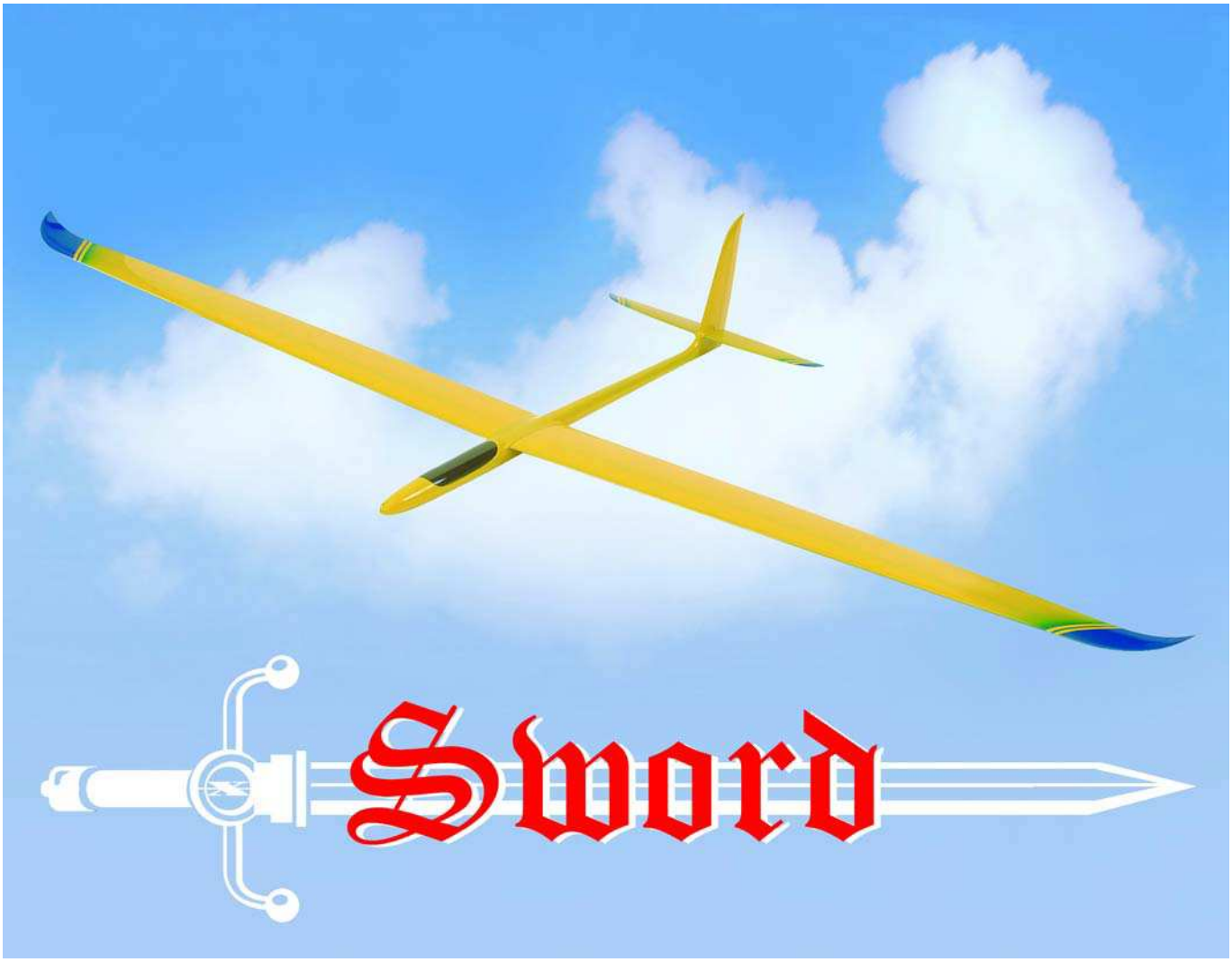

BUILDING INSTRUCTIONS - OPERATING MANUAL

Sword V.: 1.3 ENG - 01/05/2007

INDEX

Sword

High performances glider model

Features

Fiberglass wing with carbon spar, RG15 (7%) high efficiency F3B derivation profile; fuselage made of fiberglass carbon reinforced, suitable either for slope-flight/air-tow than for electrical motor powered flight (12 ~ 18 cells), all movable tailplane for a better efficiency.

Sword is perfectly compatible with **F3B** and **F3J** regulations and, cause of its best flight performances, competitive with other models of the same category; therefore, it can be easily equipped with tow hook.

Two different wingspans are available: **2.5** or **3.1 m**.

WARNING! This model is NOT for beginners.

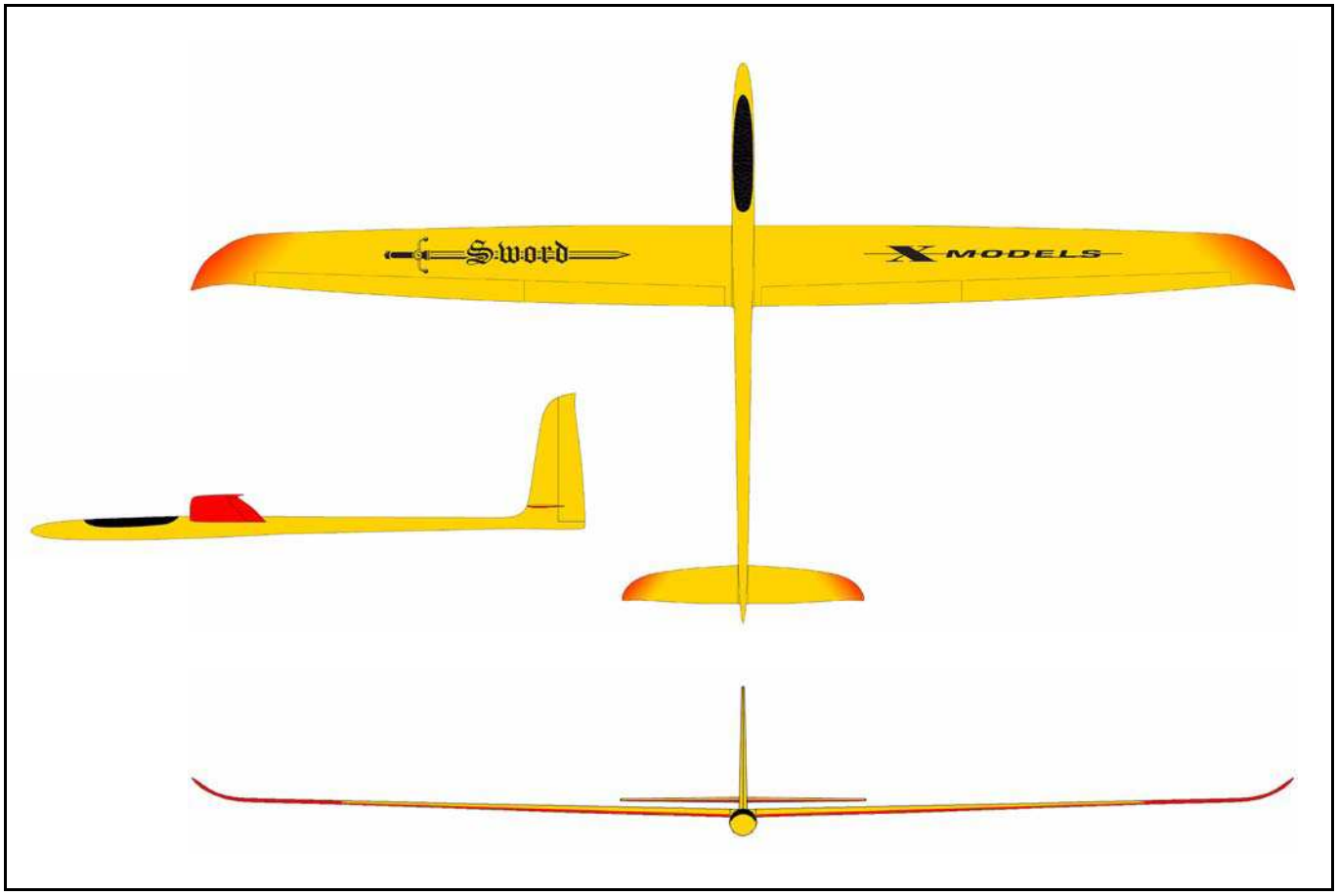

Fig.1: **Sword.**

Technical data

Wingspan (2.5 / 3.1):	2500 / 3080 mm
Length:	1560 mm
Weight - 2.5 version (empty / in flight):	about 1900 / 2400 g
Weight - 3.1 version (empty / in flight):	about 2100 / 2600 g
Profile:	RG 15 mod. (7%)
Radio control:	7 channels

Controls: ailerons, elevator, rudder, flaps.

Note: on request the model can be configured for the air tow and as motor-glider.

CHAP. 1 PARTS LIST, MATERIALS AND TOOLS LIST

1.1 Warning

DO NOT EXPOSE THE MODEL TO HIGH TEMPERATURES. Exposing the model (or its parts) to high temperatures, over 50°C (example: in a car parked directly in the sun) may deform structures and make it unusable.

1.2 Components included in the kit

The following list includes all the parts supplied with the kit.

COD.	QT.	Item	Remarks
FUSO	1	fuselage	fiberglass, carbon reinforced (optional, all carbon fiber)
CAPP	1	canopy	carbon fiber
BASE	1	servos mounting frame	ply-wood
FOM2	6	clevis (little)	M2 thread
DBM2	6	clevis locking nut (little)	hole M2 thread
CAPD	2	screw with hole	M2 thread with hole for pull-pull cable
ARCB	1	elevator pushrod	carbon tube - length: 100 cm, external diameter: 10 mm, internal hole: 8 mm
TCAR	2	spacer for pushrods	hard wood - length: 30 mm - diameter: 8 mm
AMM3	2	metal pushrod	length: 200 mm - diameter: 3 mm - one tip M3 thread
FOM3	2	clevis (big)	M3 thread
DBM3	2	clevis locking nut (big)	hole M3 thread
CUNI	1	cable	length: 5 m three wires (signal, positive, mass)
TBAL	2	ballast tube	fiberglass - length: 250 mm - internal diameter: 18 mm
OASB	1	ballast group front frame	ply-wood
OPSB	1	ballast group rear frame	ply-wood
LCOR	1	frames connection strip	hard wood shaped strip
SGTR	1	tow hook support	alloy plate with M4 threaded hole
GTRA	1	F3B / F3J tow hook	steel
MPXF	2	MPX wing servo connection socket	plastic, with six pins
BAIO	1	wing rod	steel 175 / 235 mm - diameter: 10 mm
SADX	1	right wing-panel	fiberglass, carbon reinforced with aileron and flap (optional, all carbon fiber)
SASX	1	left wing-panel	fiberglass, carbon reinforced with aileron and flap (optional, all carbon fiber)
ARM2	4	metal pushrod	length: 200 mm - diameter: 2 mm - one tip M2 thread

COD.	QT.	Item	Remarks
CSAL	2	servo hole cover	2 pair supplied to suit 4 holes
MPXM	2	MPX connector male	plastic - 6 pin
BOM3	4	threaded bush	brass M3 thread
PERN	4	threaded horn	brass M3 thread
PCDX	1	right tailplane	fiberglass/balsa (optional, all carbon fiber)
PCSX	1	left tailplane	fiberglass/balsa (optional, all carbon fiber)
BSPC	1	elevator rod	steel 115 mm - diam. 4 mm
BRPC	1	connection rod for tailplanes	steel 110 mm - diam. 2.5 mm
BCPC	1	central bush for tailplanes	brass
SQRV	1	elevator bellcrank	fiberglass
SQRR	2	bellcrank reinforcement	fiberglass
DLPC	2	spacer for the bellcrank	carbon
RDER	1	fin reinforcement	plywood
VDER	1	rudder	fiberglass
SSUP	1	upper support for the rudder pin	fiberglass
SINF	1	lower support for the rudder pin	fiberglass
SQDR	1	rudder horn	fiberglass
PDER	1	rudder pin	steel - 375 mm - diam. 1.5 mm
CAVD	1	rudder pull-pull cable	steel wire, diameter 0.8 mm - length 3 m
LOCK	2	wire-locking tubes	brass

Decal

If you like, you may stick the decal we supply with the kit (see figure 2).

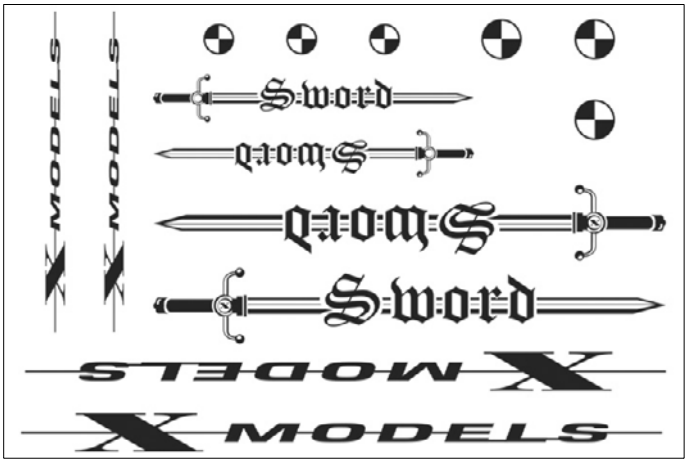

Fig.2: **Decal "Sword".**

1.3 Parts needed to complete the kit, but not included

These are the parts you will need to complete the model (see “List of parts you will need to complete the model”) and some you may need as option (see “Optional parts”).

List of parts you will need to complete the model

To complete the model you will need the following (purchasing separately):

COD.	QT.	Item	Remarks
SEAL	4	wing servo	suggested HI-TECH HS-125MG
SEDR	1	fin servo	suggested HI-TECH 225 BB
SEPC	1	tailplane servo	suggested HI-TECH 235 MG
RIC7	1	receiver (+ xtal)	min. 7 channels
BATT	1	rx battery pack	4 (better 5) cells from 1700 mA - SC size
INOO	1	ON/OFF switch	with RX (UNI) connector
PBBS	1	ballast locking plate	ply-wood, 50 x 40 mm
VB25	1	ballast locking plate nut	hole M2.5 thread
DB25	1	ballast locking plate screw	screw 20 mm long - M2.5 thread
BA75	16	ballast	iron cylinder (30 mm long and 20 mm diameter) about 70 grams each one

Note: not included in the table are glues and small parts that should obviously be present in every modeler’s house.

Optional parts

Once ready You can take the model off only by hand launch or with winch. To let the model; fly in other ways, it must be equipped in a different way, according with the towing method chosen:

— **air towing**: having an air towing model at your disposal, Sword can be equipped with a servo actuated tow hook system;

— **as a motor-glider**: the model must be equipped with a brushless motor, the proper controller and the battery pack (to mount instead of the ballast hold tubes).

More options

Wings, tailplanes and fuselage made of carbon fiber

On request, wing, tailplanes and fuselage are available completely made of carbon fiber.
The model, made in this way, offers more torsional strength and an exceptional sturdiness.

The fuselage (see figure 3) is painted like the model but with the rear part unpainted (made to save weight without to reduce the strength).

Fig.3: **Carbon fiber fuselage.**

Model carrying bag

A special bag (see figure 4) it's available, made to measure, to safely carry your model around.

Each part (wing panels, tailplanes and fuselage), take place on a separate compartment.

Fig.4: **Model carrying bag.**

The bag is completely hand made.

Other features: quilted and trimmed cloth, lined with internal protections in polyethylene, velcro-fastening, handles for wing and fuselage.

Towing parachute

Hand made very strong towing parachute (see figure 5) to help in successful winch towing.

Fig.5: **Towing parachute.**

1.4 Tools and materials needed (not included) to complete the kit

Tools

These tools may help you while assembling the kit:

— electric drill;
— cutter;
— solder;
— hair drier (at least 1500W);
— sandpaper P400;
— set of files;
— usual tools like screwdrivers, pliers, side cutters, etc.;
— Z-bend pliers.

Note: other tools may help you too...

Materials

To complete the model, You need the following materials:

— super-glue (CA, cyano, like Green ZAP an so on);
— “5 minute” epoxy;
— tape and masking tape;
— double adhesive tape, thin;
— heat shrink sleeve (diameters: 3 mm e 6 mm);
— about 20 x 10 cm polyethylene (or similar) 5 mm thick.

Note: other materials such as paints, brushes, pencils, etc. are not mentioned.

WARNING! PAY ATTENTION TO THE SAFETY INSTRUCTIONS FOR THE USE OF ANY KIND OF GLUE OR TOOLS.

If you should need we may supply all you need to complete your model:

S.r.l.

Via Castelleone, 9 - Costa S. Abramo - 26022 Castelverde - CR (ITALY).

Tel.: 0039 0372 35138 - Fax: 0039 0372 27121

e-mail: info@fulcroservice.it

www.xmodels.it

CHAP. 2 BUILDING INSTRUCTIONS

In order to achieve a correct assembling of the model, we suggest to follow carefully the instructions.

2.1 Preliminary operations

Kit components control

Have a look at the components (see “PARTS LIST, MATERIALS AND TOOLS LIST” at page 3) in order to easily identify them.

It is strongly suggested to trial fit all the parts “dry” before gluing them.

2.2 Fuselage and tailplanes

Rudder & fin

The rudder must fit with the fin.

The correct alignment can be verified fitting the rudder with the fin; doing in this way, an excessive gap stands clearly out (see figure 6).

- Check both sides of the fin;

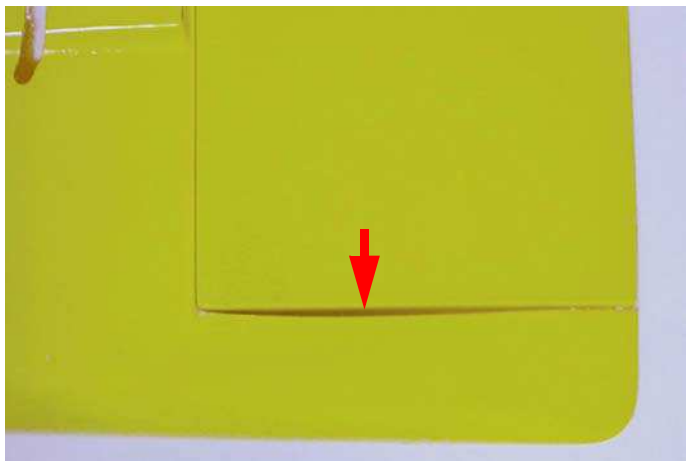

Fig.6: **Too much gap: reduce it.**

- using a file, remove the excess part (see figure 7) up to form an angle of 90° with the fin;
- check once again (see figure 6) and repeat up to fit perfectly the fin with the rudder.

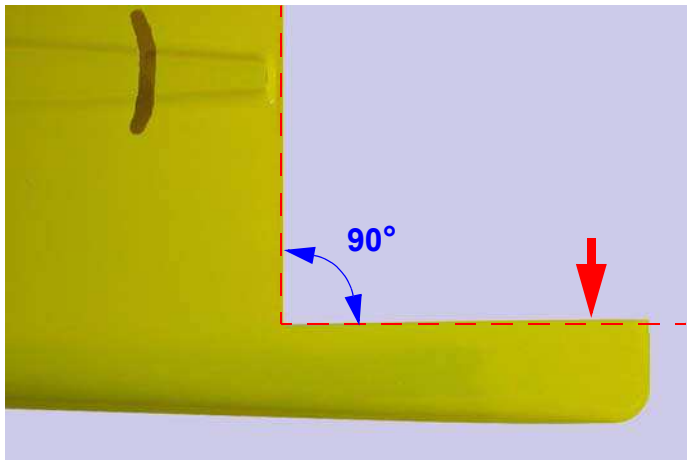

Fig.7: **Remove the excess part.**

Housing for the rudder horn

- Using a pencil, mark (on both sides) a **5** x **2.5 mm** rectangle in the position shown in figure 8;
- before with a cutter, then using a flat file, remove the inner part of the marked rectangle;

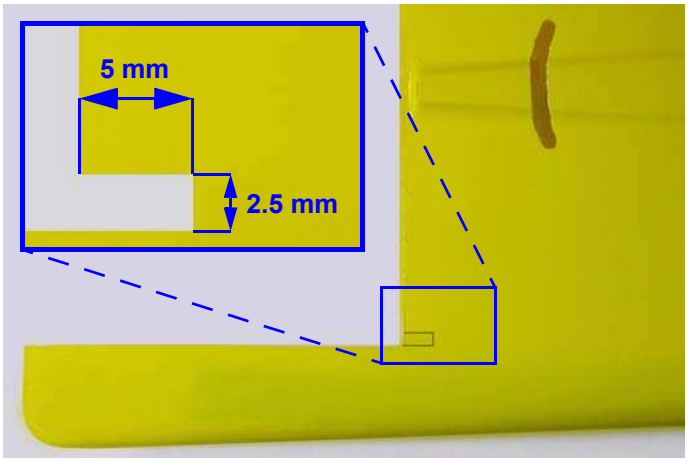

Fig.8: **Part to remove (and detail).**

Lower support for the rudder pin

- Using some cyano, glue the lower support "SINF" exactly at a distance of **50 mm** from the end of the tail (see figure 9);

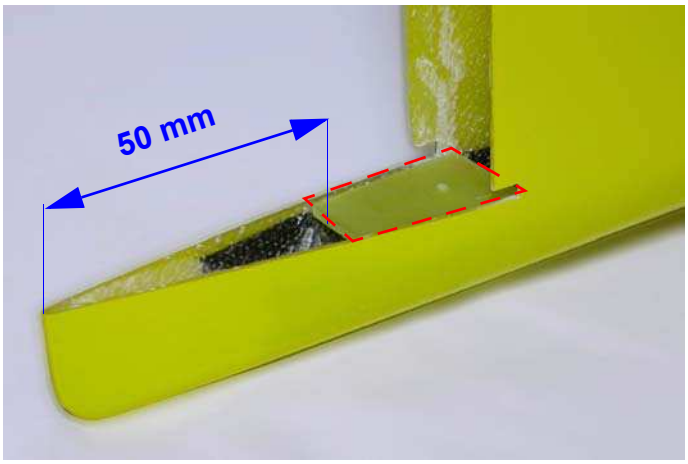

Fig.9: **Glue the support at the distance shown.**

Bellcrank

The bellcrank group for the all moving tailplanes is made up joining the two reinforcement parts "SQRR" with the central bellcrank "SQRV".

To mount the bellcrank group:

- insert the central bush "BCPC" through the bellcrank "SQRV" then add the two reinforcements "SQRR" (one for each side) as shown in figure 10;

Fig.10: **Insert the bush into the pieces.**

- spread some cyano on the internal side of the two reinforcements “SQRR” and fit them with the bellcrank “SQRV” as shown in figure 11(taking care to avoid to glue the central bush);
- when the glue is dry, slip off the central bush from the bellcrank;

Fig.11: **Glue the bellcrank to the reinforcements.**

- using a file (half-round section), hone the central bush insertion hole (see figure 12) in order to reduce the friction between bush and bellcrank (the bellcrank must be free to turn around the bush with the minimum friction, but without to swing);

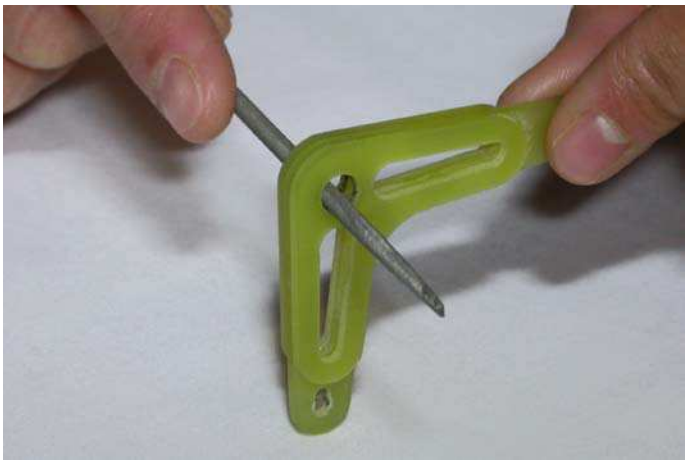

Fig.12: **.Hone the insertion hole.**

- mount the two carbon spacers “DLPC” on the bush “BCPC” (see figure 13).

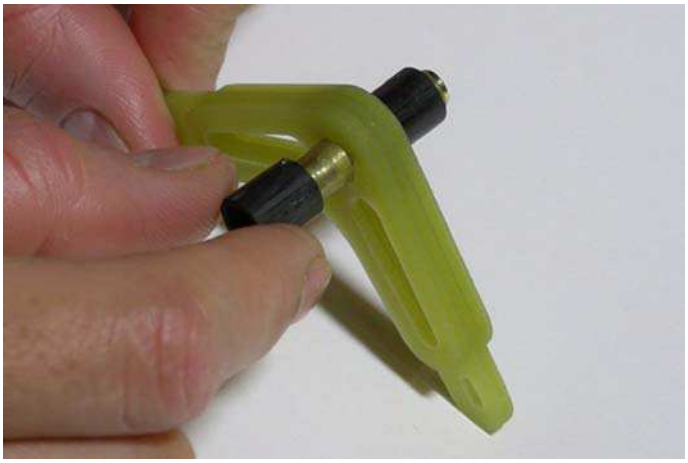

Fig.13: **Mount the two spacers on the bush.**

Pushrod group for the elevator

This is the pushrod group that joins the servo (horn) to the elevator (bellcrank).

The pushrod group is made up of:

— front pushrod group;
— rear pushrod group;
— carbon pushrod.

Preparing the two pushrod groups (front and rear)

- Axially drill **3 mm** diameter hole through each wooden adaptor "TCAR" (see figure 14);

WARNING! We recommend to take all the precautions in order to execute the operation safely (locking the piece with a vice).

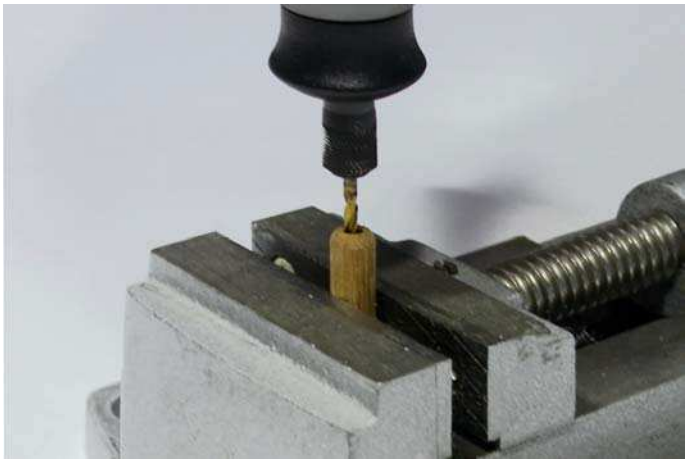

Fig.14: **Axially drill the wooden adaptor.**

- using a fibre-tip pen, mark the two pushrods "AMM3" at a distance of **80 mm** (take the measure starting from the threaded side);
- using side cutters, cut the metal pushrods in the marked point, then make some dents on the non threaded part of the metal rod, for a length of about three centimeters (see figure 15);

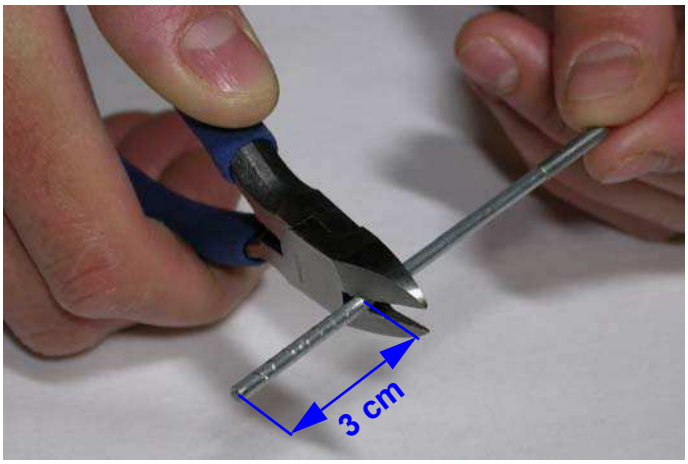

Fig.15: **Make some dents on the pushrod.**

The rear pushrod group and the front one are identical (therefore this operation must be done twice):

- insert and glue the metal pushrod "AMM3" (from the NON threaded side) into the wooden adaptor "TCAR" hole;
- screw the nut "DBM3" and the clevis "FOM3" to the pushrod "AMM3".

Now, the pushrod groups are ready (see figure 16).

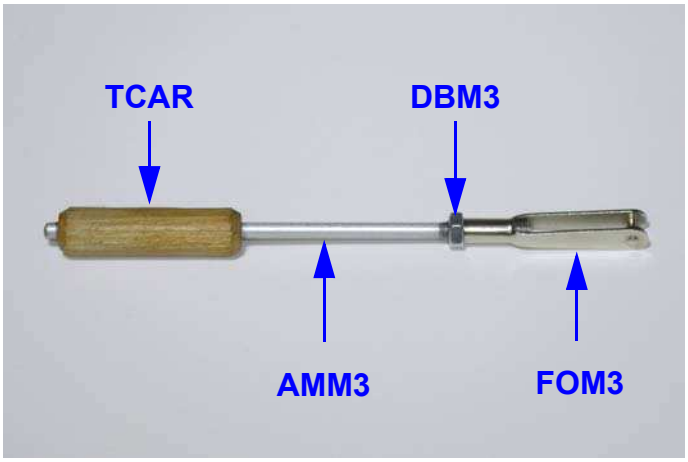

Fig.16: **Pushrod group.**

Pushrod

- Shorten the carbon pushrod “ARCB” at a length of **95 cm**;
- insert and glue the rear pushrod group into the carbon pushrod;
- using some cyano, glue the points shown in figure 17;

Fig.17: **Put some cyano where shown.**

- connect the bellcrank to the pushrod group (see figure 18);

Fig.18: **Bellcrank and pushrod group.**

- using the fingers, keep the fin walls open, as shown in figure 19, and insert the pushrod group into the fuselage;
- position the bellcrank group into its housing up to fit the central bush with the elevator rod insertion holes.

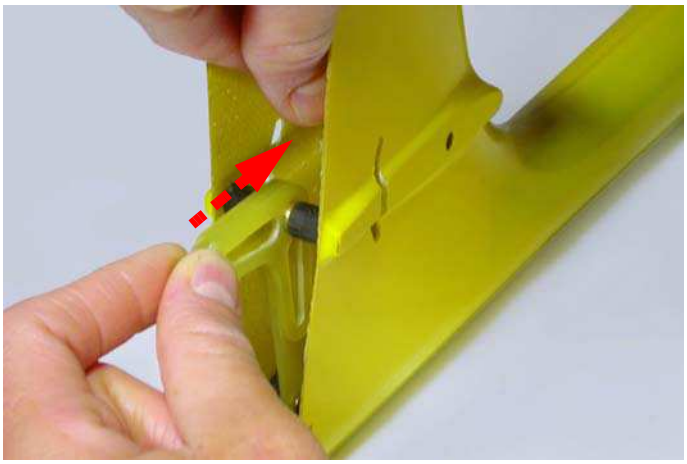

Fig.19: **Insert the group.**

Taliplanes

Here is shown how to check (and eventually correct) the alignment from the tailplanes to the fin.

Checking the alignment between tailplanes and fin

- Once having positioned the bellcrank group, check the alignment comparing it with the fin: the bellcrank must be perfectly vertical (the example in figure 20 shows a not well aligned bellcrank: this must be corrected).

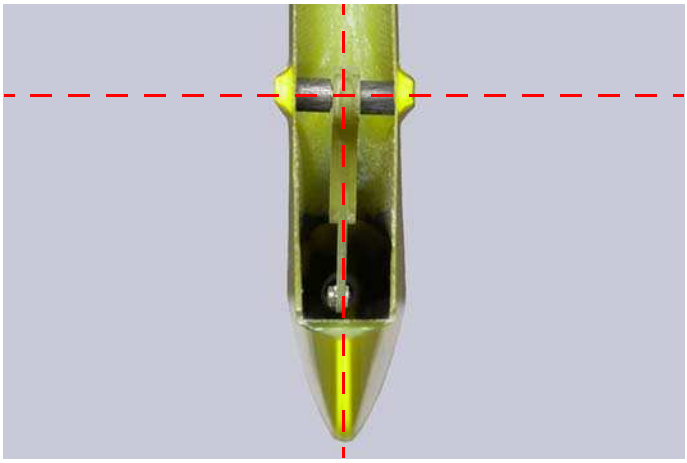

Fig.20: **Perfectly vertical, not like this!**

Correcting the alignment between elevator and fin

To correct the alignment (if needed), act on the elevator rod insertion holes:

- remove the bellcrank group;
- using a file (round section), file:
  - the lower side of the hole where the bellcrank is up (see figure 21)

  or

  - the higher side of the hole where the bellcrank is down;
- insert the bellcrank group and check again;
- repeat the operation up to the perfect alignment.

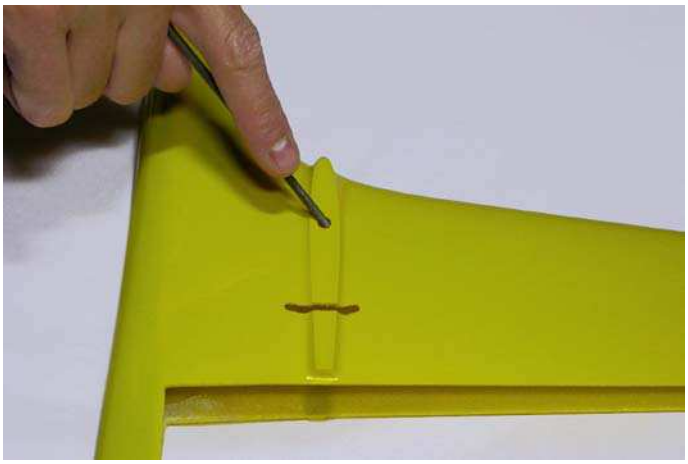

Fig.21: **Correction of the holes alignment.**

Checking the alignment between tailplanes and fuselage

- Insert the elevator rod “BSPC” through the central bush;
- insert the rod “BRPC” through the bellcrank slot;

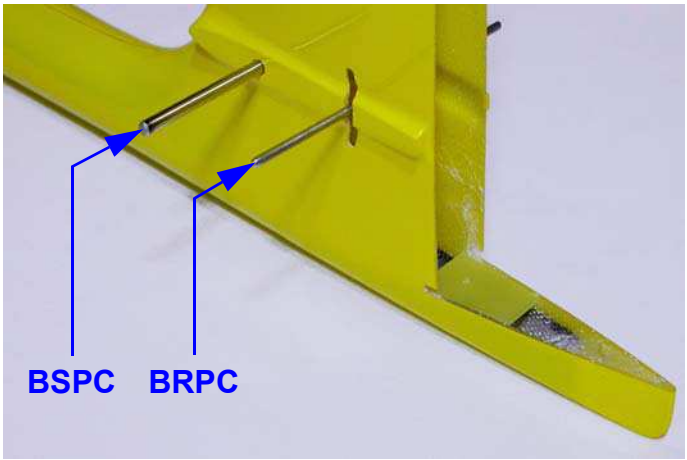

Fig.22: **Insert the elevator rods.**

- insert the two tailplanes fitting the rods with the taliplanes holes (see figure 23);

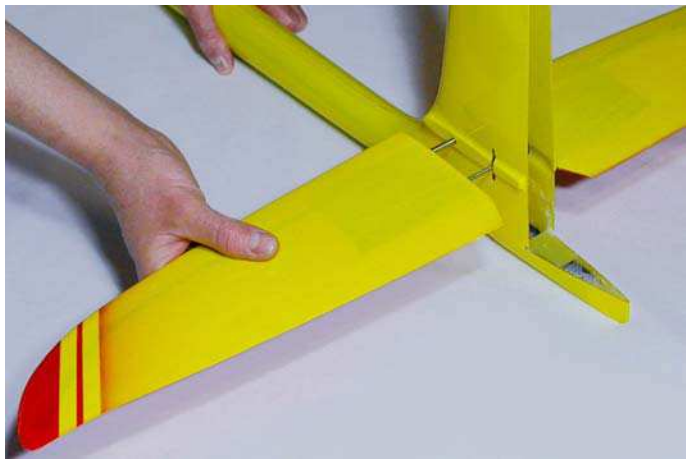

Fig.23: **Inserting tailplanes.**

Should the elevator tailplanes not be correctly aligned, as shown in figure 24, you will need to correct it;

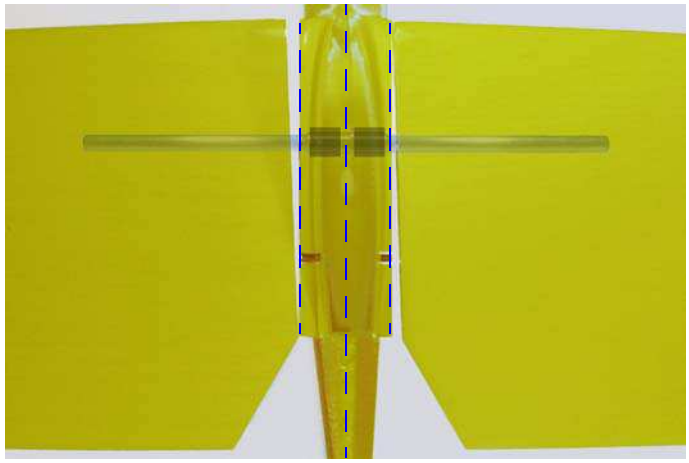

Fig.24: **Elevator alignment check.**

Correcting the alignment between tailplanes and fuselage

In order to correct the alignment (if necessary), act on the elevator rod insertion holes in the same way used for the alignment between elevator and fin (see “Correcting the alignment between elevator and fin” at page 14) keeping in account that, now, the sides of the hole to correct, are the front and the rear ones.

Final installation of the bellcrank

Once achieved the alignment:

- spread some epoxy in the points shown in figure 25 (but, be careful: don’t glue the bellcrank);
- keep the group in position until the glue is not completely dry, continuously checking either the alignment between tailplanes and fuselage than the one between tailplanes and fin.

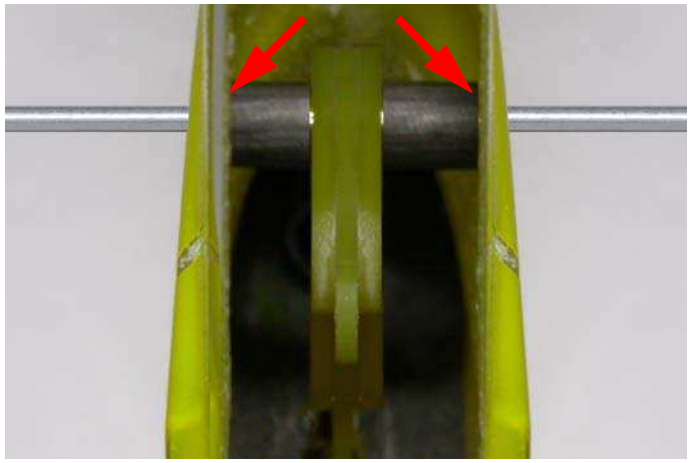

Fig.25: **Points to glue.**

Checking the travel of the tailplanes

- Using a file (convex section), remove the roughness of the slot (see figure 26);

Fig.26: **Remove the roughness.**

- (temporary) mount the tailplanes;
- move the tailplanes up and down in order to check that their movement happens without frictions;
- using a file (round section), eventually remove the excess part (see figure 27);
- once achieved a good result, remove the tailplanes.

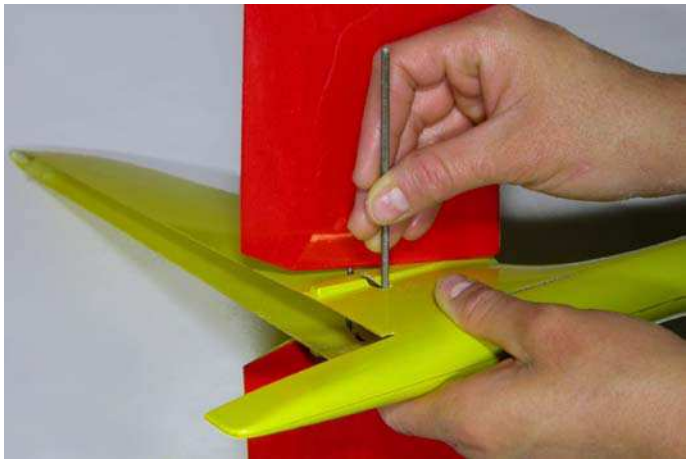

Fig.27: **Remove the excess part.**

Tail assembly

The tail assembly is made up of a fin (joined to the fuselage) and a (movable) rudder.

Preparing the opening for the rudder's cables

- Using a pencil, mark the position following the dimensions shown in figure 28;

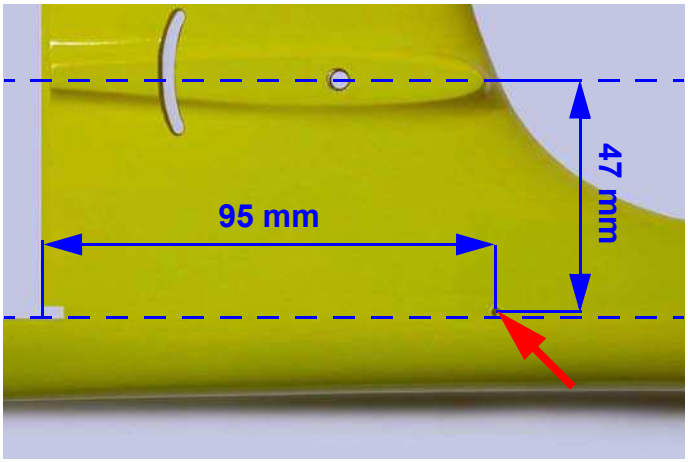

Fig.28: **.Mark the position.**

- drill **1.5 mm** diameter hole on the marked point (see figure 29);
- repeat the operation also on the other side;

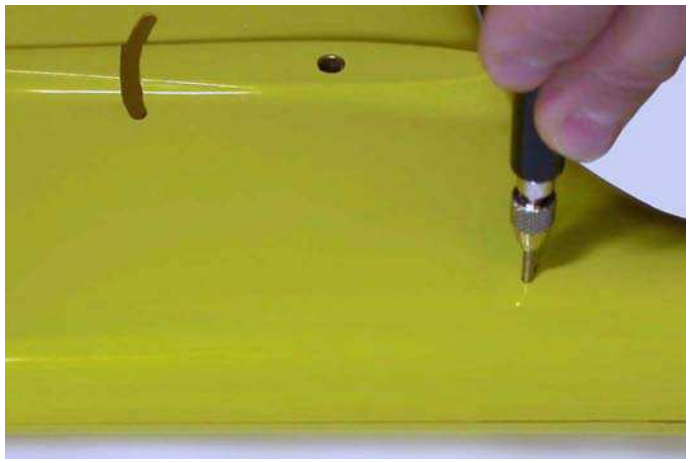

Fig.29: **Drill the marked point.**

- using a pencil, starting from the hole, track an horizontal line (towards the tail) **40 mm** long;
- using a cutter, cut along the marked line (see figure 30);

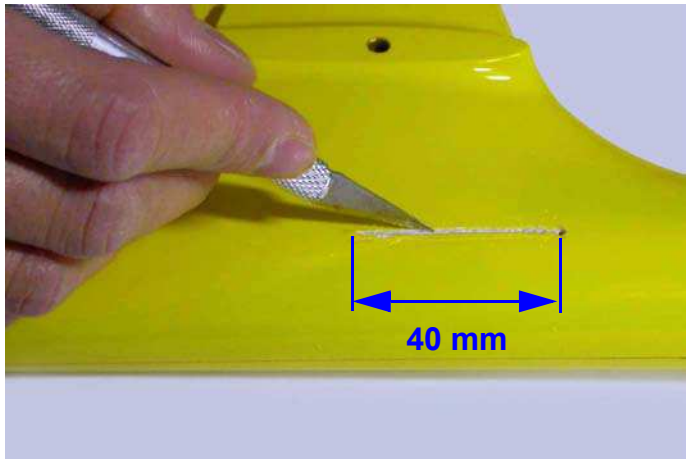

Fig.30: **.Cut.**

- using a flat file, finish the opening (see figure 31);

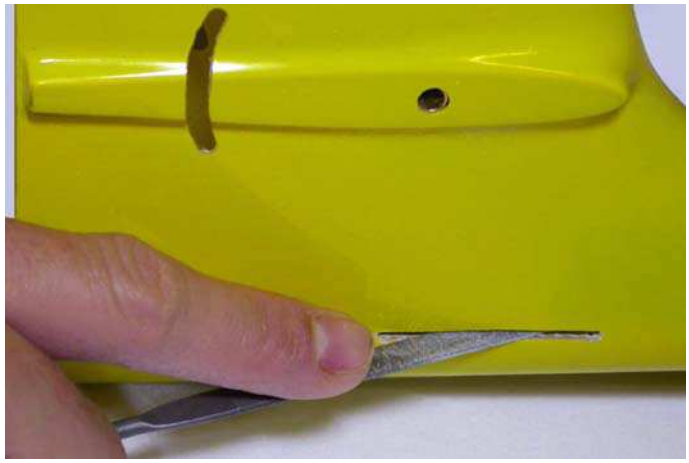

Fig.31: **.Finish the opening.**

- check the correct alignment between the two openings (see figure 32) and (eventually) correct.

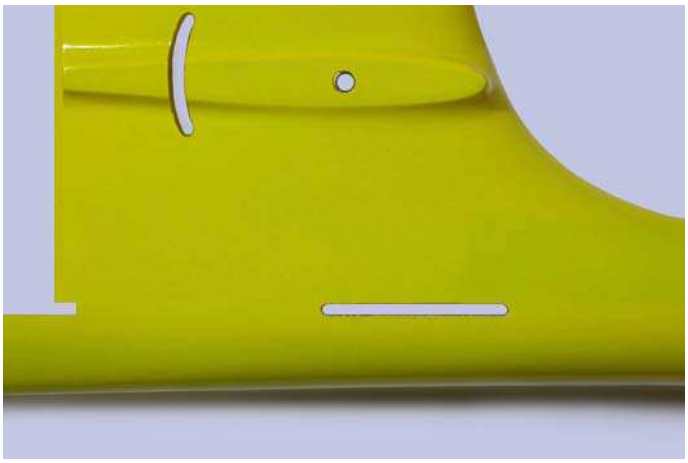

Fig.32: **.Final result.**

Fin reinforcement

- Spread some epoxy on the internal walls of the fin, near the edge;
- insert the reinforcement “RDER” positioning it one centimeter inside the edge of the fin (see figure 33);

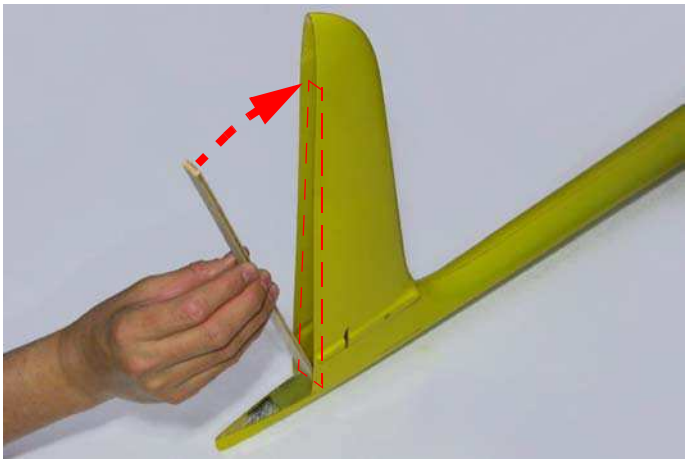

Fig.33: **Insert the reinforcement.**

- protecting the fin with some paper, hold the reinforcement with some clothes-pegs (see figure 34);
- wait until the glue is dry;
- remove the clothes-pegs;

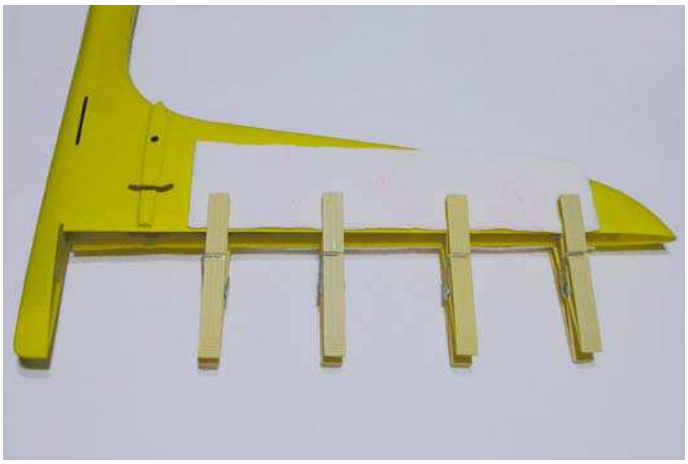

Fig.34: **Hold the reinforcement.**

- roll up a sheet of sandpaper (grain P400);
- position the sandpaper as shown in figure 35;
- moving the roll (up and down) along the fin, remove the internal excess of glue and any roughness.

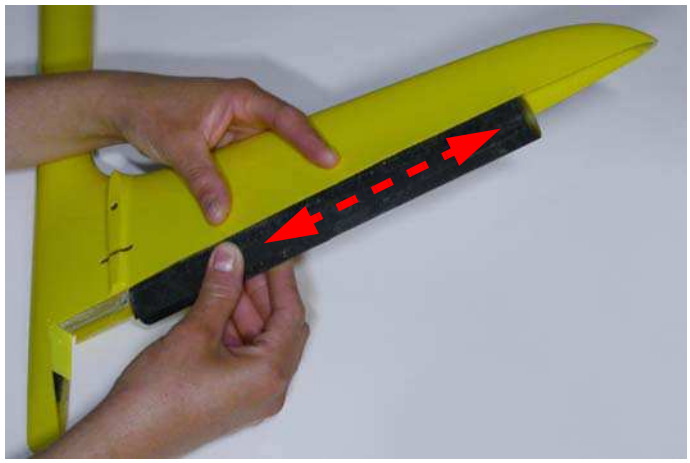

Fig.35: **Remove the internal excess of glue.**

Inspection hole

Once having positioned the reinforcement, the pushrod group of the elevator is no longer reachable; therefore (in case of braking or maintenance), if You want to access to the pushrod group, it will be necessary to open an inspection hole in the position shown in figure 36 (wide enough to insert, at least, the jaws of a clamp).

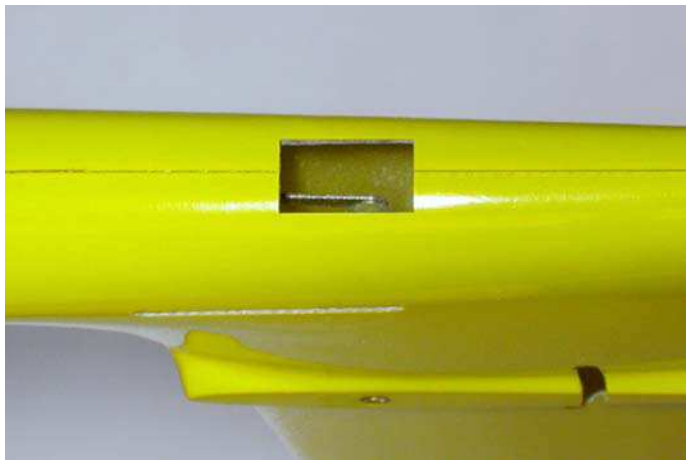

Fig.36: **Inspection hole.**

In order to prevent the entry of dirt during the landing, the hole should have to be covered with some adhesive tape.

Horn for the rudder

- Place the horn “SQDR” on the lower side of the rudder “VDER”;
- using a pencil, mark the position of the horn (see figure 37);

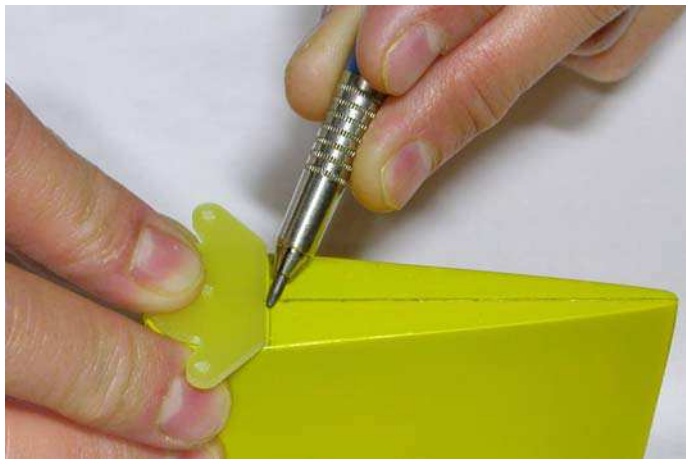

Fig.37: **.Mark the position of the horn.**

- using a cutter, engrave the marked line for a depth of about one millimeter (see figure 38);

Fig.38: **Engrave the marked line.**

- using a cutter, remove the part shown in figure 39 for a depth of **1.5 mm**;

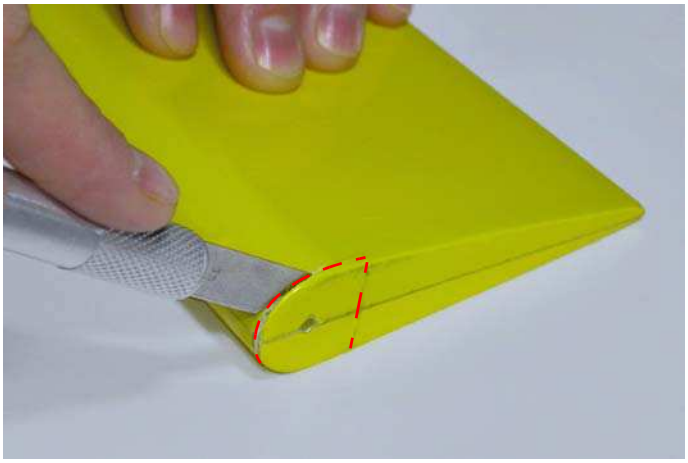

Fig.39: **Remove the part shown.**

- using a flat file, remove the roughness and level the part shown in figure 40 for a max. depth of **2 mm**;

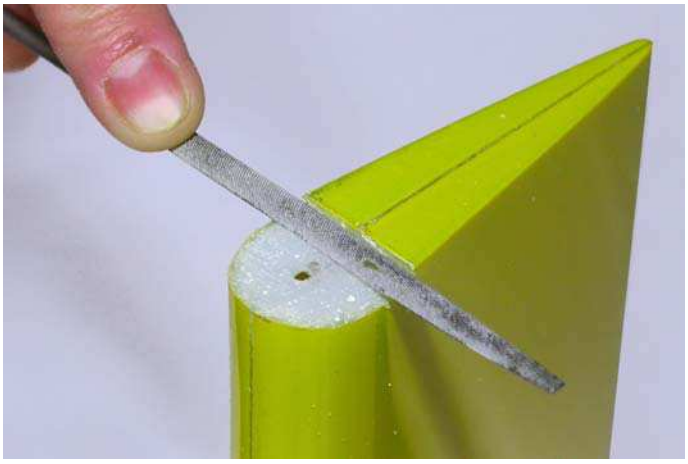

Fig.40: **.Remove the roughness and level.**

- using some cyano, glue the horn “SQDR” to the rudder “VDER” (see figure 41).

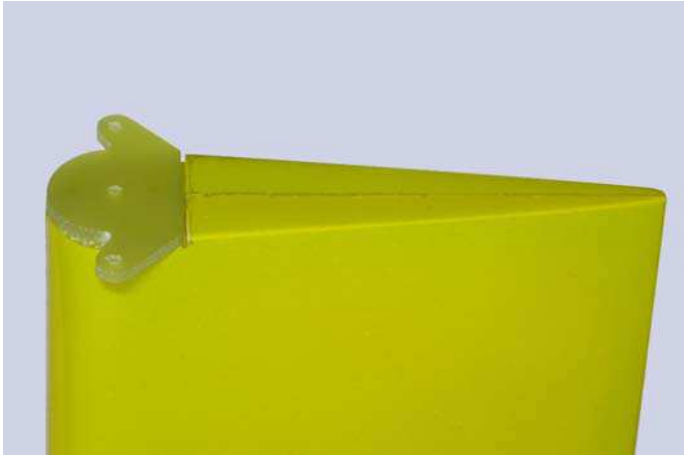

Fig.41: **Glue the horn in this position.**

Upper support for the rudder pin

- Using some cyano, glue the rudder pin support “SSUP” in the position shown in figure 42;

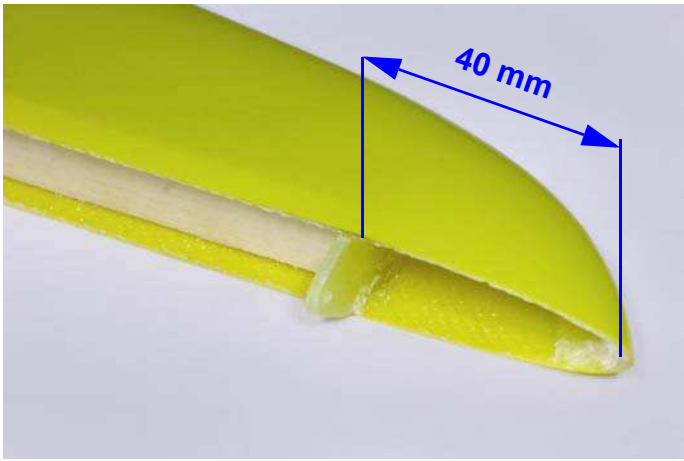

Fig.42: **Glue the support in the position shown.**

- put the rudder close to the fin (see figure 43);
- using a pencil, mark the contact point between rudder and fin upper pivot support “SSUP” (see figure 43);

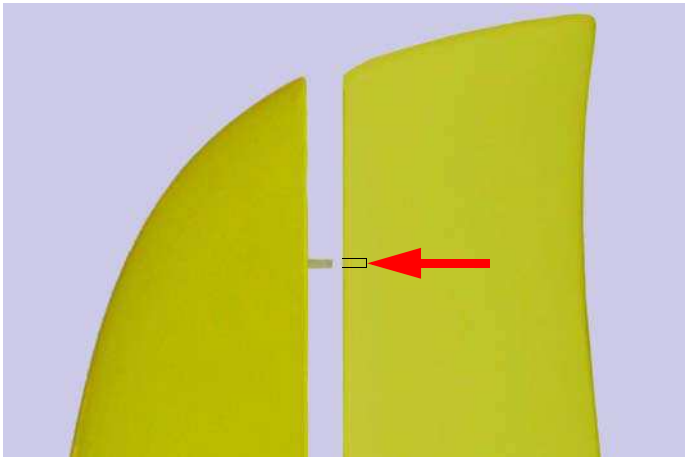

Fig.43: **Mark the contact point.**

- before with a cutter, then using a flat file make a notch, in the marked point, **3 mm** wide, across the rudder as shown in figure 44;

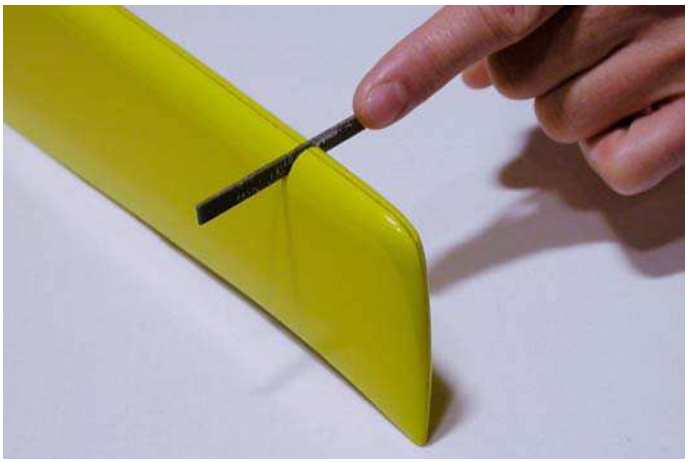

Fig.44: **.Make a notch 3 mm wide.**

- drill **2 mm** diameter hole on the upper side of the rudder as shown in figure 45;

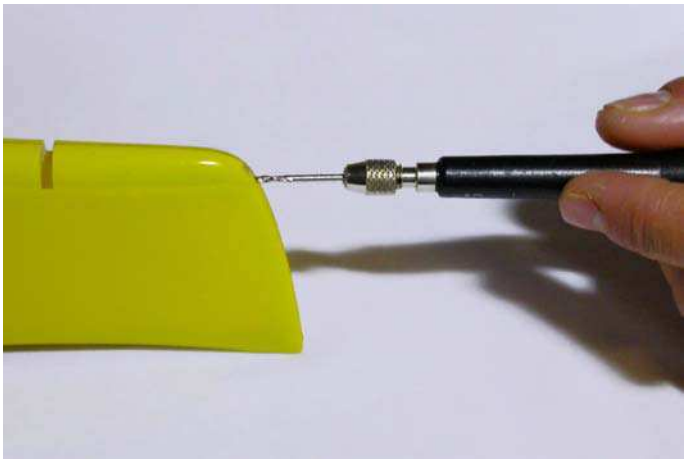

Fig.45: **Drill in the point shown.**

- mount the rudder on the fin fitting the support with the notch (see figure 46);

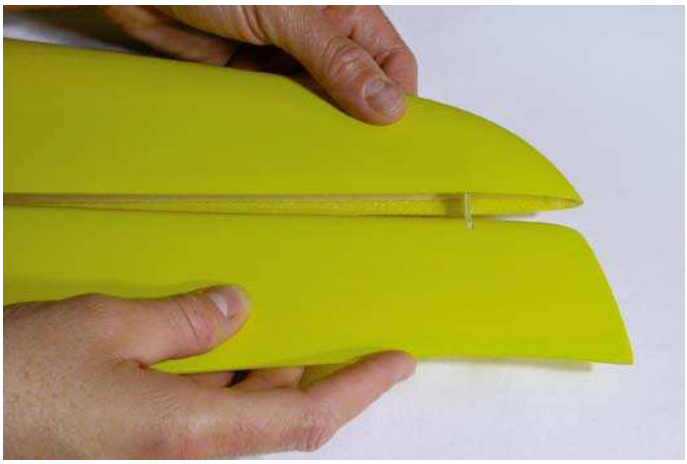

Fig.46: **Mount the rudder.**

- insert the pin “PDER” as shown in figure 47 intercepting the holes of both the supports “SSUP” and “SINF”;

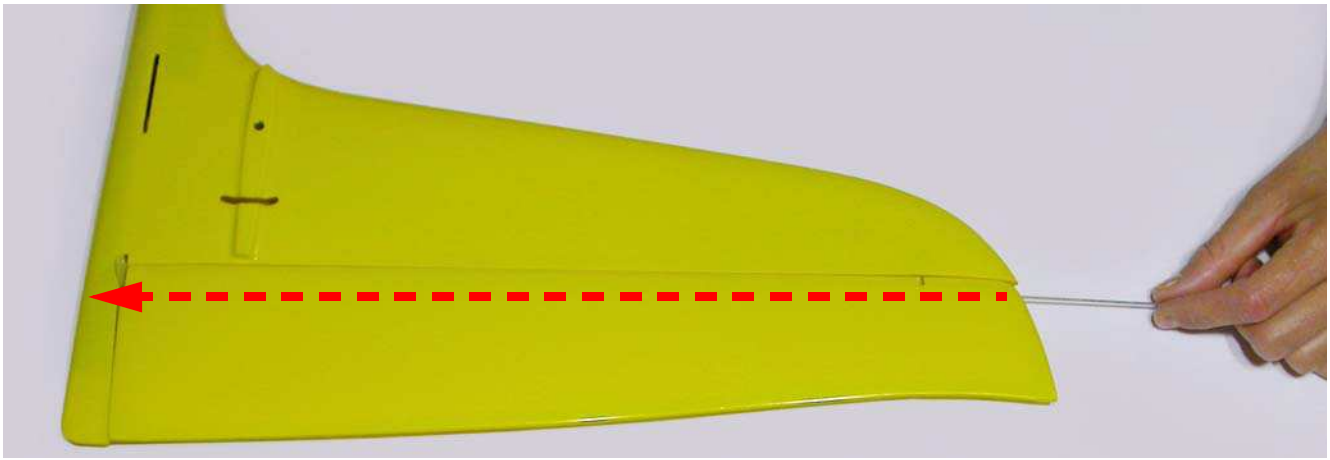

Fig.47: **Insert the pin.**

- fasten the end of the pin to the rudder with a sip of glue.

Balancing weights

Model balancing requires some weights placed inside the fuselage nose.

- Using some epoxy, fasten about **150 ~ 200 g** of weights in the position shown in figure 48;

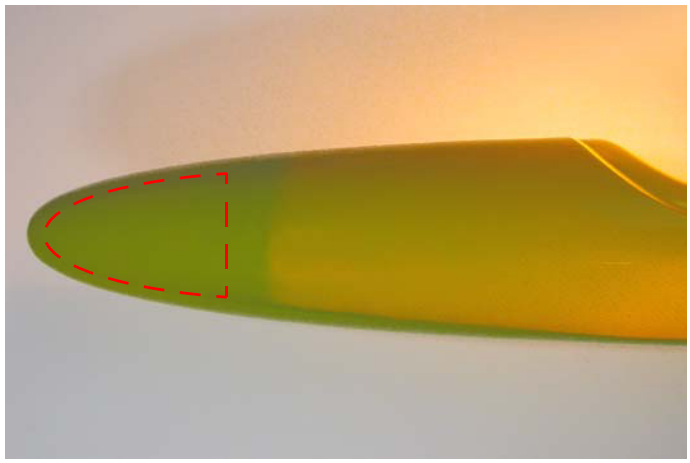

Fig.48: **Position for the weights.**

Some more weights can be added later (if necessary) and fastened with some double adhesive tape.

Battery pack

Because of the power of servos in use and the length of connection cables, the model needs a battery pack with five cells.

In order to make maximum use of the available space, the cells must be positioned as shown in figure 49;

Note: the connector must be chosen according to the ON/OFF switch used.

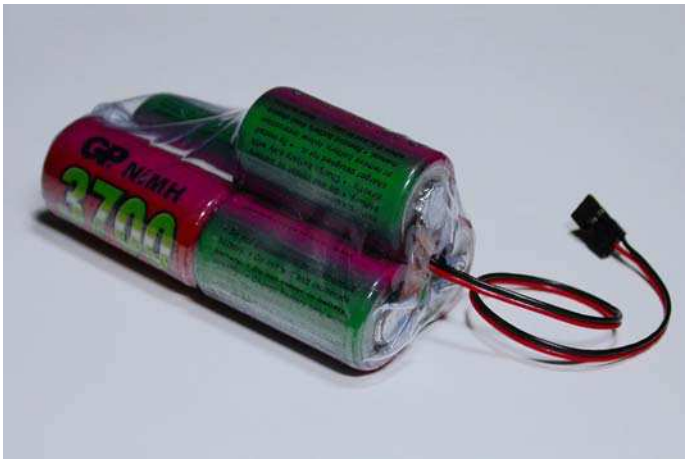

Fig.49: **Layout of the battery pack.**

- cut a strip made of polyethylene (**5 mm** thick, dimensions **8** x **8 cm**);
- insert the strip into the fuselage's nose as shown in figure 50;

Fig.50: **Insert the strip into the fuselage's nose.**

- firmly insert the battery pack into the fuselage's nose (see figure 51) and check that it keeps the position either turning upside down or shaking the model.

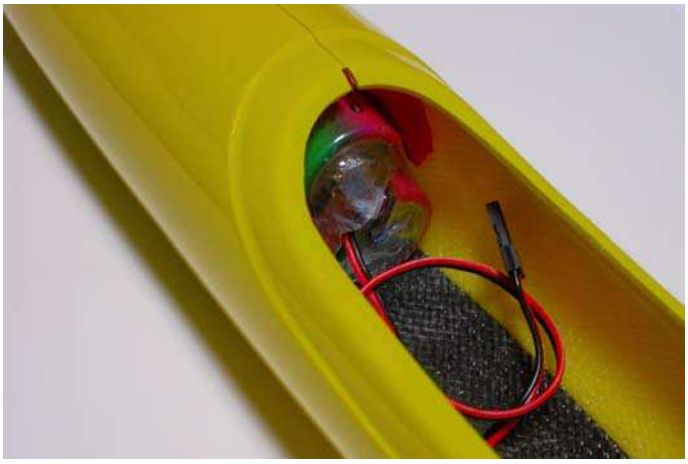

Fig.51: **Insert the battery pack.**

Electrical connections for wing servos

The electrical connection between wing servos and receiver is made with a set of connectors like the ones shown in figure 52.

- Take the external dimensions of the “MPXF” connector.

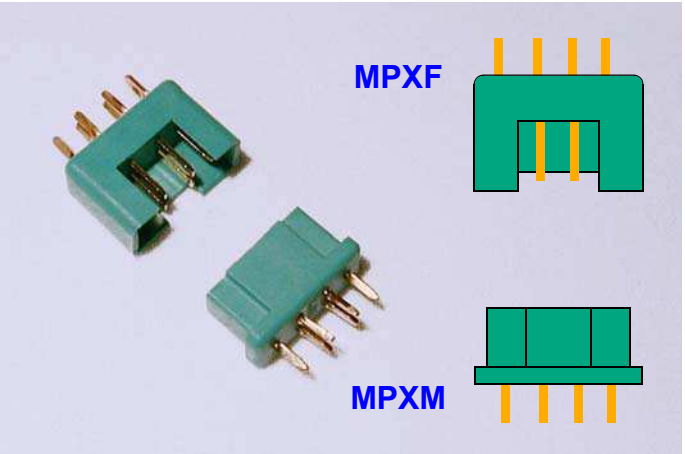

Fig.52: **Wing servos connectors set.**

Preparing electrical connections

- Before soldering, insert the free tip of every wire, into a **15 mm** long heat shrink sleeve of suitable section;
- solder wires of the cables to the connectors “MPXF” as shown in figure 53 and cover with the heat shrink sleeves.

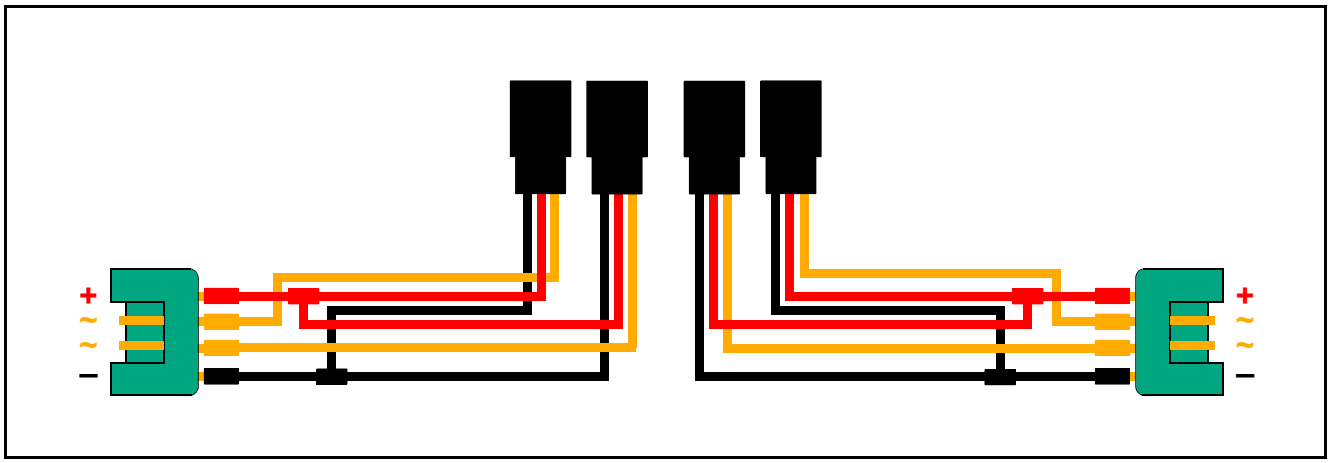

Fig.53: **Connection diagram from wing servos to receiver.**

Holes for the wing servos connections

- Spread two strips of masking tape, each one about **10 cm** long, on a flat surface;
- draw, on each strip, the hole for the wing rod (diameter **10 mm**), the hole for the servo connection (**16 x 7 mm**) and the little hole for the wing alignment pin (diameter **2.5 mm**) at the distances shown in figure 54;

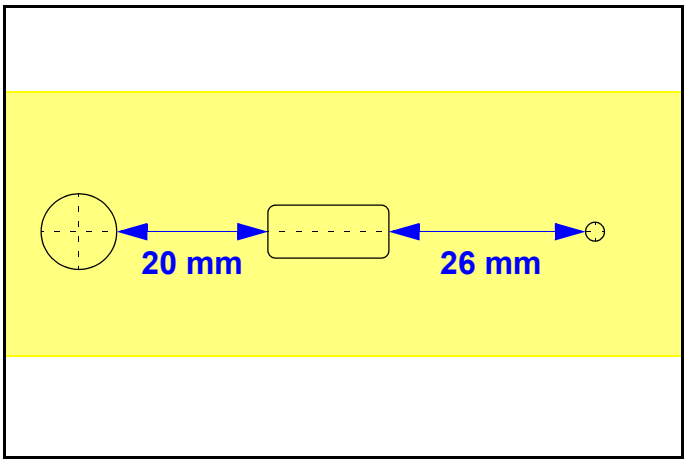

Fig.54: **Distances between the holes.**

- carefully remove one of the two strips of tape and apply it on the fuselage wing root making coincide the hole for the wing rod and the hole for the alignment pin with the drawings on the tape (see figure 55);

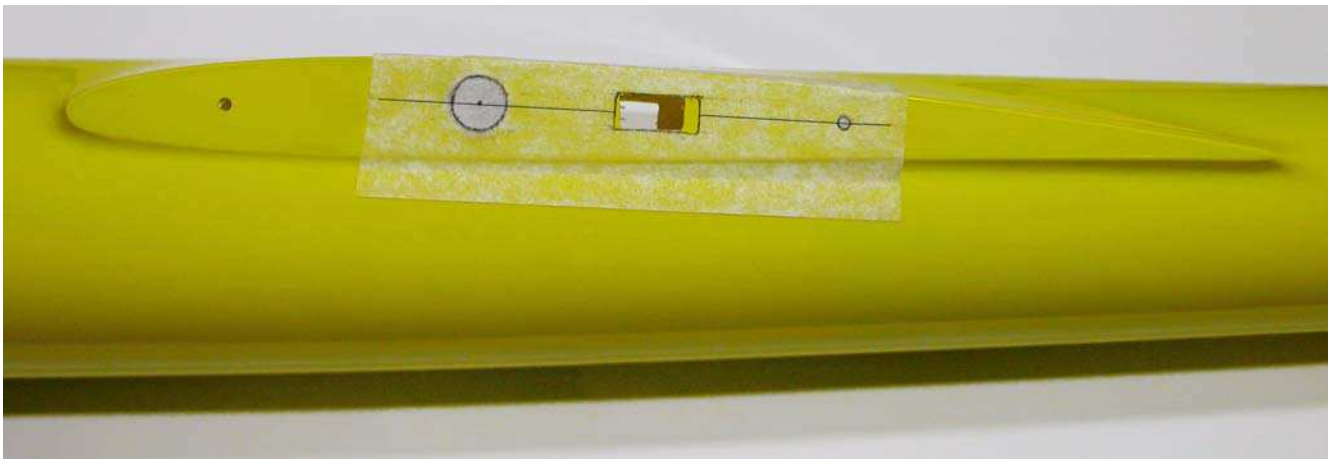

Fig.55: **Position of the tape.**

- using a cutter, engrave the contour of the rectangular hole for the servos connection;
- using a flat file, finish the shape of the hole (see figure 56);
- using the other strip of tape, repeat the operation, using the maximum precision, also on the other side of the fuselage (the two holes should be identical and perfectly aligned).

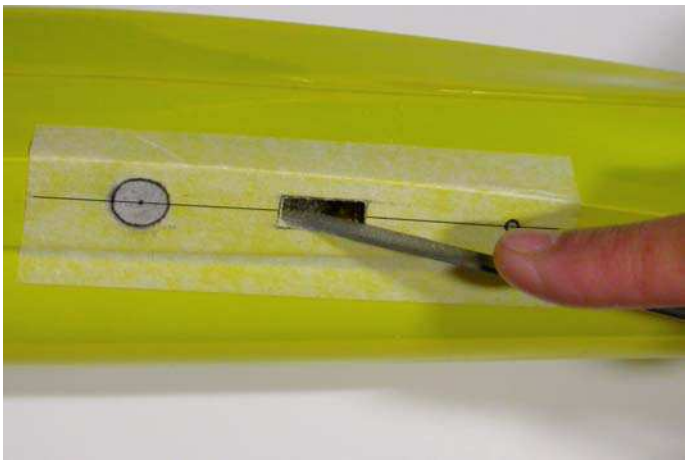

Fig.56: **Finish the shape of the hole.**

Preparing the wing root holes

- Insert the wing rod “BAIO” into its housing (see figure 57);

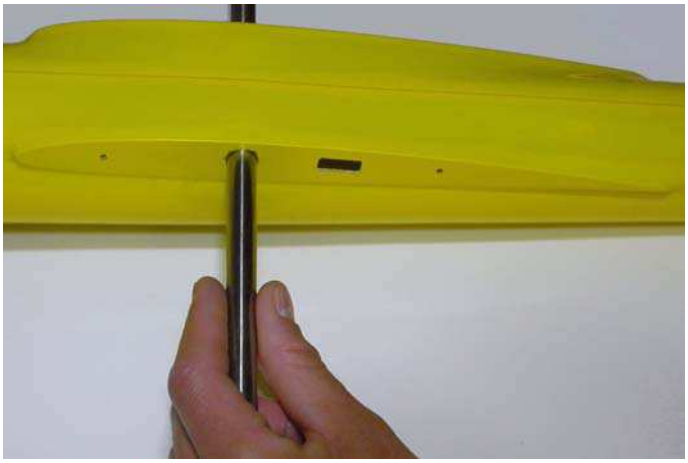

Fig.57: **Insert the wing rod into its housing.**

- insert a wing-panel (see figure 58);

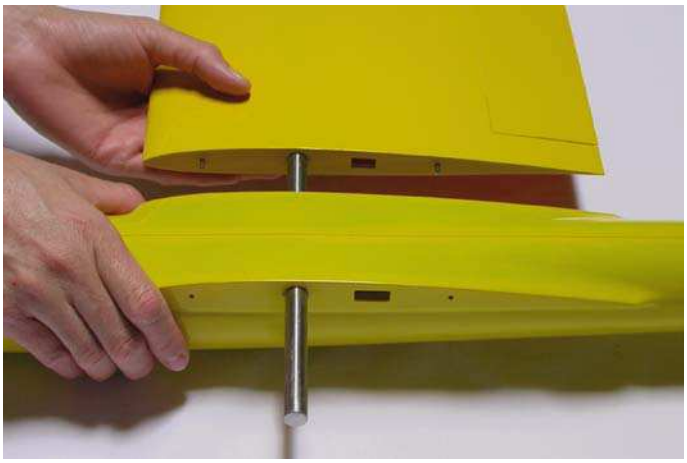

Fig.58: **Inserting a wing-panel.**

- using a pencil lead or a metal scriber (at least **6 cm** long), mark the shape on the wing root tracing it from the hole already done (see figure 59);

Fig.59: **Trace the contour of the hole.**

- remove the wing-panel and trace better the contour (see figure 60);
- repeat the operation also for the other wing-panel.

Fig.60: **Trace better the contour.**

How to finish this hole on the wing-panels will be described later.

Preparing electrical connections

- Insert the cables (from the side of the RX connectors) into the hole made in the fuselage (see figure 61);

Fig.61: **Inserting RX connectors.**

- insert the cables up to the socket “MPXF” (see figure 62);

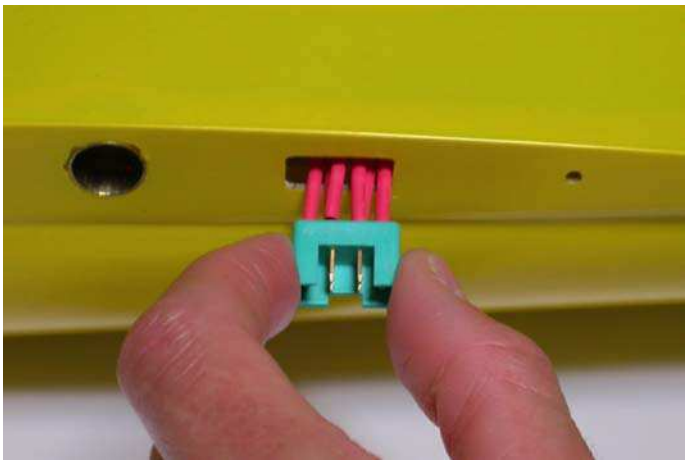

Fig.62: **Inserting a cable up to the socket.**

- spread some epoxy around the socket “MPXF” and insert it into the proper housing in the fuselage as shown in figure 63;
- wait until the glue is dry;

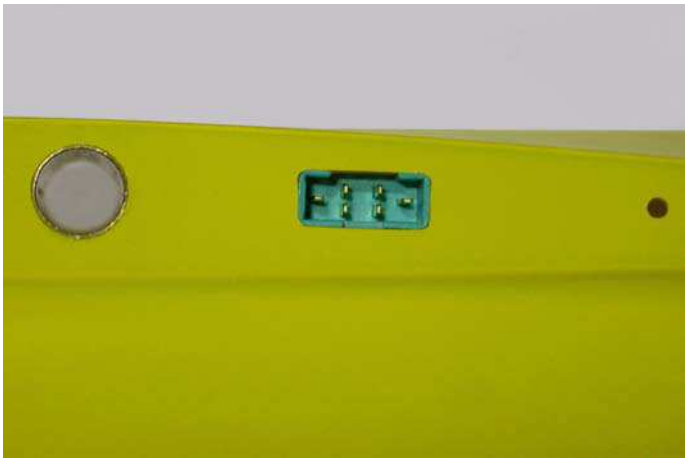

Fig.63: **Socket in position.**

- repeat the operation also on the other side.

Hook for the towed take off - like F3B/F3J

The model (other than the hand launch or the take off from a slope) can be towed with a winch.

WARNING! The tow hook structure must be mounted BEFORE to mount the servos mounting frame.

Hole for the tow hook

- Spread about **20 cm** of masking tape on a flat surface;
- using a pencil, draw a line in order to divide the tape in half lengthwise (see figure 64);
- carefully remove the strip of tape;

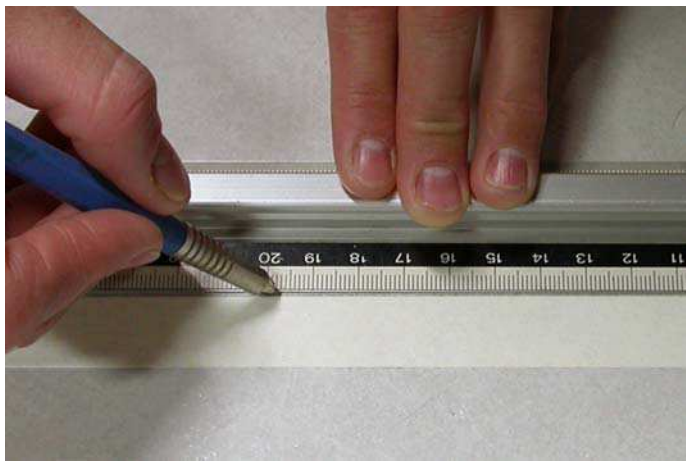

Fig.64: **Draw a line in the middle of the tape.**

- spread the strip of tape around the fuselage making coincide the line with the wing leading edge (see figure 65), on both sides;

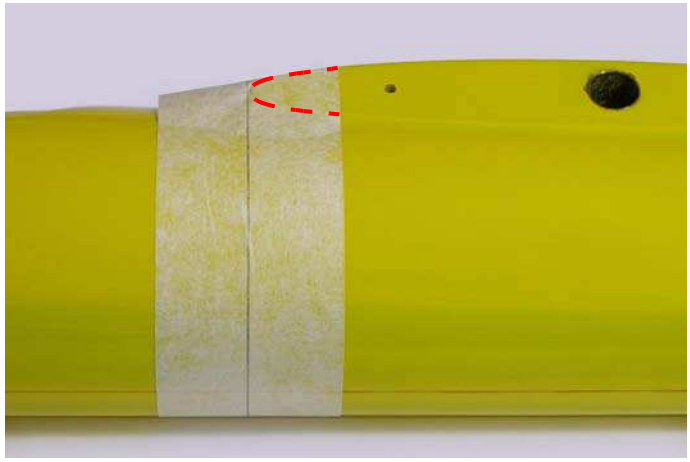

Fig.65: **The line must coincide with the leading edge.**

The hole for the hook must be done under the fuselage:

- using a pencil, mark a point **6 cm** behind the wing leading edge (see figure 66);

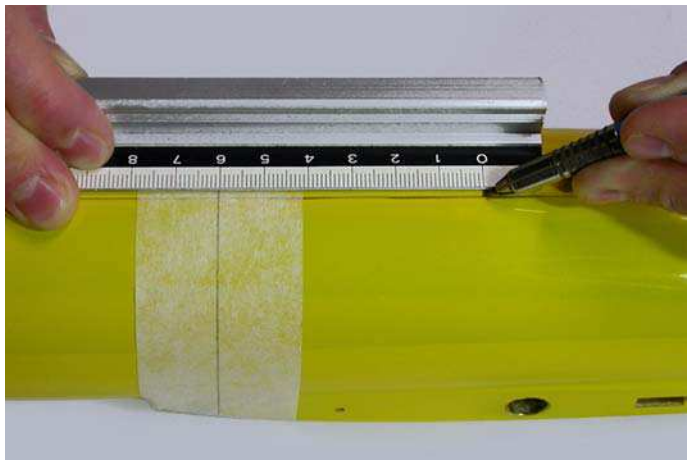

Fig.66: **Mark a point 6 cm behind the leading edge.**

- drill **4 mm** diameter hole in the marked point (see figure 67).

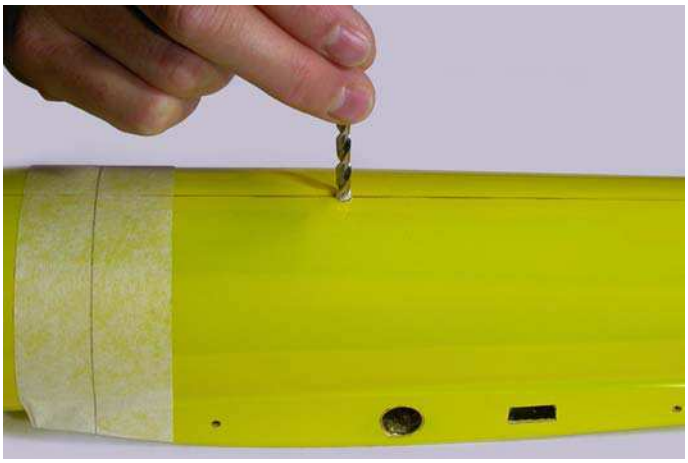

Fig.67: **Hole for the tow hook.**

Ballast holding structure

- Using some cyano, glue the tow hook support “SGTR” to the shaped strip “LCOR” as shown in figure 68 (notice the position of the hole faced to the thinner side);

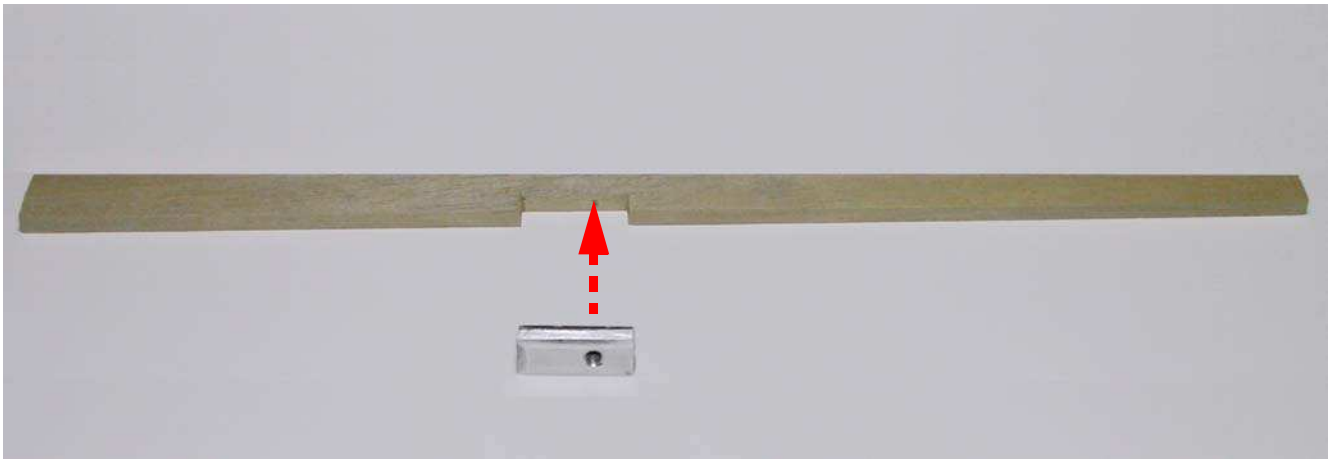

Fig.68: **Glue the tow hook support.**

- keep the shaped strip with the hook support downwards and, using some cyano, glue the rear frame “OPSB” to the thinner side of the strip (see figure 69); i

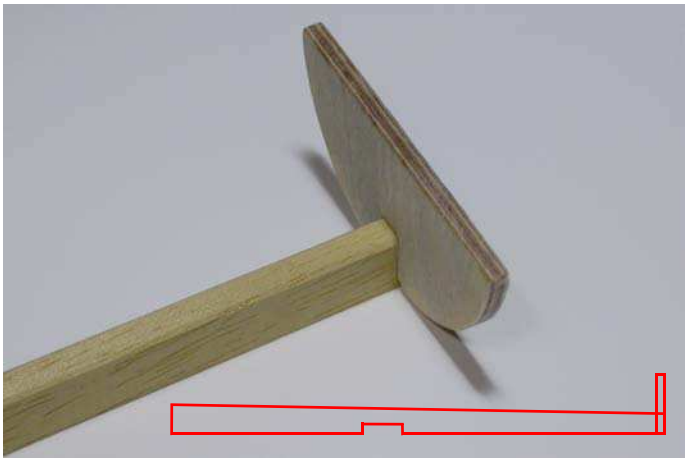

Fig.69: **Rear frame in position.**

- using a flat file, smooth the part shown in figure 70;

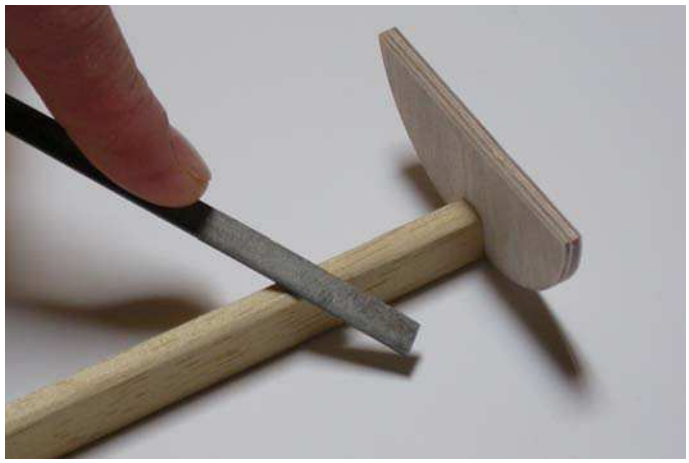

Fig.70: **Smooth the part shown.**

- **30 mm** inside the wider end of the shaped strip, drill **2 mm** diameter passing hole as shown in figure 71;

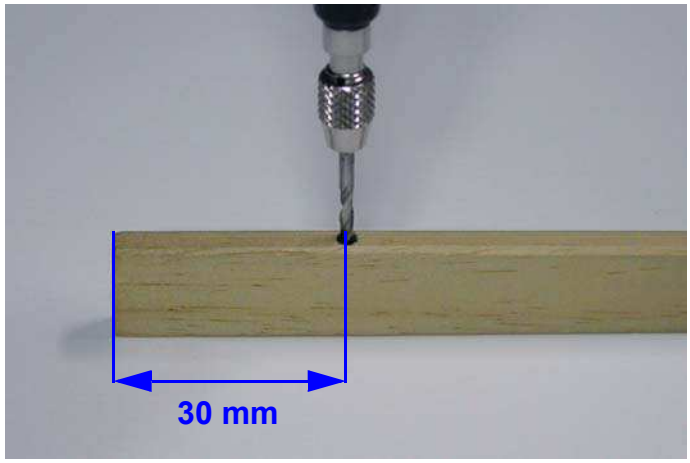

Fig.71: **Make a passing hole here.**

- in the same position, (on the lower side of the strip), using a flat file, make a notch about **5 mm** wide and about **2 mm** deep (see figure 72);

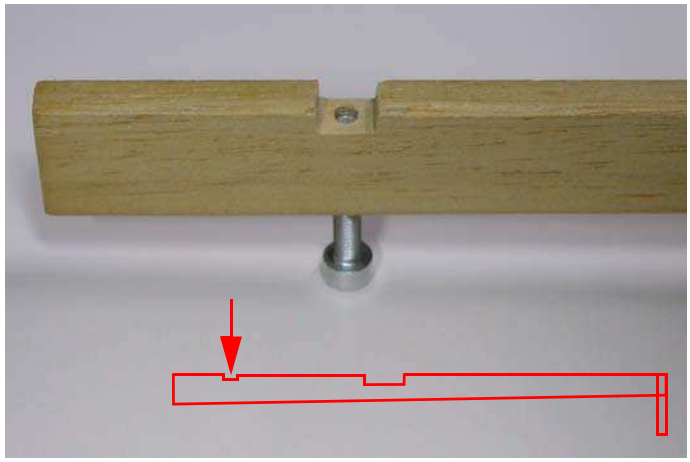

Fig.72: **Notch for the nut.**

- position the nut “DB25” in the notch and lock it with a sip of cyano in the point shown in figure 73 (without to glue the screw with the nut);
- remove the screw;

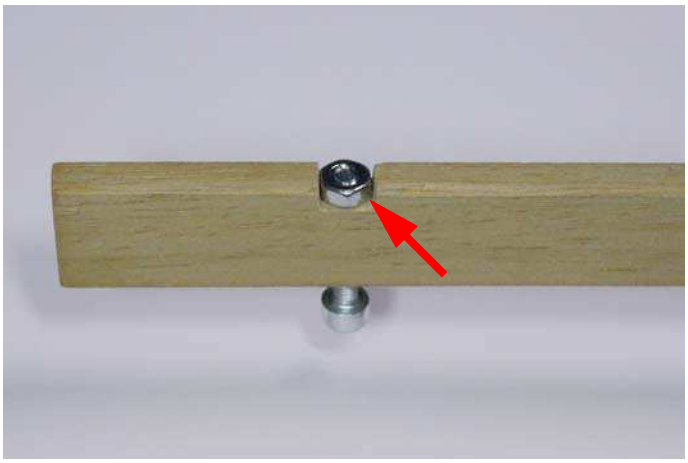

Fig.73: **Nut and screw in position.**

- drill **3 mm** diameter hole through the shaped strip and the hook support hole as shown in figure 74 (but, be careful: don’t waste the thread).

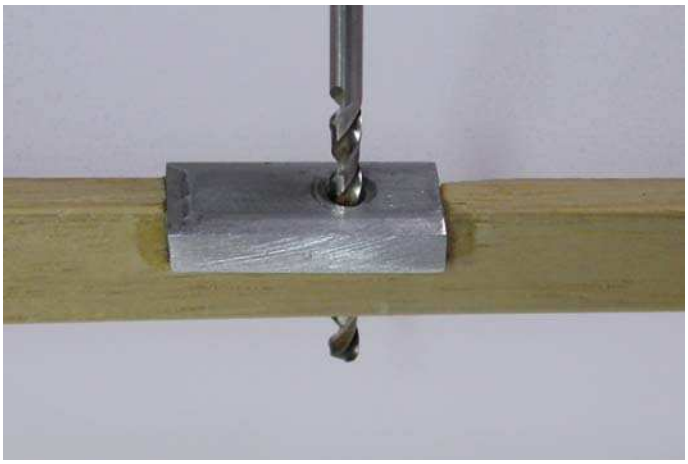

Fig.74: **Passing hole for the hook.**

Ballast hold tubes

- Join the two ballast hold tubes “TBAL” keeping their closed sides aligned;
- using some scotch tape, join the two tubes;
- scratching the open sides of the ballast hold tubes on a sheet of sandpaper (grain P400), level the length (see figure 75);

Fig.75: **Level the two ballast hold tubes.**

- using a pencil, axially divide the open side of each tube for a length of **40 mm**;
- using a cutter, remove the marked part (see figure 76);

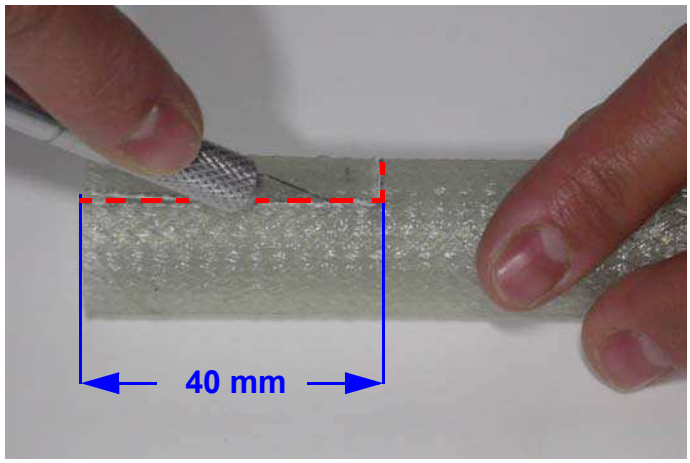

Fig.76: **Remove the marked side.**

- using a flat file, remove all the roughness (see figure 77);

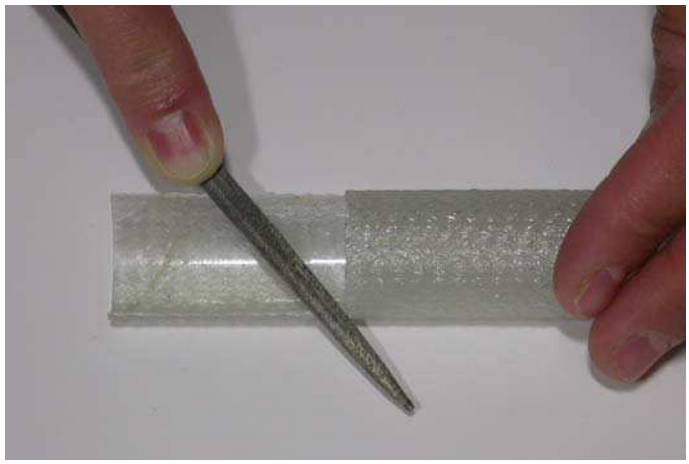

Fig.77: **Remove the roughness.**

- position the ballast hold tubes on the structure as shown in figure 78 (few sips of cyano are enough to hold temporary the group in position);

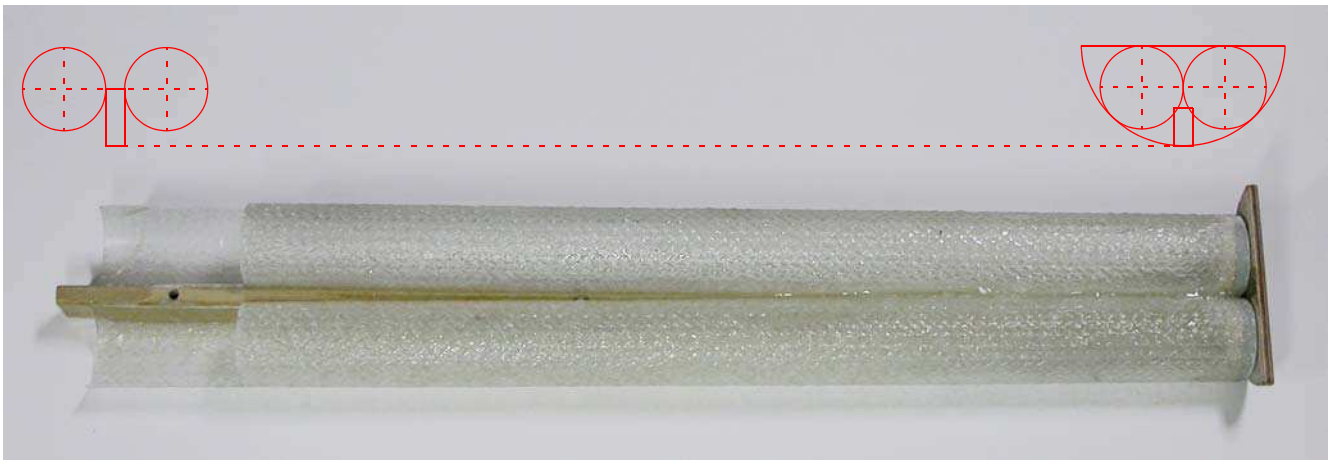

Fig.78: **Ballast hold tubes in position.**

- spread some epoxy along the structure (avoiding to let the epoxy penetrate in the threaded holes) and let it dry (see figure 79);

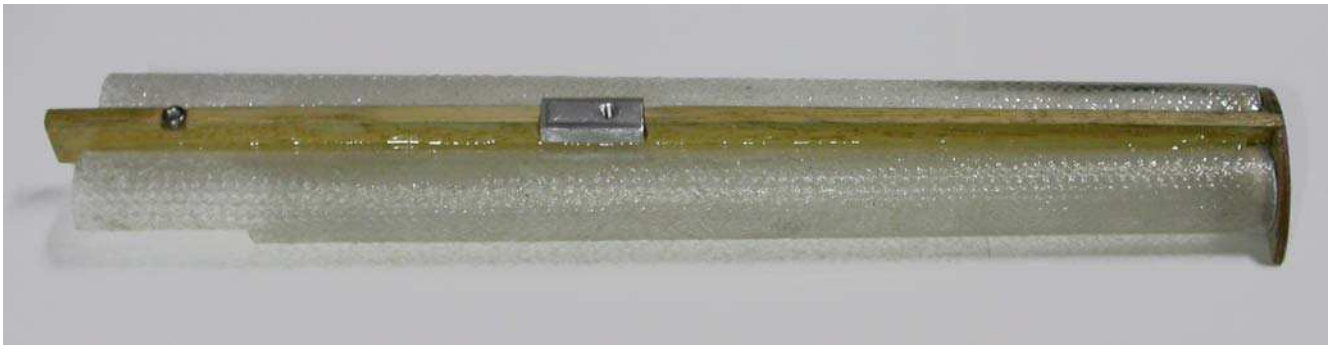

Fig.79: **Resin all the structure.**

- before to insert the structure into the fuselage, spread again some epoxy on the bottom of the structure;
- before that the epoxy drys, insert the structure into the fuselage as shown in figure 80 (be careful: don't smear the external side of the fuselage);

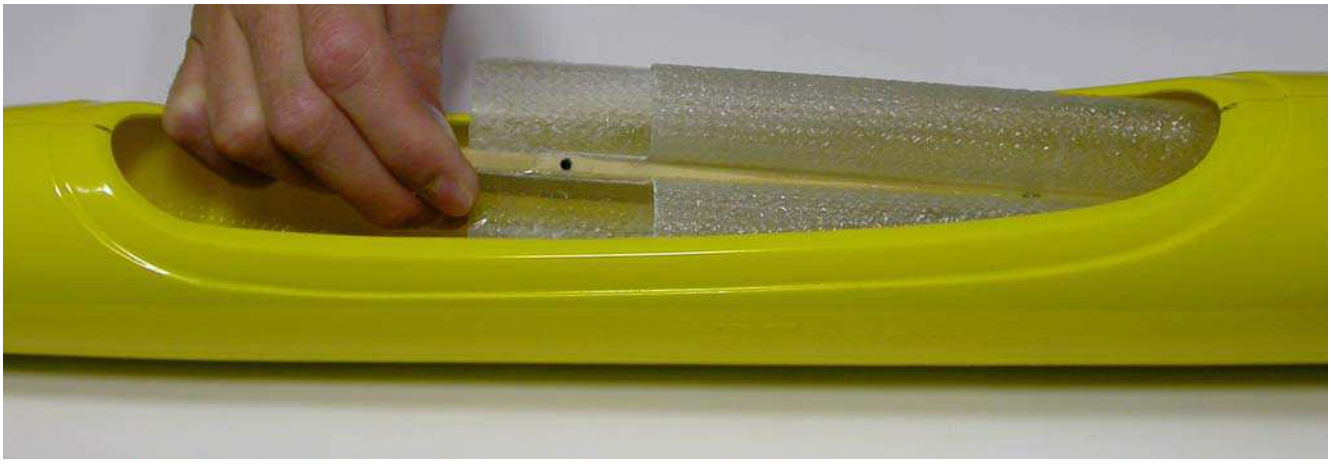

Fig.80: **Insert the ballast holding tube structure into the fuselage.**

- push the structure up to fit together the fuselage hook hole with the hook support threaded hole;
- screw (and strongly tighten) the hook "GTRA" aligning it towards the tail (see figure 81);

Fig.81: **Screw the hook (oriented towards the tail).**

- when the ballast holding structure is in position (see figure 82), slightly press it in order to better adhere to the fuselage;

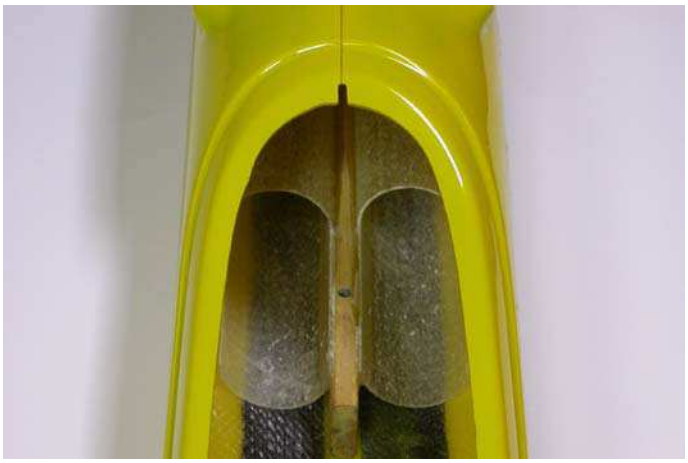

Fig.82: **Ballast holding structure in position.**

- insert and glue the front frame “OASB” as shown in figure 83.

Fig.83: **Front frame in position.**

Preparing the servos mounting frame

- Using a pencil, draw the central line of the servos mounting frame “BASE” (see figure 84);

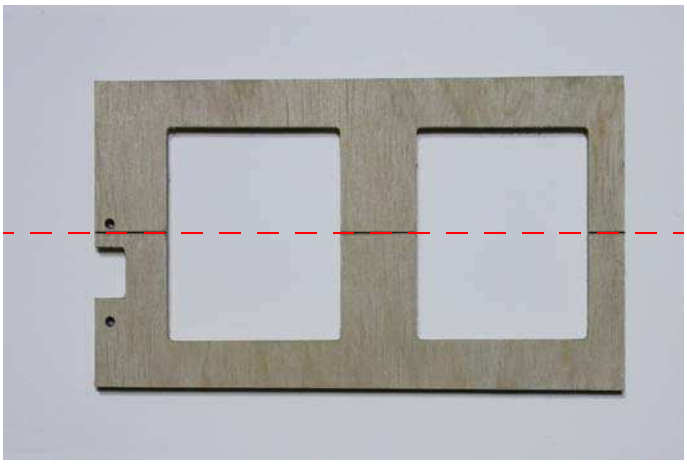

Fig.84: **Draw the central line.**

- mount gromlets and eyelets on the servos “SEPC” and “SEDR”;
- mount the two servos on the frame as shown in figure 85: the servo “SEDR” must be positioned exactly on the central line, while the servo “SEPC” must be positioned with one side on the central line;

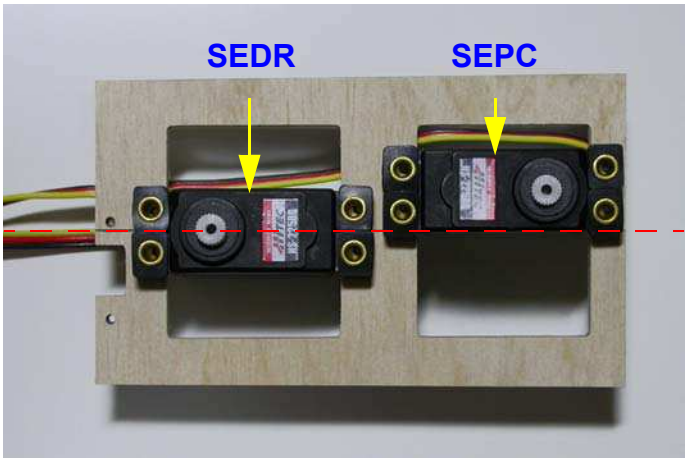

Fig.85: **Position of the servos on the frame.**

- hold the servos and, using a pencil, mark the position of the servos fixing holes;
- drill **1.5 mm** diameter hole on the marked points (see figure 86).

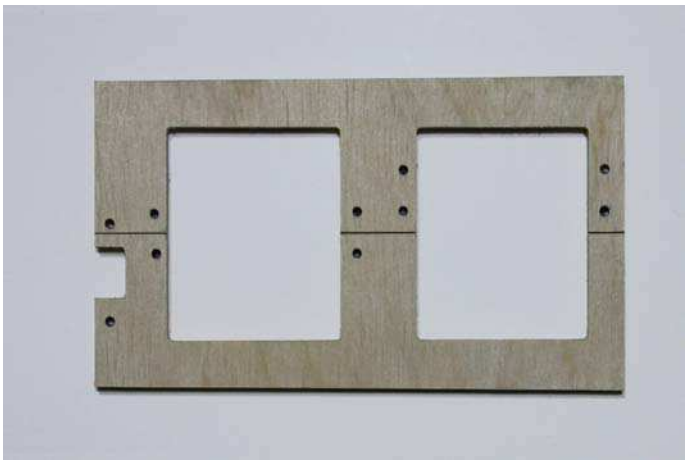

Fig.86: **Drill the marked points.**

Servos and ON/OFF switch

- Mount the two servos on the frame as shown in figure 87 and fasten with the proper screws;
- mount also the ON/OFF switch;

Fig.87: **Position of the components on the frame.**

- drill **1.5 mm** diameter hole in order to widen the servo horn hole (see figure 88).

Fig.88: **Widen the servo horn hole.**

Mounting and inserting servos

- Mount the single arm horn on the servo "SEPC" for the tailplanes and the double arm horn on the servo "SEDR" for the rudder (see figure 89);

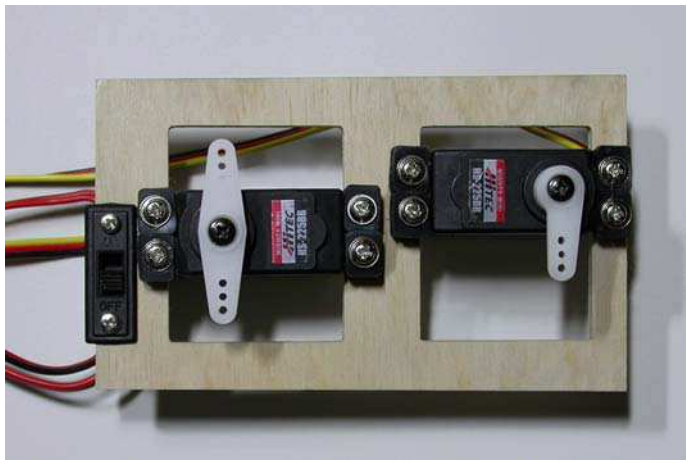

Fig.89: **Mount the horns on the servos.**

- keeping the fuselage wide with the fingers, insert the servos frame group (see figure 90);

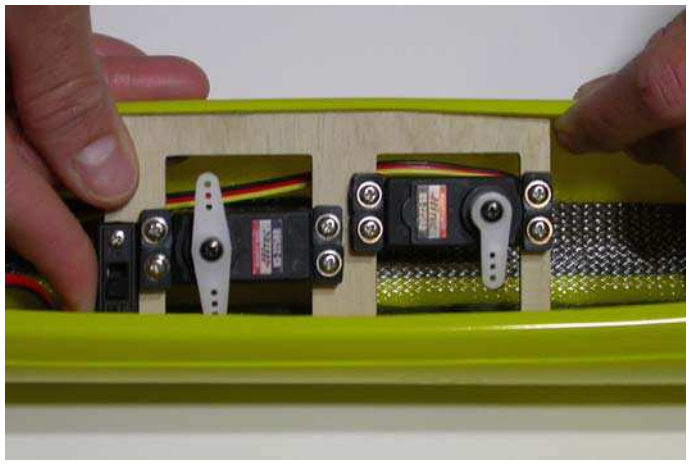

Fig.90: **Insert the servos frame group.**

Pushrods

Connecting servo to the elevator pushrod group

- Spread some epoxy around the wooden adaptor “TCAR”;
- insert the front pushrod group into the carbon pushrod “ARCB” (see figure 91);

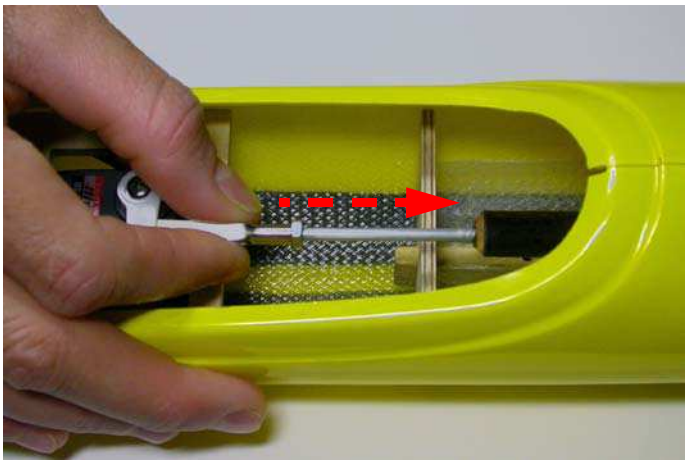

Fig.91: **Insert the group into the carbon pushrod.**

- connect the clevis of the front pushrod group to the single arm servo horn as shown in figure 92;
- temporary mount the tailplanes;

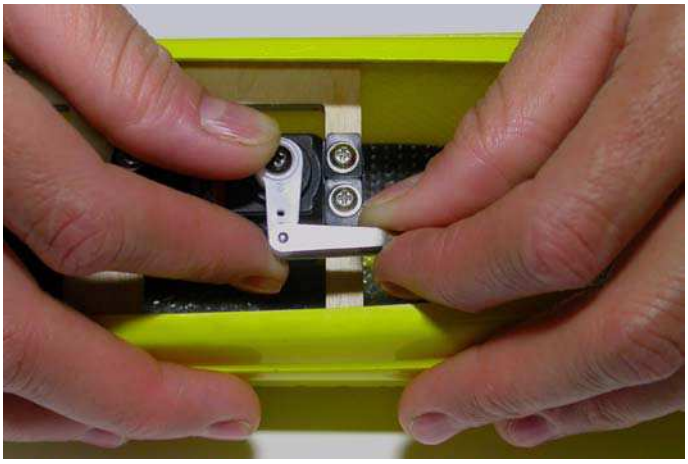

Fig.92: **Connecting the clevis.**

- push the servos frame (see figure 93) until the tailplanes are not perfectly aligned (horizontal);

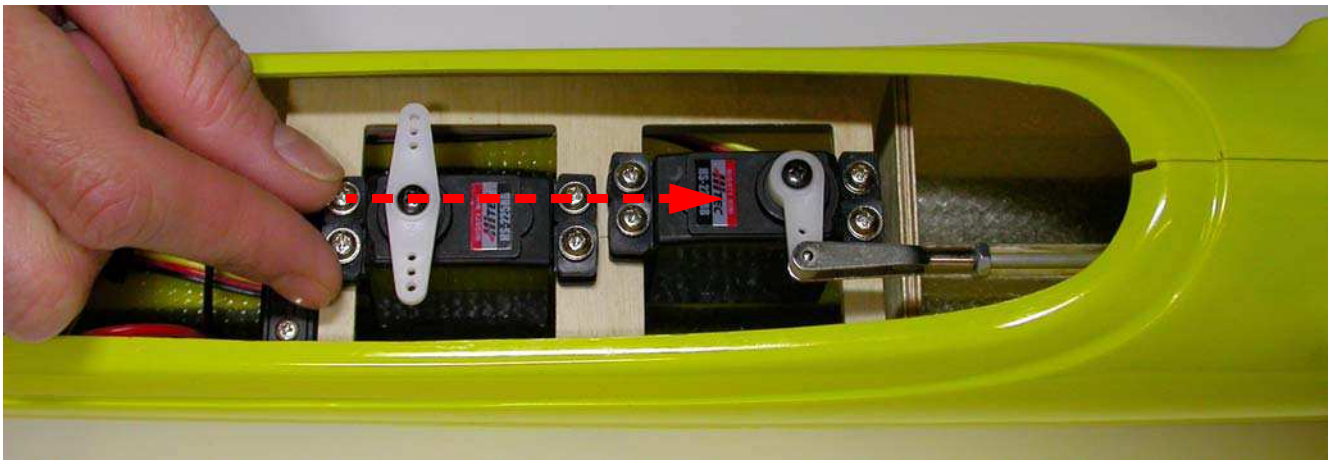

Fig.93: **Pushing the servos frame.**

- check the servos frame alignment with the fuselage (it must be horizontal);
- using some cyano, fasten the group to the fuselage;
- remove the tailplanes.

For each clevis:

- screw the nut “DBM2” on the screw “CAPD”;
- screw the clevis “FOM2” on the screw.

The final result is the group shown in figure 94.

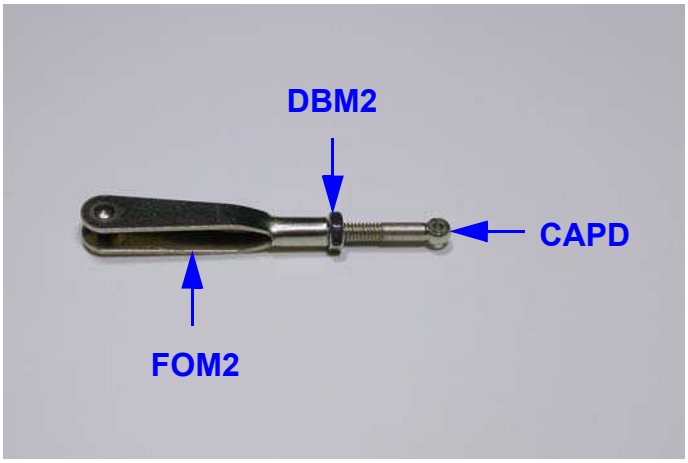

Fig.94: **Clevis, nut and screw.**

- connect the clevises to the double arm horn of the servo “SEDR” (see figure 95);

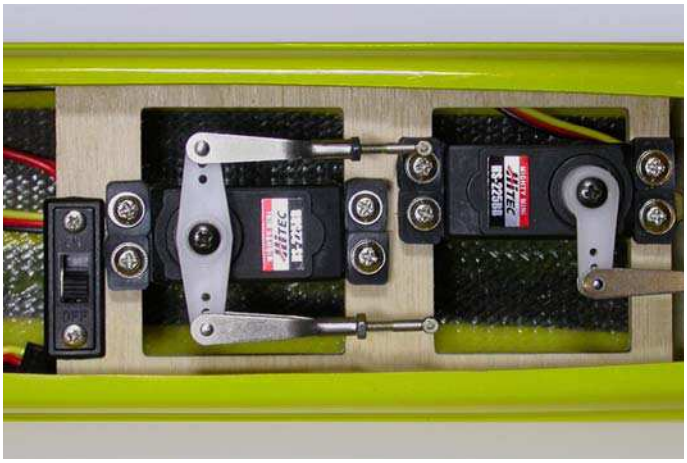

Fig.95: **Connect the clevises.**

- cut in two parts (**150 cm** each one) the pull-pull cable “CAVD”;
- insert each cable into its slot (see figure 96);
- insert the two sections of the cable inside the fuselage.

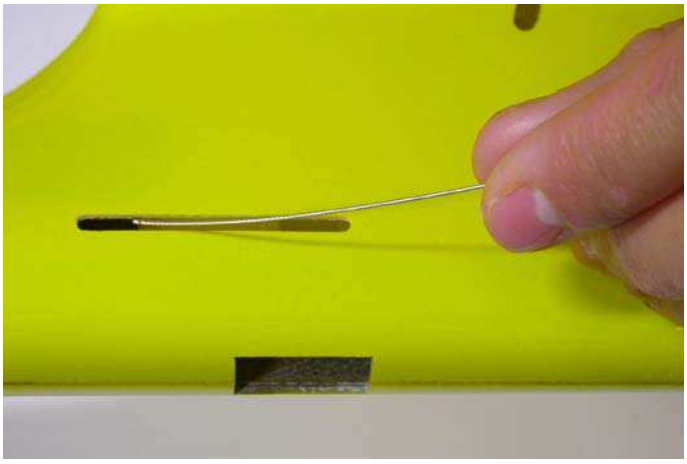

Fig.96: **Insert the cables in the slots (one each side).**

Connecting servo to the rudder cables

For each cable:

- put a wire-locking tube “LOCK” on the end of the cable;
- using a pair of pliers, insert the end of the cable into the external hole of the servo horn “SEDR” (right cable into the right hole);
- from the horn, insert the end of the cable into the wire-locking tube as shown in figure 97;

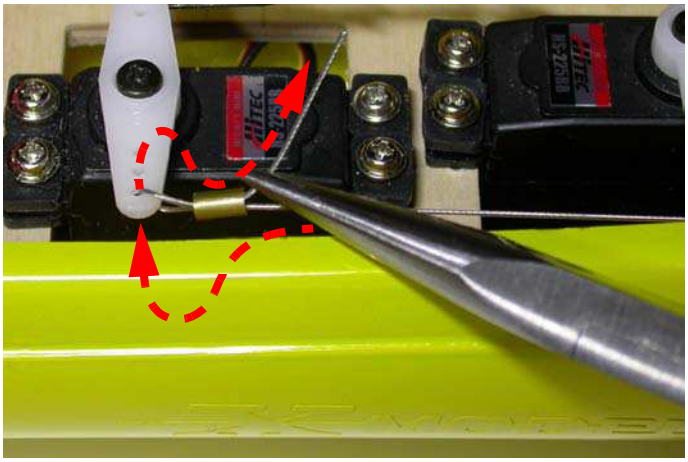

Fig.97: **Inserting the cable into the servo horn.**

- make a ring with the end of the cable and insert it, once again, into the same tube and in the same way (see figure 98);
- pull the end of the cable up to close the ring;

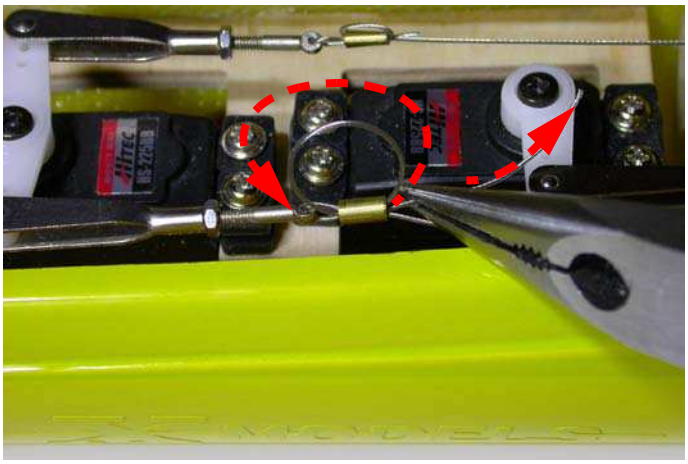

Fig.98: **Make a ring with the end of the cable.**

- using side cutters, squeeze the wire locking tube more times, but, be careful: pressing too strongly You risk to cut off the wire (see figure 99);
- cut off the wire in surplus;

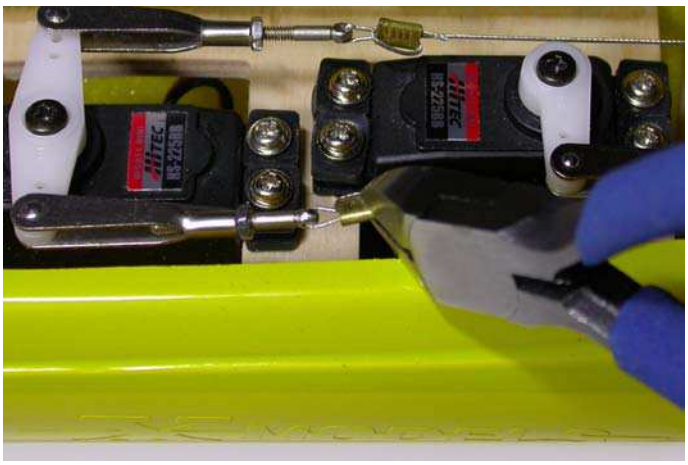

Fig.99: **Squeeze the tube in more points.**

- repeat also on the other side.

Connecting the cables to the rudder

- Fasten the rudder to the fin with a strip of masking tape in order to lock the rudder in a neutral position;
- put a wire-locking tube “LOCK” on the end of the cable;
- insert the end of the cable in the horn “SQDR”;
- from the horn, insert the end of the cable into the wire-locking tube as shown in figure 100;

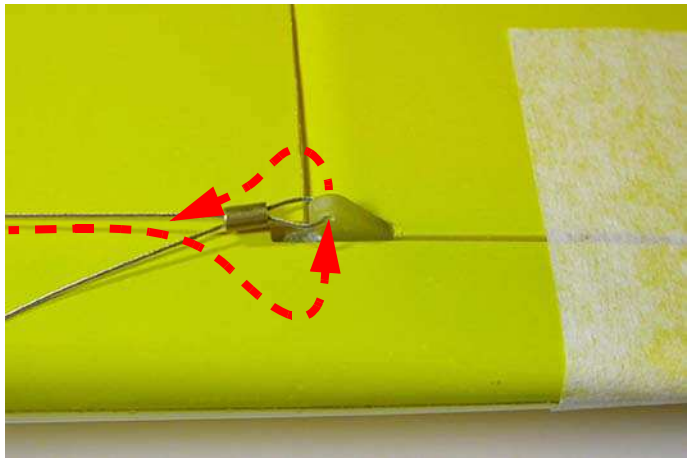

Fig.100: **Inserting the cable into the horn.**

- make a ring with the end of the cable and insert it, once again, into the same tube and in the same way (see figure 101);

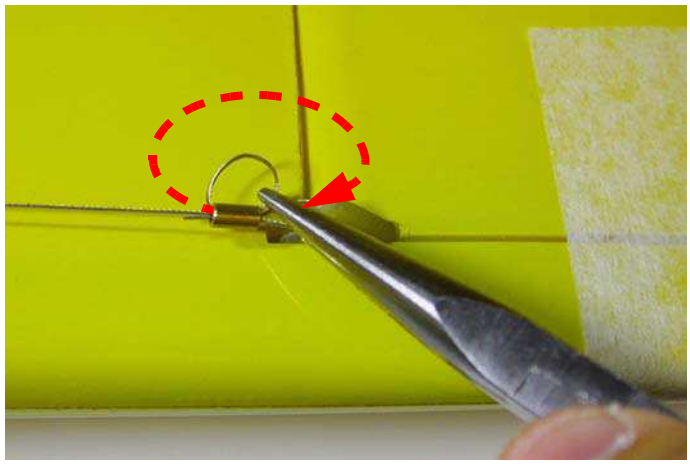

Fig.101: **Make a ring with the end of the cable.**

- pull the end of the cable up to close the ring (see figure 102);

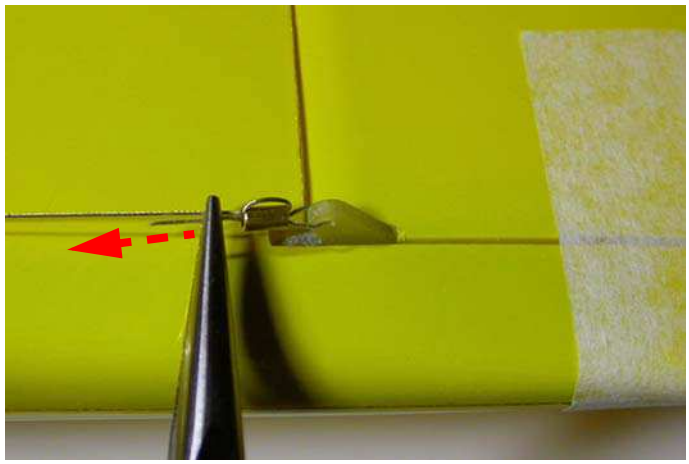

Fig.102: **Pull the cable in order to close the ring.**

- using side cutters, squeeze the wire locking tube more times, but, be careful: pressing too strongly You risk to cut off the wire (see figure 103);
- cut off the wire in surplus;

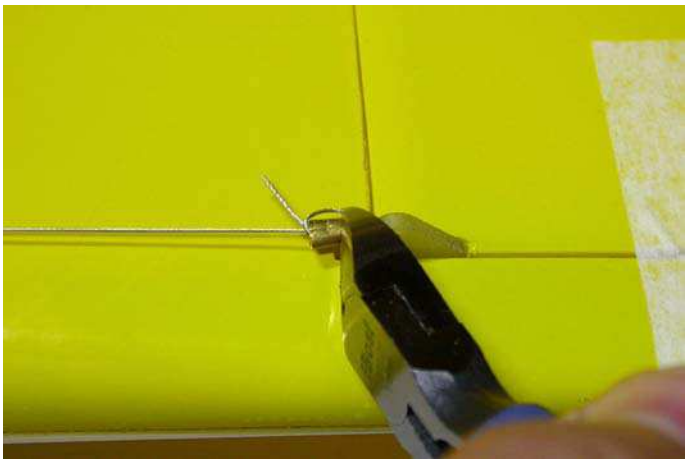

Fig.103: **Squeeze the tube in more points.**

- repeat also on the other side.

Rudder alignment

- Remove the masking tape from the rudder;
- screwing or unscrewing the screws "CAPD" in the clevises (see figure 104), align the rudder to the servo horn;
- lock the nuts "DBM2".

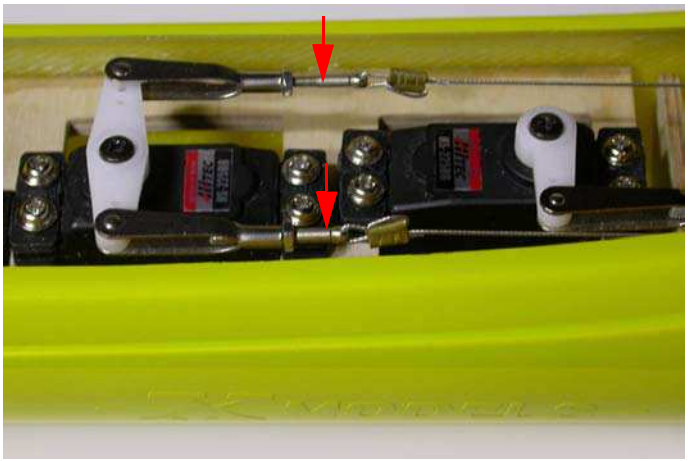

Fig.104: **Align the servo horn.**

Ballast locking plate

- Drill **2 mm** diameter hole, exactly in the middle, the ballast locking plate "PBBS";
- temporary disconnect the clevis from the single arm horn of the servo "SEPC" in order to make the insertion of the ballast locking plate easier;
- insert the plate in fuselage in the position shown in figure 105 and fasten it with the screw "VB25";
- connect the clevis.

Fig.105: **Ballast locking plate in position.**

Receiver and electrical connections

The receiver must be protected against possible shocks due to hard landings;

- cut a strip of polyethylene (about **5 mm** thick) and insert it into the fuselage in the position shown in figure 106;

Fig.106: **Insert the strip in fuselage.**

All the cables (coming from servos, battery pack, and so on) must be arranged in order to avoid any interference with the servo pushrods and cables.

- Plug the connectors, coming from the servos, to the receiver following the diagram in figure 142 at page 59; the position of the connectors depend from the receiver and from the transmitter settings;
- check that the ON/OFF switch is turned OFF and plug the connector to the battery pack.

Fig.107: **Electrical connections in position.**

Antenna

For the best reception signal, the position we recommend is the one shown in figure 108.

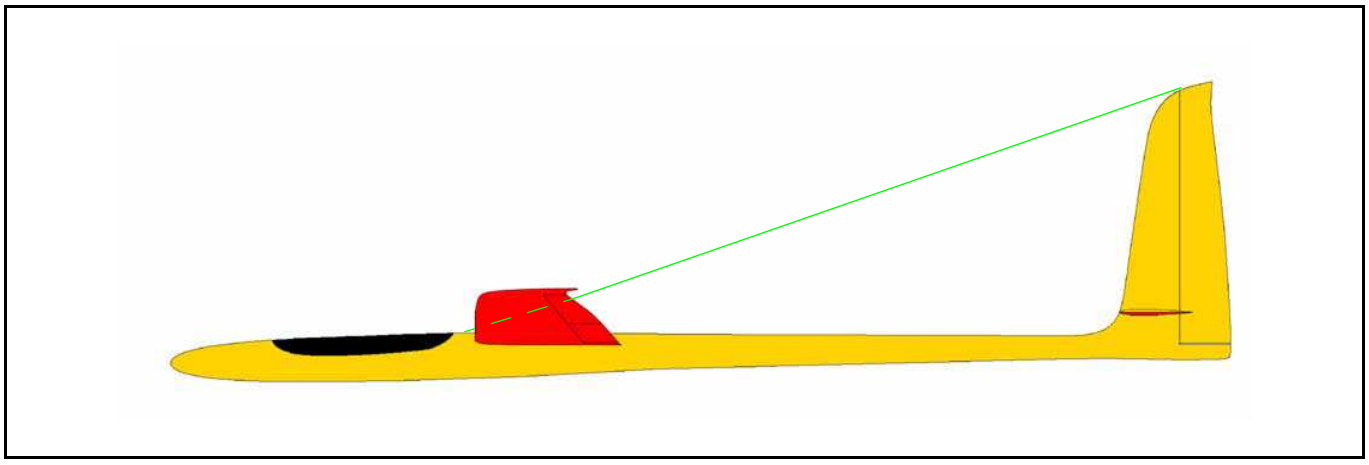

Fig.108: **Antenna's (recommended) position.**

Anyway, we recommend to equip your own model with a long range high quality receiver and carefully to check the long range behavior with a field test.

- Drill **3 mm** diameter hole on the fuselage in the position shown in figure 109;
- place a round servo grommet into the hole, in order to avoid any damage to the antenna's wire;

Note: the gromlet can be recycled from an old servo no longer in use.

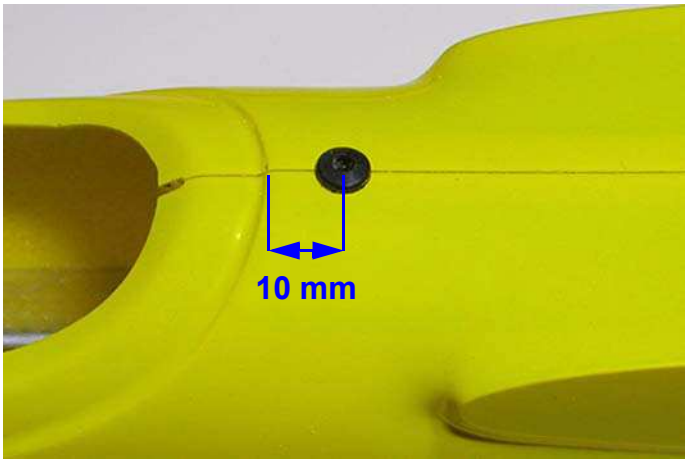

Fig.109: **Antenna's hole position.**

- let the wire pass through the hole as shown in figure 110;
- fasten the end of the antenna's wire to the rudder pin.

Note: if the wire is too short and don't reach the pin, it can be extended connecting its end with a nylon wire or hanged somewhere else.

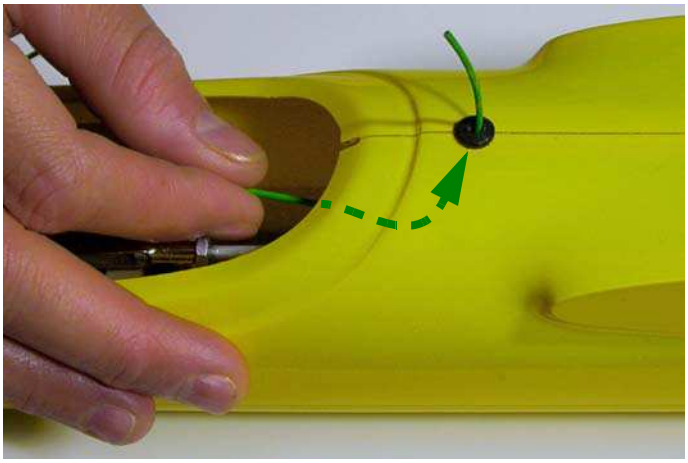

Fig.110: **Insert the antenna's wire in the hole.**

Canopy locking system

The almost symmetric shape of the canopy make the identification of the front side difficult; for this reason, the label FRONT (see figure 111) has been properly positioned.

Fig.111: **How to identify the canopy front side.**

Positioning

To position the canopy:

- let the canopy connection front pin slide in the point shown in figure 112;

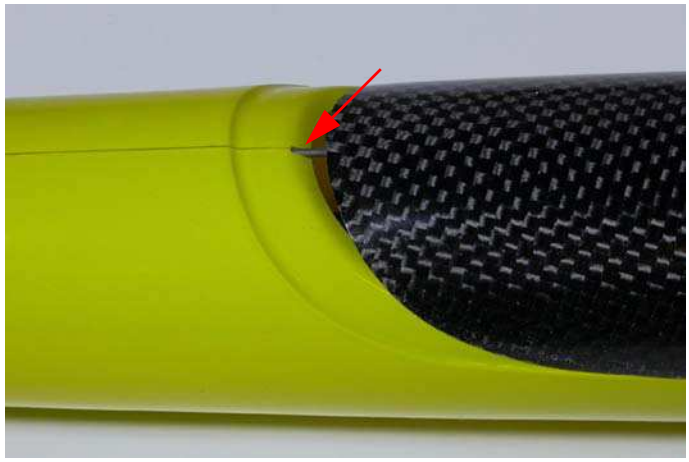

Fig.112: **Canopy connection pin.**

- push the canopy in the direction shown in figure 113;

Fig.113: **Push the canopy forwards.**

- let the canopy connection rear pin slide under the edge of the fuselage;
- push the canopy in the direction shown in figure 114 up to the complete closing.

Fig.114: **Push the canopy backwards.**

2.3 Wing

The wing is divided in two panels, each one equipped with aileron and flap.

Flaps and ailerons servos are fitted into the wings. For this reason, each wing panel is fitted with two rectangular housings where servos can be mounted. The use of flat servos (max. **13 mm** - better **11**) with high torque (at least 20 Newton/centimeter) is foreseen.

The assembling procedure is identical (as in a mirror), for each wing panel.

Installing bushes for control horns

- Drill **4 mm** diameter holes on ailerons and flaps in the points shown in figure 115;

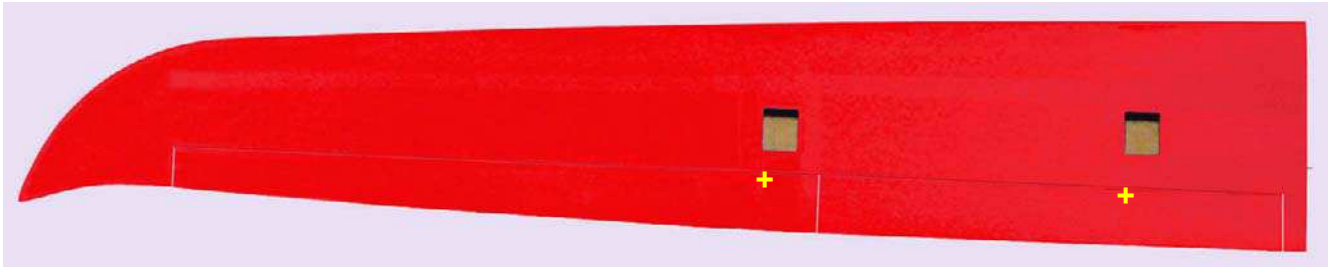

Fig.115: **Position of the bushes.**

WARNING! the center of the hole must be, at least, **10 mm** away from the leading edge of the movable surfaces (see figure 116);

- using a file (about **5 mm** diameter, round section), finish the holes;

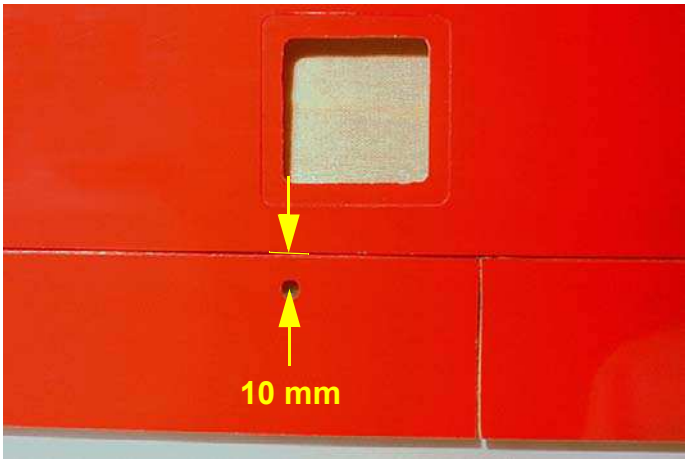

Fig.116: **Distance of the hole.**

- insert the threaded bushes "BOM3" in their holes from the top surface (see figure 117);
- with a drop of cyano or epoxy glue the bushes.

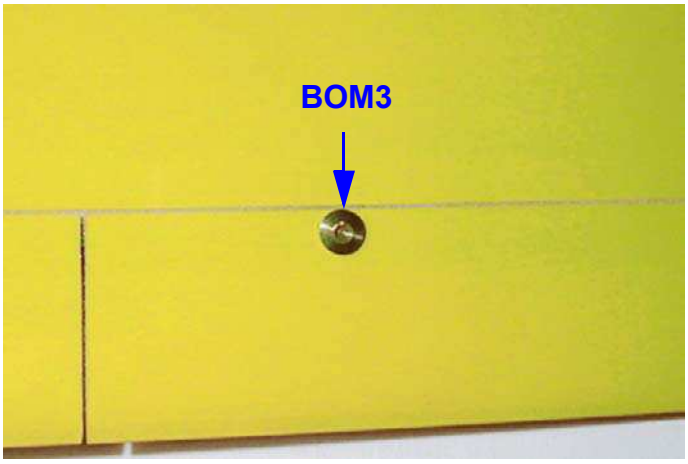

Fig.117: **Bush in position (wing seen from top).**

Electrical connection for the wing servos

The the wing servos connection needs just four wires to connect following the diagram shown in figure 118.

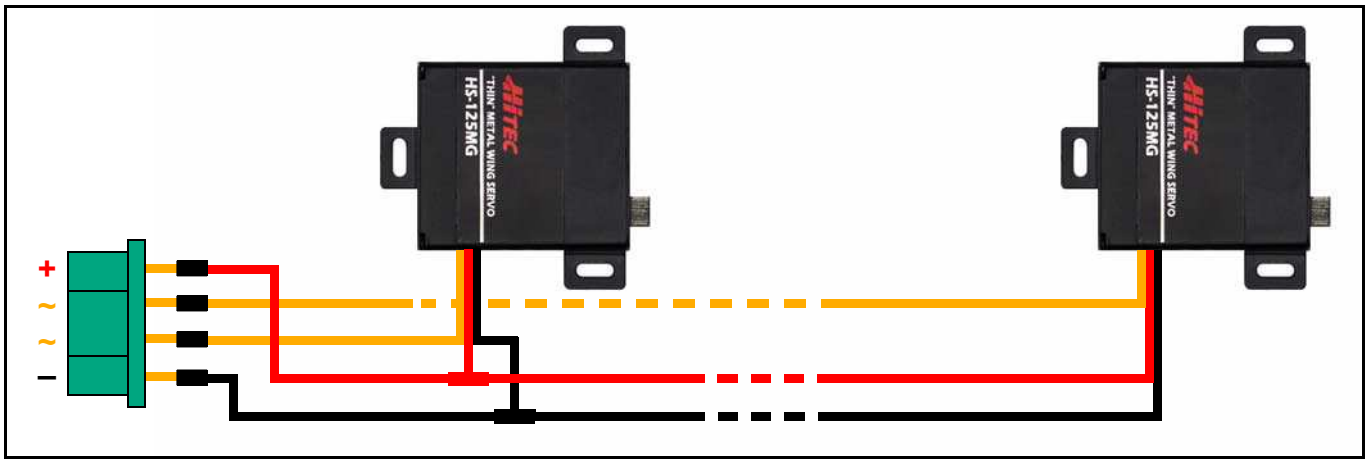

Fig.118: **Connection diagram for the wing servos (the same for the other wing).**

- Insert the four wires into the wing up to the servos housings.

The positive (red) wire of flap servo can be connected with the same wire coming from the aileron servo; the same thing can be done also with the negative (black or other dark color) wire, but (ATTENTION!) this can't be done between the signal (orange or yellow) wires: the signal wires must be always kept separate; in this way, only four wires (positive, servo flap signal, aileron servo signal, negative) will arrive to the connector "MPXM".

Connectors

- Before soldering wires to the connector "MPXM", insert the free tip of every wire into a **15 mm** long heat shrink sleeve of suitable section;
- solder the wires to the connector "MPXM" as shown in the diagram in figure 118;
- let every heat shrink sleeve slide on its soldering;
- using a hair drier (at least 1000W), direct the (very hot) air blow over the sleeves and let them mould on the solderings.

Caution! - when shrinking sleeves over joined wires, do not allow the hot air to `blast` over the wing or control surfaces - you will irreparably damage the wing!

- widen the rectangular hole on the wing root until the connector will not perfectly fit;
- spread a little bit of epoxy around the connector and fasten it in the position shown in figure 119;
- let the glue dry and repeat also on the other side.

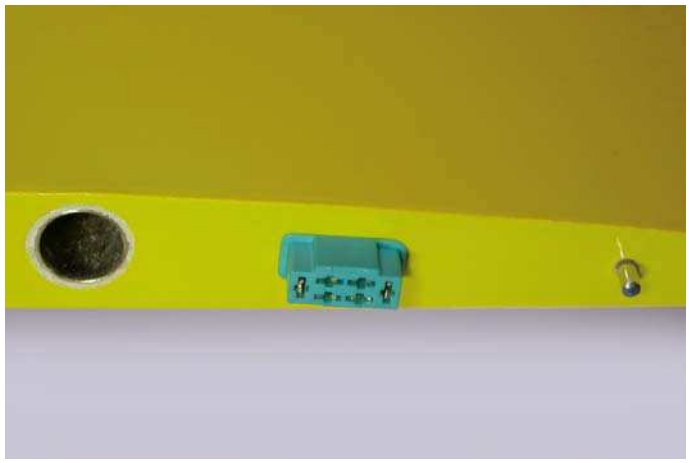

Fig.119: **Connector in position.**

Flap servo

- Using side cutters, remove the RX connector of the servo;
- cut and strip, for a length of about **10 mm**, the three wires coming from servo;
- strip the black and the red wire coming from the wing for a length of **10 mm**, but, WITHOUT CUT THEM;
- before soldering, insert the free tip of every wire into a **15 mm** long heat shrink sleeve of suitable section;
- solder the end of the red wire, coming from servo, to the skeined red wire coming from the wing and do the same soldering the black (or dark) wire, coming from servo, to the black one coming from the wing (see figure 120);

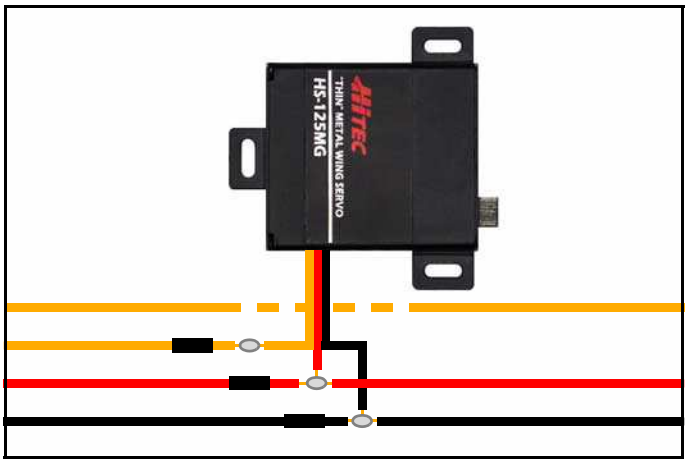

Fig.120: **Flap servo connections.**

- cut and strip, for a length of about **10 mm**, the end of the orange wire coming from the wing and solder it to the end of the signal wire coming from servo; but, **don't touch the other signal wire (the one for the aileron)**;
- let every heat shrink sleeve slide on its soldering;
- using a hair drier (at least 1000W), direct the (very hot) air blow over the sleeves and let them mould on the solderings.

Caution! - when shrinking sleeves over joined wires, do not allow the hot air to `blast` over the wing or control surfaces - you will irreparably damage the wing!

Aileron servo

- Using side cutters, remove the RX connector of the servo;
- cut and strip, for a length of about **10 mm**, the end of all the three wires coming from servo;
- cut and strip, for a length of about **10 mm**, the end of all the three wires coming from the wing;
- before soldering, insert the free tip of every wire into a **15 mm** long heat shrink sleeve of suitable section;
- solder the end of the orange wire coming from the wing, to the end of the same wire coming from the servo; solder the end of the red wire coming from the wing to the red one coming from the servo and do the same soldering the black (or dark) wire, coming from servo, to the black one coming from the win (see figure 121);
- let every heat shrink sleeve slide on its soldering;

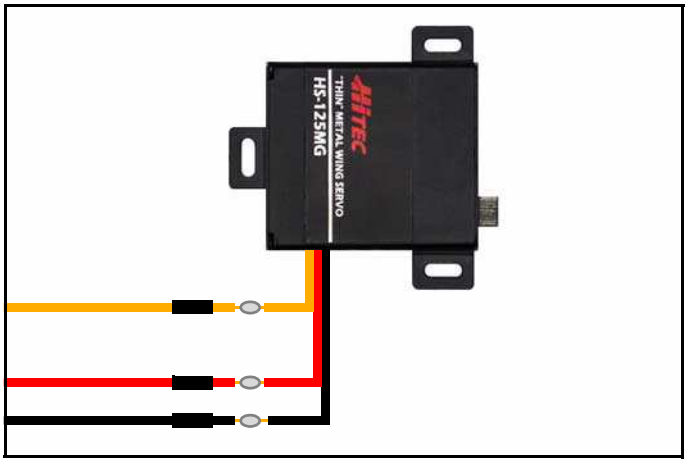

Fig.121: **Aileron servo connection.**

- using a hair drier (at least 1000W), direct the (very hot) air blow over the sleeves and let them mould on the solderings.

Caution! - when shrinking sleeves over joined wires, do not allow the hot air to `blast` over the wing or control surfaces - you will irreparably damage the wing!

Mounting servos inside the wing

For each wing servo “SEAL”:

- shorten the horn of (at least) two holes (see figure 122);
- fasten the horn to the servo;

Fig.122: **Shorten the horn.**

- remove protection film and apply the double adhesive plate to the servo (see figure 123);

Note: we suggest to spread some “five minutes” epoxy in order to better glue the servo to the wing”.

Fig.123: **Apply the double adhesive plate.**

- insert the servo into the housing (the horn must be on the EXTERNAL SIDE OF THE WING and towards the trailing edge (see figure 124);
- press the servo to fasten it.

Fig.124: **Servo housing.**

Wing pushrods

For each wing servo:

- screw the nut “DBM2” and the clevis “FOM2” on the threaded pushrod “ARM2”;

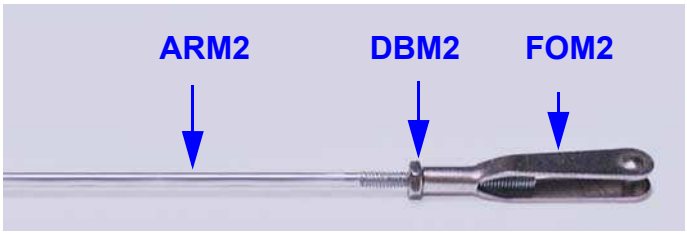

Fig.125: **Pushrod, nut and clevis.**

- screw the threaded horn “PERN” in the bush “BOM3”;
- connect (temporary) the clevis to the horn;
- using a fibre-tip pen, mark the distance from the servo horn and the threaded horn (see figure 126);
- remove the clevis from the threaded horn;

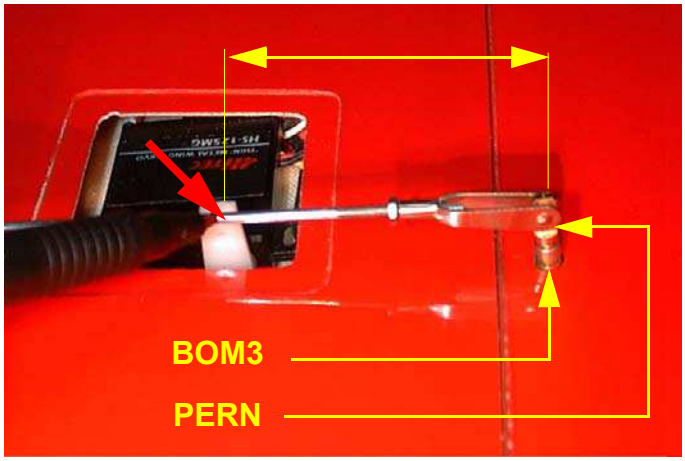

Fig.126: **Mark the distance on the pushrod.**

- using the Z pliers, make a “Z” bend on the pushrod “ARM2”: the marked point must correspond to the reference point on the pliers as shown in figure 127;
- using side cutters, cut the pushrod about half centimeter behind the Z bend;

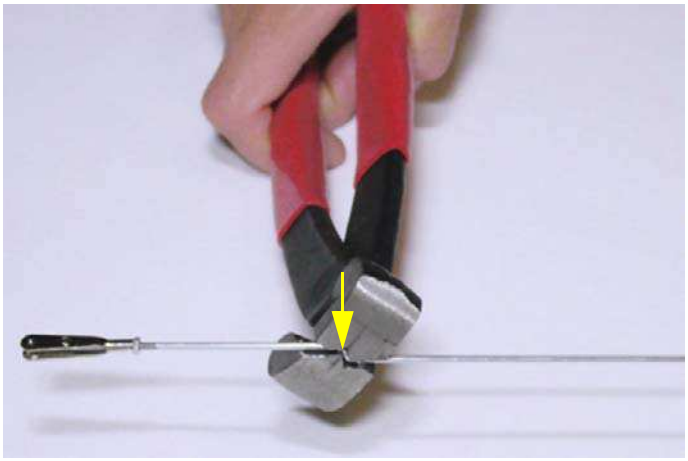

Fig.127: **Bend the pushrod.**

- insert the Z bent pushrod in the servo horn (see figure 128) and connect the clevis to the control horn

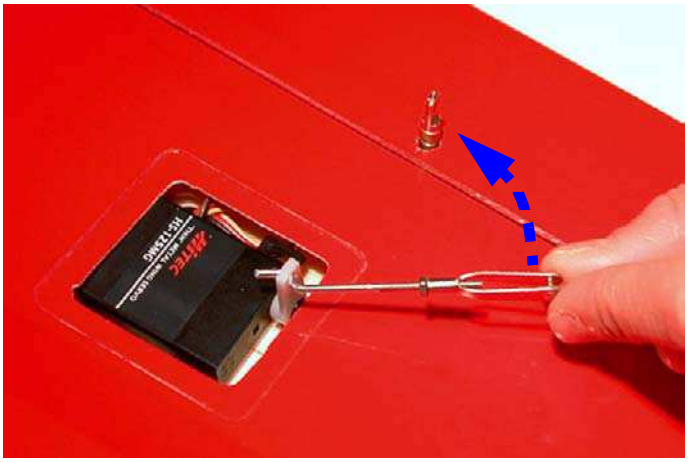

Fig.128: **Insert the pushrod and connect the clevis.**

Servo covers

The wing servo covers are made from the shapes “CSAL”.

From every shape, two covers can be made (left and right):

- take the distance (1) from the external edge of the servo housing and the servo horn (see figure 129);
- take the dimensions (2 and 3) of the external servo housing edges;

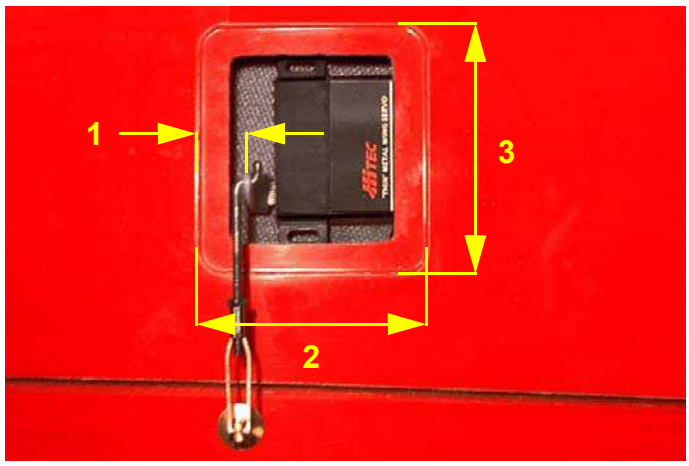

Fig.129: **Take the dimensions.**

- taking as reference the center of a bulge of the shape “CSAL” (see figure 130), carry the taken measure (1) from the external edge of the servo housing and the servo horn;
- from that point, using a pencil, draw a rectangle with the same dimensions (2 and 3) of the external housing edge taken before;
- symmetrically, make the other servo cover from the other half of the shape;

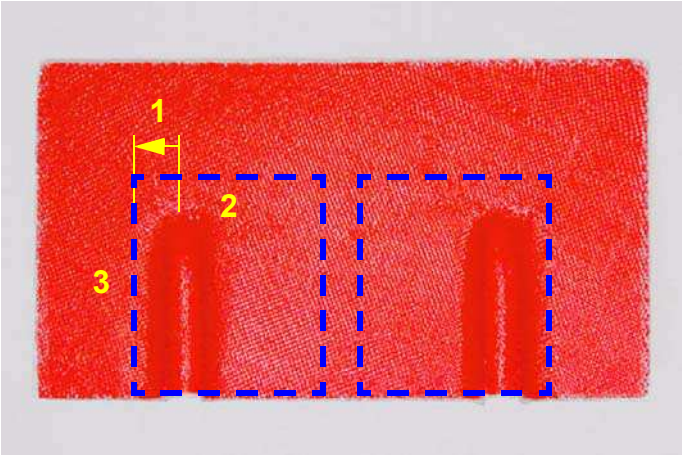

Fig.130: **Shape for two servo covers (left and right).**

- repeat the procedure for the other shape in order to obtain the four servo covers required;
- using a file, finish every cover fitting it to the corresponding housing;
- using some thin double adhesive tape, apply the inner covers (see figure 131).

Note: the outer covers will be applied to the wing just after the lateral model balancing that will be described later.

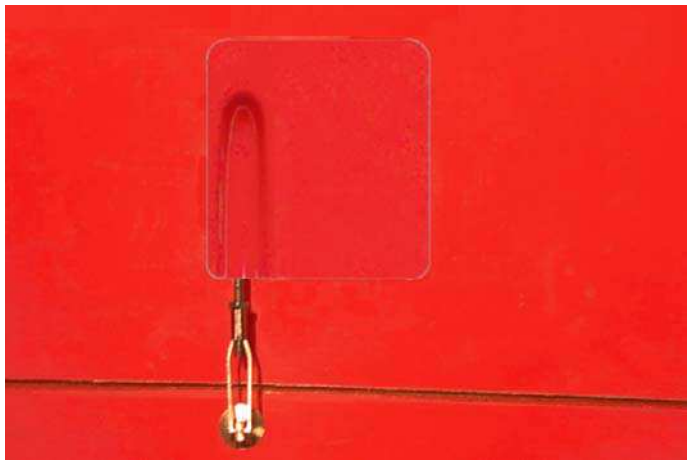

Fig.131: **Servo cover in position.**

2.4 Connecting wing panels and tailplanes to the fuselage

Wing panels

- Insert the wing rod “BAIO” into its housing (see figure 132);

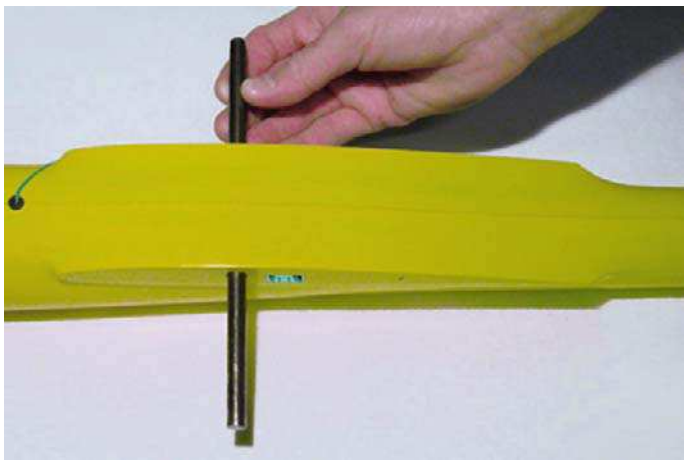

Fig.132: **Insert the wing rod.**

- insert the wing rod in the hole on the root of the wing (see figure 133);
- insert the wing completely, fitting the electrical connections and the alignment pin;
- repeat the operation also for the other wing panel.

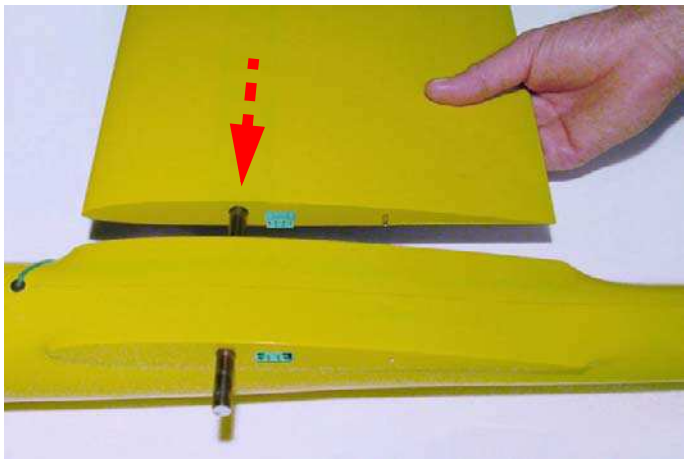

Fig.133: **Insert the wing panel.**

Tailplanes

- Insert the elevator rod “BSPC” through the central bush;
- insert the rod “BRPC” through the bellcrank slot;
- insert the two tailplanes fitting the rods with the taliplanes holes (see figure 23);

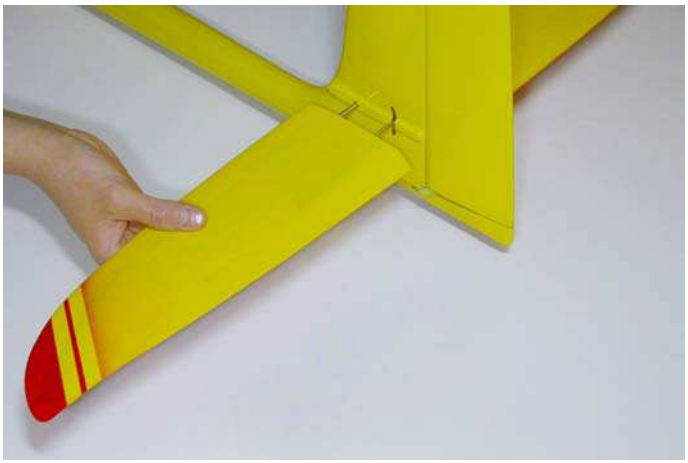

Fig.134: **Inserting tailplanes.**

If You notice that is too easy to insert end remove the tailplanes it is better to bend a little bit the rod “BRPC” in order to avoid the loss of tailplanes during flight.

CHAP. 3 MODEL SETTINGS

3.1 Servos settings

Identifying the control surfaces

Refer to figure 135:

— ailerons **1** and **2** (roll);
— flap **3** and **4** (camber changing, crow brake);
— tailplanes **5** and **6** (pitch);
— fin **7** (yaw).

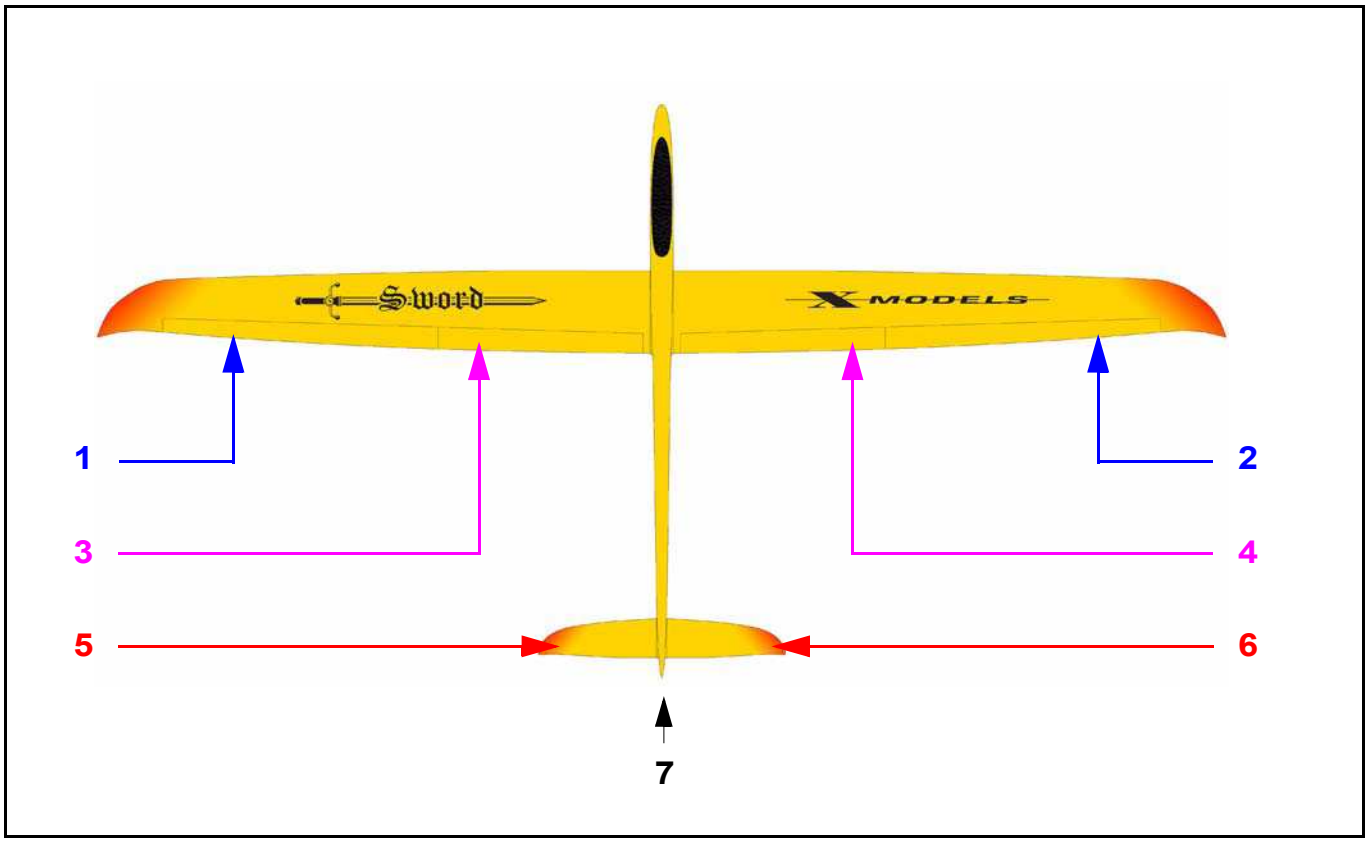

Fig.135: **Control travel.**

Travel values

These are suggested values, found during our test flights. Just consider these a starting point and feel free to modify the travel values according to your flying skill, style, flying area, etc.

Ailerons

Up ..... **10 mm** (min.) / **14 mm** (normal) / **2 mm** (flaperons) / **20 mm** (butterfly)
Down ..... **8 mm** (min.) / **10 mm** (normal) / **2 mm** (flaperons).

Flap

Up ..... **2 mm**
Down ..... **4 mm** (normal) / **30 mm** (butterfly).

Note: value good when the flaps are used by themselves, if used in mix with aileron to change camber, please refer to FLAP to AILERON mix set up.

Tailplanes (elevator)

Up ..... **8 mm** (min.) / **10 mm** (normal)
Down ..... **8 mm** (min.) / **10 mm** (normal).

Note: measurement taken at the fuselage side.

Rudder

Left side ..... **as much as possible**;
Right side..... **as much as possible**.

Special mix

If you have a computer radio you may take advantage of it and use also the following mix:

Aileron to Rudder (Combi Mix):. 30% aileron to rudder mix will help a lot on poor lift condition;

Flap to Aileron: ..... to take advantage of changing the profile camber,
speed: flap 2 mm up, ail 1.5 mm up
thermal: flap 2 mm down, ail 1.5 mm down

Elevator to flap: ..... to make square figures, flap up and down 5 mm on full elevator up or down

Aileron to flap: ..... to increase roll rate (but only in good lift conditions)
flap up 2 mm and down 2 mm

Butterfly: ..... aileron up 20 mm, flap down 30 mm, elevator down 2 mm (you will have to try the butterfly at a safe height the first time, to check for the right travel value).

3.2 Model balancing

CG

The CG of the model must be placed at **70 ~ 75 mm** from the wing leading edge at the wing root (see figure 136).

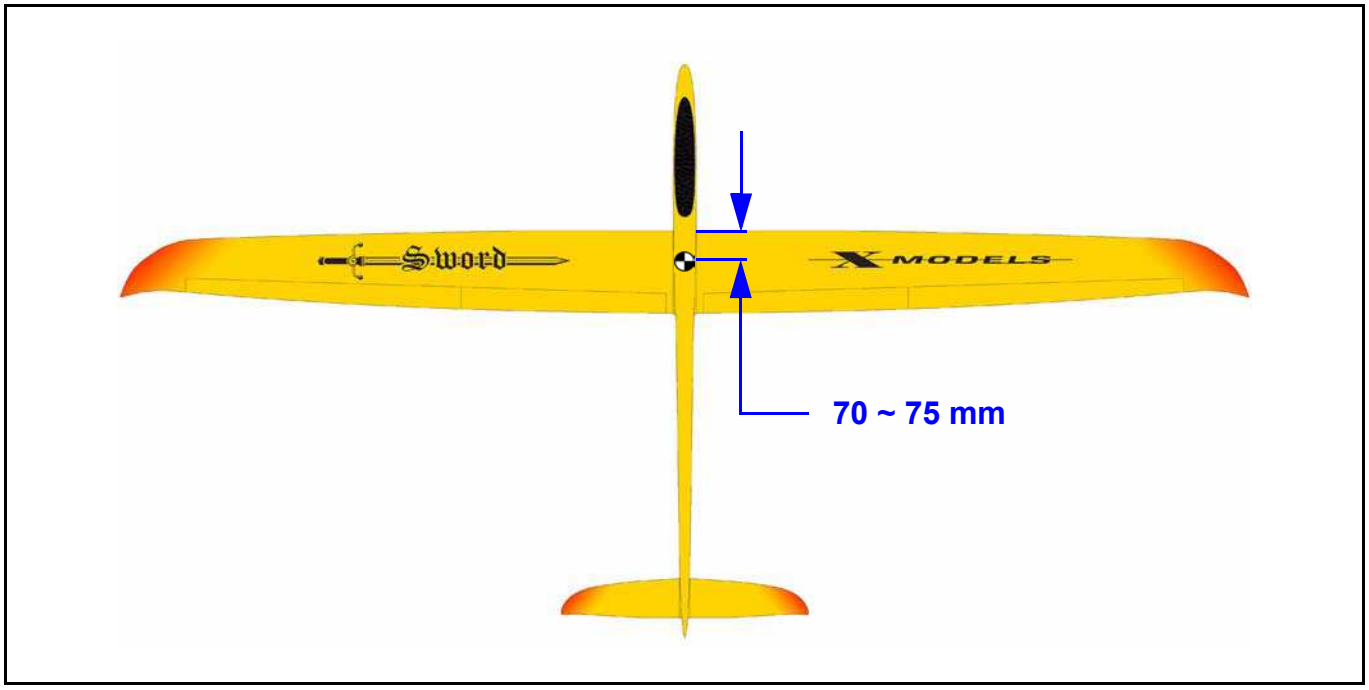

Fig.136: **CG position.**

Note: You may in a second time move it a little backwards if you feel (and if you are a real good pilot...).

Checking and correcting the CG position

- Mark with a piece of tape the CG position under the wing and hold the model with your fingers: the model must stay level;
- remove or add lead to front until satisfied.

Note: the model must be complete with all his part (including the cowling) during the CG check.

- once positioned the CG in the correct point, steady fasten the lead bars.

Checking and correcting the lateral balance

Before to apply the outer servo covers, we recommend to check (and eventually correct) the model lateral balancing.

Checking

- Lay the model on a flat hard surface;
- try to keep the model flat rising the wing that is in touch with the ground;
- gently leave the model alone (see figure 137);

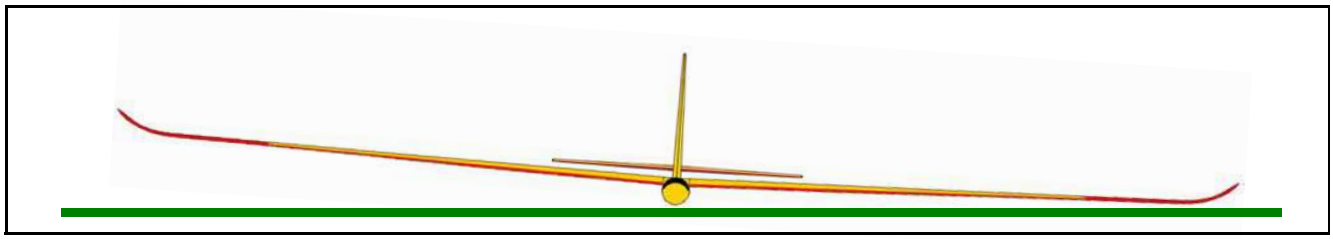

Fig.137: **Checking for lateral balance.**

- repeat the operation more times.

Correcting

If the same wing half drops all the times:

- add some lead pellet to the lighter wing (you can place the lead in the servo hole) until satisfied (usually a few grams do the job);
- repeat the test (see “Checking”).

If the wings halves are dropping randomly, the model is ok; in this case:

- apply the servo covers (see “Servo covers” at page 51).

How to add ballast

Flying in the wind (dynamic fly) requires the addition of ballast in order to increase the stability of the model in turbulent air.

To add ballast:

- temporary disconnect the clevis from the elevator servo single horn;
- using an Allen key, completely unscrew the plate locking screw (see figure 138);
- remove the ballast locking plate;
- insert the ballast hold tubes as shown in the paragraph “Ballast distribution diagram” on page 57;
- mount and lock the plate;
- connect the clevis.

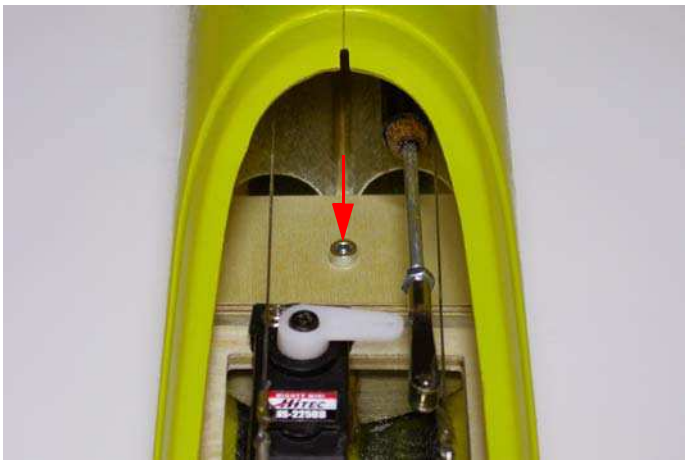

Fig.138: **Ballast locking system.**

Ballast distribution diagram

The ballast is made by some iron cylinders (diameter **20 mm** and **30 mm** length each one), available, on request.
Up to a maximum of **16 pieces** can be inserted into the ballast hold tubes. Each piece weight around **70 g**, therefore, at the maximum configuration, the model weight can be increased about **1100 g** more.

We suggest an uniform distribution of the ballast pieces, starting from the center of the tubes (see figure 139); the empty space must be filled with some wooden spacer to insert either in front than behind the ballast.

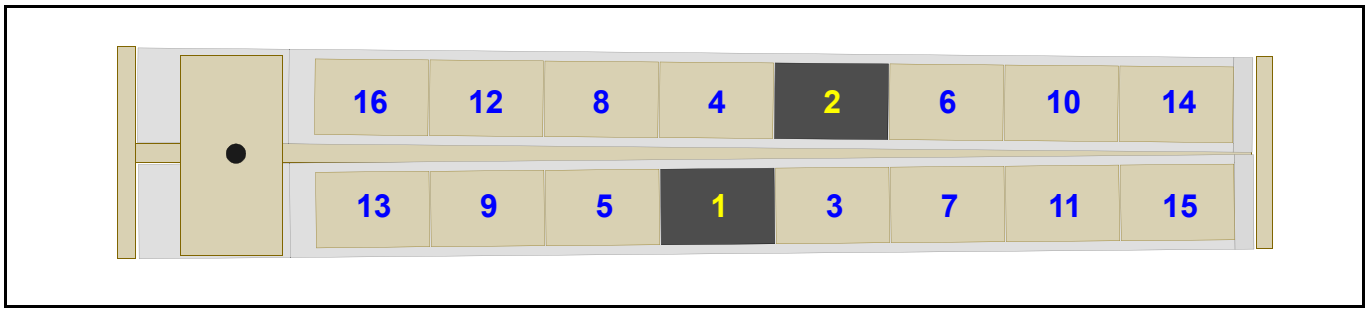

Fig.139: **Correct distribution of the weights (positions: 1, 2, 3, ...).**

IMPORTANT! Once inserted the ballast, we recommend to accurately check the CG position.

A wrong distribution of the weights (see figure 140) jeopardize the correct model balancing.

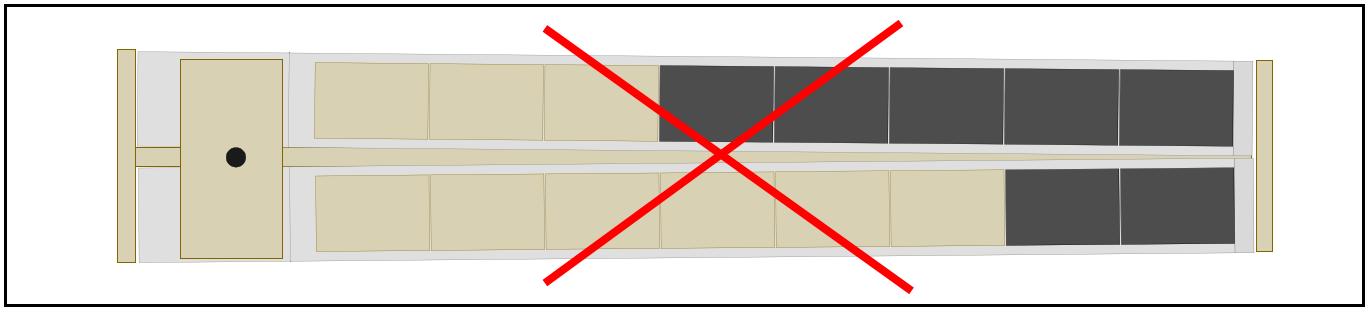

Fig.140: **Wrong distribution of the weights = model balancing jeopardized.**

The non-insertion (either total than partial) of the spacers (see figure 141), involves the continuous variation of the model CG, strongly jeopardizing the stability during the fly (and the consequences are easy to imagine).

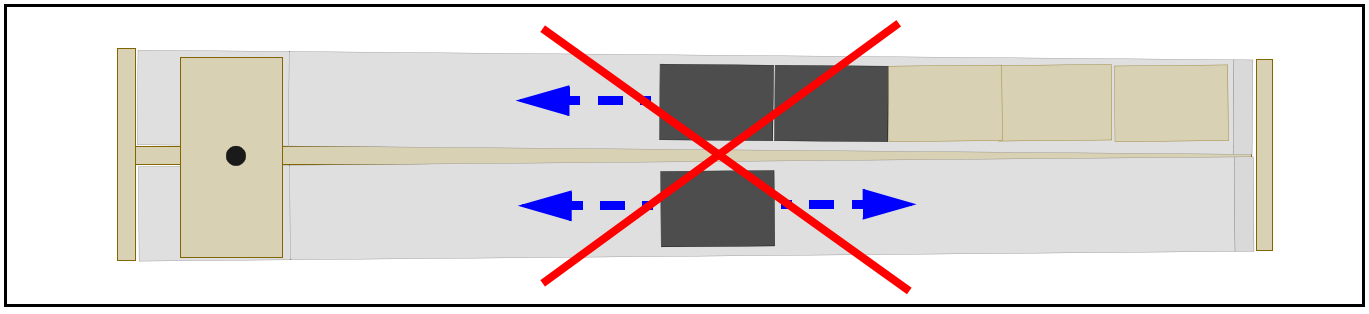

Fig.141: **Non-insertion of the spacers = jeopardized stability during the fly.**

CHAP. 4 CONNECTIONS DIAGRAM

Schematic drawings for connecting servos, receiver and battery.

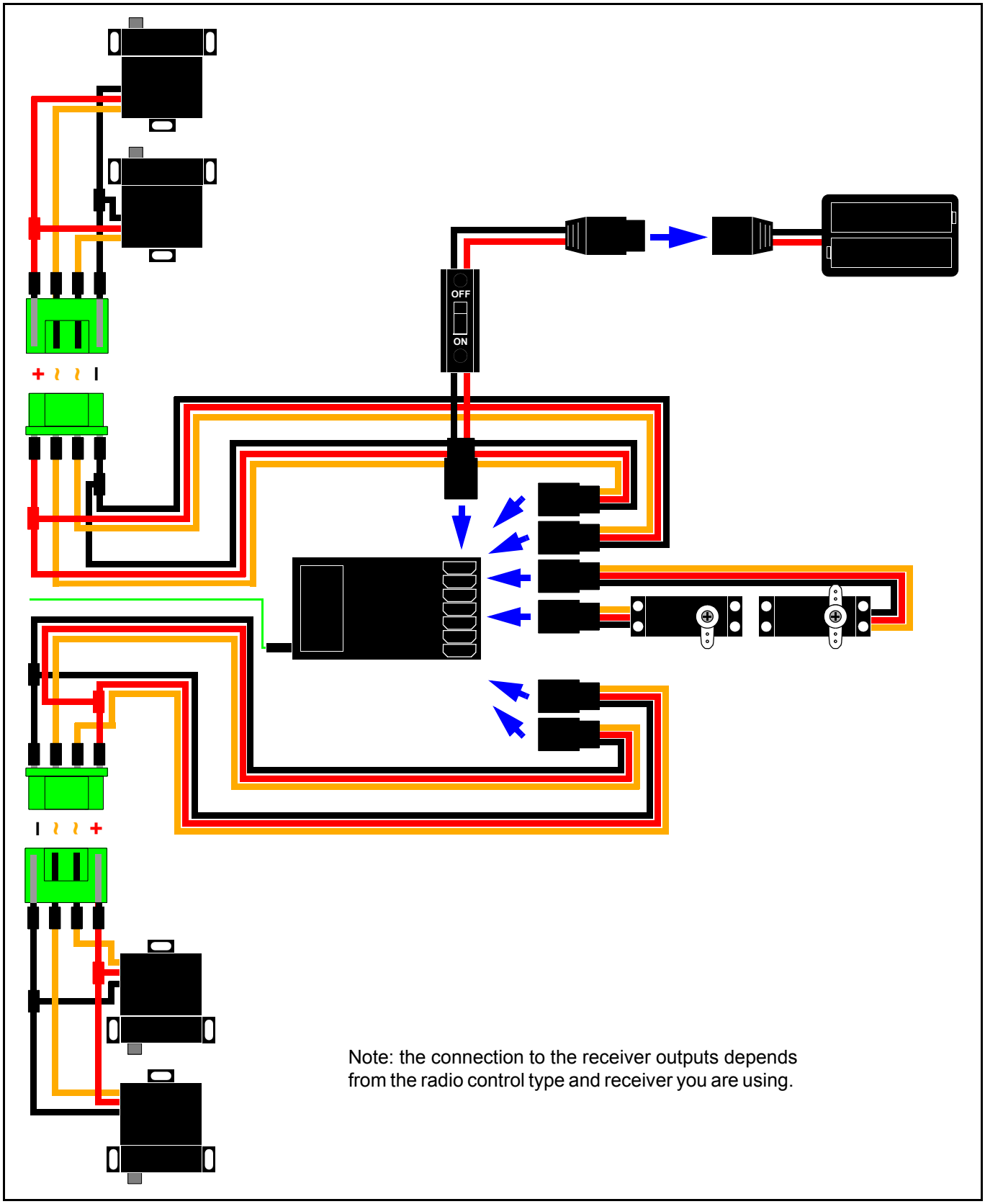

Fig.142: **Electrical connections.**