant pot or similar) compressing the sand so that it forms around the tin foil nose and sits securely without any chance of tipping. Remove the nose without disturbing the shape and you have a mould to cast with. Place this on scales and carefully pour in no less than 140g of molten lead, a little more than you need. When cool use a file to adjust the fit, knock off the tip and shape and reduce the weight to 130g. Ensure that the weight goes as far up the nose as possible then fix in position with epoxy or thick cyano and kicker. This is now only roughly balanced and less than what you actually need. When you finely balance you will probably need another 20g or so trimming weights which will allow you to changes to the cg to suit your tastes. Note, it's much easier to do the nose weight now instead of after the radio tray goes in! However, if you don't wish to mess about with molten lead there's enough space to add lead loose, ideally with lead shot glued in with epoxy. Just be weary of using too much space; dry fit with the radio tray and battery and double check (!) remembering you will also need a bit of clearance for the canopy retaining pin.

Elevator servo:

The elevator is driven from a servo in the fin which is only a few grams heavier than a bellcrank and pushrod driven from the nose but produces a much better linkage. The servo extension cabling that you choose is significant as the thick heavy stuff will weigh nearly the same as a 10g servo. Thin 26swg wire is fine but if you can get hold of the thin German Litze wire, $0.25mm^2$ that's even better and will show a little less resistance. The recommended servo is the MKS DS6100. You will need a 5mm arm.



The servo is hardwired to the servo extension. Ensure sufficient length of wiring to reach the radio tray comfortably. Strip and twist the wires together, solder then cover with heatshrink. Notice that lugs have been removed, it will save you opening the servo well but you will still need to angle and 'jiggle' the servo in to fit!



2mm ball link with 20mm long steel tube sleeve using RDH adaptor. Note recess to clear the servo arm screw.

Elevator Servo continued…..

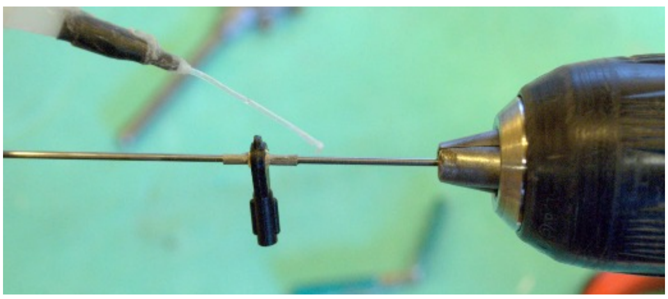
It's difficult to find a ball link with exactly 2mm ID hole, usually it's just a bit smaller and may need the brass ball removing and drilling out to exactly 2mm. The steel tube will then be a tight fit. It needs to be 20mm long. This then drives the 1.5mm elevator wire but it will be a loose fit. The simple solution is to crimp each end with the wire in place using the jaws of a drill. The jaws will squish the tube down and take up the slack. Do on both sides but ensure the ball link is in the middle of the tube. The steel tube can be secured to the ball with a small drop of cyano applied with a pin. If there is still a bit of play try a drop of cyano to wick inside the tube. Then once cured break free holding the tube with pliers and wire in the drill. A very close tolerance fit results.

Alternatively this is a neat way using a 90 degree L bend. The rod is 2mm dia and threaded with the servo arm tapped. The linkage runs on the threads and can't pull out. You need a 2mm tap and die for this.

Check that the servo orientation is correct and the arm is at the 90 degree position. Trial fit using the tailplane with elevators taped at neutral. Check that the installation does not foul the rudder pushrod and adjust the elevator pushrod length if necessary. However, you may have found the wire, connecting the two elevator halves, a tight fit, which is no bad thing but if you find it too tight to get the tails on or off you will need to slightly enlarge the pin holes. The easiest way is to use the elevator wire itself as a drill, just attach to an electric drill and run a few times but be careful not to break the end stops inside the elevators. You may also need to adjust the carbon joiner lengths to enable the tailplanes to sit flush.

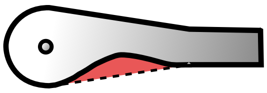
I use a brush to coat the servo and skin with epoxy, you don't need lots if using slow epoxy. Now insert the servo and pushrod, you will need to move the arm and rotate the servo to get in. Insert the elevator wire and then with the elevators taped to neutral, put on the tails. Centre the servo and then slide it in square to the servo well. The servo position will cure at neutral, to prevent any movement you can cyano a scrap of liteply to the bottom edge of the servo. Prop up the fin and nose so that it lies horizontal and a piece or two of ballast placed on the servo then leave to cure. When cured strapping the servo. This will make the installation more secure with less chance of it ever popping off and reduce any skin flex. It's just a scrap piece of ply or similar to tie the servo to the opposite skin and goes across the servo well. This adds a great deal of strength.

If there is still a bit of play between the tube and the wire, carefully get a drop of cyano to wick inside the tube. Once cured break free holding the tube with pliers and wire in the drill.



Wing Servo Linkages:

The wing horn geometry requires 9mm of linear aileron throw to give full travel and for the flaps 11mm linear throw. This means the aileron servo arm needs to produce 9mm movement and dictates the minimum arm length required.
However, you will need more flap throw if you do not have 'Offset' mixing' on your TX. Offset is used to provide 20% up flap and 80% down flap movement. (If you don't have this then you need a bigger arm to give sufficient down travel and so rate down the up movement- not ideal as this reduces servo torque and will make your linkages more sloppy). Assuming you do have all the mixes required then the ailerons need a 5.5mm arm and 7mm arm for the flaps but it's OK to use 7.5mm (usually this is a standard hole size for many brands of servos and don't need to drill a new hole) for the flaps but will give a little more movement than actually required.



Remove red shaded area.

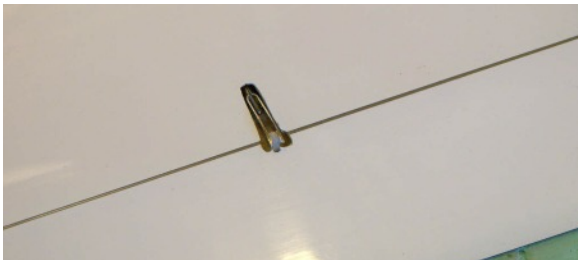
The clevises need scalloping to allow the movements required. All 4 pairs of clevises will require relieving. Use a Dremel drum sander or similar.

Tip: to accurately drill new holes for the Ailerons (and any other surface) you will need a jig. Pictured here is the jig unit that's available from Sloperacer.

In fact 6 jigs are provided with arm sizes ranging from 4.2mm to 6.5mm. Place the servo arm in the large hole then use a 1.5mm dia drill to make a new hole in the arm. For small arms, 4.5mm and less you will need to relieve the servo arm hub for enough clearance for your linkage.

M2 hardware is fine for most flying but for the ailerons we did use RDH adaptors as shown here. Note the clevis ground down to fit the 'finger nail' shrouds

On the wing top surface file the pushrod exit cut outs to depth of 20mm. All the cut-outs need to be at 90 degrees to the hinge line to reduce binding.



In some of the prototypes M3 fittings were used all round and this makes a much stronger linkage but is not necessary unless you want high stress set up for DS'ing etc!

The control horns are short with the hole on the hinge line (to minimise mechanical differential) but not so short as to require really tiny arms. Aim was for servo arms under flat covers but being able to use standard clevises albeit with quite a bit of filing to fit. You can do it with minimum arm size of 5.5mm.

The holes at the wing root for the MPX plugs need to be enlarged so that they are about 1mm oversized. Thus you will end up with the fuselage socket glued in and the wing plug loose.
This is preferred to 'automating' plugs and fixing both sides as we found with one of our test pilots. He was doing the most violent flick rolls which actually separated the wings. Fortunately wing plugs were loose fitted so remained connected but an automated wing would have lost both wing servos. A freak incident perhaps but it was an extremely cold and damp day and the wing tape used just didn't stick well enough!

Setting up the wing servos:

When setting up the servos a digital servo tester is invaluable. Most brands of radio will centre servos at 1500ms except Futaba which is 1525ms (Futaba owners please read 1525ms instead of 1500ms), so first stage is to set up all 4 servos with the correct centres. Arrange your servos mirroring each pair left and right hand side. With the output shaft towards the LE put the arms on one spline towards the TE. This will help with stopping the clevis being fouled by the servo arm hub as the servo moves fully towards the LE and also bearing kit shaft if you decide to use one.

Fully towards LE, this is with M3 fittings and 5.5mm arm. Depending whether RHS or LHS servo this will be at 900ms or 2100ms. Notice the relief scalloped in the clevis to allow this movement.

Fully extended in the opposite direction and almost pointing flat.

From the 2 pictures you can see why the servo arm is not set at 90 degrees when centred. It will foul if you do! I always use a Fu-Fix Bearing kit as it can take load away from the servo head resulting in less head and gear train wear. This will make a tighter linkage from the start and will help keep it that way.

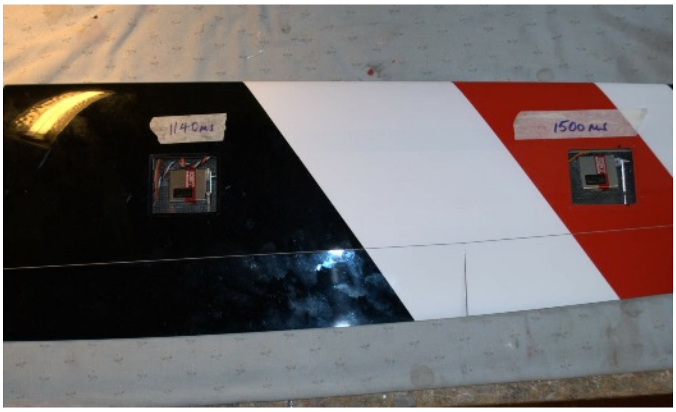
For the ailerons you need to position the servo whilst centred at 1500ms and the servo at 90 degrees to the hinge-line. This is an installed aileron servo in a prototype but uses a clear cover so you can see the servo position. It uses M2 clevis to clevis. Ignoring the actual fitment, point to note is that the pushrod is at 90 degrees to the hinge-line as shown by the set square and therefore the servo is not square with the servo well! If you attach square it will bind as you will need side movement to achieve aileron throw. This will either cause flex in the pushrod or enlarge the holes in the arm and horn as it wears in- either way not good for a tight linkage.

Adjust the pushrod length (and attach to the aileron horn) so that the servo arm is near the top of the servo well to ensure it remains under the skins. Attach the servo too low (towards the TE) and the arm will sit above the skin. You will need a blister cover in that case. Tape the aileron at neutral. This is your servo position. Now do the same for the opposite aileron.

A little note about servo centring: Servos cannot be centred exactly in the same place when flipped to make mirror images for left and right hand sides. In fact, if say you set a pair at 1500ms and flip one over to mirror each other, there’s about 30ms difference. So getting exactly the same length pushrods and exact positioning of servos is a little pointless unless you electronically compensate for the centres too. However the end points will still be slightly different, so for this small inaccuracy I don’t bother and use the servos at 1500ms as a starting point and compensate with slightly different length pushrods between right and left hand side.

Further, the throws for the ailerons and flaps are more than enough using the arm sizes recommended so any differences in the throws between left and right hand side is compensated with TX 'computer' mixing. If you really want to do this mechanically you need to centre left and right servos differently. That's a more time consuming set up as you need to ensure the horns exactly mirror each other and pushrods exactly the same length and geometry. It's only really beneficial if you don't have computer mixing. I call it zero tolerance building and pretty sure not many can actually achieve this although you could spend many hours trying!

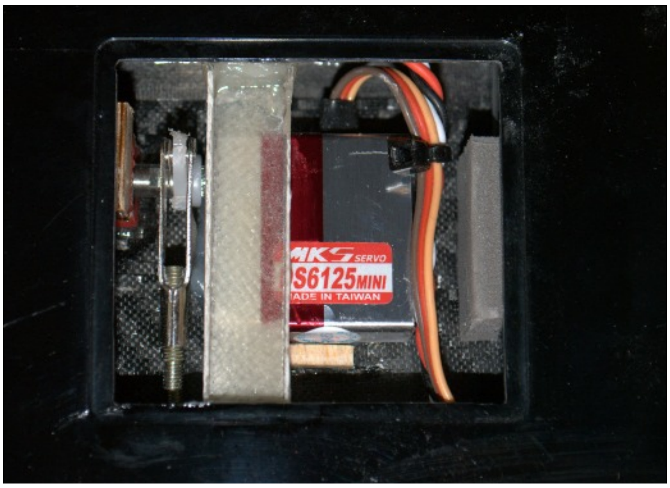
Now the flaps next:
Flap servo using M3 fittings. This is RHS wing and servo set up at 1860ms. This will allow the TE to line up so whole wing can be taped in line.



The position of the servo must be at 90 degrees to the hinge-line again (use a set square) but the difference is the RHS wing is set to 1860ms. This will allow 2100-1860=240ms up travel and 1860-900=960ms down travel for butterfly brakes. This is 20% up and 80% down. The beauty of this method is that the flap can be taped up in line with the aileron and rest of the wing at neutral. The servo doesn't need to sit so high as more depth in the flap servo well. Again the actual position of the servo is set by adjusting the pushrod length. Not essential but adjust so that both RHS and LHS servos are in the same position. That goes for the ailerons too. It just looks better if using clear covers!

Once the servos and linkages all set up you can thread the loom through, don't tape or heatshrink the connections just yet. You will need to check the servos again after the servos are installed. If you have a spare fuselage lead (and always a good idea to make one up) then tape away. I never connect the wing loom without tape (or heat shrink) as too easy to pull off when unplugging the wing. You should still have the fuselage part of the loom and this is used to connect your servos just in case they have moved and need to reset them now. So a good reason not to put the fuselage loom in just yet! However you will need one final check after the fuselage loom is installed so either make a spare lead or keep the servo ends accessible.

Attaching wing servos:



I prefer to glue servos and don't normally use a servo frame. In fact I often cut off the lugs as they can get in the way of the ideal position I want to place the servo.

Flap servo, very little epoxy used but notice it's also attached to the bottom skin with a strap and anchored by the bearing kit. Also I've cable tied the wires for a bit of strain relief and glued a sponge block on the RHS to prevent chaffing as this is over the end of the ballast tube which may not be too smooth.

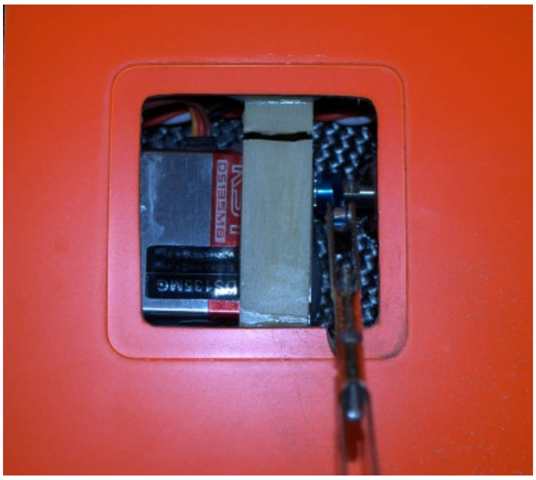
The servo is epoxied in but whilst it sets, a scrap of lightply is cyano'd to help keep the position. The bearing kit housing helps too as this is also cyan'd. Once it's cured the strap attaching to the bottom skin and scrap in fill over the bearing housing is attached. Straps can be made from various materials from fancy sectioned pieces like this, ply or G10/FR4 fibreglass board; main thing is that it needs to be as strong as the top skin to work properly.

Without doubt you need a rigid installation to reduce skin flex to allow a servo to perform. This is often ignored. Servo frames secured to just the top skin are just not as rigid, even frames with external bearings as the bearings do nothing in stopping the whole skin flexing under load. The use of small horns makes this problem much more apparent because of the higher loads. It's rather like opening a door by the hinge instead of the handle. You need more force and therefore your servo installation needs to be more rigid. It's something that was pointed out by Joe Wurts many years ago. He cited F3J planes being winch launched and the flap holding position under these loads. It doesn't matter how good your linkage is if it's just attached to one skin. The skin will flex and the flap will not hold its position with these lightly built wings. He advocated tying the servo to the bottom skin too so that the servo forms part of the structure sandwiched between both skins, from an engineering perspective it's very efficient adding a small amount of material but gaining a great deal of strength exactly where its needed.

The biggest criticism I hear about this method is that you won't get them out which actually is not the case. I've heard the same horror stories about removing servos where a whole servo has had to be ground out, case and all because it was epoxied in (worst still if cyano'd in). This results in skin damage and pulling away big chunks with the servo but it doesn't have to be that way. You just need the right technique to glue it in the first place.

I bond with thickened laminating epoxy because it goes off very hard but is brittle and will shear. It works for me because I cure in a heat box so hard enough in an hr or 2 to continue working. However, any long setting epoxy (24hr, ideal) will be fine but not the gummy 5 mins stuff. You want epoxy that goes off hard so that it can break cleanly. I use very little epoxy and a paint brush to apply. You do not need to pool your servo in a well of epoxy! This will created a mechanical lock and make it harder to release. I don't clean or sand the servo. What I'm trying to achieve isn't a strong single joint but with 3 anchoring points, the top skin, bottom skin and bearing kit. This structure doesn't allow flex so there is less chance for the servo to pop off. Each joint doesn't need to be the strongest it can be; together they are more than sufficient.

Removing a bonded servo:



This servo is strapped with G10 to the bottom skin. It moved whilst the epoxy was setting and not quite where it should be for bind free movement, so now being removed and reinstalled! First step is to cut the strap, which I've done in picture left.

It's just easier to break out with pliers as 2 pieces instead of trying to break effective 3 joints in one go.

Next, as this is using a bearing kit, is to unscrew the shaft so that it no longer anchors the servo head. I've done it already here and you can see the threaded portion pushed out of the way.

Then pull the servo out! I've used a bit of strapping hooked over the arm here. No skin damage (or servo damage). Usually it leaves a perfect imprint of the servo on the skin as the weak point is the bond to the servo, which is as intended.

It took all of 5 minutes to take out this servo. There really isn't any reason to think an epoxied servo is permanent, done this way it is quite easy to remove. In fact I find them easier and quicker to remove than screwed frames as quite often there are angles and jiggling to contend with to get them out because the servo well is only just big enough.

Incidentally although this one is using a metal arm and it is unlikely to break but plastic arms can. If you need to replace an arm you don't need to remove the servo if using the bearing kit. You simply unscrew the shaft and replace the arm with the servo in situ.

Now back to the build.
Hopefully you have the ballast tube curing already and the wings taped up and everything set with a servo tester and if you have done really accurately when that's cured it should centre up exactly as per the settings!

Ballast tube and radio tray:

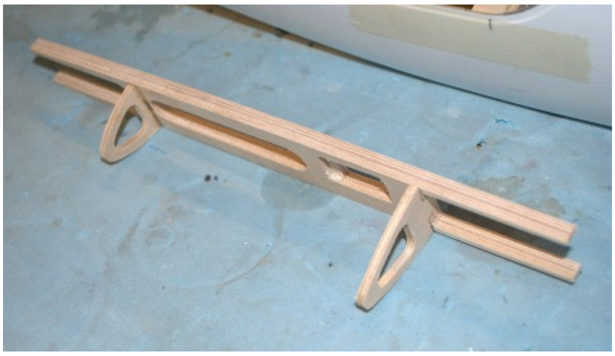
Sand the inside of the fuselage where the radio tray will meet and the bottom of the fuselage at the front of the ballast tube position and at the rear. The 155mm position from the cg (95mm) should be clearly marked. With the front of the ballast tube at 155mm and rear of the tube touching the bottom of the fuselage raise the front until just under the joiner slot. Putting in your joiner will help here so you will have no chance of lining this up wrong! You need to measure the height of the front of the ballast tube, it needs to be raised so add a piece of scrap ply (anything 3-6mm ideal) as support. The shape/height will depend on the shape of the T nut reinforcement and a bit of shaping required with a Dremel to get a good fit. I usually cyano a piece overly tall and trim back until the correct height with a bit of trial fitting.

Scrap ply support. The ballast tube is going to be installed very rigidly!

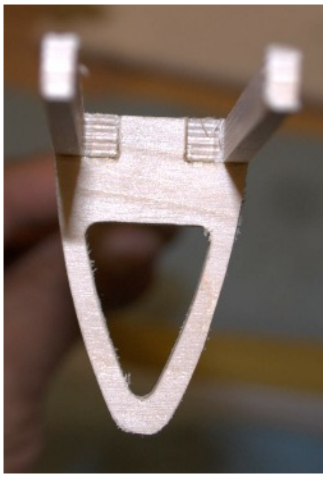
Shape to fit and then use thick cyano and kicker to attach.

Too high is OK you can trim back to fit. Bolt inserted in T nut will help line up and keep things square.

Leave aside the ballast tube and go onto the CNC radio tray (which you've probably been itching to get to!) It's going to give the front of the fuselage a great deal of strength and take away a major headache in installation as there is no guesswork figuring how to install.



Make up the tray as shown, glue in the formers with thick cyano. Note: the top of the tray it is the widest and the bottom has a slight in step acting as a chamfer! The servo well has a recess (to help insert the servo clearing the wires) make sure it's at the bottom! It also makes it a bit easier to cut if you need to adjust the length for a bigger servo as the tray is 6.5mm thick 12 ply birch!



Got to love what CNC can do! Perfect joints but may need a bit of sanding to knock off any furry bits if you are really fussy! Because of the formers the tray automatically sits square with no doubts about how high or low its position. You should not need to trim to fit. It's very accurate and even has a slight recess for the thickness of the carbon reinforcement!

With a pencil mark the former positions and top of the tray onto the inside of the fuselage. This will guide your glue line when you come to epoxy the tray. Remove the tray and go onto the wiring loom.

In using the bigger MPX socket for the fuselage loom its's easier to get a good bond and besides there's enough room to do it! You might need to slightly file to get a good fit before you glue though. I usually have the position the socket slightly proud (not flush fitting), not critical by how much but I use the first recess (on the MPX socket) as a guide. It enables the MPX socket to be glued through the slot and a bit of reinforcement on the outside too (actually it's the overspill from gluing in the slot). You don't want a large fillet as you will need to make the corresponding wing slot bigger to fit the wings fully home. However it's a stronger joint than installing flush and very quick if using thick cyano (acetone and cotton wool bud will clean up any mess) but use epoxy if you prefer. Syringe epoxy to the back of the plugs through the joiner hole afterwards but that's after ballast tube in place so don't do at this stage. Gather all 5 servo leads including the elevator and temporarily tape to the top of the fuselage to keep clear for now.

OK so if you've trial fitted everything you'll know that the ballast tube sits just below the radio tray in order not to block the joiner. It's not a design fault it's just the limitations of having a flat radio tray (and not making it any more complicated than it is now!) You can fill this gap with thickened epoxy but it's messy. It's easiest to add a 3mm ply (scrap) doubler to the bottom of the ballast tube 'forks' on the radio tray. It needs to be chamfered to follow the former. This will then tie in the ballast tube to the radio tray which itself is bonded to the fuselage and makes a stronger joint.

Now you can start epoxying!

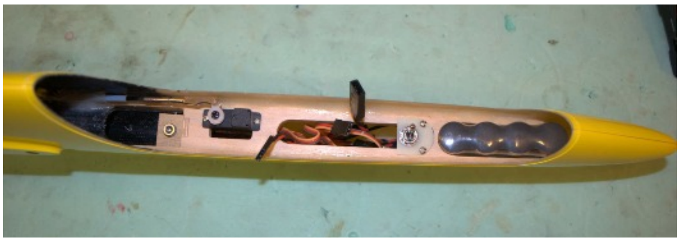
Apply slow setting epoxy to the back of the ballast tube (ideally 24hr or thickened laminating epoxy- you want plenty of working time for this stage. Also apply epoxy down the boom at the position of the back of the ballast tube. Apply some at the location of the front of the ballast tube underneath the ply spacer you made earlier.

Route all the servo leads around the opposite side of the rudder pushrod, including the elevator lead. This is why the thinner flat servo wire is recommended. It's possible with thicker gauge but it's more of a squeeze! Notice: the wires are routed away from the joiner slot. You don't want the wires chaffing on the joiner!

Apply epoxy to the inside at the tray and former contact points and slide in the radio tray. It a juggle as you will need to thread the wiring through the former and will help to first tape up the leads to prevent epoxy spoiling them. You will be sliding the ballast tube out of position then back again to the proper location (155mm mark) in order to get it all in. Clean up any stray epoxy with thinners and use a small brush to make sure you have applied enough to the tray etc and to brush off any excess especially underneath the battery slot.

I usually then check the joiner still goes in and bob a few ballast slugs in to weigh down the tube with the fuselage supported horizontal and sitting square. It will also help to screw in a longer M4 bolt if you have and check this is plumb vertical as likely that you will be slightly off when positioning the tube.

Clean the brush with thinners, dry on paper and go over the joints to make neat. Having a few cotton wool buds dipped in thinners helps clean off the excess and clean up the fuselage exterior if any epoxy has strayed onto it. Then let it cure.



Here's what it will look like when all done! Notice the wiring is tucked away in the slot and if you use a small RX it will slide in lengthwise or vertically as the fuselage is so deep. Even bigger RXs can just sit on top of the tray. A conventional toggle switch is used here and mounted in the RX slot.

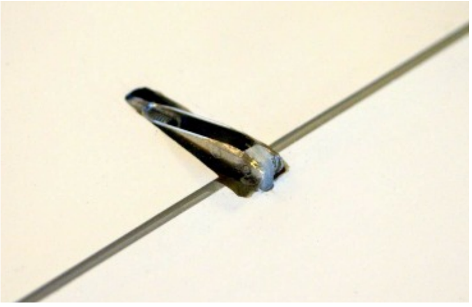
It is a messy job to do in one go and if that puts you off you could do in stages; instead of epoxying the front of the ballast tube use thick cyano but no kicker (rear is still epoxied) and slide in the radio tray without gluing so that it lines up the ballast tube centrally. Use the long bolt to eye up square before the cyano grabs. When it has gone off enough remove the tray and spray kicker ensuring still square, then route the wiring, with this joint holding the tube in place you can epoxy the tray before the rear ballast tube joint has gone off. It's still a bit messy especially routing the wires through the former but much less so. Just keep in mind what the formers are doing; adding strength to such a deep fuselage and locating the tray, it's all worthwhile!

Back to the wing:
Wait until the wing servos are fully cured as you need to move the surfaces for this stage. If you don't, the skin around the servo locations can show bulges on the top surfaces if the servos moved under load, so be patient!

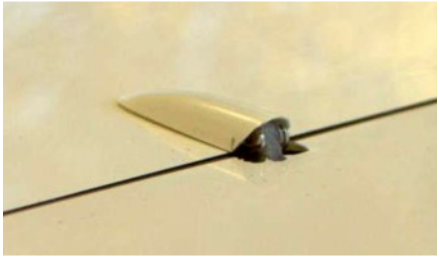
You need your servo tester again and with the wing surfaces with taping removed, check the centring. So ailerons should line up and 1500ms and flaps at either 1140 or 1860ms depending on which side. If you've been accurate it will but if just a tad off. Adjust the pushrods to the closest full revolution to get as close as possible. Check the throws at the same time you'll find you will have plenty! Once satisfied I use thin cyano wicked into the threads to lock the clevises in position to make them secure and take out the play. If there is play in either the servo arms to clevis or horn to clevis a drop of cyano on the clevis pin and hole will take care of this; use kicker and keep the surface moving (using the servo tester) whilst it cures or you will lock in position! If it ends up being too high in friction a drop of penetrating oil will make good.

You will have a set of clevis slot covers which we call ‘finger nails’ for obvious reasons to cover the top surface. Trial fit to make sure the clevis is not too high. Hopefully you should have these correct at the pushrod making stage and not need much grinding if any.

These are glued on with thick cyano after cleaning the surrounding area around the slot with acetone or thinners. I just run a thin bead on the inside the lip of the finger nail and using tweezers position in place. The bead will run down to the skin and hopefully not too much so that it runs out. If it does spray kicker and clean up with acetone and cotton wool bud.



Clevis ground to fit under the ‘finger nails’ covers.



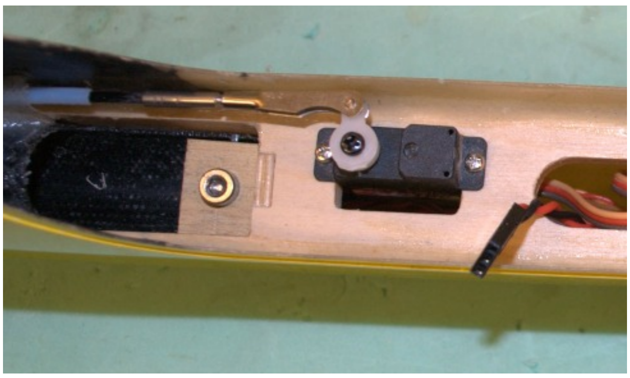
Strapping the wing servos:

As mentioned earlier, an essential part of the wing installation technique is to strap the servos to the bottom skin (and tie the bearing housing too, to the bottom skin). It will reduce skin flex under load dramatically. The previous pictures show a multitude of different materials to do this. However if you don’t want to make your own you can purchase ready made straps as an optional extra, CNC cut from G10, 0.4mm thick for the ailerons and 1mm thick for the flaps. (15mm W and 55mm L perfect for Aresti 2m).

Here the servo and bearing kit is in a ½ frame. It’s still glued in place (as the servo position needed means you have no access to screw in the top lug) but the frame helps line everything up to make things a bit easier. Clear covers are a good idea as they allow you to be able to inspect the installation for pre-flight checks.

Rudder servo:

When the servo tray glue is install the rudder servo. Connect the clevis adapter onto the rudder end first by sanding the carbon pushrod and use cyano. Crimp the adapter with side cutters to get good contact. Screw on M2 clevis and connect to rudder. Now tape the rudder in neutral and put in the servo with a 7mm arm set at 1500ms. If you want crazy rudder throws use 10mm arm but you might need to sand back the wiper to allow this much movement. You will need to position MKS DS6100 as shown below as full movement will foul the servo body in any other orientation. Cut the pushrod and outer to get the correct length and relieve the clevis as shown to allow full travel. Cyano the adapter and clevis as previously. It’s best to do the next adjustments with the joiner in so no chance of inadvertently setting the pushrod high and fouling the joiner. The servo needs to be slid over to one side so that the pushrod does not interfere with ballast entry/exit and tight to the sides without fouling the clevis. Adjust the clevis once in this position if rudder not in neutral. Then mark the hole positions and drill/ screw the servo in position. The slot is wide enough for a variety of servos but any increase in length required needs some filing. Weight is not critical here so go as large as you wish. If you don’t use MKS DS6100 you can position with the arm facing forward, so adjust the pushrod length to suit. Once installed lock the clevises at both ends with thin cyano. Check for play in the arm and horn and if there is, use a drop of cyano to cure as before.



Note: The pushrod outer is cut to the minimum length to allow servo travel and then fixed in position with glass and thickened epoxy (or for speed use thick cyano and glass cloth + kicker) but I prefer epoxy for this job. If you want stiff linkages that don't blow back you need to support the pushrod! Do under the joiner position too and hold down the outer with tape through the joiner hole if required.

Just behind the ballast tube opening and just in front of the wing leading edge position fill in around the ballast tube with epoxy and colloidal silica and an added a layer of glass across tying in the ballast tube to the sides and securing the pushrod all in one go. It not only makes the ballast tube more secure but acts as a compression strut to stop the wing pushing the fuselage in at the LE.

At the same time you can apply epoxy either with a stick or syringe to the back of the fuselage plugs (via the joiner hole). Let it go onto the ballast tube in between the plugs. It will give some mechanical strength to the plug installation but also act as compression strut tying the sides to the plug and to the ballast tube.

You're done! Well almost, tape on the wind servo covers, either clear or those supplied, add a switch and balance with trimming weights stuffed in a bag in front of the battery (for easy changes). Position the aerials with good separation and at 90 degrees to each other and you will find no problem with space doing this. Now set up your Tx as below and go fly!!

For the maiden flight you may want to start the CG at 93-94mm but the Aresti is well behaved at 95mm and we are sure you'll end up there! It's a good idea to balance laterally too. It's not critical unless you like to fly slow and in light lift.

Balance and throws:

The set up guide is as our test pilots like it so not a tame set up! These were largely from the conventional spar prototypes but what we have since found is the sine wave spar production models require less throw. So rates are a good idea especially for the maiden. 95mm cg seems ideal. The ballast tube will need a shim at the back if you want a more forward CG. We never have found the need though. One other characteristic to note is that a good idea is to fly with a lot of rudder expo as it extremely powerful and if don't pull the sticks very cleanly it's quite easy to upset the Aresti 2m by inadvertently applying rudder. We increased the rudder size after our initial prototypes which is great for intentional usage but requires very precise control when not required. Same goes for the elevator but to a lesser degree as it's also very powerful. James Hammond designed the Aresti 2m tail section to provide pitch change with small deflection (and therefore reduced drag). Of course he was correct and that's exactly what our test pilots found. So go easy on the elevator and it is not a bad idea to use expo too. Other than that just brush up on your repertoire of acrobatic manoeuvres; you will find that the A2M is very efficient and just keeps going. You don't want to run out of ideas of what to do next too early on.

Happy flying!

Aresti 2M Setup

		Normal mm	Notes	Extreme mm	Notes
Butterfly	Ail	14	At Tip	14	At Tip
	Flap	-40	At Root	-40	At Root
	Ele	-3	Compensation	-3	Compensation
Elevator	Up	10	20% Expo	8	
	Down	-8	20% Expo	-8	
Rudder	Left/Right	36	50% Expo	Maximum	Expo to taste
Aileron	Up	11	25% Expo	11	At Tip
	Down	-7	25% Expo	-11	At Tip
Flap (with Ail)	Up	6	At Root	14	At Root
	Down	-5	At Root	-14	At Root
Snap-Flap	Ail	+/- 1	At Tip	+/- 1	At Tip
	Flap	+/- 4	At Root	+/- 4	At Root
Thermal *	Ail & Flap	-3	At Root	-3	At Root
Speed *	Ail & Flap	1	At Tip	1	At Tip
	* Across whole TE				
CG 95mm at Root					

Specifications

Wing Span: 2m
Wing area: 0.37m2(4ft2)
Flying weight empty: 1.8kg - 2kg depending on lay up
Ballast option: up to 1kg approx

Instructions written by Tony Fu and edited by Peter Burgess
V1