

Welcome to the
Mark 23
 Discus launch Glider



Thanks for buying my glider!

I wanted to try provide a more entry level pathway into discus launch gliding. Sure, there are some nice little built up DLG models out there but the cost and availability in Australia drove me to build my own and now that diode laser cutters are a thing, it has become possible to design and produce my own kits to share with you.

The Mark 23 is a two channel design which has turned out to be a very versatile model that's easy to fly and maintain with great durability in terms of hard landings and hanger rash.

I still find it absolutely thrilling to catch a thermal from a hand launched glider or just have a few easy throws on a dead calm evening and try to catch it which, for me, is endlessly amusing.

There's also no reason why you couldn't fix a little electric motor to the front or a tow hook under the wing for bungee or winching.

I'd love to hear any feedback you might have or suggestions for improvements and again, thank you so much for your purchase and support, it means the world to me.

I hope to be adding to my range in the future, possibly starting with an aileron version of the Mark 23 as well as few other ideas I have kicking around but we'll see...



Start with the vertical tail stab.

[I have removed the Carbon Strips from the design as they were an unnecessary complication.](#)



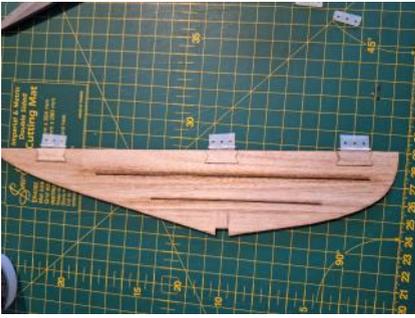
These cutouts are to accommodate the rudder hinges.

Take three hinge tabs and seat each one into position like so.



Use a pair of heavy scissors to cut the hinges so they fit. I actually prefer the "Simple hinges" pictured on the right from www.wightsmodelaircraft.com.au Your kit will include which ever I have ended up deciding on, they are both excellent hinges. Wights also have a selection of covering films.





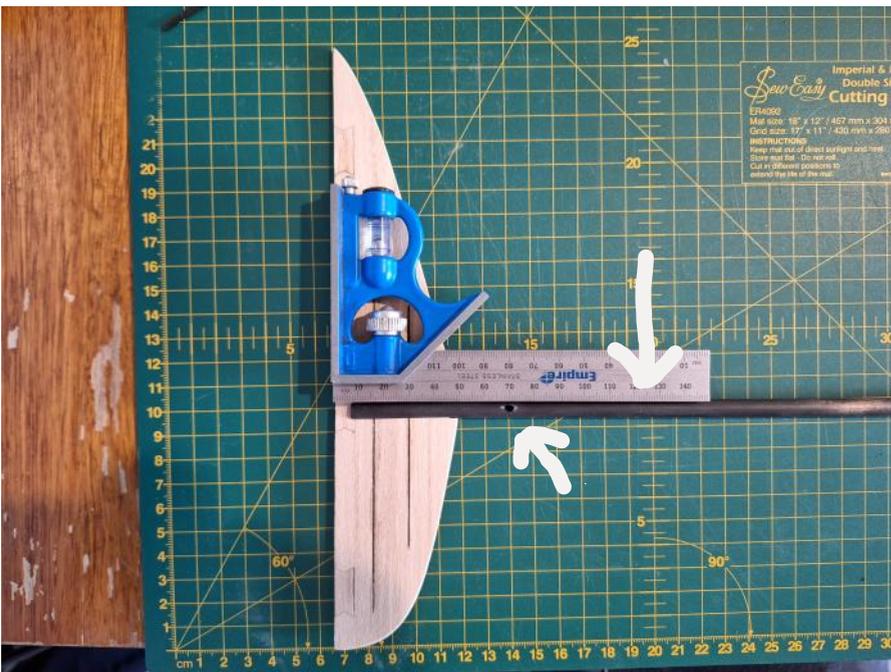
Place the top layer of hinge tabs into position. Be careful not to get glue on the hinges if you intend to remove them for covering.



Sand the part with fine sand paper (120 or similar). Now you can cover with heat-shrink or whatever you like. For illustration purposes I will just give mine a layer of clear coat.



You should now have three perfect sized hinge slots.



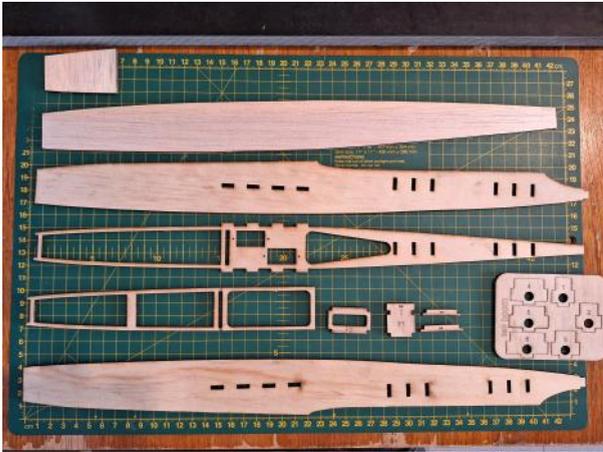
One of the arrow shafts has a slot in the end and two holes pre-drilled. The holes are for the pull-lines that will move your control surfaces and need to be orientated as shown. See how one hole will be on the side and the other will be on top.

Slide the tail into position and check for fit. Sand if needed.

Use a square (or something that is square) to get a good right angle.

Use a good amount of CA and clamp until dry.

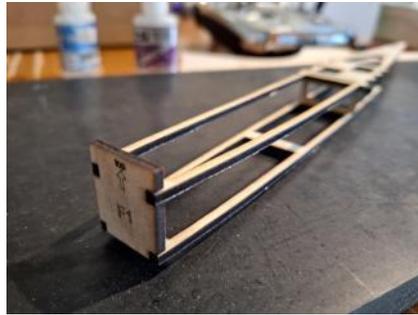




Locate these parts.
Most of them are from 3mm ply with the exceptions being the top and bottom skins which are of balsa



Glue F1 and F2 into positions shown. Note that F1 has an arrow pointing up

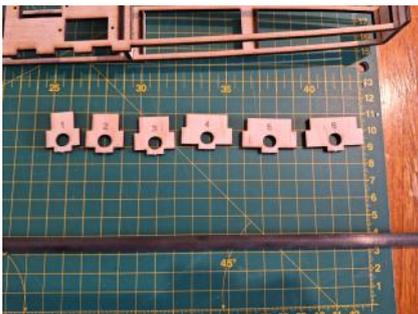


Glue the upper sub-frame into position.

See how this part has the cut outs and screw holes for servos.



F3 and F4 go underneath as shown here. They will contact the bottom skin.



Pop out the tail boom formers 1-6. Thread these onto the shaft smallest to largest. The fit will be quite tight so take time not to damage any parts.





We need the spacing of the tabs to line up with the fuselage subframe as shown. Go slow with this process as good alignment of all these parts will make life so much better down the track

Don't glue them to the arrow shaft yet. We might want to rotate the tail assembly to line the wing up later.



Eyeball down the shaft. We want the tail to be straight up and down when all the parts are assembled



Do several dry-fits until you are happy



Finally seat the parts and glue lightly. If you try not to get glue on the actual arrow shaft at any time it will remain possible to rotate the tail alignment later when we are positioning the main wing.

See how I am using the cutting mat to hold the rear of the shaft level.



Should look a bit like this



Lightly sand as shown.

We want the side skins to have good contact with the subframe. Especially at the front end where any hard impacts will happen, so make it nice and strong now and it will last a good long time.





Dry fit the side skins into position. Manipulate them until all the tabs are located correctly. It may be necessary to (very slightly) round off the corners of some tabs as shown on the right. Go slow and make several dry fit tests until you are happy.



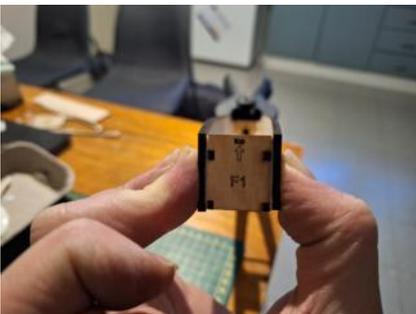
Coat all contacting surfaces with lots of PVA or Epoxy. If you get any glue on the arrow shaft, wipe it off.

Here, I am using a stick to apply the glue more precisely.

Apply glue to both sides. We are gluing both skins at the same time.



Here I am clamping the back end first



Here is a view of the front. See how I am holding the side skins and making sure that one is not higher than the other.

Clamp that puppy.



Check for alignment. When you put the clamps on, the excess of glue can make the parts "float around" as they are squeezed together.

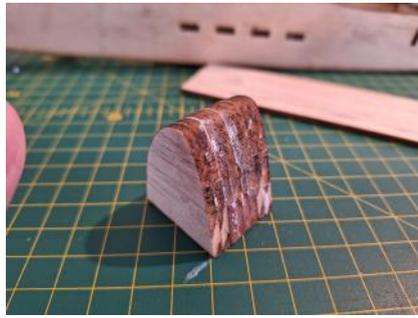
Use cloths pegs and make sure the sides are contacting the thinner parts of the subframe





Take the top and bottom skins and the nose cone parts.

Laminate the nose cone parts together with an even coat of glue. Alternate the direction of the grain.



Clamp until dry



Glue the smaller top skin in place lining the front up with F1. you may have to sand the area flat beforehand.

I have taped mine in place to dry because I am using PVA but you could use CA if you wish.



Here I have coated the bottom in PVA and taped on the bottom skin to dry. Again, use CA or epoxy if you want to but make sure all surfaces are fully bonded



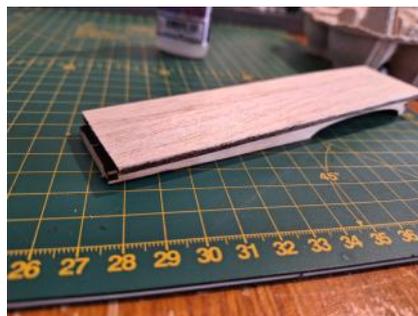
These parts are for the hatch. assemble them as shown here.

I have since modified the larger former with a cutout to accommodate the servo strings better



Apply the top skin. Notice how the front of the plywood frame protrudes out the front by 3mm.

This will hook under the top skin to retain the hatch.





Test fit the hatch. Probably it will be too wide. Arrange some sand paper on the block as shown. Note that the paper does not extend around the bottom corner of the block.

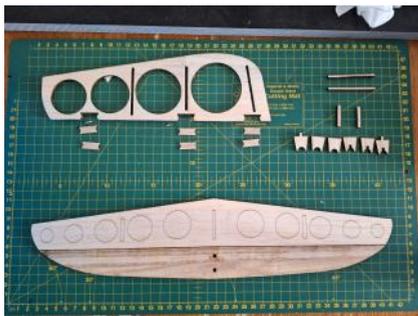


Lightly sand the front of the hatch frame as shown until a tight fit is achieved.



Square up the front end with some sanding and glue on the nose cone assembly with epoxy or PVA to fill in any gaps.

I have used masking tape to secure the part until dry.



Time to build the rest of the tail feathers.

The six "tooth" shaped parts on the right here will be glued together.

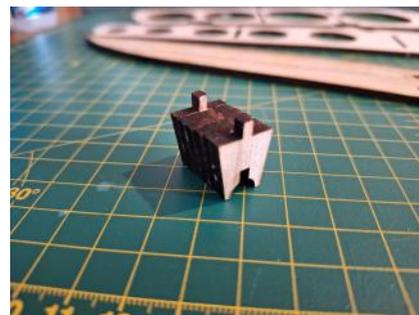
The hard sticks are inserts to stiffen the control surfaces



This is the riser that will connect the horizontal stab to the tail boom.

Note the notch at the bottom, that will face toward the rear when assembled.

Laminate and glue them together showing care for alignment





Here I am cutting a slight angle onto the pins on top of the part. Depending on variations in material thickness from my supplier, you may not need to do this.

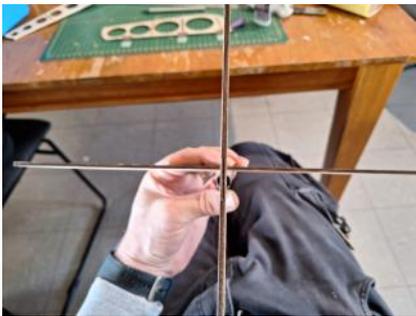
I want a tight press fit into the horizontal stabiliser. Don't glue it just yet though.



Roughen the spot up on the carbon shaft prior to gluing. Seriously, do it or the tail will fall off the first time you have a sketchy landing. Remember that hole on top of the tail boom? You want to locate the notch in the tail riser on top of that hole. The pull string for the elevator will pass through there.

As is tradition, do a dry fit and see how it looks by eyeballing it down the length.

When you're happy, apply lots of medium CA glue.



We want nice right-angles between the upright tail and horizontal stab

I am pressing down hard to seat the horizontal stab onto the riser part because I still haven't glued it on. I am only gluing the riser to the tailboom at this stage.



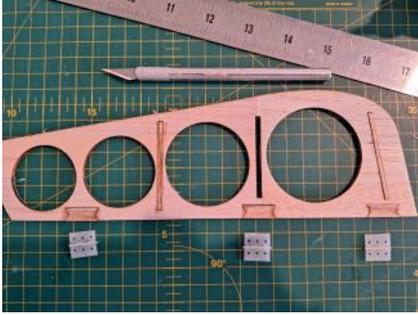
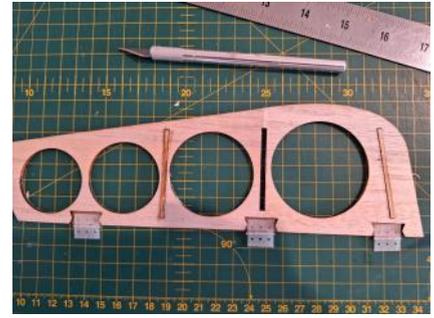
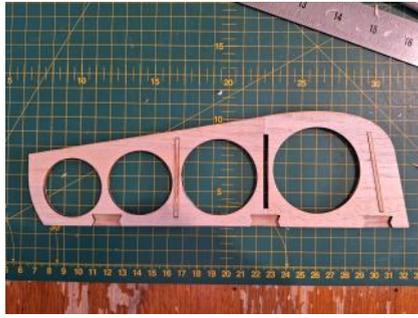
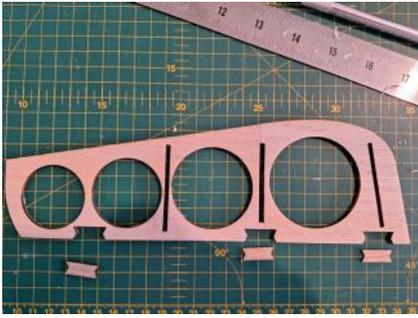
You can see in the picture on the left, that the Elevator and horizontal stabiliser use exactly the same method to attach the hinges.

Perform the same process that we did with the vertical stabiliser of in-laying the hinge tabs

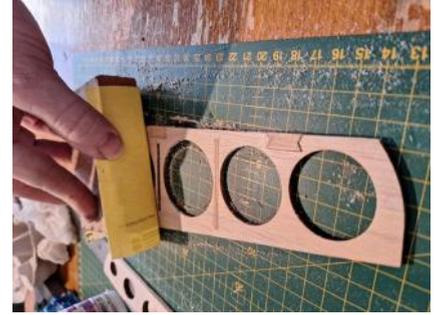


Glue the stiffening sticks into the rectangular holes of the elevator control surface.

The centre slot is for the 3mm ply control horn which we will glue in after covering, so leave that for now.



Remember how we installed the hinges onto the vertical stab way back at the start? Its time to do that for the rudder. See how I place the actual hinges into position, sandwich them with the top layer and then remove the hinges without gluing them in. Insert the stiffening sticks into the rudder, again leave to middle one free for the control horn after covering.

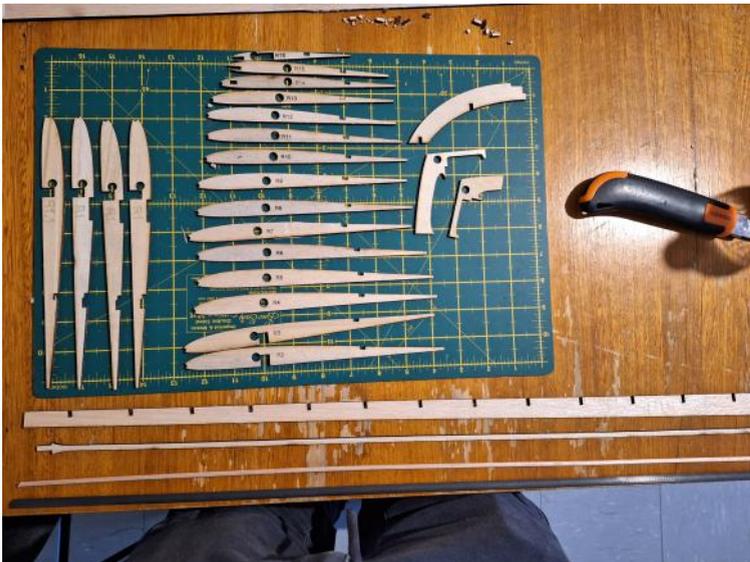


Finish the parts by sanding with 120 grit.

You could also thin down the trailing edges of all the control surfaces to around 1mm if you wish to slightly improve performance. It is worth noting that even with 2 metal geared servos, a ten channel receiver, 300mah 2 cell battery and power converter in the nose, I still generally need 2 small lead sinkers for balance, so we can always afford to make the tail a bit lighter.



Give the fuselage and all the other parts a final smoothing over and let's get started on the main wing



Here we have all the parts for one wing. The parts for both sides of the wing are completely identical so make sure to build a left and right wing. DO NOT BUILD TWO RIGHT HANDED WINGS and definitely don't do that multiple times when prototyping a new glider kit design.

Anyway the parts for one wing are as pictured.

4 large centre ribs, 3 are marked R1 and one is R1.1

The other ribs from R2 to R16

There are 3x 3mm ply wingtip parts

There is a 3mm hardwood dowel which is the leading edge.

The arrow shaft is a 7.46mm spine stiffness 350 carbon shaft.

The rear spar of harder wood has one end that fits into the centre section.

The trailing edge has notches into which the ribs will locate.



Take the 4 centre ribs R1, R1, R1 and R1.1 which is missing the notch out of the top. When we get to mating the two finished wing halves together it will be two R1 ribs that meet in the middle. Just to be absolutely clear here, the order of ribs starting from the root is R1, R1, R1, R1.1, R2, R3, R4 and all the way to R16 at the tippy tip.

Start by gluing all 4 centre ribs together. I am using PVA. Lightly roughen the end of an arrow shaft and insert all the way into the rib sandwich. **Note that all the ribs in this wing are not actually flat on the bottom.** See how I am using my sanding block and a heavy bottle of glue to weight down the trailing edge flat to my building surface in the right hand picture. Whenever securing a rib always make sure the trailing edge is pressed down.



Use an engineering square and clamp the parts up.

Since I am using PVA, I will also soak some thin CA into the where the spar inserts to really make sure that carbon spar becomes one with the wood.

CA works unbelievably well on carbon. Let all of that dry before the next step.



Take the rest of your ribs and thread them on to shaft. See how I have the trailing edge laid out and I am using the notches to locate the approximate positions of each ribs.

Don't start gluing yet. We will get the rest of the parts fit tested before we start gluing.



take the 3mm ply wing tip parts shown on the left picture

The two with holes are laminated as shown in the right picture. The smaller goes on top. Make sure the holes line up. That will form the hole for the throwing peg later. This will obviously be the other way around for the opposite wing.





Insert the curved 3mm ply wingtip part into wingtip ribs R14, R15, R16 as shown. Seat it all the way in.

On the right I have inserted the trailing edge of each rib into each notch. Work from the wing root towards the tip and go slow.

We want all the ribs to sit at right angles to the arrow shaft and be fully seated into the trailing edge



When the laminated wing tip parts are dry insert the hook-like part through the rectangular hole in R16.

See how the part contacts with the main spar and trailing edge connection is nice and flush.

Start gluing all these parts if you are happy.

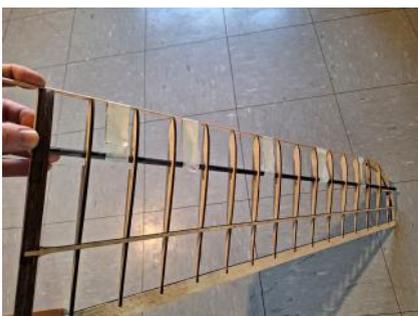


Lay the rear spar into the notches as shown on the left. I like PVA glue but whatever goes.

On the right here I am using a clamp on the tip. Use weights all along the spar until dry or just use CA but make sure it is fully seated down into the ribs. And the rear of the wing remains pressed to the building surface until dry. The picture shows mine tending to lift out so provide even pressure all along the spar and it will work out beautiful



Use thin CA to fix the ribs onto the arrow shaft., I have laid a long steel ruler along the trailing edge and weighted it down with hand weights. This is the last chance you have to get the ribs square with the main spar and make sure the trailing edge of each rib is flat to the board.



Take the 3mm hardwood dowel and glue it into the notches to form the leading edge as shown. I use tape to secure the dowel until dry.

Trim the overhang at the wing root.



It bit hard to see in this picture but the leading edge dowel will sit little lower where it connects to the ply leading edge of the wing tip. This is intentional and after we smooth it in with final sanding you can bind it with the supplied thread if you wish. Personally I don't bother and have not had this fail in any of my testing.



Go ahead and repeat all those steps on the Left hand wing and we are really starting to get near the end of the building phase now.

Use a fine toothed saw to trim the main spar and leading edge. Sand for a smooth finish. Don't breath that carbon dust.



Find the dihedral brace and the angle gauge

We want this angle sanded into the root of both wings.



You can sand it by hand if that's all you have.

Use a long sanding block and stop frequently to check for straightness and fit.

Personally I get the most consistent results by clamping a belt sander on its side to a bench and presenting the wing at the desired angle.

Imagine that the desired angle passes from the bottom of the root rib until the top of the rib is almost completely gone. Then use the angle gauge to fine tune.



Do a dry fit with the wings together and the dihedral brace fitted. The fit should be reasonably close where the two wing roots connect. We will be using a good amount of epoxy to fill in any imperfections.





Trim the rear spars such that the top plate fits. The hole will be drilled all the way through later



Test fit the main wing bolt plate. Sand any parts that require fitting.

The two plates can be found on the "wing mounts" card pictured right. The two at the top!



Rough up the carbon spar

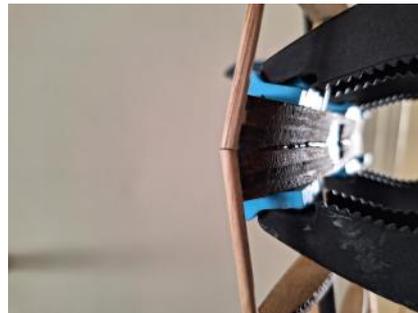
I use a stick to press epoxy into the spar recess on one wing then coat the root. Here a have inserted the dihedral brace into one side.



Glue and clamp the wing halves together. Use a good amount where the spars contact the dihedral brace.



Make certain that the leading and trailing edges line up and do not shift when you place the wing in safe place for drying





Take one of the supplied torsion springs these are made of 0.6 mm spring steel.

I am pressing it flat onto the tailplane to show the approximate location to install.



Mark the location of the first hole by lightly pressing a pin into the desired spot on the edge of the elevator.

take the supplied 1mm drill and very carefully finish the hole to depth. Trim the torsion spring arms as necessary

Insert the torsion spring, adding a spot of CA glue. Locate and drill the hole in the hardwood stabiliser.

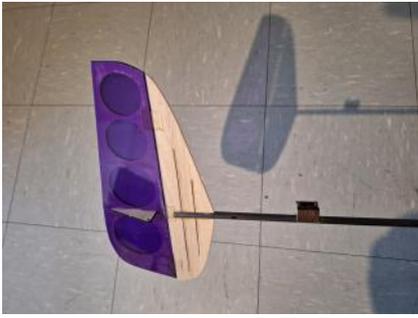


Once the torsion spring is in, test the elevator for range of motion. It should be able to go up and down about 10-15 degrees without too much force.

It should spring back to the extreme up position shown on the right.

I have glued in the elevator control horn part # H1





Lets do the same process for the rudder. Again, glue in the pre-covered rudder. I have also glued in the control horn for the Rudder, H2.

On the Right I have shown the position for the rudder torsion spring.

See how it crosses one of the hinges. Mark the locations for the drill holes using a pin and fit the spring with a spot od CA glue on each end.

we want the spring to be holding the control surface in opposition to the pull string.



Like so



Make certain that tailplane is square and glue it on

Place the wing into position and check that the tail is perfectly vertical and the tail[plane is perfectly horizontal in relation to the main wing



Make any necessary adjustments and glue the tailboom into its formers properly if you have not already done so. I have wrapped some braided line around the rear of the fuselage for luck and soak with CA glue.



Take the wing mounting parts. Notice how these parts have larger holes and are very slightly wedge shaped. Lamine them together and push in the threaded inserts. Use CA which works very well on metal to wood bonds.

****Please Note ****
Your kit may include T-Nuts instead of threaded inserts but the process is identical.
The inserts were too long fouling the wing which needed to be counter-drilled to fit.





Sand to fit and then use a good amount of epoxy to fit the wing mounts into the fuselage as pictured. Push them all the way in. we don't want them to be protruding out the top. Also be careful not to get epoxy on the threads.

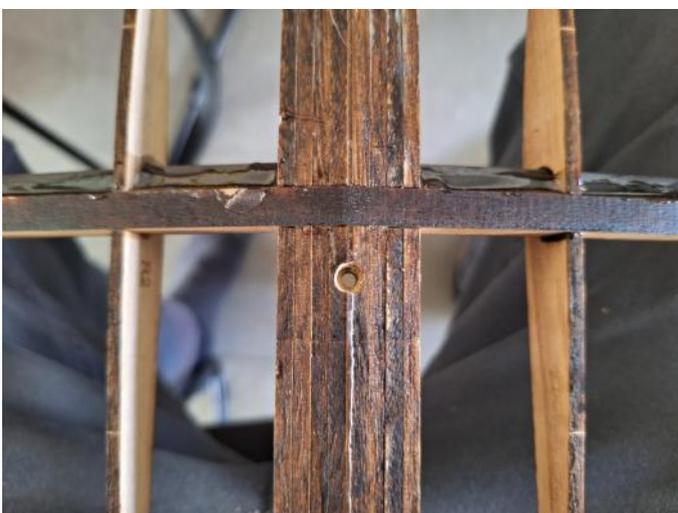


Drill the wing bolt holes all the way through. It may be helpful to start with your 1mm drill and work up to 3mm



The holes need to come out as close to centre line as possible.

The centres of each hole should be 80mm apart to line up with the wing mounting threads.

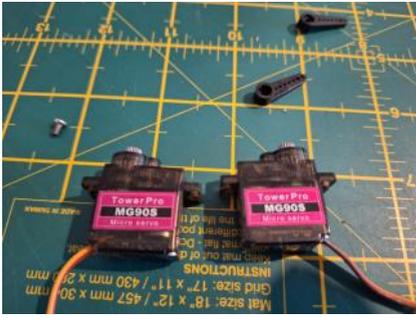


Hopefully your kit will have T-Nuts instead of the threaded rivet inserts that I am using in which case the following step will not be necessary

On the centre hole just behind the dihedral brace you may need to counterbore a 5mm clearance hole approximately 2-3 mm deep.

Place your 5mm drill in reverse and run it slowly into the hole to gently enlarge the first 2-3mm.

Use thin CA to harden the wood in both holes when your done.



Take your servos and mount them into the servo tray as shown. Be certain that the screws bite and careful not strip them

We don't want those servos to move at all.

On the right is another completed Mark 23 to give you an idea



For my setups I like the MG90S tower pro servo which is a cheap servo with metal gears. I have striped a number of different plastic geared servos in the past.

I am using a 300mha Turnigy 2 cell with a UBEC power converter. This gives a good few hours of flight.

My 10 channel Turnigy RX fits easily into the pod.

Install the electric and centre the servos.



Tie a length of braided line to the rudder control horn and thread it through the hole and down the shaft.

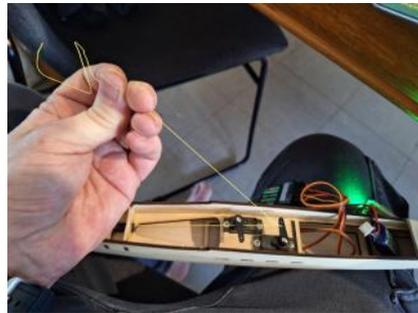
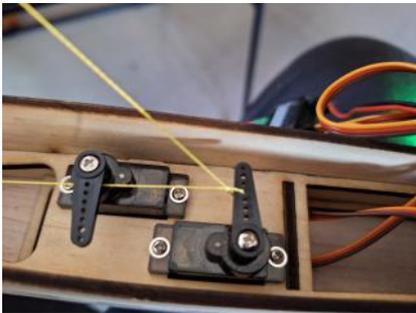
See how I have a clamp the rudder to hold it in a neutral position



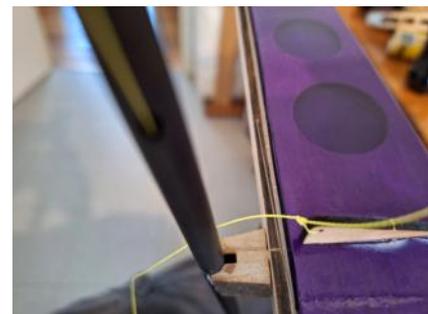
I like to make one granny knot of the braid through the servo control horn.

Pull the line tight until the rudder and servo are both in a neutral position

Put a spot of CA glue on the granny knot, give it a moment to dry and then add more knots to secure the line



Put a spot of CA on the rudder knots as well.





Repeat the process on the elevator. Take a length of braided line to the elevator control horn. Thread the line as shown through the hole at the bottom of the tailplane riser..



I am using a clamp to hold the elevator in a neutral position to make it a little easier.

Again make a single granny knot of the braid onto the servo control horn and pull it tight until the elevator is in a flat, neutral position. Pop a spot of CA glue on your knot. Repeat with 2 or 3 additional knots and CA for a reliable pull string.



I like to secure my antenna to the side of one servo with a piece of tape.
Pack the remaining space in the nose with foam.



Make a hatch retainer by wrapping tape with sticky side out around the fuselage as shown. Finish with a top layer of tape to for a square ring that is a slip fit.



All that's left now is to thin down the trailing edge of the main wing to around 1.5 - 2 mm and give the wing tips and any other rough spots a final sanding before covering. The cheaper no-name covering films from China are actually pretty great and will add a good amount of stiffness to the wing.



A good balance point to start at is 70mm behind the leading edge. That's right on the main wing joiner.

My models usually require a couple of small lead sinkers in the nose.



Once the wing is covered fit the throwing peg into the wingtip. I am right handed, so looking at the plane from the top, I will fit the peg into the Left wingtip. Use medium CA or epoxy. The example shown here is from an older, very much used and scuffed prototype.



Flying for beginners.

When you're happy with the balance and familiar with how the controls move, take the Mark 23 out on a calm day. It's often difficult to "trim" a model in windy conditions.

Hold the model at shoulder height and give it a firm, level throw. We are looking for upward or downward tendency's in pitch. If you've balanced the model at 70mm behind the leading edge it should be pretty close. Use elevator trim adjustment on your transmitter to fine tune for a level glide path.

Indications that your model is too tail heavy are that the model will tend to pitch upwards and be very difficult to steer and control in general. Slightly nose heavy is generally considered better because in that case the model will be more controllable however, you'll be constantly pulling up from its tendency

to dive which wastes energy and shortens flight times.

If the model is balanced correctly it will be possible to adjust the trim on your controls for quite long level glides from a simple hand launch. Likewise with the rudder. Adjust the trims until you have a straight level hand launch.

As confidence increases you can start increasing the firmness of your throws. Make smooth control inputs and try to use small amounts. If you have a computer radio it's good to program in some exponential.

Work up to throwing the glider with enough energy to turn around and come back for a catch.

Notice how when you input the rudder control, the wing tip dips down as the glider banks into the turn. It is possible to turn so hard that you end up "cartwheeling" the glider into the ground so use minimal inputs and be ready to apply the opposite direction of rudder or a little up elevator, if you need to straighten out for landing.

After a while you'll get a feel for the way it turns and understand how much altitude traded for speed you need to cover a given distance. Soon you'll be able to throw the glider and catch it pretty much every time.

Let's do some discus launches.

If you have a computer radio it's a good idea to have a launching condition set up with a slight amount of right rudder to keep the glider straight on the zoom. Gentle launches are best for starters. You don't have to be an Olympic athlete to get a nice launch.



Hold the throwing peg with your index and middle fingers. I am right handed. I have the peg resting on the end pads of my fingers. I have small amount of right rudder programmed to a switch on my TX.

As I begin to step forward into my rotation, the wing comes up off the ground

Continuing the first step, I begin to rotate my shoulders. My arm is straight. I am letting the glider trail my motion.



I plant my left foot at an angle as I continue to rotate my shoulders

See how the glider is starting to level out as air begins to flow over the wings

I am keeping my feet under me, transferring my weight as I come around and we pick up speed.



As we approach release the glider is starting to rotate skyward. I am not forcing it, simply allowing it to happen. I am looking where I want the glider to go.

As my final speed is reached and the glider continues to rotate I allow it to escape my fingers.

As the glider zooms off I judge how much speed is on it. We want to transition into level flight without stalling. Don't forget to deactivate the launch condition switch. It is also possible to just hold a little rudder if you don't have a fancy radio.

Well, now you know enough to get yourself into trouble, here's a picture of my cats for luck.

