

Vortex building guide

Version 1

5.11.2011

1 TABLE OF CONTENTS

1	Table of contents	2
2	The Vortex	4
2.1	Introduction	4
2.2	Limit of liability	4
2.3	RECOMMENDED RC-Components	4
3	The Guide	5
3.1	The package	5
3.2	Preparing the working Area	6
3.3	installing the wing on the fuselage	7
3.3.1	What you need	7
3.3.2	Steps to be performed	7
3.4	INstalling the bell crank	10
3.4.1	What you need	10
3.4.2	Steps to be performed	10
3.5	Installing the vertical tail	14
3.5.1	What you need	14
3.5.2	Steps to be performed	14
3.6	Installing the throwing peg	20
3.6.1	What you need	20
3.6.2	Steps to be performed	20
3.7	Installing the flaperon connections	23
3.7.1	What you need	23
3.7.2	Steps to be performed	23
3.8	GLUING the bell crank, Flaperon CONNECTIONS, throwing Peg	28
3.8.1	What you need	28
3.8.2	Steps to be performed	28
3.9	Installing the horizontal tail	31

3.9.1	What you need.....	31
3.9.2	Steps to be performed	31
3.10	INSTALLING the ball ends on the flaperon connections	33
3.10.1	What you need.....	33
3.10.2	Steps to be performed	33
3.11	Fabricating the flaperon pushrods	35
3.11.1	What you need.....	35
3.11.2	Steps to be performed	35
3.12	Installing the servo board	37
3.12.1	What you need.....	37
3.12.2	Steps to be performed	37
3.13	Installing the servos.....	39
3.13.1	What you need.....	39
3.13.2	Steps to be performed	39
3.14	Installing the BALLAST	44
3.14.1	What you need.....	44
3.14.2	Steps to be performed	44

2 THE VORTEX

2.1 INTRODUCTION

The Vortex is a high performance Discus Launch Glider and is not designed for other types of operation. The Vortex was designed for superior handling in thermals and very good penetration. To minimize the bending of the fuselage and twisting of the wing on launch, all parts are cured and post-cured in a temperature chamber. In addition to that the fuselages cross section is elliptical in the horizontal so that the fuselage is as stiff as possible. The result is an extremely strong fuselage and wing with excellent launch and durability characteristics. The mount point for the rudder is molded as part of the fuselage ensuring perfect vertical alignment. The horizontal-tail is an all flying stabilizer mounted with a micro ball bearing for precise and direct control inputs.

This building guide describes all important steps in the process of building your Vortex. You can read it as a recommendation how to build the Vortex, but feel free to use your own experience.

As we are somewhat more of a visual type we will try not to write too much text but show everything in pictures. In the end a picture says more than a thousand words.

We hope enjoy building and most of all flying your Vortex.

2.2 LIMIT OF LIABILITY

Regardless of construction and manufacturing of the Vortex your personal craftsmanship will determine the airworthiness of this glider. The manufacturer will not take any responsibility for the usage of your glider. By keeping your Vortex, you confirm that it is fit for the intended type of operation. Take special care never to launch in the direction of people or objects. Fly responsibly and make sure your third party liability insurance is valid!

2.3 RECOMMENDED RC-COMPONENTS

For flaperons it is very important that the servos are precise and have no dead movement in the neutral position otherwise flutter of ailerons can occur.

For the horizontal tail it is extremely important that the servo has precise centering. Otherwise a zigzag flying pattern in the horizontal will occur.

We recommend the following servos:

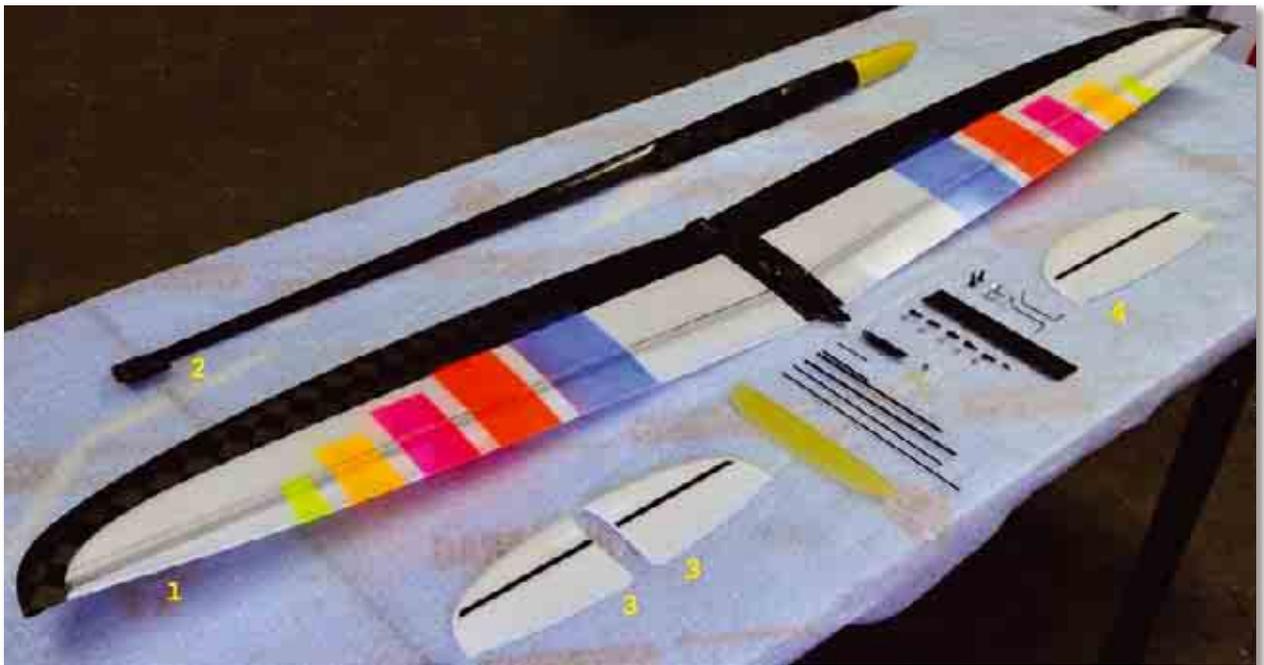
Falperons	Graupner: DS281, C261, C271; MKS: Pegasus DS480; Hyperion: Atlas DSC09 (The bottom case has to be removed)
Horizontal tail	Graupner: DS281; Hyperion: Atlas DSC09
Vertical tail	Dymond D47; Graupner C 141
Receiver	2,4 GHz (min. 4 channels) such as Jeti RX 5 and Mutiplex RX5 light
Battery	SmartLipo 450mAh (or other weighting from 15 to 25 grams)

3 THE GUIDE

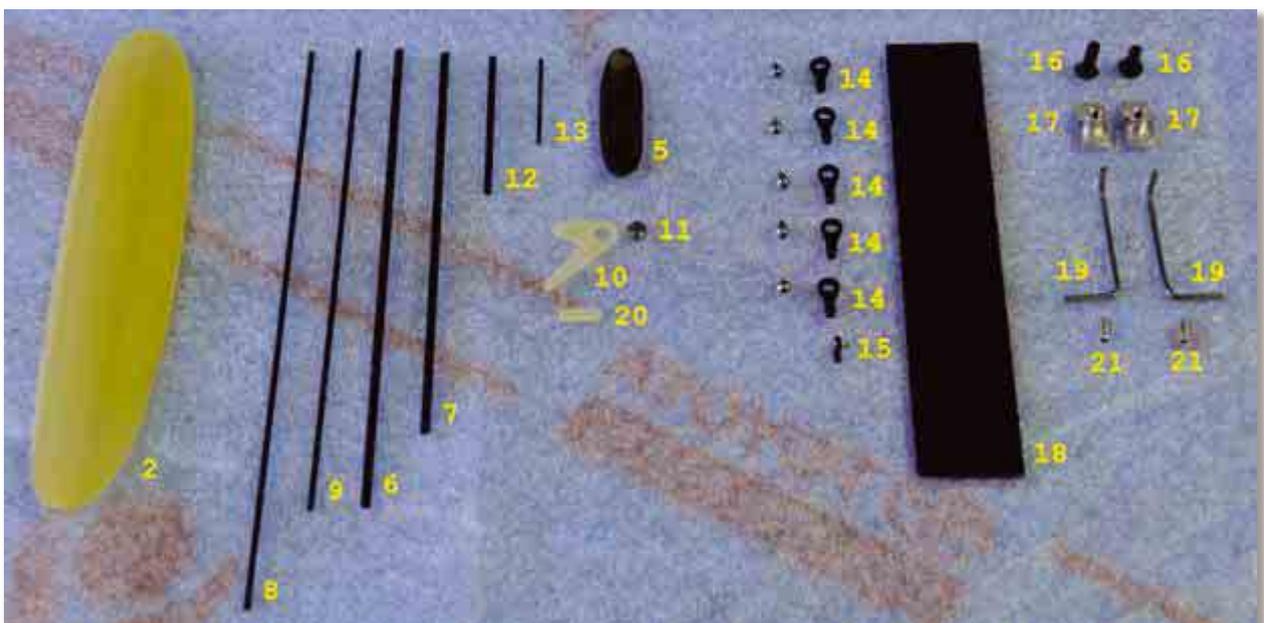
The guide is structured so, that it follows the building process in the order works to be performed as from our opinion is the natural one, to build the Vortex. It is set up so that you perform as much work as possible on the first day, then glue all what has to be glued with 24 epoxy resin and finish on the second day. Of course you can do it also differently if you decide to build in smaller steps. If so just combine parts of chapters as you see fit.

3.1 THE PACKAGE

The whole package



Small parts



Contents of the package:

- Wing (1)
- fuselage with canopy (2)
- elevator (3)
- rudder (4)

Additional if ordered:

- throwing peg (5)
- $\varnothing 0,6\text{mm}$ steel pushrod for elevator 1m
- $\varnothing 0,5\text{mm}$ steel pushrod for rudder 1m or $\varnothing 0,7\text{mm}$ carbon pushrod for rudder 1m
- $\varnothing 3/2\text{mm}$ carbon rod (170mm & 150mm) (6 and 7)
- $\varnothing 2\text{mm}$ carbon rod (200mm & 180mm for connection ball pan) (8 and 9)
- bell crank for elevator with micro ball bearing $\varnothing 6/2,5\text{mm}$ (10 and 11)
- $\varnothing 2,5\text{mm}$ carbon rod 56mm for elevator / $\varnothing 1,5\text{mm}$ carbon rod for elevator 35mm (12 and 13)
- five ball ends large and five ball pans large (14)
- one ball end small and one ball pan small (15)
- two M4 screws for wing-fuselage (16)
- two M4 socked nut (17)
- servo installation board (18)
- two steel flaperon connectors (19)
- rudder horn (20)
- two brass ball had connectors (21)

The ballast

3.2 PREPARING THE WORKING AREA

Just a friendly advice ☺

The surface of wings and tail is prone to get indents so the working area should be laid out with soft foam before you start to work.

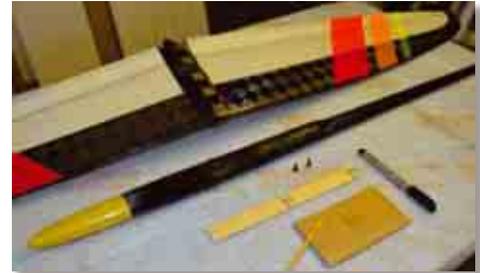
In the production of the Vortex we have to specially take care that the plane is not damaged so it would be unfortunate that you damage it in the workshop even before the first flight.



3.3 INSTALLING THE WING ON THE FUSELAGE

3.3.1 WHAT YOU NEED

Wing, fuselage, 5 min. epoxy, M4 nuts for the wing, M4 screws for the wing, piece of balsa wood, double sided tape, an distance holder (any suitable material, we use a pen - a piece of Styropor also does the job to), Inbus screwdriver of the corresponding size for the supplied screws.



3.3.2 STEPS TO BE PERFORMED

Take the piece of balsa and glue double sided tape to it. The distance between the tapes is measured optically on the predrilled holes on the wing.

Insert the nuts that are used to screw the wing onto the fuselage into the predrilled holes on the wing. Do not insert the nuts too deep because it is hard to remove them.



Glue the piece of balsa to them (with double-sided tape).



Once you have glued the nuts to the piece of balsa you are ready to glue them into the fuselage.



To glue the nuts into the fuselage use **5 min. Epoxy**. A release agent was already applied to the wing and the fuselage on the appropriate places so you do not need to worry about that.



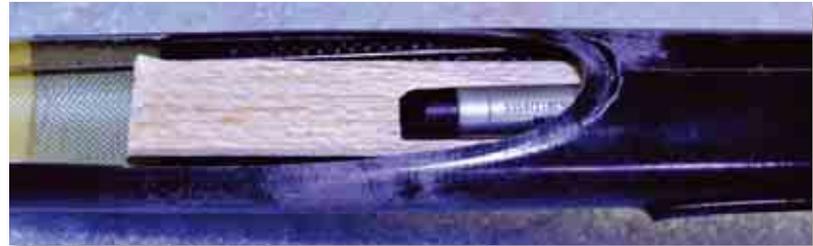
Apply the Epoxy to the nuts and insert them with the piece of balsa into the fuselage



Align them with the holes on the fuselage and push them through.



Use the distance holder to prevent pushing them inside when putting on the wing.



Adjust the holes on the wing to the nuts and screw the wing to the fuselage.



Be careful that the nuts are not turned around when screwing on the wing. But you should nevertheless screw it tightly on.



Be careful to adjust the wing precisely to the fuselage. The middle line on the wing and the fuselage is a good point of reference ;-).

Patently wait for the glue to harden ;-).

Remove the wing from the fuselage. To do this push it gently on one side and lift it from the fuselage.

And you are finished.



3.4 INSTALLING THE BELL CRANK

In the fuselage two steel wires are inserted. Note that they are not of the same thickness one is 0.5 and one 0.6 mm thick. For the horizontal tail use the 0.6 one which was inserted into the left PTFE tube then you received the plane. If you have removed it now is the time to insert it into its tube again.

3.4.1 WHAT YOU NEED

Fuselage, horizontal tail, Drill 2.5mm, carbon rod 2.5mm, carbon rod 1.5mm, bell crank, bearing, sand paper (granularity 500), 5 min. epoxy, super glue.



3.4.2 STEPS TO BE PERFORMED

In the fuselage has clearly marked places where the holes for mounting the horizontal tail have to be drilled.

Use a 2.5 mm drill to drill all the holes. Drill the front hole exactly in the center of the marked place.

Drill 4 holes in the place where the back rod moves when the tail moves.

With sandpaper connect the drilled holes and make the cut out

of the marked shape

Sand the 2.5 mm carbon rods slightly so that they will fit the holes in the horizontal tails easy but tightly and moves easy.

DO NOT SAND THE MIDDLE OF THE 2.5mm ROD WHERE THE BEARING IS MOUNTED.





Sand the ends of the 1.5 mm carbon rod just so much that you remove the edge.

DO NOT SAND THE WHOLE ROD. THE HOLES ON THE HORIZONTAL TAIL ARE BIG ENOUGH A VERY TIGHT FIT IS WANTED.



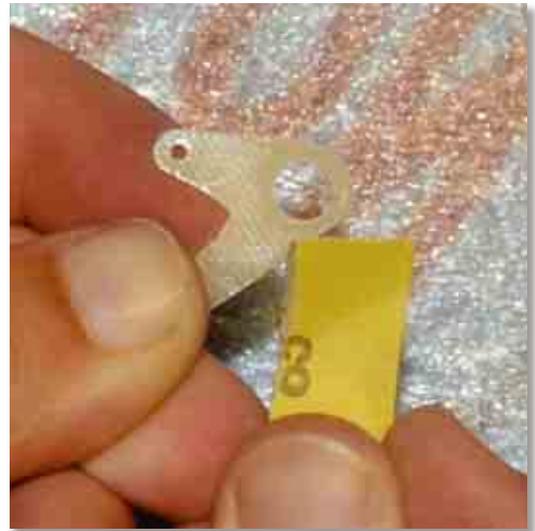
To prepare the bearing for gluing sand it. We use the method shown on the picture but normal sandpaper will do to.



Sand the big hole on the bell crank so that the bearing fits in it.



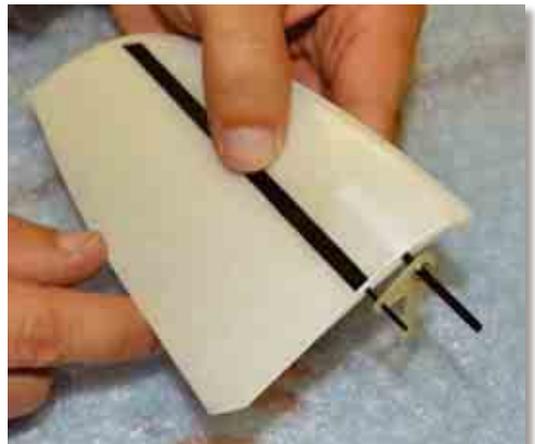
Sand the bell crank around the hole to prepare the surface for gluing.



Glue the bearing into the middle of the bell crank with 5 min epoxy.



Before the glue hardens assemble one half of the tail with the carbon rods and the bell crank as shown in the picture. This will ensure that the bearing is positioned in the correct position. Leave the glue a while to harden.



Sand the surface around the hole on the fuselage, where the bell crank will be glued in, to prepare it for gluing.



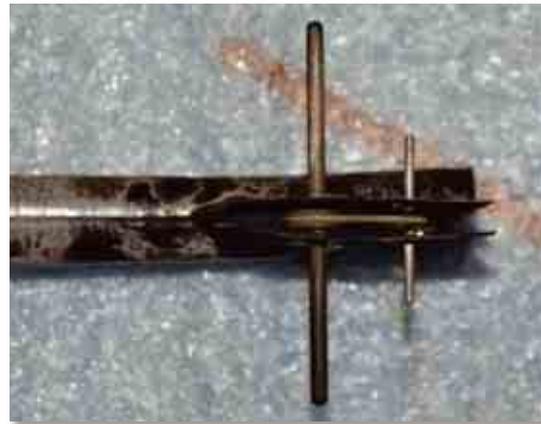
Bend the steel pushrods that are installed in the fuselage, in the well known Z form, to prepare them for the connection with the bell crank and the rudder. As shown on the picture. The Z should not be more than 1,5 mm high so that it will have enough space to move in the fuselage.



Assemble the bell crank with the pushrod.



Assemble the bell crank with the fuselage as shown on the picture.



Glue the part of the bell crank (as shown on the picture) that is moving in the cut out from both sides with super glue. Make sure that it does not run to the bearing.

Remove the horizontal tail and you are finished. The final gluing of the bell crank will be done in a later step with 24 hour epoxy.



3.5 INSTALLING THE VERTICAL TAIL

Important information: The rudder box on the fuselage is sanded in the manufacturing process. We blow out the carbon dust that is produced during sanding, but there can still be some residue of it. This carbon dust is hard to remove from the tail and wing surfaces. We suggest cleaning the rudder box before starting and being careful when building.

3.5.1 WHAT YOU NEED

Rudder, rudder horn, Tesa paper tape, pencil, knife, ruler, super glue, caliper, wood/plastic block



3.5.2 STEPS TO BE PERFORMED

What we want to achieve is that the vertical tail is mounted symmetrically to the fuselage. To achieve this the middle point of the fuselage as shown in the picture has to be found first. This is a reference point so that the vertical tail can be installed centered.



It can be done also without the Tesa paper tape using a ruler and marked directly to the fuselage.



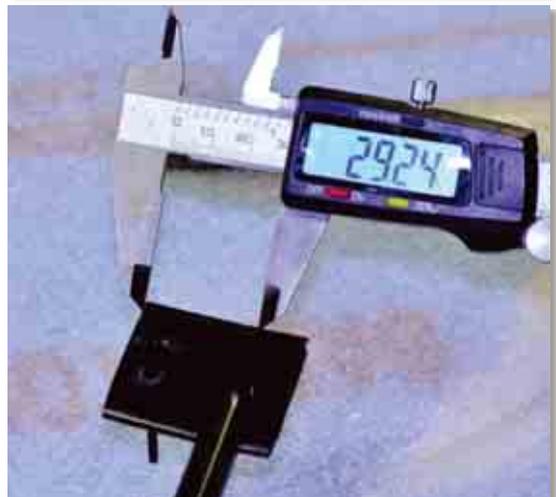
Now we have to get the exact measurements for the mounting point of the vertical tail (rudder box) that is molded to the fuselage. The depth we measure as near to the fuselage as possible. It should be somewhere near 40 mm.



Next we measure the part below the middle point that we determined previously. It should be around 13 mm.



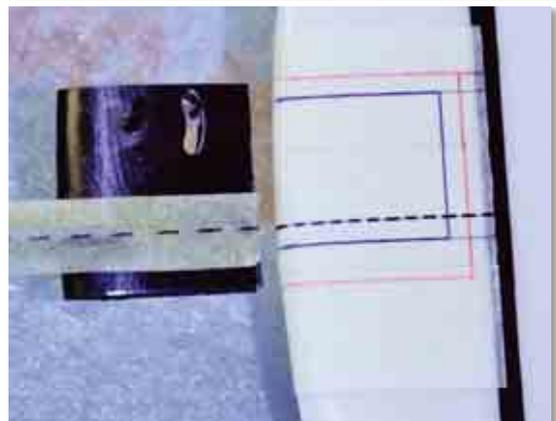
At last we measure the top part. It should be around 30 mm.



Now that we have determined the measures of the rudder box we have to transference them to the vertical tail. For this first we have to determine the middle of the vertical tail. Use the carbon strip as a reference it is layed out very precisely.



Tape down the vertical tail with Tesa paper tape, so that you will be able to draw on it. **BE GENTLE WHEN DRAWING BECAUSE THE SURFACE IS DAMAGED VERY QUICKLY.** Now draw the box on the rudder. Use the distances measured in the previous step. As a reference line the carbon strip is used and the box is drawn parallel and rectangular to it. All measurements are performed from the middle point that was determined in the previous step. Once you have drawn the box on the vertical tail (in red color) you have draw the box that have to be cut out (in blue color).

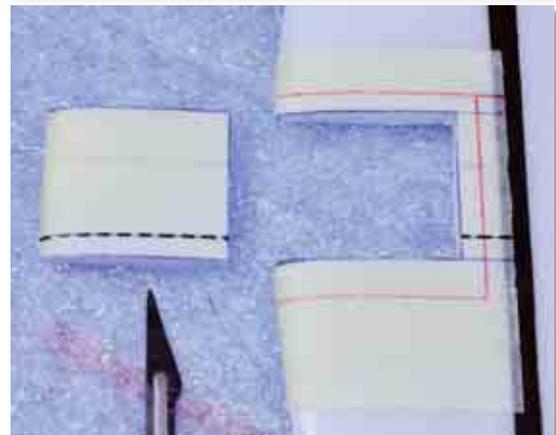


The cut out has to be a little smaller than the rudder box on the fuselage so that some surface for gluing the vertical tail to the fuselage is left.

The blue box should be smaller as the red one for approximately: at the top 5 mm, at the bottom 8 mm and at the rear end 5 mm.

The dashed center line in black is not needed it was added for better understanding.

You are ready to cut out the smaller box drawn (in blue) with a scalpel or very sharp knife.



Now carefully, once the box is cut out, **GENTLY** only for the thickness of the laminate of the rudder box on the fuselage, push in the section of the box that is still left on the vertical tail. If you are not gentle the fitting will not be precise and you can even destroy the vertical tail. This is necessary to get a step free transition from the vertical tail to the rudder box and the rudder box is designed for such fitting otherwise vertical tail is too thick. The Tesa paper tape has to be removed before this is performed. Otherwise it is not possible to control that you have done. Do it in small steps and each time compare the result to the rudder box.



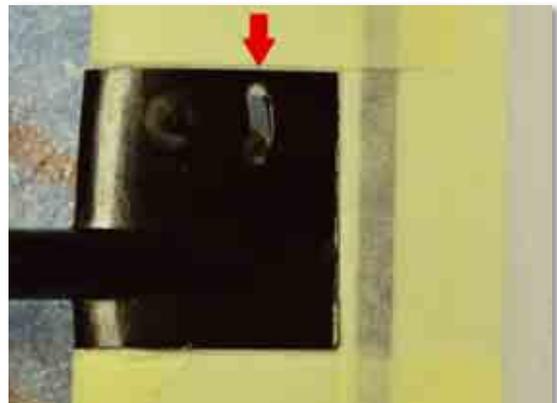
This is how the rudder should look like before proceeding.



The leading edge of the rudder has to be cut away as shown on the picture. Use a scalpel for this. Cut it as much as needed (1-2 mm) so that the rudder fits into the fuselage exactly. You will have to try this out and proceed in small steps until it fits. Sand paper is also a useful tool at this job. You will notice the traces of black carbon powder because the rudder box was not cleaned before trying. This is not a problem once the vertical tail is glued in this is not visible though it can be with hands transferred to other places easily so some cushion is necessary.



Place the rudder on its position, you will see that the space where the bell crank moves, a small part of the vertical tail prevents the it from moving. With a pencil mark the excess piece of rudder.



Also tape the down again the vertical tail around the rudder box for later gluing. Leave only a small gap (0.5 mm) between the rudder box and Tesa paper tape. With this you will also get a god reference line not to cut away to much.



Take the rudder out and sand the marked piece away, so that it will not obscure the movement of the bell crank. You can mark it with a pencil so you will be precise. Place the rudder back on its position and check it.

After you have sanded away enough of vertical tail you will still notice that the bell crank does not move freely to its maximum positions. This is expected. The mechanism inside the rudder box touches the rudder before reaching the maximum possible end positions. With a small pressure on the mechanism in the end positions you can make a small dent in the vertical tail (at top and back side of the cutout) and then with a knife or a milling machine make some space for the bell crank to move freely to its maximum end positions. You will have to try it several times to get the size of the holes right.



Once the vertical tail fits perfectly and bell crank moves freely you are ready to glue it onto its position. Align the vertical tail and use super glue to glue it onto the fuselage



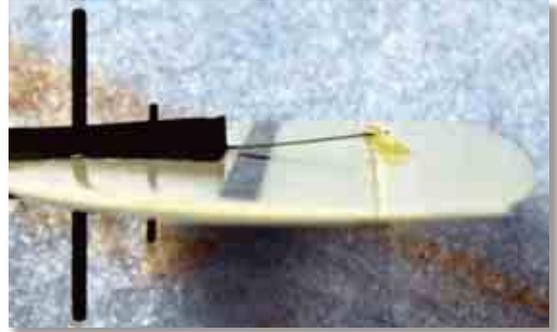
The only thing left to do is to glue in the ruder horn. To do this you have first to determine where it should be placed. This have to be done in the middle of the space prepared in the fuselage. The fuselage has a widening so that the rudder horn can be as long as needed and move freely. Do it as Shown on the picture.



Once you have defined the place make as small cut in the rudder with a scalpel or sharp knife. The cut has to go down to the second layer of glass fiber on the other side but not thru it.

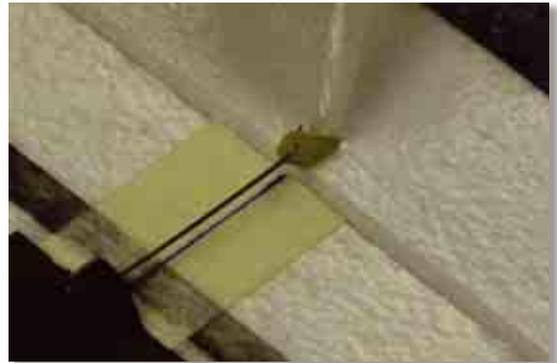


Connect the steel wire for the servo connection to the rudder horn. Insert the rudder horn into the cut. It has to be rectangular to the surface and it is VERY important that the hole on the rudder horn is exactly above the hinge.



Glue in the rudder horn with as small drop of Super Glue.

This was a long one but you are done.



3.6 INSTALLING THE THROWING PEG

3.6.1 WHAT YOU NEED

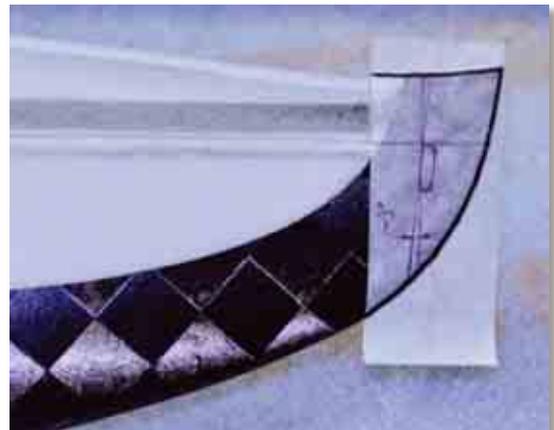
Wing, throwing peg, Tesa paper tape, pencil, sand paper, drill 2,5 mm, knife

3.6.2 STEPS TO BE PERFORMED

The throwing peg is installed in 3° angle towards the fuselage. The wing is enforced at the recommended installation position though some repositioning is possible to match your personal preferences.

Tape down the end of the wing. Use Tesa paper tape as shown on the picture. Now you can draw on it.

Finding the correct position for the throwing peg is very simple. Extend the line from the flaperon cutout to the end of the wing.

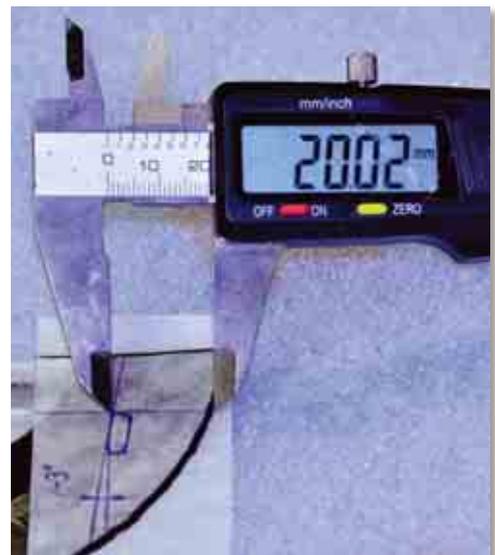


Measure 2 cm from the intersection of this line with the edge of the wing and you have the point where the trailing edge of the throwing peg should be placed.

Now draw a line rectangular to the previous one. This is approximately parallel (the difference is minimal) to the fuselage.

Now a line that, is at the leading edge of the wing, for $\sim 3^\circ$ inclined towards the fuselage is drawn.

Draws the approximate cross-section (a bit smaller is better) of the throwing peg and you are ready.

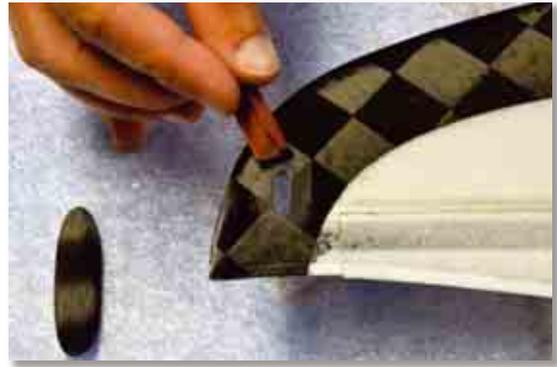


Drill 3 or 4 holes where the throwing peg is installed and send the hole to the correct shape. In between try out the fitting of the throwing peg. The page should go into the hole VERY tightly, but do not brake the wingtip when pushing it in, this would be too tight.



Remove the paper tape and sand 4 to 5 mm of the surface around the hole. This is needed for gluing in the peg.

Do not forget to do it on both sides (upper and lower) of the wing.



Now on a board prepare a two pieces of Tasa paper tape and cut a hole into each one of them that is the size of the sanded area on the wing. Take the Tesa paper tape from the board and stick it to the wing as shown on the picture. Again do it on both (upper and lower) sides.

The gluing of the throwing peg will be done in a later step with 24 hour epoxy.



3.7 INSTALLING THE FLAPERON CONNECTIONS

3.7.1 WHAT YOU NEED

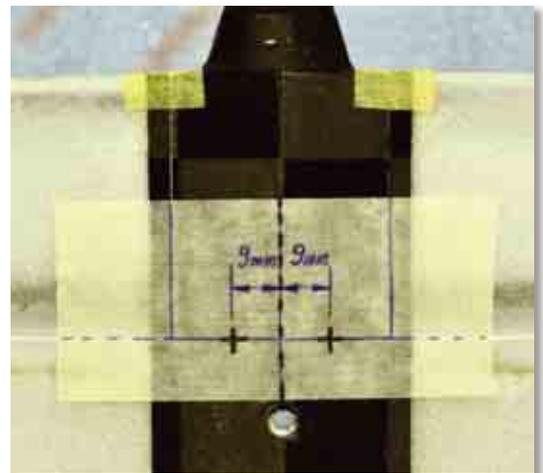
Wing, two steel flaperon connectors, drill 2 and 4 mm, cone shaped sand paper, caliper, Tesa paper tape, pencil, Proxxon cutting disc



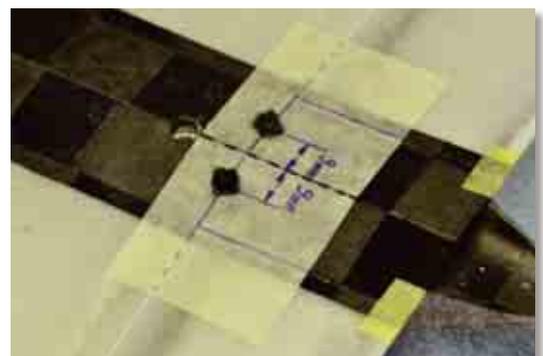
3.7.2 STEPS TO BE PERFORMED

Protect the lower wing surface with Tesa paper tape and mark the points where the holes for the flaperon connectors have to be drilled.

The center of the holes should be in the line of the flaperon hinges 9 mm left and right from the center of the wing as shown on the picture. It is important that the distance is exact otherwise the ballast cannot be installed.



Drill the holes start with the 2 mm drill, then use the 4 mm one and then enlarge them with the sand paper cone until they have 8 mm diameter.



Measure the distance from the leading edge of the wing to the center of the drilled holes. It should be near 133,7 mm.



Now the holes for the flaperon connector in the fuselage have been drilled. Protect the fuselage at the appropriate place with Tesa paper tape and draw the centers of the holes. They have to be 133,7 mm from the wall where the trailing edge of the wing leans on the fuselage and 9 mm left and right from the center.



Use the same procedure as used to drill the holes into the lower surface of the wing.

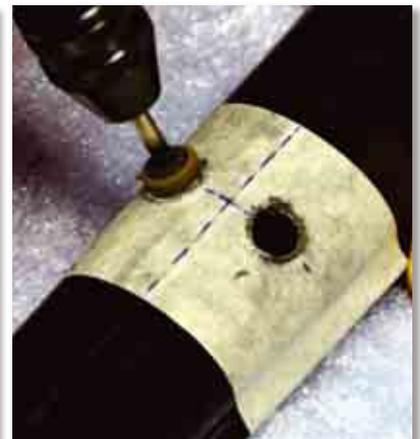


There are two more holes to be drilled on the outer skin of the fuselage for the later mounting of the ball heads.

The holes should be drilled 148.7 mm (your measured distance from the previous steps + 15 mm) from the tip of the cutout for the servos and 9 mm left and right from the center of the fuselage.



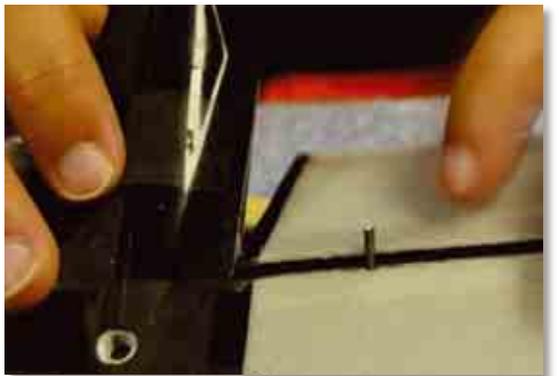
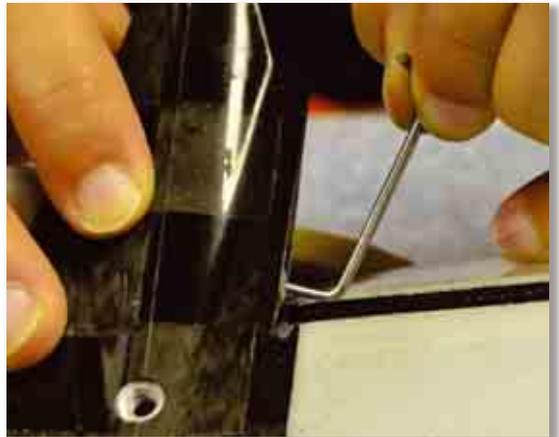
Use the same procedure as described in the steps before.



Now the connector for flaperons have to be installed into the wing. Note the connectors are already bend so you do not have to bend them but you have to turn the correctly. One side is bend rectangular (upper picture) and the other is not (picture below marked with a red arrow). The one that is bent rectangular goes into the flaperon. Here caution is required because the difference is small.



Insert the connection into the wing as shown on the pictures. If you have drilled the holes in the sizes it was suggested you will with a little trying get the grip and having no problems with that.



Position the connection at 9 mm from the center of the wing as shown in the picture.



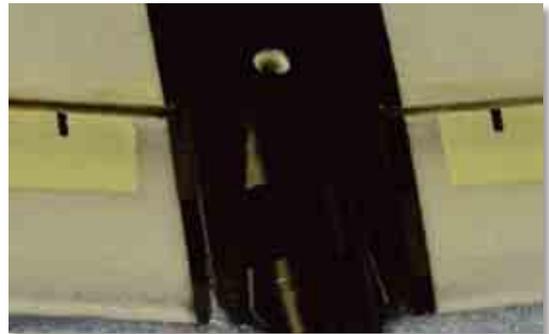
Turn the wing around make sure the connection stays in the place. Protect the surface with a strap of Tesa paper tape and draw the position of the connection to it as shown on the picture.

Do the same on the other side with the other connection.

Do not switch the connections from this point on any more.



You should get the result shown in the picture.



Now you can drill the holes into the flaperons. You should drill a 2 mm hole rectangular to the spar in the flaperon. The hole should go through the front side of the spar and the whole way through the spar but **should not** go through the back side of the spar. Do this on both flaperons.



Insert the connections and see how they fit. They should lean on to the spar on the whole length and the endings should not be too short.

On the picture you see an example of a too long ending.



If the ending is too long shorten it with a Proxxon cutting disc.

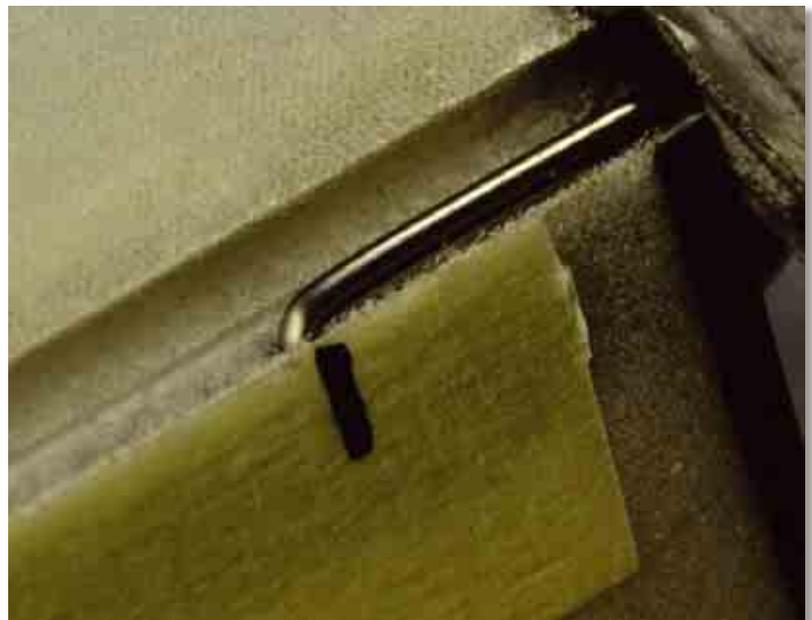


This picture shows how it should be and how you can check the length of the ending.



The final result should look as shown on the picture. Take your time to reach it. If this is not done properly flutter of the flaperons can be the result.

Of course do this for both flaperons. Do not forget not to switch the connections.



3.8 GLUING THE BELL CRANK, FLAPERON CONNECTIONS, THROWING PEG

3.8.1 WHAT YOU NEED

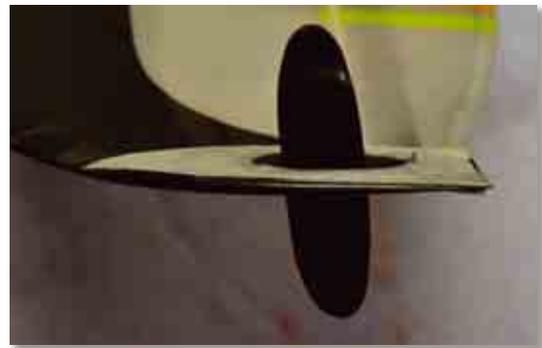
Wing, steel flaperon connectors, throwing peg, fuselage, 24 hour epoxy, micro-balloons, Tesa paper tape

3.8.2 STEPS TO BE PERFORMED

Apply 24 hour epoxy in the hole prepared for the throwing peg.



Insert the throwing peg, wipe it clean if some epoxy was transferred from the hole to it and adjust its position so that it suites your habits.



Mix some of the epoxy with micro-balloons the mixture should not be too thick just so it does not run and apply it around the throwing peg. Do not forget to do it on both sides. You should apply enough to cover the sanded area around the hole. (The throwing peg was sanded when produced).

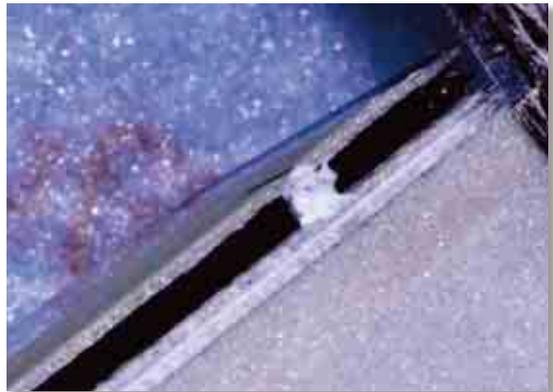
In the picture some black epoxy color was added to the mixture of epoxy and micro-balloons that is why it is black.



Apply mixture of 24 hour epoxy and micro-balloons into the hole that was drilled in the flaperon for the flaperon connection.



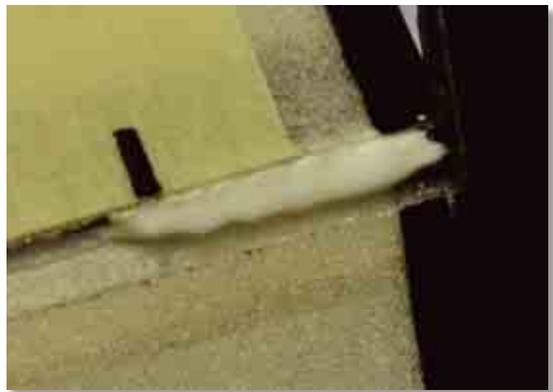
Make sure the hole is filled from the bottom to the top not that just the entry of the hole is filled.



Apply the micro-balloons mixture on the spar of the flaperon and insert the flaperon connection as shown on the picture.



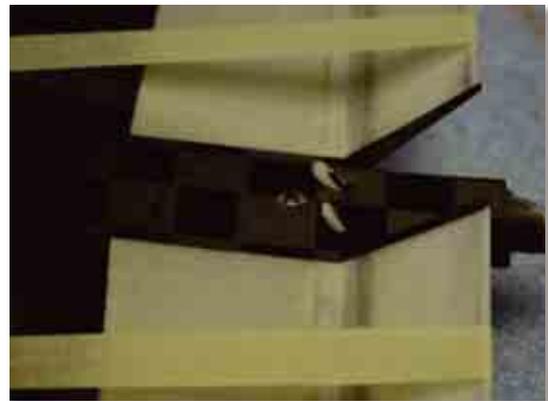
Push the connection the whole way into the hole and cover it with micro-balloons.



Be certain that the micro-balloons are applied all the way around the connection.



Fixing the flaperons as shown in the picture and putting a piece of Styropor under the connection will help you to achieve the desired result.



Apply some micro-balloons around the 2.5 mm carbon rod that holds the horizontal tail. Make the rod is horizontal and rectangular to the fuselage.

Here again we used some black color for the epoxy.

The amount of micro-balloons should be just right so that it does not go too much up on the rod otherwise it will be later not possible to mount the horizontal tail tightly to the vertical tail.

Wait 24 hours for the epoxy to harden well.

Take a break.



3.9 INSTALLING THE HORIZONTAL TAIL

3.9.1 WHAT YOU NEED

Horizontal tail, fuselage, ruler, pencil, sand paper

3.9.2 STEPS TO BE PERFORMED

First you have to mill away some of the micro-balloons around the hole for the 2,5 mm carbon rod. This is necessary because when in the previous step the carbon rod was glued in, we applied some micro-balloons which now prevent the horizontal tail to be pushed on till the end.



This is how the result should look like.



It can be necessary to sand away a bit of the fuselage as shown on the picture to achieve a really tight fit.



This pictures show how the result should look like



Now the part of the horizontal tail that prevents the rudder to move has to be cut away. For this mount the horizontal tail and mark it exactly at the hinge.



Now cut away the appropriate part of the horizontal tail so that you achieve the rudder movement you desire. We recommend cutting it away parallel to the already prepared line, but if you want you can cut away less (more we do not recommend). Note that the mark made in previous steps was also cut away.



This pictures show how the result should look like

And you are finished.



3.10 INSTALLING THE BALL ENDS ON THE FLAPERON CONNECTIONS

3.10.1 WHAT YOU NEED

Wing, two brass ball end connectors, two large ball ends, 5 min. epoxy, caliper, Proxxon cutting disc



3.10.2 STEPS TO BE PERFORMED

The brass ball end connectors have been prepared in the correct length of 9 mm on one side they have a M2 thread on the other side they have a 2 mm hole.

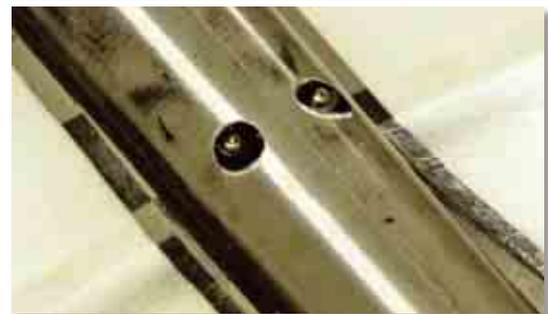
First screw in the ball ends delivered. (The package contains 4 large ones and one, small use two large ones). **Important: The threads in the brass ball end connectors are very small. Be always careful when screwing on the ball ends to position them correctly not to damage the threads.**

Now put them on the flaperon connections installed in the wing and put the wing onto the fuselage. The ball ends should be just under the wings surface as shown on the picture.

If the flaperon connections are two long and the ball ends touch the skin or are sticking out thru the holes in the fuselage, cut away some of the flaperon connections **MISSING PICTURE**, using the Proxon disc cutter, so that you achieve the result on the picture.

If you were not precise when cutting away the connections do not and the connectors area little too deep (but not more that 1 mm) do not worry the holes in them are 6 mm deep so you do not need to push the on to the flaperon connections all the way down when gluing them on.

Sand the steel flaperon connections and glue on the brass ball head connectors with 5 min epoxy. Make sure to fill the holes with the glue before pushing them on the flaperon connectors.



Leave the ball ends screwed on while gluing so that you do not get glue on the thread. If some excess glue was pushed out of the holes wipe it off. Both installed ball heads should have the same distance from the wing. The end result should look like shown in the picture. Once the glue has hardened unscrew the ball ends.



3.11 FABRICATING THE FLAPERON PUSHRODS

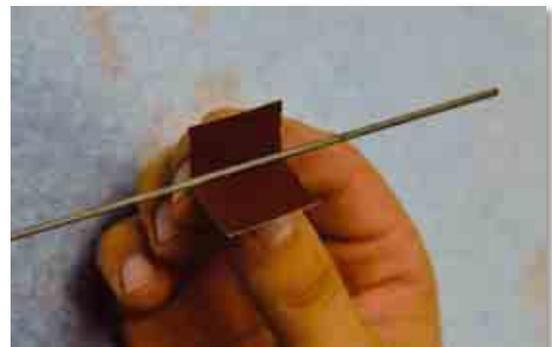
3.11.1 WHAT YOU NEED

$\varnothing 3/2$ mm carbon rod (170 mm & 150 mm), $\varnothing 2$ mm carbon rod (200 mm & 180 mm for connection ball pan), two large ball ends with housing, 2 mm drill, Proxxon cutting disc, 5 min. epoxy, super glue, sand paper (granularity 500)



3.11.2 STEPS TO BE PERFORMED

Sand the $\varnothing 2$ mm carbon rods so that they will fit into the $\varnothing 3/2$ mm carbon rods.



Insert the $\varnothing 2$ mm carbon rods into the $\varnothing 3/2$ mm carbon rods. The longer one into the longer one and the shorter one into the shorter one of course.



On the supplied ball end housings the holes for the pushrods are too small so you have to enlarge them with the 2 mm drill.



Now we suggest making some notches into the $\varnothing 2$ mm carbon rods on one side as shown on the picture



With 5 min epoxy fill the hole on the ball end housing and insert the notched end of the $\varnothing 2$ mm carbon rod.



Once the glue hardens apply some super glue on the $\varnothing 2$ mm carbon rod and push the $\varnothing 3/2$ carbon rod down to the ball end housing.



The result should look like this.

Do this only on one side of the rods the other side you will glue when you install the servos.



3.12 INSTALLING THE SERVO BOARD

3.12.1 WHAT YOU NEED

Servo board, fuselage, sand paper (granularity 120 and 500), Tesa paper tape, ruler, caliper, 5 min epoxy.



3.12.2 STEPS TO BE PERFORMED

Glue the paper tape to the servo board. Draw the shape, to which it should be sanded, to the paper tape. As reference use the picture. On the slim side the board should be 26 mm in width and slightly rounded in the length of 56 mm.

Sand the board into shape. (Sand paper granularity 120)



Now the board is in shape, it still has to be sanded in angle so that the glue surface is as large as possible (angle approximately 60°). (Sand paper granularity 120)



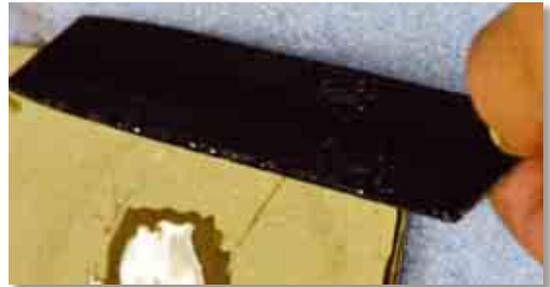
Sand the servo board on both sides. The whole top side, where the servos are mounted, has to be sanded, on the bottom side only 5mm from the edge have to be sanded. (Sand paper granularity 500)



Use 5 min epoxy to glue in the servo board. Note on the picture the bottom side of the board is turned up.



Apply the glue on the edges and put the board into the fuselage. Adjust the trailing edge of the board with the back edge of the canopy.



Hold down the board for the glue to harden enough.

You are done. The end result should look like in the picture.



3.13 INSTALLING THE SERVOS

3.13.1 WHAT YOU NEED

Fuselage, flaperon pushrods, three large ball ends with housing, one small ball ends with housing, servos, pencil, cutting disc, 2 mm drill, 5 min. epoxy, super glue (M2 hand tap if you have). **PICTURE NEEDED**

3.13.2 STEPS TO BE PERFORMED

Mount the ball ends into the servo head. If you have, use the M2 hand tap to prepare threads for the ball ends. As shown on the picture. If not screw the ball ends directly into the plastic.

Use two large ball ends.



If you have looked carefully you have noted that the four large ball ends supplied are different. Two have been sanded so that there have more space to move in the housings, two are standard ones. The standard ones are mounted on the servos.



The sanded ball ends have to be mounted on the wing side.

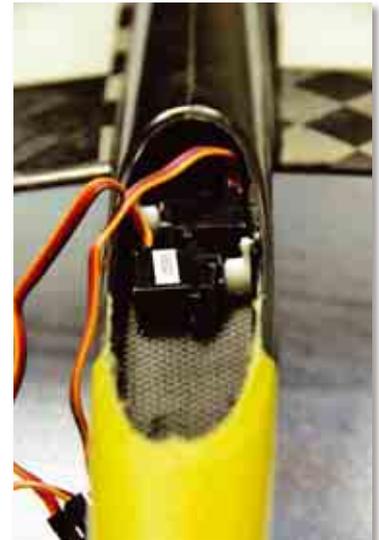
Exchange the ball ends now (take them out of the housing) if they have been switched before.



Before proceeding of with finishing of flaperon pushrods it is necessary to put assemble the Vortex and put all equipment into the canopy and adjust its positions so that the desired CG is reached. If it cannot be reached you can add some weight in the nose later.

Put on the wing and mount the pushrods to the wing. The pushrods are mounted so that the ball ends are put into their housings and then they are screwed on the brass flaperon connectors with a 1.5 mm hex key.

Put the ball end housings on the ball ends which are installed on the servos and insert the servos into the fuselage. Put them to their installation place as shown in the picture.



When the servos are centered the flaperons should be deflected down from 6 to 8 mm. This is needed to reach the maximum brake deflection.

With a pencil mark the appropriate length of the pushrods. Remove the pushrods from the fuselage and the ball end housings from the servos.



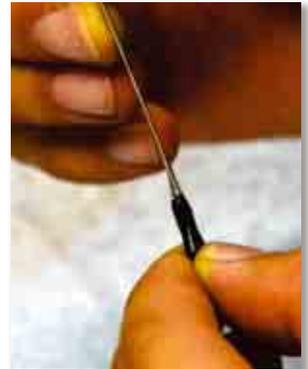
Cut the pushrod onto the appropriate length and make some notches into them as shown on the picture



On the supplied ball end housings the holes for the pushrods are too small so you have to enlarge them with the 2 mm drill.



With 5 min epoxy fill the hole on the ball end housing and insert the notched end of the $\varnothing 2$ mm carbon rod.



The result should look like shown on the picture.



Install the pushrods again and insert the servos into the fuselage. Mount the pushrods to the servos.

Now you are ready to glue in the servos. Deflect one flaperon for 6 to 8 mm down. Position the servo onto its final position (do not forget to center it) and glue it in with super glue.

We recommend that the servos for flaperons are glued in without wrapping them into paper tape or anything else (as sometimes is done). We noticed that wrapped servos tend to move in the wrapping and problems with centering of the flaperons resulting from that movement.

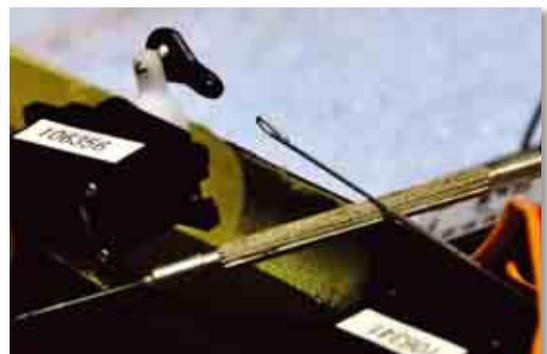


Now the servos for the horizontal and vertical tail have to be installed. Note that we have installed the servo for the horizontal tail nearer to the flaperon servos but you can install the servo for the vertical tail first. Also be careful that you will be later able to install the battery and the receiver.

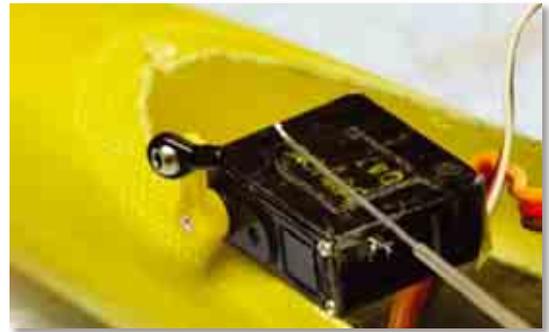
Mount the ball ends to the servos for the vertical and horizontal tail the same way as described for the flaperon servos. Use the large ball end on the vertical tail servo.

Cut the steel wires which are used to move the horizontal and vertical tail to an appropriate length and glue them into the ball end housings (sand them before) as shown on the next two pictures.

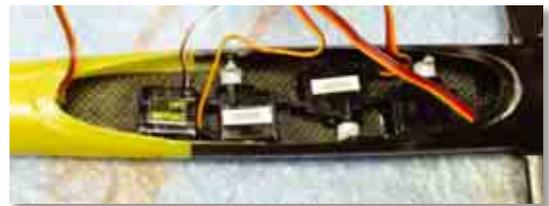
The ball end housing for the vertical tail has a big enough hole, make a loop on the steel wire before gluing it in with 5 min. epoxy (sand the wire before gluing).



The housing of the smaller ball end has a smaller hole so just twist the end of the wire before gluing it into the housing with 5 min. epoxy (sand the wire before gluing).



Place the servos on the appropriate position into the fuselage and glue them with super glue. We recommend that the servo for the horizontal tail is glued in without wrapping it into paper tape or anything else.



Now there is only one thing left to do. Glue in the PTFE tubes in which the steel wires are running. The PTFE tubes are glued in on the whole length of the fuselage except in front part. Here you have to glue them to the sides of the fuselage with 5 min. epoxy. Make sure that the tubes are enclosed with a little glue.

Note: Some problems have been noticed when gluing them in with super glue. The steel wires were not running smoothly so we advise not to use super glue.



3.14 INSTALLING THE BALLAST

3.14.1 WHAT YOU NEED

Fuselage, carbon ballast tube, 5 min. epoxy, sand paper, one plastic tie.

3.14.2 STEPS TO BE PERFORMED

4 SETTING UP THE VERTEX

4.1 CENTER OF GRAVITY

4.2 CONTROL SURFACE THROW

4.2.1 LAUCH

4.2.2 THERMA

4.2.3 SPEED