CARF-MODELS

...the best flying planes on the planet!

MiG-15 bis “Fagot”

Construction Manual

Museum Scale All Composite Jet Aircraft

Version 2

techsupport@composite-arf.com / V2.1, March. 2012

contents


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safety instructions and warnings

In the interests of your own safety and that of others, the model must only be operated by experienced, disciplined modellers with sufficient specialised expertise, and it must be serviced and maintained regularly and competently. If you have no experience in building and operating models of this type, it is vital that you enlist the help and advice of an experienced jet modeller if you are to avoid potentially catastrophic errors; this applies in particular to the jet engine itself, which should only be run when an experienced operator is present. If you have a model flying group or club in your area where training and support are available, we strongly recommend that you join that group. With this model any defect or deficiency in its construction or operation can result in serious personal injury or even death.

CAUTION!
Before you operate this model aircraft, you must determine the local by-laws and regulations which apply to you. In legal terms our models are classed as aircraft, and as such are subject to legal regulations and restrictions which must be observed. Contact your Rep regarding the AMA Regulations for turbine powered aircraft.

WARNING!
It is your responsibility to protect others from possible injury. Keep a safe distance from residential areas in order to protect people, animals and buildings: at least 1.5 km “as the crow flies”.
Keep well clear of high-tension overhead cables. Don’t fly the model in **poor weather**, especially when there is **low cloud cover** or **fog**. Don’t fly the model directly **into the sun**, as you could easily lose visual contact with the model. To avoid collisions, always keep well clear of full-size aircraft, whether manned or unmanned. It is your responsibility to land immediately if a real aircraft approaches.

When operating a jet engine you must keep people and animals in a safe distance from it. This means:

In front of the turbine	4.5 m
To the side of the turbine	7.5 m
Behind the turbine	4.5 m

WARNING!
The operator of the model must be in full possession of his or her bodily and mental faculties. Operating a model aircraft under the influence of alcohol or drugs is not permissible under any circumstances. This applies both to the operator and to his or her assistants.

WARNING!
Radio-controlled model aircraft may only be used for the purpose intended by the manufacturer. They must never be used as machines for carrying people or goods, nor for any other purpose except as model aircraft. Misuse of this model may result in serious personal injury or even death.

WARNING!
It is important not to make any modifications of any kind to the model. If you deviate from the instructions, perhaps by using different components or materials, or by making changes to the structural design, you may seriously affect the ability of the model aircraft to function correctly. Please resist the temptation, and build the model exactly as directed.

WARNING!
Before you fly the model it is essential to check the Centre of Gravity and the control surface travels, as stated in these instructions. These settings are very important, and our recommended values must be observed. Before you fly the model, carry out a careful check of all the working functions and all the control surfaces. Check the range of the radio control system with the transmitter aerial collapsed. If the check is satisfactory, repeat it with the engine running, with an assistant holding the model securely. Read the instructions supplied with your radio control system, and make sure that you observe the manufacturer’s recommendations.

LIABILITY EXCLUSION AND DAMAGES

You have acquired a kit which can be assembled into a fully working RC model when fitted out with suitable accessories, as described in the building instructions in the kit. However, as manufacturers, we at Composite-ARF are not in a position to influence the way you build and operate your model, and we have no control over the methods you use to install, operate and maintain the radio control system components. For this reason we are obliged to deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect application and operation of our products, or which are connected with such operation in any way. Unless otherwise prescribed by binding law, the obligation of the Composite-ARF company to pay compensation is excluded, regardless of the legal argument employed. This applies to personal injury, death, damage to buildings, loss of turnover and business, interruption of business or other direct and indirect consequent damages. In all circumstances our total liability is limited to the amount which you actually paid for this model.

BY OPERATING THIS MODEL YOU ASSUME FULL RESPONSIBILITY FOR YOUR ACTIONS.

It is important to understand that Composite-ARF is unable to monitor whether you keep to the instructions contained in this operating manual regarding the construction, operation and maintenance of the aircraft, nor whether you install and use the radio control system correctly. For this reason we at Composite-ARF are unable to guarantee or provide a contractual agreement with any individual or company that the model you have made will function correctly and safely. You, as operator of the model, must rely upon your own expertise and judgement in acquiring and operating this model.

SUPPLEMENTARY SAFETY NOTES

Pre-flight checking

Before every session check that all the model's working systems function correctly, and be sure to carry out a range check. This is the procedure: switch on the transmitter, followed by the receiver. Leave the transmitter aerial collapsed and walk away from the model. At the appropriate range check that all the control surfaces work perfectly when you move the sticks.

Repeat the procedure with the engine running, while an assistant holds the model securely. The first time you fly any new model aircraft we strongly recommend that you enlist the help of an experienced modeller to help you check the model and offer advice while you are flying. He should be capable of detecting potential weak points and errors.

Be certain to keep to the recommended CG position and control surface travels; if adjustments are required, carry them out.

Don't ignore our warnings or those provided by other manufacturers. They refer to things and processes which, if ignored, can result in fatal injury or permanent damage.

Recommended equipment

Servos

Ailerons: 2x DS 8411 or similar
Elevator: 2x Mini Servos with 50 in/oz or more (DS3328)
Flaps: 2x DS 8411 or similar
Rudder: 1x DS 8411 or similar
Nosegear steering: DS 8411 or similar

Engines

We recommend 20-25lb thrust engines.
JetCat P-80SX, P-100RX, or similar.

To use bigger engines is only recommended, when the pilot really knows how to use the throttle stick. Of course, in vertical manouvers it is good to have the power. But - in the horizontal manouvers you have to have the throttle stick at 1/3rd AT MOST!!! It is not, that you would destroy the plane with too high speeds, it is just that you will kill any scale flight appearanceif you fly with to much thrust. The full scale just did not have it either!!!

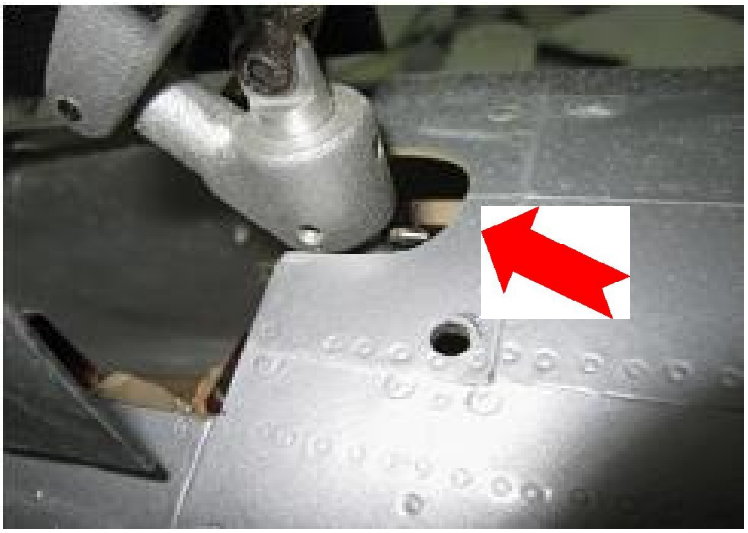
Recommended CARF accessories

1x # 370550 Mig-15 retract set
1x # 370600 Mig-15 Fuel Tank set
3x # 961100 Electronic 2-Way retract valve
1x # 961150 Electronic 1-Way brake valve
6x # 630530 Robart cylinder 3/8" no165

You should use at least a gyro on rudder, we recommend even to use a gyro on ailerons to make the plane “fly on rails”-performance, even in heavy winds.

1. Nose gear installation and nose gear doors

The front air intake duct and the nose gear formers are already pre-installed.
The nose gear unit is preassembled already. Still you might better take off the strut, so that you can mount and handle everything easier.
Fit the assembled nose gear unit into the fuselage. Mark the holes with a pencil.



Make the half round cutout for the strut, as shown in the folloing photos.

Drill the 5.5 mm holes and insert the T-nuts from the top.

Check the movement of the gear carefully, check the angles and, especially, the fit of the wheel inside the air intake, when retracted.

The cylinder of the retract unit will stick into the fuselage as shown. This gives easy access to the air nippels later.

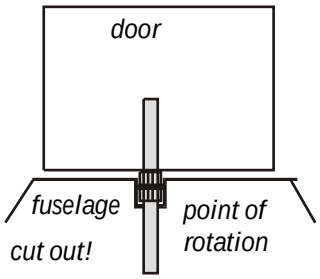
File a grove in the former to easyly slide the air nippel through.

Now cut the nose gear door in half, and check the fit in the gear door cutout.

Mark the position of the hinges atboth gear doors and fuselage.

Use a needle file to cut the cutouts for the hinges, and glue the hinges into the fuselage. Make sure the point of rotation is in the center of the fuselages cutout, approx 3 mm inside of the border. See drawing on the next page.

Be very careful with the CA glue on the hinges, as said before, it makes the plastic weak. Only apply glue to the hinge tips. The rest will be filled with epoxy, after the correct position is confirmed.



Finally, when the glue has set, move the gear doors and see if they lock anywhere. If so, sand carefully in this area, until they move smoothly.

Glue in the radio compartment floor and the top part of the rear nose gear formaer which will complete your RC Box. The front former can be glued in now, but if you decide to do a landing light, leave it out for now.

The gear door cypinders (we recommend Robart #165) are mounted to the front gear former. Determine the correct position of the mounting holes, and predrill these holes with a small drill bit.

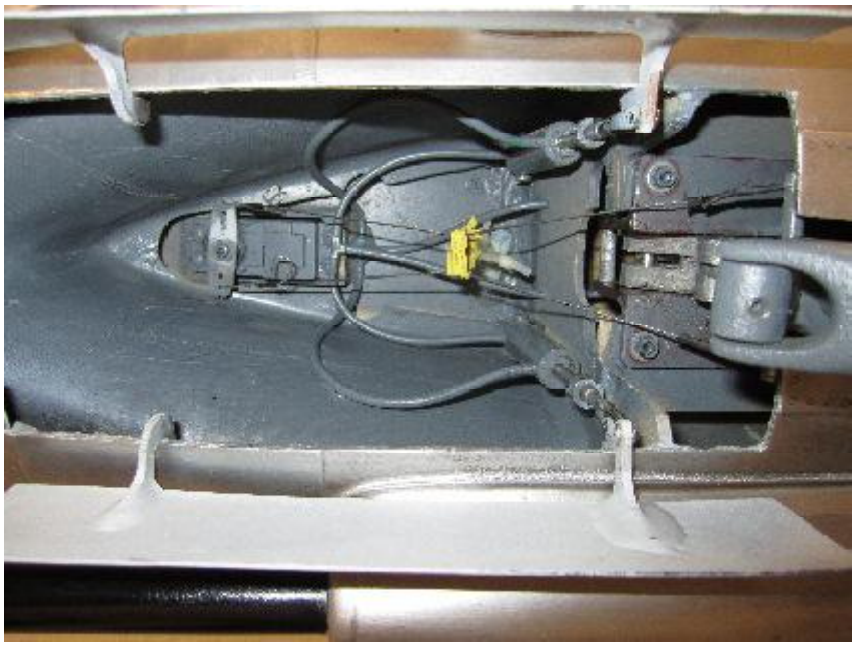
to dertermine the correct position, take the cylinder and extend it to full. Fix the control horn with a drop of CA to the gear door.

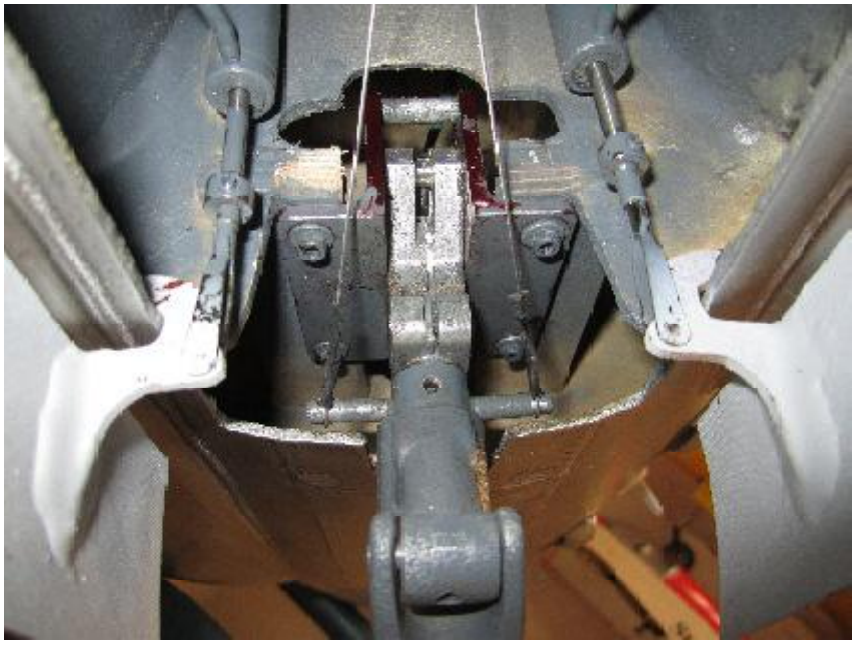
After you set the angle of the gear door to 90 deg. when opened, you got the right point where to fix the cylinder.

Mount the cylinders for both gear doors with 2 sheet metal screws each.

To adjust the correct closing block position use a 4mm collar on the piston rod. Make sure not to tighten the screw to much when testing to find the correct position to not damage the piston.

The nose gear steering servo gets mounted in the front edge corner of the nose gear compartment. The cutout in the former is already prepared.





As the nosegear will get it's steering connection with two pull-pull wires, the servo will have to be mounted at an angle, therfore a plywould block of 9mm should be glued under the rear mounting as shown in the previous picture.

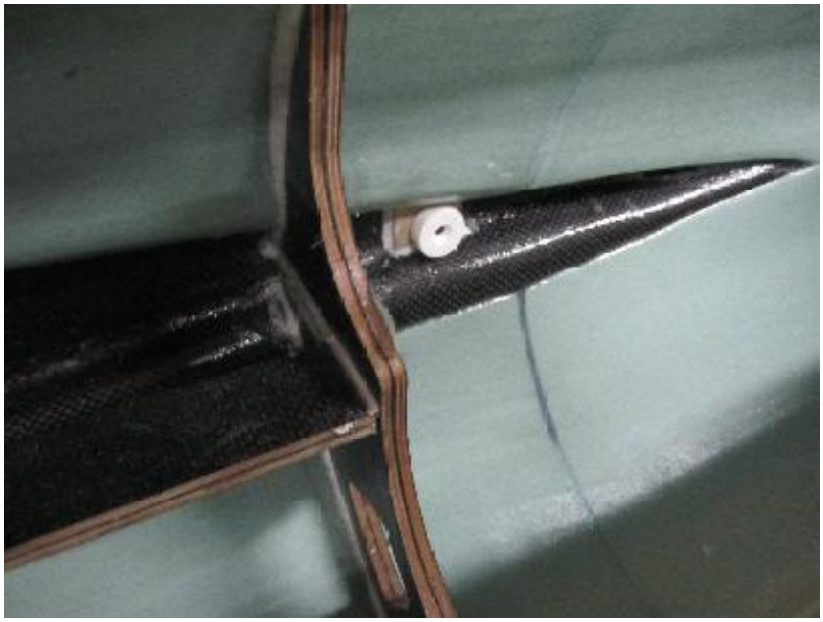
2. Ataching the wings to the fuselage

The wings are already allinged and the mounting is already installed in the factory.

Slide the carbon wing rods in the funselage sleves and then slide the wing on to doublecheck propper fit of the allingmet between Fuselage and wing.
If necessary, sand on the root rib sligtly to achief perfect fit.

The wing rods are slighly different in length, the longer ones go in the front, the shorter ones in the back.

Each wing gets secured to the fuselage with two plastic nuts as shown.



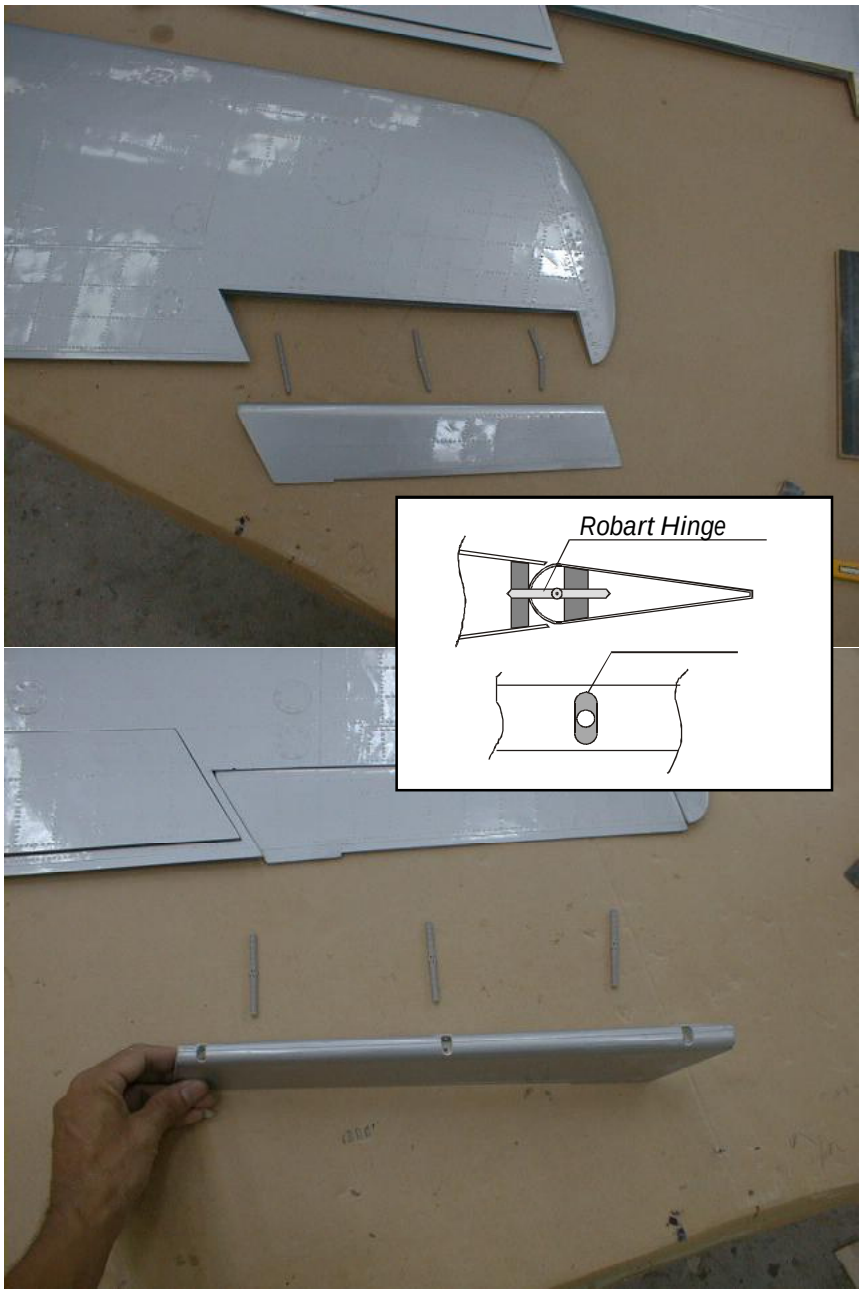
3. Installing ailerons and servos

Working Steps:

- install hinges and control horns to the ailerons
- install ailerons to the wings
- cut rear former of wings, install aileron servos and linkages.

You need:

- drill bit 5mm, round file, cutter, long phillips screw driver
- dremel milling tool, small pliers
- 5 minute epoxy (NO CA-Glue!!!)
- both wings and ailerons
- 6 Robart hinges, 2 small phenolic control horns, 2 servos
- servo installation hardware such as screws, extension servo lead, 2 pieces M3 all thread, 4 clevis and 4 M3 nuts.



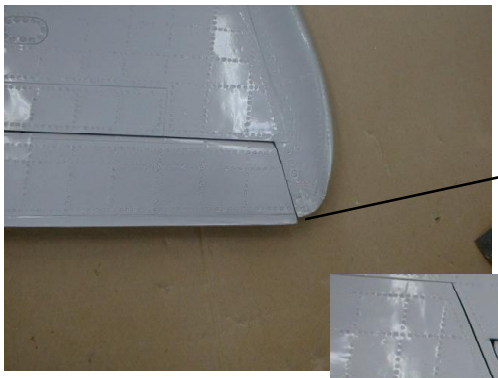
Installing the ailerons is an easy job, installing the servos is a little bit more delicate....

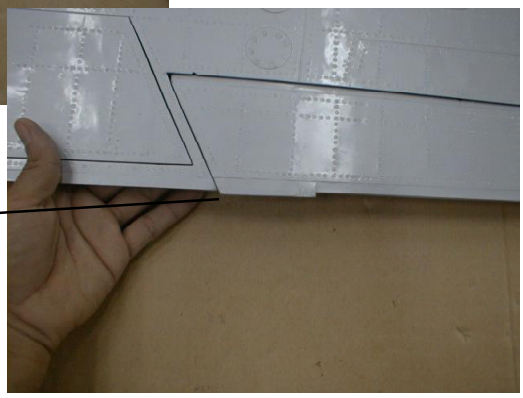
Every aileron is mounted with 3 Robart hinge pins. Drill 3 holes in each aileron, as seen on the bottom photo. Open the holes in the fiberglass to an oval shape, so that the hinges can move free.

Gue in the hinges in one line into the aileron. Use only 5 minute epoxy. See the drawing for the principal of the working hinge.

Make sure that you under-stand, that the point of rotation is NOT at the leading edge of the aileron, but in the center of the curved leading circle! So glue the hinges into the wood only.

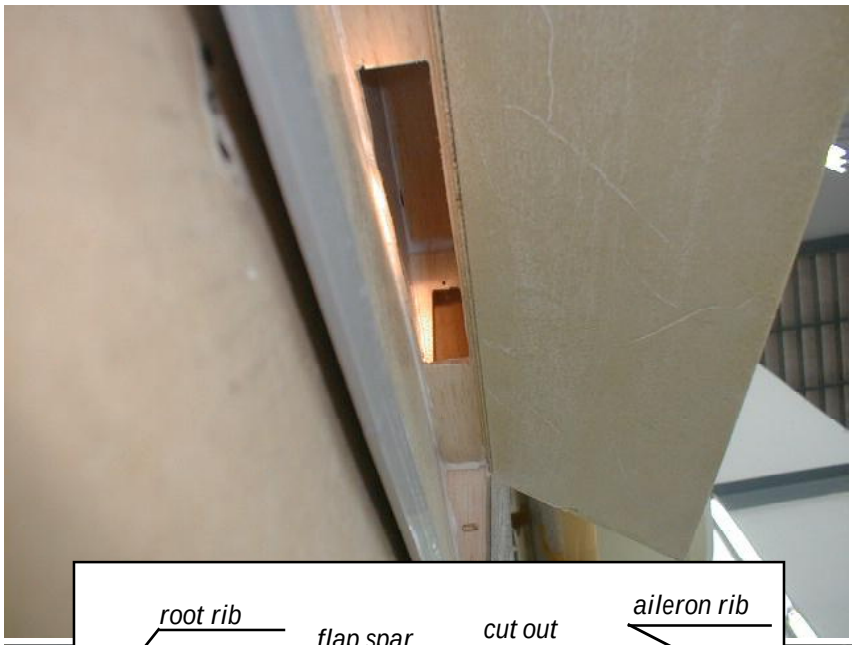
Tip for the Pro's:
In case of the MiG-15's swept back wing the hinges should not be mounted perpendicular to the leading edge of the aileron. They should be mounted parallel to the aileron's tip. Otherwise you will have a difficult time to insert the alileron into the wing. If you drill the holes and glue in the hinges parallel to the aileron tip this makes the assenbly much easier. Of course the axis of rotation of any hinge will not be in one line then, but the flexibility of the hinges and thereally small travel of the ailerons allow definitely to do it this way. So make sure that you drill all holes in the correct angle, in aileron AND wing.

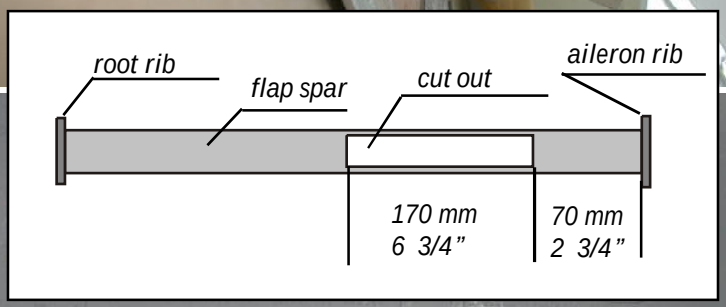




When you trial fit the ailerons to the wings please check on the photos left hand side. The trailing edge of the aileron steps back 3 mm from the wing tip, and the trailing edge then continues in one line to the trailing edge of the wing. The little trim tab on the aileron steps out of this line again about 3 mm.

Now cut a rectangular hole into the rear spar of each wing. See the drawing below for the exact dimensions. First, this hole is to mount the aileron servo, second, it allows to bring in the flap linkage easily.

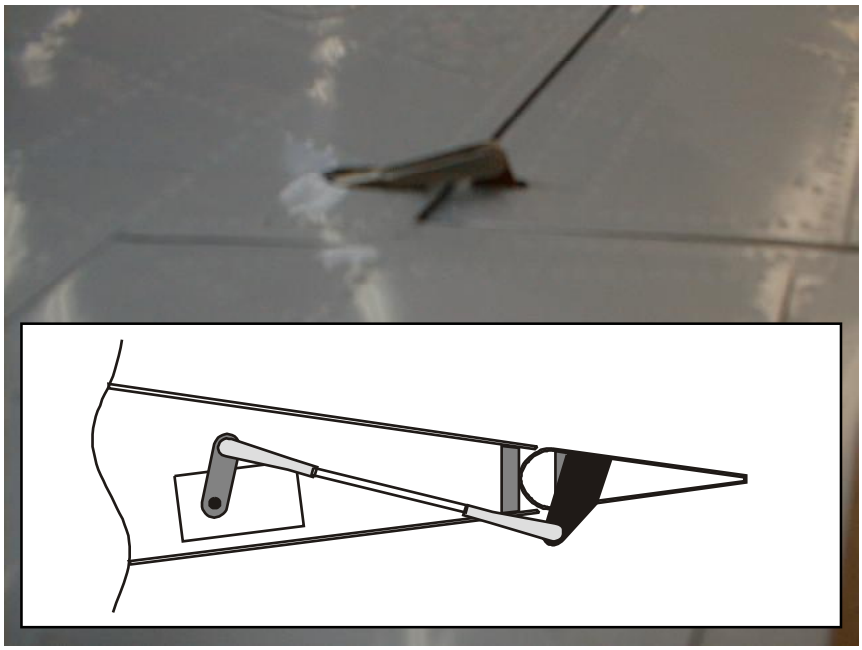




Through this hole you can see the servo mount for the aileron servo. It is designed for a standard size servo. The servo arm will have to be mounted to the top wing, slightly angled backwards, so that the linkage can go perpendicular from the control horn directed to the bottom surface of the wing. The aileron control horn is glued in from the bottom side, and you have to cut a slot for the linkage into the bottom wing skin, approx 25 mm (1”) in front of the aileron control horn.

But now mount the control horn first into both ailerons.

Mill a slot 2mm wide and approx. 10 mm long into the botton side of the ailerons, about 5-6 mm (1/4”) distance from the aileron root. Make sure NOT to cut the



top side of the ailerons. Then glue in the control horn with 5 minute epoxy, so that the hole is approx. 6-8mm above the aileron surface (1/4 - 3/8th"). Make sure the horn is placed exactly perpendicular to the axis of rotation.

Mounting the servo is a bit tricky. The servo is mounted reversed into the installed servo mount. Go ahead with the following steps:

1. Trial fit the servo into the mount. Mark the position of the servo horn on the servo mount rib. Then take the servo out again.

2. Now cut a 10-15 mm hand hole into the bottom wing skin, exactly where the servo horn is located. You will need this hand hole to snap on the clevis to the servo horn, when the servo is finally installed. this hole can be covered with a small piece of lithoplate aluminun later.

3. Make the linkage with the supplied M3 all thread. Adjust the length, so that it can accept an M3 clevis on both sides.

4. Slide the linkage through the slot in the bottom wing skin and snap it on to the control horn in the aileron. Then check the length and direction of the linkage inside the wing, whether it is matching up with the mark you set to the servo mount rib. If not matching, adjust the length of the linkage, and if necessary, the position of the slot. Use the hand hole to check visually the position of the clevis.

5. After all is confirmed, finally mount the servo into the rib. Snap on the linkage to the servo horn. (The shorter the horn, the better it is, as the control horn on the aileron is also very short)

6. Now use a long Phillips screwdriver (if not long enough available, extend one with a piece of brass- or carbon tube, to mount the servo screws. You should use a drop of CA glue to fix the screws on the screw driver, and then insert them into the hole and tighten them carefully. The servo wire will be long enough to work on it through the hole in the rear spar in the flap area, we suggest to extend the wire permanently by soldering, better than using a stock extension wire.

5. Installing Flaps and Servos

Working Steps:

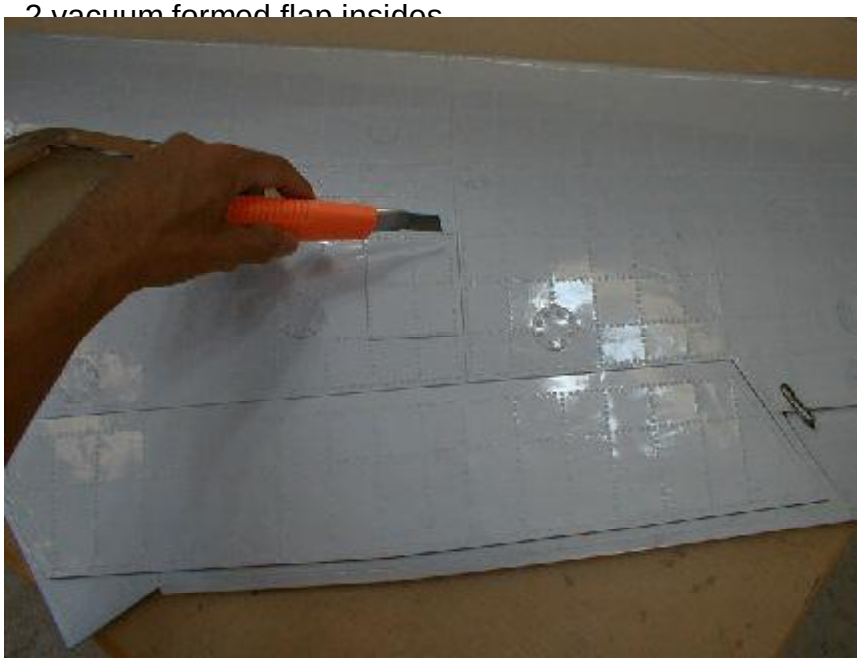
- cut flap servo hatch and mount servo
- install control horn and linkage
- install inner scale surface into the flap

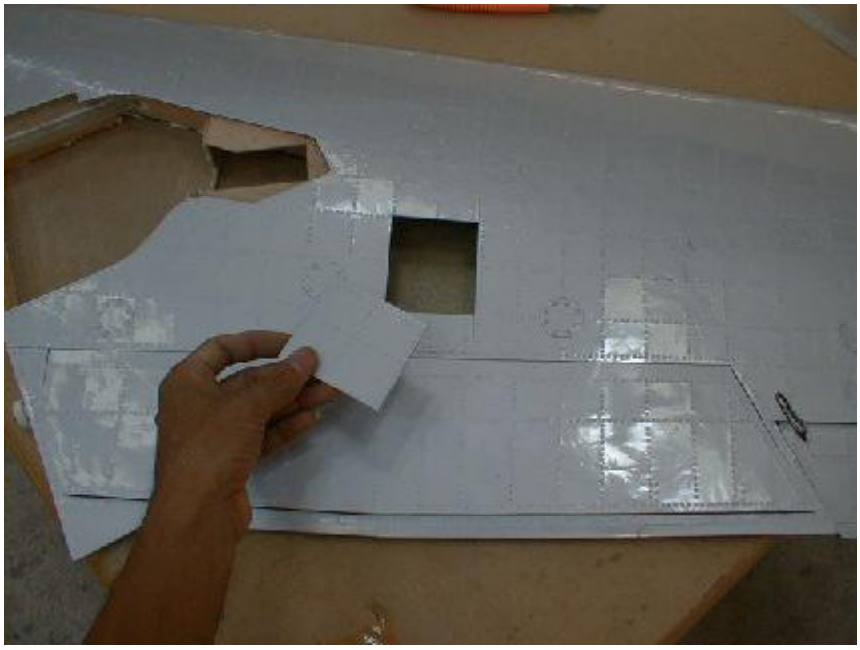
You need:

- cutter (X-Acto Knife), sand paper
- CA Glue, Epoxy glue
- your wings
- 2 control horns large, 2 all thread M3, 4 clevises, 4 nuts M3,
- 2 servos, 2 milled servo mounts, balsa reinforcement parts
- 2 vacuum formed flap insides

Your MiG-15's flaps are already precut and hinged with a special nylon elastic hinge. The flaps are stiff already, but will need some more rib and spar structure, especially to mount the scale inner surface plates. This gives a sophisticated scale impression on the plane on the ground, when the flaps are down.

Start with cutting the servo hatch. Locate the hatch in the center of the flap, and see the photos. Use panel lines as cutting line. The wing skin cuts easily with a cutter only.

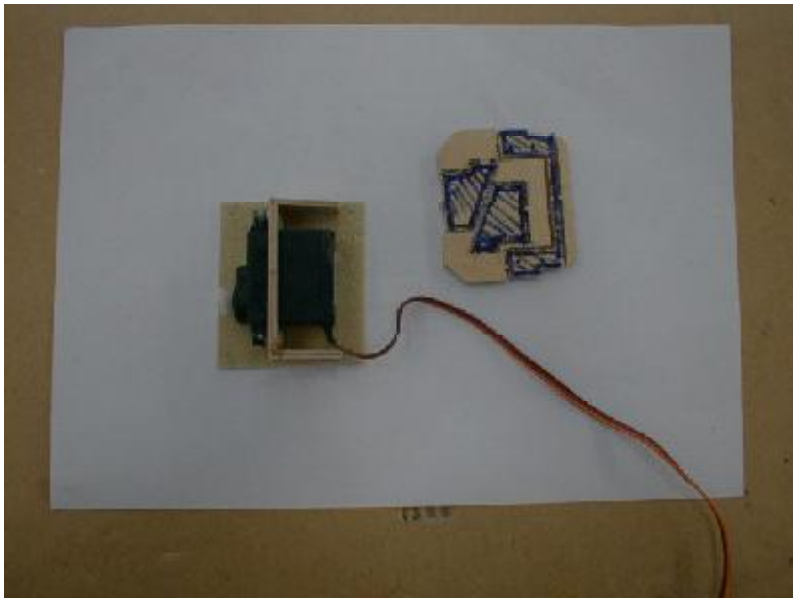




Tip for the Pro's:
The elastic hinge is a very common way to hinge any control surface, which has only throw to one side or the throw to the other side is at least not too much. Contest pattern planes, TOC-Planes, also gliders and F5-E composite wings have this kind of hinging. It is one of the most reliable methods to hinge any control surface.

Some important notes on the "Elastic Hinge" in General:
The hinge is set up as a layer of special "Perlon" cloth, which does not soak up resin during the laminating process. This cloth is embedded in 2 layers of fiberglass, so that the skin around the hinge is hard. To make the hinge flexible, both glass layers must be cut or broken, to achieve flexibility in exact the hinge point.

Done right, this kind of hinge is unbreakable, and it will take many thousands of deflections with no wear and tear. You should keep CA-Glue away from it, though.



Take out the hatch and assemble the servo mount. The photo shows, which parts to use. Make sure that you glue the milled wood parts very well to the hatch cover. Use CA glue first, and then fill excessively with epoxy and milled fiber to get a strong bond. To sand the surfaces with a rough sandpaper is mandatory and not further mentioned in this instruction book.

Then build a frame into the cutout in the wing, so that you can mount the hatch with 4 sheet metal screws. It will be sufficient if you use small plywood triangles and glue these 45 deg. into each corner of the cutout, so that the hatch can rest on the triangles. Make sure that the screws have a good grip in the wood, as there is a lot of load espcially on the flap servo. Mount the servo in the wood frame, using the standard servo screws.

Now assemble the balsa stick and the control horn inside the flap. You must understand, that the control horn must point 30 deg. forward, to have a symmetrical travel through the whole throw, especially to have enough holding power on the flap when fully extended.

Cut 3mm balsa triangles, using the vacuum formed pattern as a template, so that the “ribs” are not across the holes. then glue the vacuum formed pattern on the wood frame of square balsa spar and triangle balsa ribs. Make sure that the bond of the control horn is strong.

After that assemble the linkage with the M3 all thread and the clevises and nuts, and mount the servo in the socket. Connect the rod to control horn and servo horn, adjust the length and check the servo travel by moving the flap by hand up and down. You should have the full servo travel for 60 deg, of flap movement!
If necessary, use a shorter servo horn!

See the photos of a finished flap. If you install the vacuum formed sheet you should prepare it with the holes shown in the photos. The effect you get is 100% realistic. Us a few triangle balsa wood ribs to stiffen the vacuum formed sheet. But make sure that these ribs are placed in the areas between the holes.

The bottom photoshows the intermal construction of your wings, so that you will get a better understanding where everything has to be placed. It shows the landing gear mount and the rib, where to place the aileron servo.

5. bottom rudder and servo installation

Work Steps:

- Cut the hatch and shape the parts to fit the rudder
- install the rudder with Robart hinges and torsion linkage
- set up the servo linkage and mount the servo and hatch

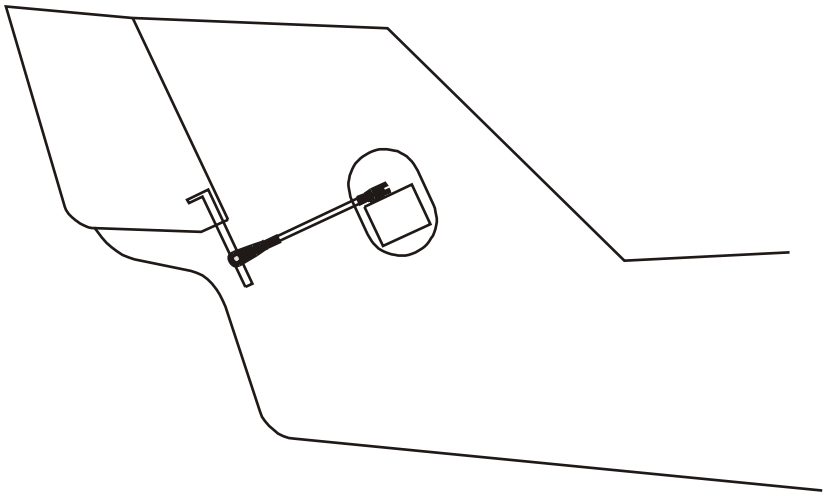
You need:

- cutter, dremel milling tool, round file, drill bit 5mm
- CA Glue, Epoxy glue with some milled fibre
- fuselage, one-piece-stab, bottom rudder
- milled rudder servo mount, 3 robart hinges, torsion linkage, 2 pushrods 2mm, 2 clevises M2, 2 threaded ends M2, rudder servo, extension servo lead, 2 sheet metal screws

Your MiG-15 has only the bottom rudder working. the top rudder is fixed. This simplifies the system very much, and at the same time reduces the chances of flutter. The one bottom rudder is very efficient, so that you would never feel the need for the top rudder working as well.

Start with cutting the servo hatch. both sides of the rudder fin shows a hatch in the center. Whichever one you pick, is up to you. Cut one hatch out with an X-Acto knife.

At that time you can install already the frame, to mount the hatch lateron. 2 scrap pieces of thin plywood do the job, just glued in on the top and bottom radius of the hand hole. Use 2 sheet metal screws, one each at the top and bottom radius to fix the hatch.



You will have to cut some areas of the rudder fin and the one-piece-stab to accept the rounded leading edge of the rudder. These cutouts could not be molded in for production reasons.

Cut both parts according to the photos, assemble the parts to confirm sufficient clearance, so that the rudder can move without hitting any other part. Better make these cutouts too big rather than too small.

Now install the Robart hinges into the rudder. You have done this with the ailerons successfully, so go ahead and do the same thing with the rudder now.

As the rudder is wider, the slots, which give the hinges clearance to move, must be longer as well.

To recall, drill the holes with a 5 mm drill bit, open the holes in the fiberglass with a small round file to ret oval slots, and insert the hinges with epoxy glue. (Do NOT use CA glue!!!)

Then make the cutout for the torsion linkage. This linkage is inserted from the front, so cut the leading edge of the rudder accordingly to the shape of the torsion linkage. Mill a 2 mm wide slot in the wood spar of the rudder, and insert the torsion linkage with plenty of epoxy glue. See dimensions given in the photo.

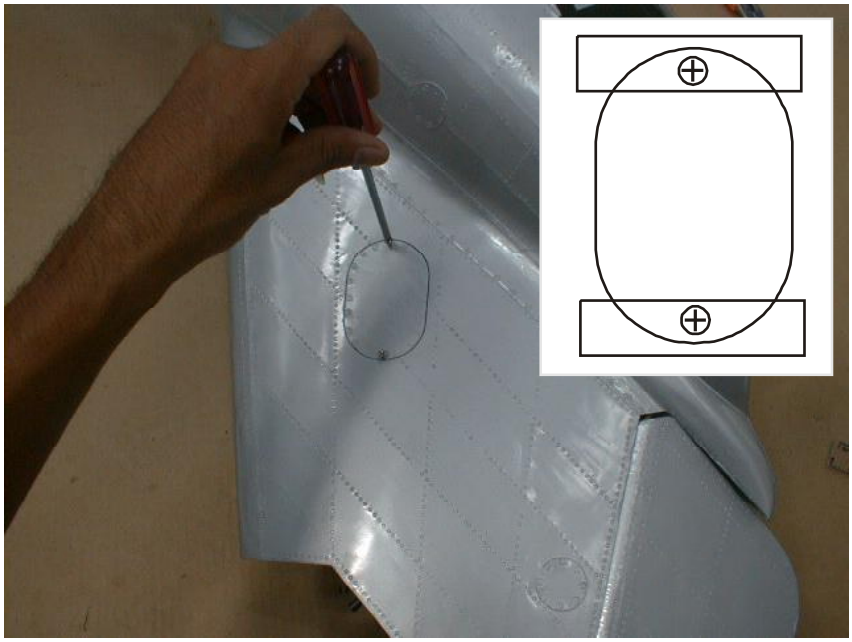
The rudder servo is mounted upside down in the rudder fin. Place the servo mount (3mm milled plywood) in the fin. Make sure that the rudder linkage can connect the torsion linkage of the rudder and the servo horn in a straight line and perpendicular to the rudders axis of rotation. This essential need gives you the right position for the servo mount.

Glue this servo mount in with eloxy and milled fibre.

You can insert and mount the rudder servo through the side hatch, and tighten the servo screws through the fuselage from the bottom side.

Make up the linkages with the correct length. Solder the threaded ends to the 2 mm push rod and connect turn the push rods about
1/4 “ into the plastic ball links of the torsion linkage. Now install the servo finally.

The bottom photo shows a version which does not call for a soldering iron... you can also Z-crimp the ends of the pushrods and connect them to the servo horn by this method. Adjustment is still given by the plastic ball links.



These photos show, where to cut or drill the holes for the linkage to pass the rudder post. These holes should be fairly large, so that the linkage does not bend ot lock at any position.

When all is done and adjusted, drill the holes for the hinges into the rudder post of the fuselage and insert the rudder by applying epoxy glue to the hinges.

After the glue has cured, finally install the linkage and confirn the free movement to both sides.

Tip for the Pro's:
This type of linkage is basically a pull pull set up. the only difference is that not flexible wires, but 2mm pushrods are used. So, it could also be a push/push linkage, which can build up a very strong tension in the system, if not done right. To set this type of linkage up properly you have to adjust the length of both pushrods exactly, before you install the servo horn to the servo. If all is tension free, the servo horn will slide on the servo axle easily, after the whole linkage is set up. Last thing is then to put in and tighten the center screw. You might use some thread locker to make sure that the screw doesn't come loose.

Do not make a support at the bottom end of the torsion linkage, as the angles of the 2 pushrods are not exactly parallel, and it would build up a very dangerous tension at maximum travel, if the rudder torsion linkage didn't have a slight flexibility. There is no one-way-load on the bottom point of the torsion linkage, as all force pulling on the one side, the same force is pushing in the opposite direction on the other side.

7. Elevator and Top Rudder

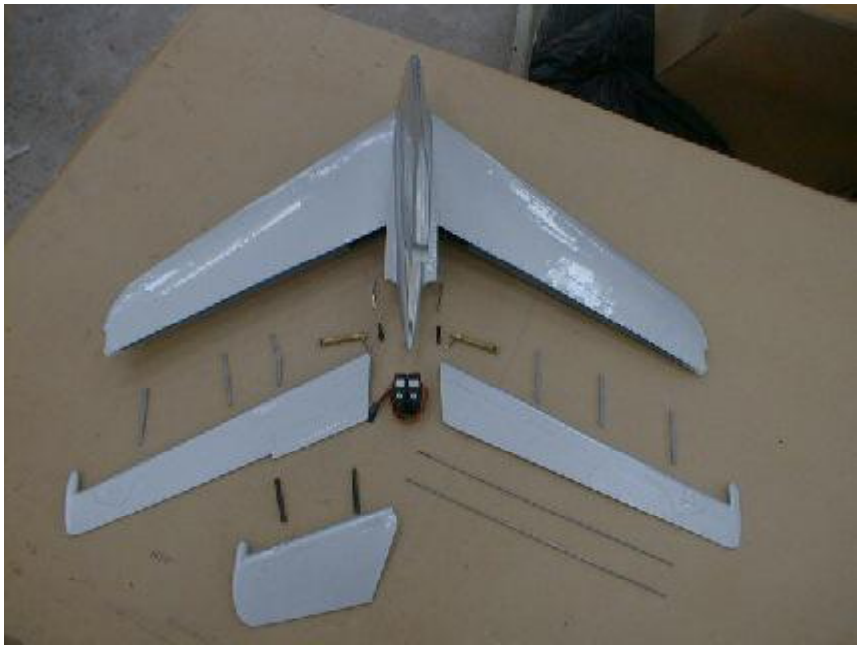
Work Steps:

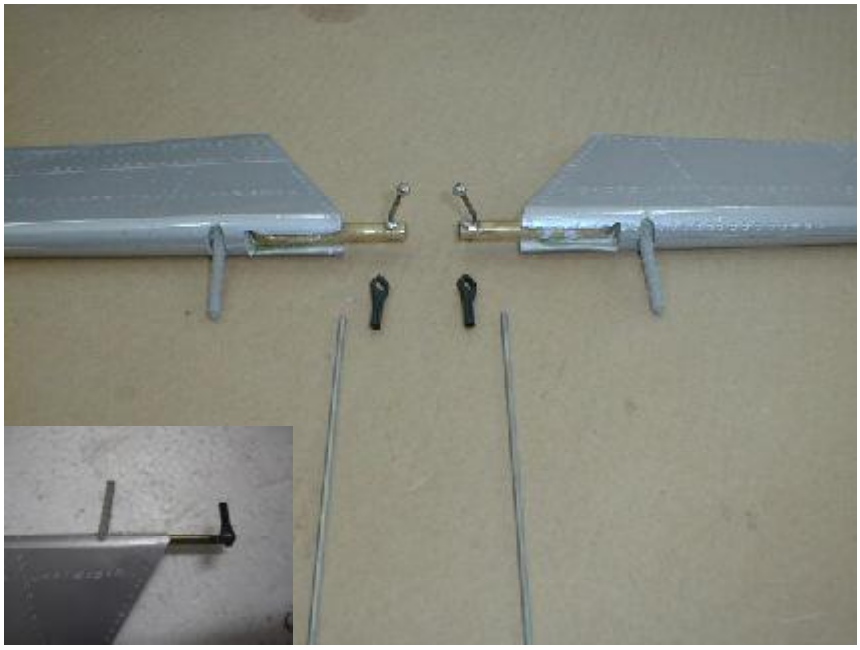
- install the hinges and torsion linkage in the elevator
- install the elevator servos and set up the linkage
- glue elevator in and glue in the fixed part of rudder

The elevator servos are hooked to a hidden torsion linkage, which does not interfere with any scale ambitions in regards to static judging. This torsion linkage is glued into the elevator controls.

You need:

- 5 mm drill bit, dremel milling tool, philips screw driver
  small pliers, small round file, sand paper
- epoxy glue, CA-Glue
- one-piece-stab, both elevators, top rudder
- 2 torsion linkages, 6 hinges, 2 carbon dowels, M2 push rods,
  2 clevises M2, 2 threaded ends M2, 2 elevator mini servos





Start with mounting this torsion linkage and the Robart hinge pins into the elevators. You did the same thing with the rudder already, so follow these steps accordingly again.

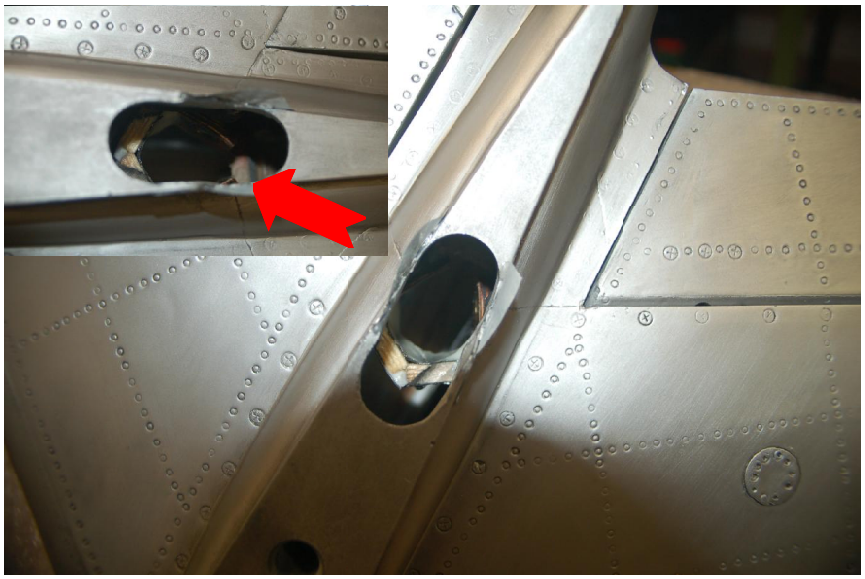
Drill the holes in the spars of the one-piece-stab and trial mount the elevators to the stab. Use the same directions as given on the aileron mount, resp. the angle of the hinges, so that you can assemble the elevators and the stab due to the swept back shape. After that cut the center hole as shown in the drawing, to have access to the servo area inside the stab.

Move the elevators carfully, and look inside to se whether the balls of the torsion linkage hit the fiberglass somewhere. You might have to bend the steel arm of the torsion linkage slightly to manage a smooth travel.

Inside the stab there is a vertical spar. There are premilled holes inside, which size might have to be enlarged, so that the linkage can be put through.

Now install the servos with short servo arms into the servo mount. You will have to make sure that the servo arms do not hit the fiberglass. It is very tight inside, and it might afford several attempts to install servos and linkages so that everyting moves smoothly.

After the linkage is set up with ball links, push rods, threaded ends and clevises in the right length, assemble everything again and confirm. After that take out the elevators again and apply epoxy glue to the hinges, and glue them in permanently.



To reduce the play and the risk of a flutter it is recomended to additionally hinge the torsion rods in the center. Use a 3mm plywood pice for this and drill a 6.1mm hole in where the torsion rods are hinged in. Glue this pice against the stab spar.

The top rudder part is fixed mounted to the fin. Drill two 6mm holes in each rudder and fin, and glue the carbon dowels in. Then join the 2 parts and glue permanently with epoxy.

Tip for the Pro's:
Whenever you finally mount a servo into a difficult accessible area, make sure that the servo arm is properly centered. Therefore connect the servo to a receiver and center th servo electronically. Adjust the servo arm perpendicluar to the linkage direction, and then mount the servo finally.

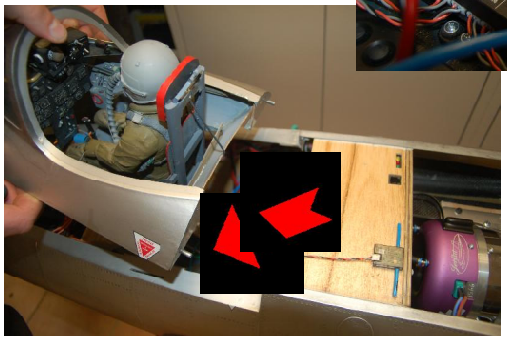
If you don't do that, you might have a bad surprise after you hooked up your radio system. When the servo arms are out of center, you will have to take out the servo again, which is a very painful job, if everything else is finished already. Think smart in advance!!

7. Fuselage hatches

Start with fitting the rear hatch to the fuselage. Sand the rear end of the hatch and the fillet of the rudder fin so that everything fits nicely. Do not worry to sand off some material in the vertical frame areas, especially rounding corners, the fiberglass is thick enough in these areas.

Also the little corners of the steps in the center area of the hatch need to be sanded slightly, so that the hatch gets a clean and proper fit.

This rear hatch now gets glued on the fuselage permanently. Use 30-min Epoxy and milled fiber for the glue joint.

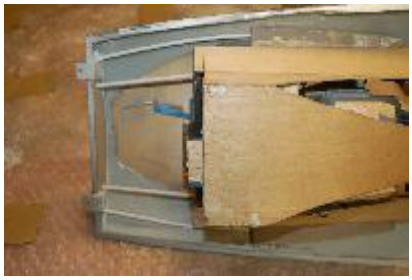


The hatch with the cockpit gets 2 6mm carbon dowels in the back and gets screwd on a 3mm plywood support with 2 L-Shape alluminium brackets in the front. This part is the one which usually does not need to be taken off once the plane is put together at the airfield.

On the picture you already see the piano wires which lock the center hatch covering the engine area.

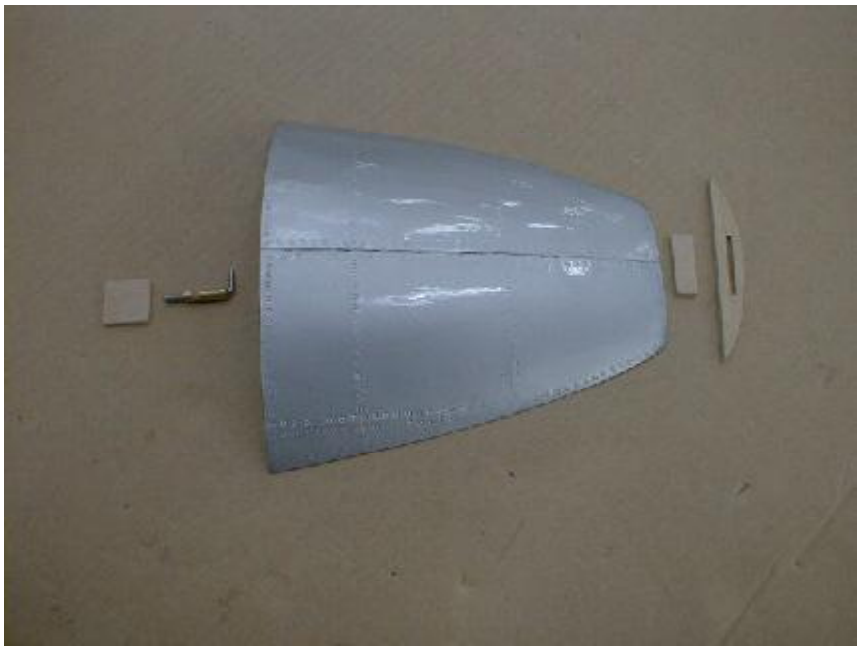
The center hatch which covers the engine is locked by two piano wires running all the way from the small hatch at the nose into the rear hatch which we permanently glued on in an earlier stage.
The piano wire runs through the white 2mm ID plastic tubing.

It is recomended to glue the plastic support rails to the hatches on various points for support. You do not need to glue them all the way through.



To allow a smooth opperation make sure not to bend the pin-line more then absolutely necessary. The more it is bend the harder the pins will slide through later.

The nose hatch needs to be cut as shown in the rear to give the clearance for the piano-pins that hold the center engine hatch.

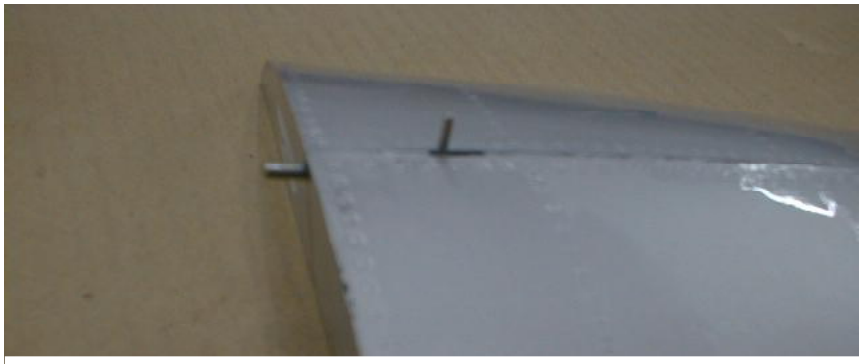


The nose hatch is a small challenge only. The 3 milled plywood parts have to be glued in place Also glue in the hatch latch. Make sure that the slot for the latch is long enough, so that you can release the hatch easily. The pin must disappear in the hole completely, when you pull it back.

As a helpful hint, you might drill the hole for the hatch latch pin when all is taped on the fuselage. So you can make sure that the wholes are alligned perfectly.

To do this, you will have to cut out the canopy before finishing this step. We explain this on the next page.

Doing this, you can insert a dremel through the canopy cutouts and drill the hole for the pin through all in one time.



Check the proper fit of the hatch, and make sure that it is removable without locking or hitting.

This is your only real quick access hatch for any switches or connectors, which you might need at the field to start up your engine or check radio and landing gear. For more access to the components you will have to unscrew the large hatch.

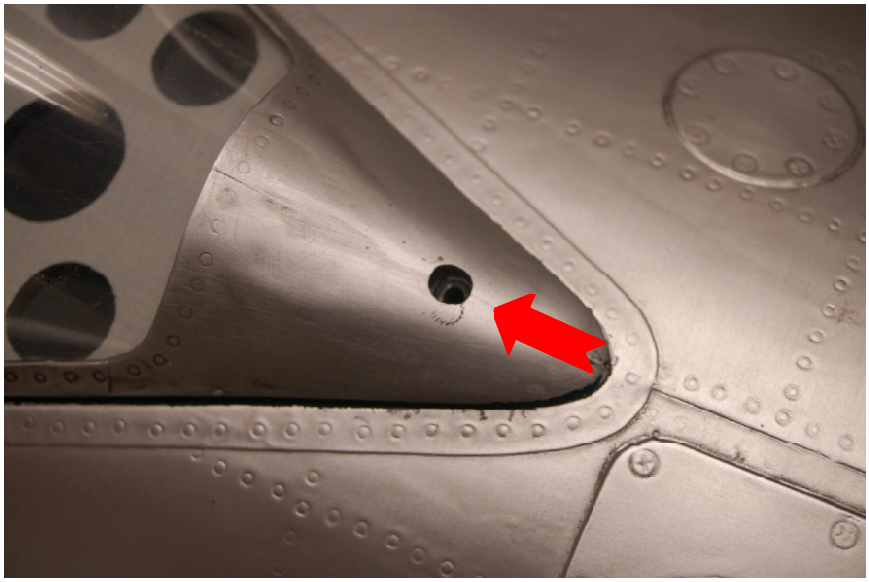
if you do not want to show the canopy hatch latch as discribed above but rather want the nose hatch latch to be invisible as well, you can do it the sane way as we did the center hatch usuing the piano wires and plastic tubing. In this case, to lock an unlock the hatch you slide the pins inside the cockpit as shown in the 4 bottom pictures.

Cutting out the canopy works best with a very sharp X-Acto knife. The layup in this area is very thin, so be careful not to cut into the frames.

After cutting out the windows roughly, use rounded file and sand paper sticks to finish the cutting borders.

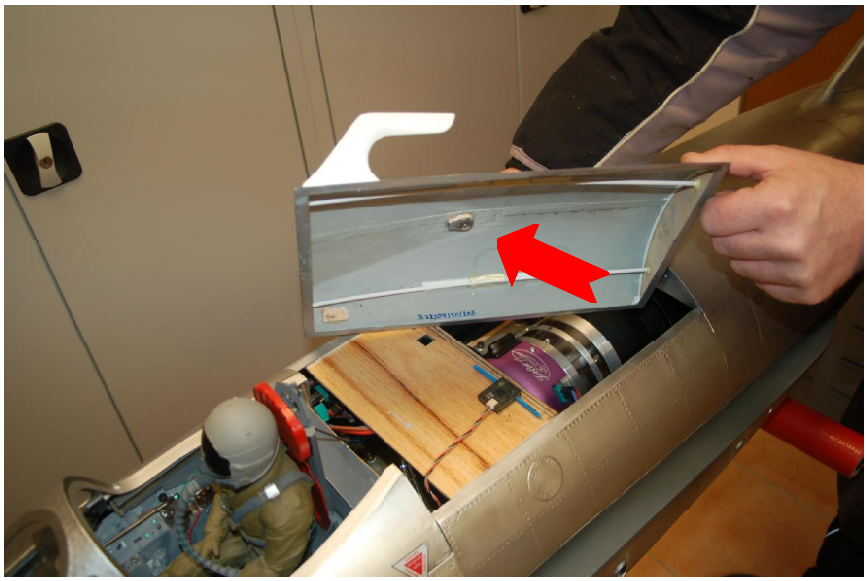
After that cut out the clear canopy. We still believe that the best way to do it is to use sharp scissors. To avoid cracking of the canopy you maywarm up a little.

After cutting the canopy roughly put it into the canopy frame from the inside. Now you can determine the exact cutting lines, to make a perfect fit



Aso the rear wood support plate and little detailing can be glued in at this stage.

The canopy frame gets 2 piano wire pins in the front edge corners and gets secured with an M3 screw at the back.



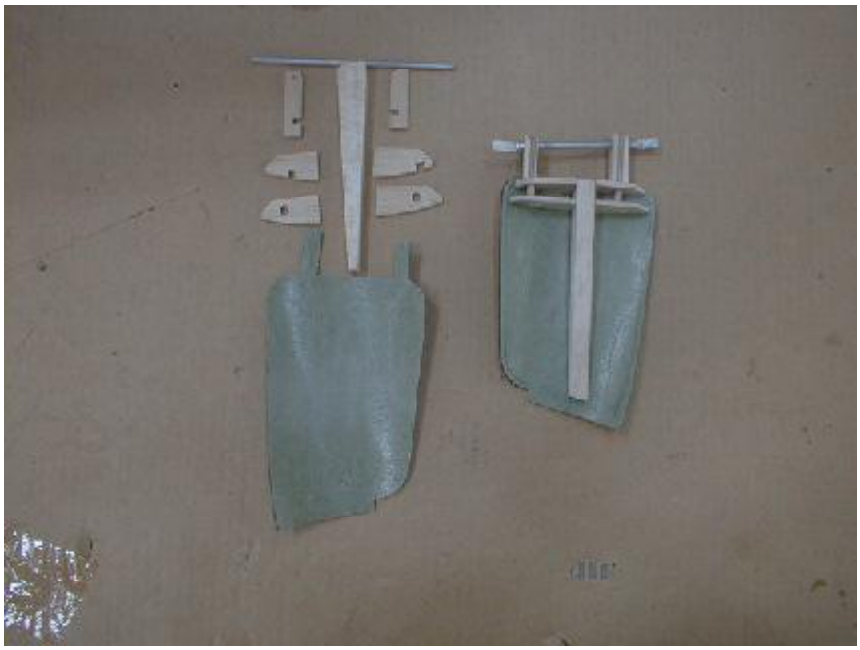
Therefor a blinde nut gets glued into the center hatch with a pice of scrap balsa or plywood.

8. Speed brake doors

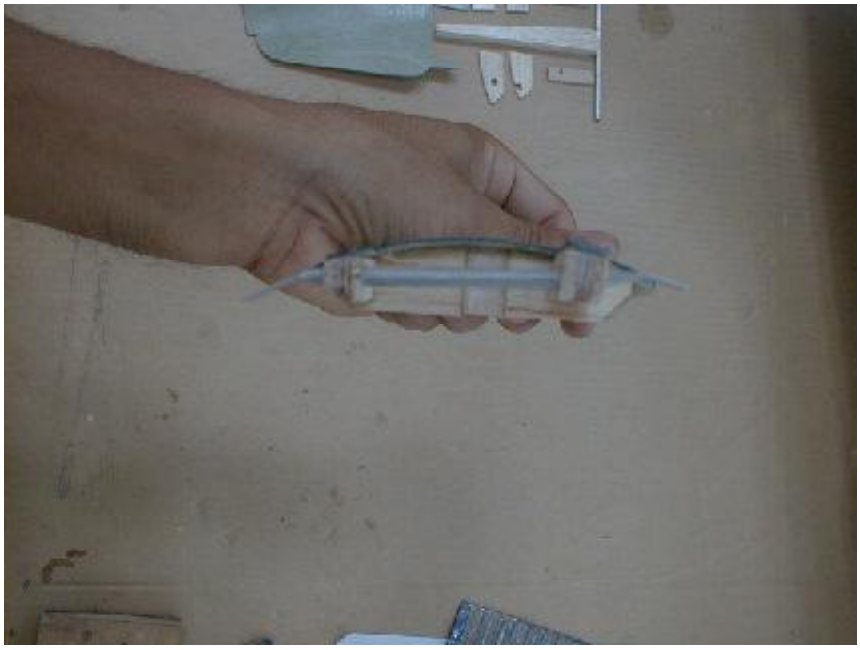
If you do not want to operate the speed brake doors in flight, you can skip this whole chapter 8.
But a plane that scale should definitely have the speed brake doors working, and they are very efficient too.
They work more neutral than the flaps, and for that reason they are highly recommended!

This is again a working step demanding a good amount of skills and
PATIENCE.

First, cut out the 2 speed brake doors at the rear end of the fuselage. You can determine the shape by checking the panel lines. They are correct and do not need any further modification. After you cut out the doors, sand the cut slightly, and make sure that your cut is not too wide. That's why we recommend to use a cutter blade only. Do not use any electric milling tools at that stage.



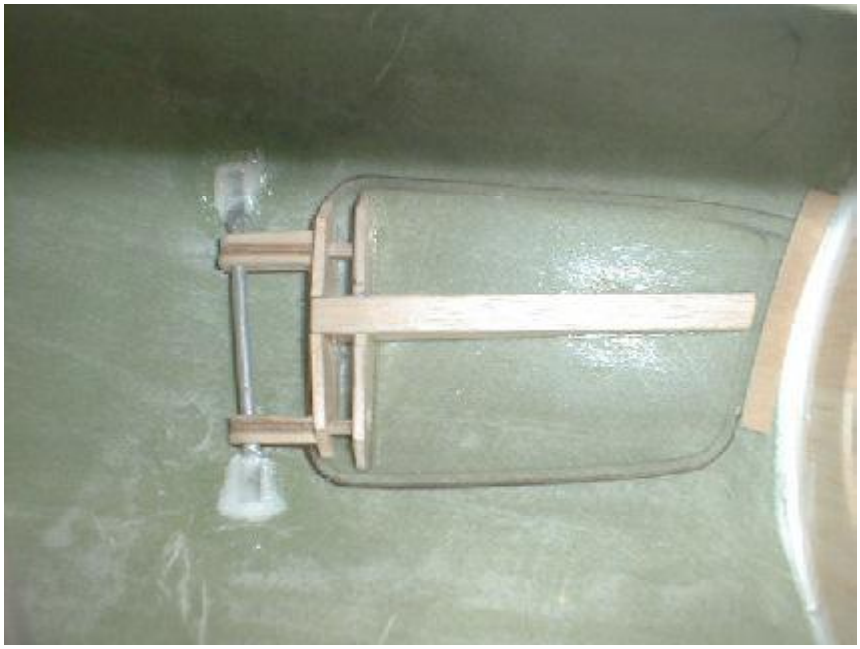
Make yourself confident with the parts. All items are supplied with the kit. The photo on the left shows a set of parts and an assembled speed brake door.



The next photo explains, how the axle has to be placed. Basically it is a 4 mm aluminum tube, with flat ends, curved according to the fuselage's shape. So, slide the tube through the holes in the ply mounts and shorten, crimp and bend it as needed.

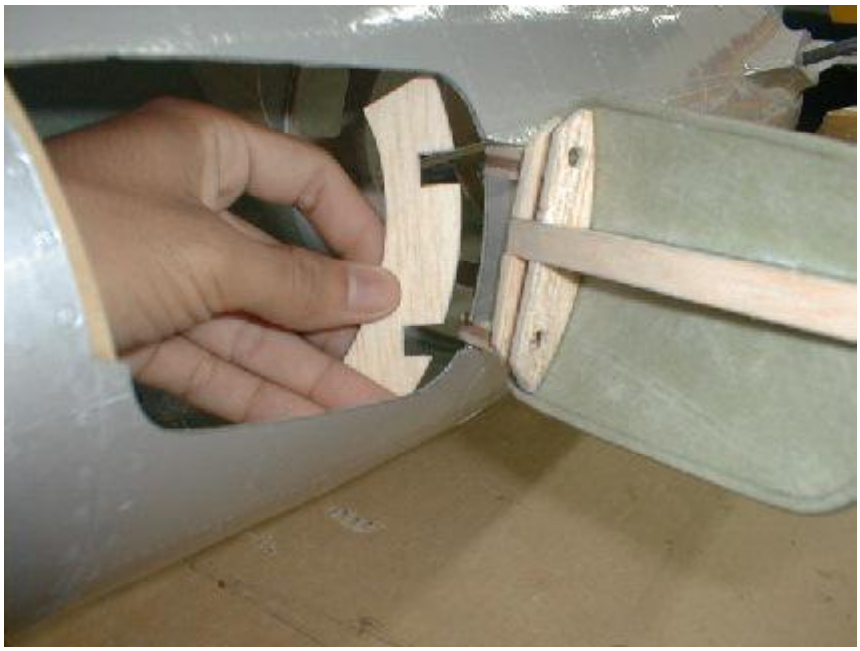
Fix the whole unit in the fuselage, using only a few drops of thick CA glue.

After you confirmed the movement is alright you glue all with epoxy and milled fibre. To reinforce the bond you should additionally cover the bond with some scrap pieces of fiberglass.



If necessary, you can now sand the corners and edges slightly. Especially in the hinge area you might have to remove some more material, to make the door moving without locking in this area.

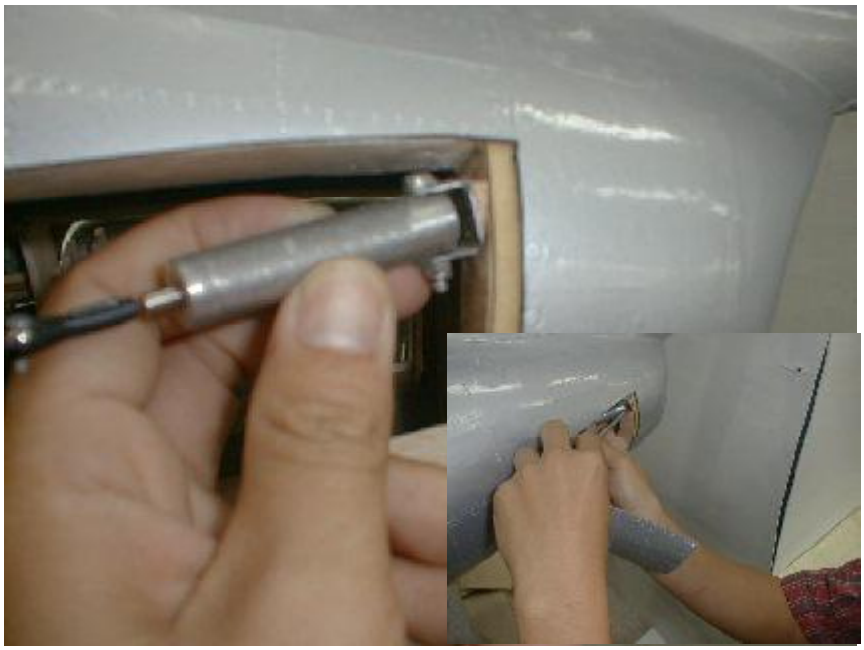
After all is set, glue a small strip of 0.8 mm plywood inside the fuselage, at the rear end of the speed brake door, as shown in the photo.



Next step is to frame the inside of the speedbrake doors. Milled balsa parts are supplied with the kit. Follow the photos to install these frames in the fuselage.

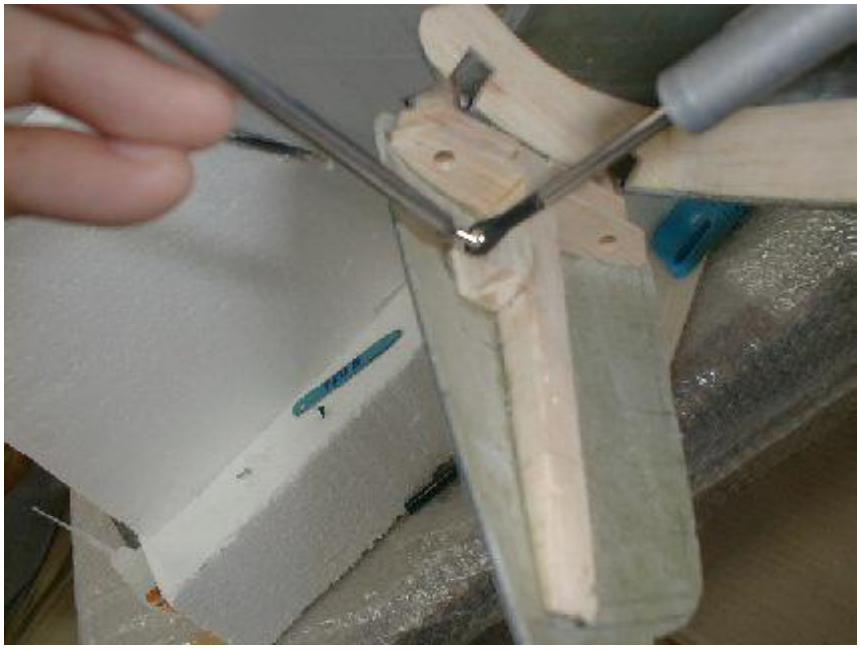
At this stage, do not glue in the inner cover. Leave the area open, until the air cylinder and further detailing are installed in the door setup.

Use CA glue to glue the frame in. You might have to reshape the parts slightly. Make sure that the frame does not put any tension on the fuselages skin in this area, so that the speed brake door closes smoothly without any gap.



Now install the air cylinder for the speed brakes.

Locate the position in the top rear corner of the frame. Reinforce this area with thin plywood from the back side, and mount the cylinder with sheet metal screws. Note, that the cylinder is pointed a little bit downwards, so you will have to use a little balsa wood triangle as a spacer.



In general, the sloppier this mount is, the better it will work. Don't worry about clearance in this mount, as the cylinder also must move slightly up and down, not only in and out.

Install the ball link to the push rod, and adjust and confirm the correct length.

The speed brakes should open approx 45 deg. So you determine the fix point where to mount the ball of the ball link inside the door. Reinforce this area with another balsa block and mount the ball with a small sheet metal screws.

After the movement is confirmed, harden the area where the ball is mounted with thin CA glue.

See the bottom photo for further reference.

Further detailing is left up to you. We recommend at least cover the frame with the 0.8 mm plywood sheet.

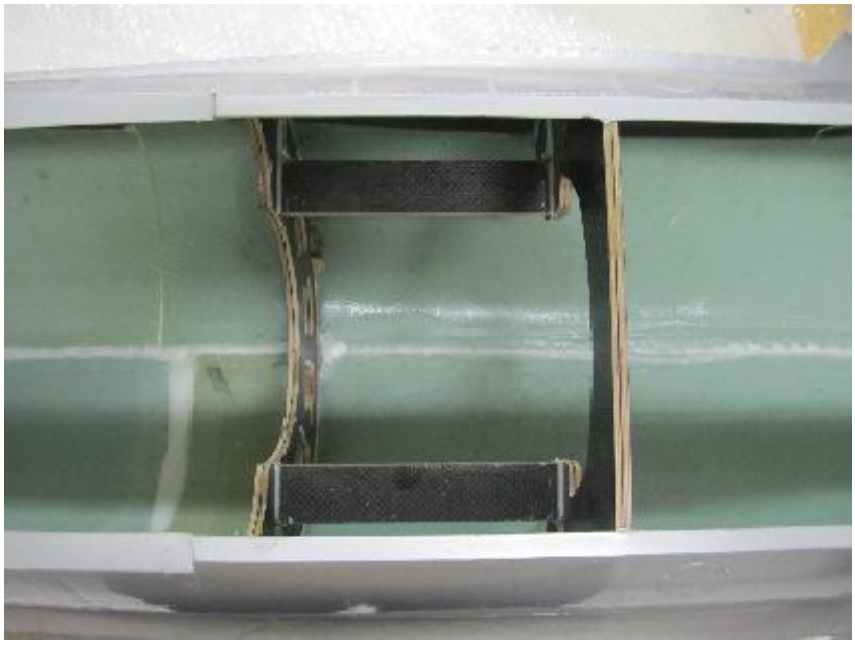
See the photo for further detailing of the inside of the speed brake door. This detailing is basically a very thin frame of plywood, 3 mm (1/8th") high, and then filled with 2 additional ribs, which you can cut from 3mm balsa.

Use primer to fill the balsa, and build up a good base coat for a later painting.

Glue the thin plywood from the inside against the frame. Use CA glue. After that you can fit the vacuum formed detail in the frame and glue it to the plywood backplate.

The movement of the speed brake door is done by an air cylinder. Although you might think that the setup and angle of the cylinder is correct, as all moves smothly when you move by hand, try to apply pressure air to the cylinder, and double check whether all moves as smoothly when the cylinder does it's job. It might be different. So you might have to sand a little more on the contours of the speed brake door, and you moght have to change the mounting points of the cylinder slightly. This is why we recommend to permanently fix everything AFTER you tested the movement with air!

9. Engine installation



First of all, we show the installation of a JetCat P-120SX.
If you use other engine brands, go ahead. Any engine between 8.5 and 12 kg of thrust will do fine.

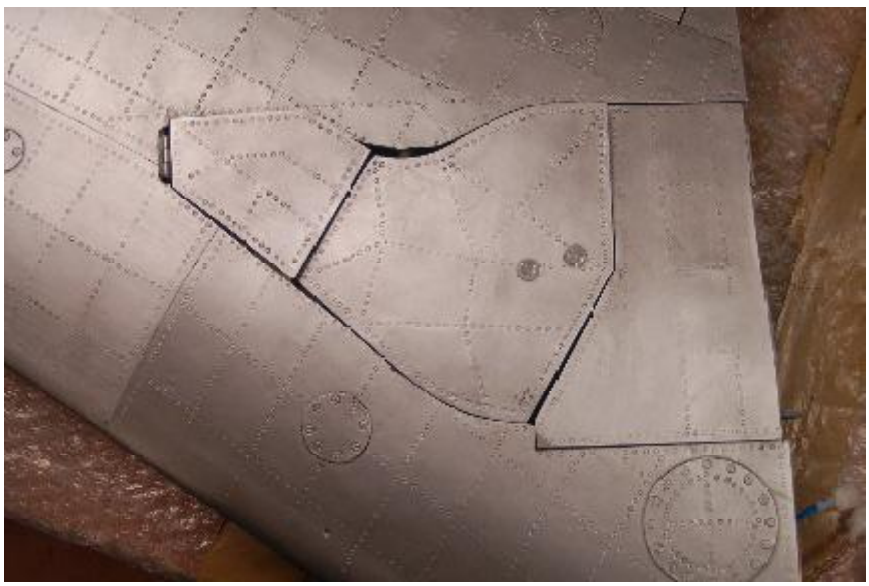
We do not mention the installation of the additional components such as fuel pump, gas tank, valves, and so on, as any engine requires different accessories.
Whenever the pictures will give you an idea of where it might makes sence to install certain components.
CG-matters might require to move these components around in the fuselage, so we recommend to install these as the very last.
The Enging Mounting rails are already pre-installed, so the position for the Engine is given by that position. Installation of the engine be a natural thing, too. It mounts on the preinstalled rails, by using the supplied M4 x 16 screws and M4 T-nuts.
Assemble the ducting first. Glue the rear cone into the bottom duct (the one with the mounting brackets molded in). Mount the stainless thrust tube to the rear end of the cone, and slide the whole unit into the fuselage. Rear end of the thrust tube is held by the rear former. Install a plywood piece in the rear end of the fuselage, to mount the outer aluminum tube to with just one sheet metal screw. Basically the tube is held by the mounting screws to the carbon cone in the front. This rear fixture is just for avoiding the aluminum tube to slide out.

Check allignment!

10. Main Gear & Doors

Work steps:

- fit the gear units into the mounts
- install struts, brakes and wheels
- mount the gear with each 4 M4 screws
- install the support air cylinder
- install small outer gear door and linkage
- install main gear door to the gear strut
- detail with vacuum formed sheets
- install inner gear door to fuselage
- install detailing
- build cylinder mounts and install gear door cylinders

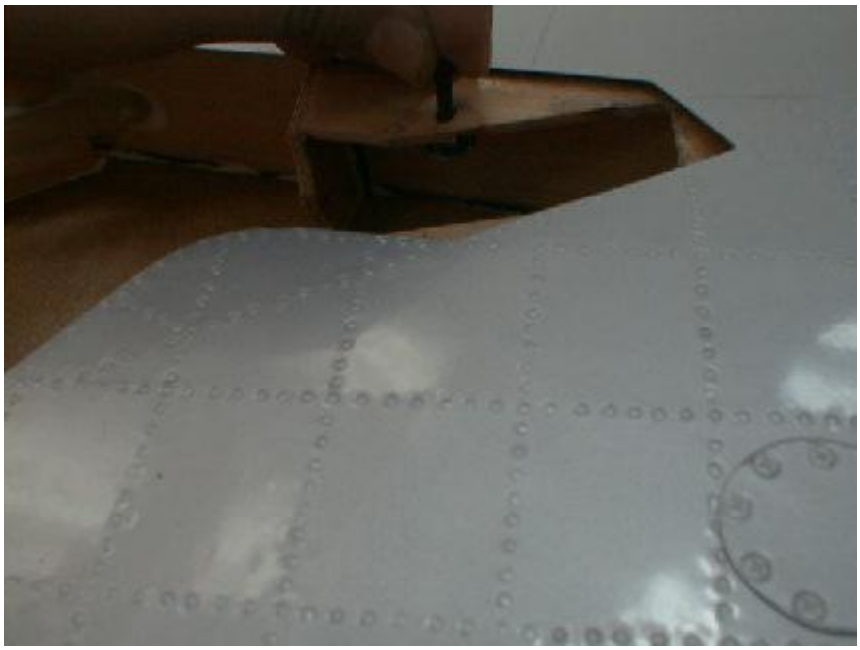


If everything went well up to that state of construction, you finally reached the most challenging point right now. It took us months to determine the correct angles of the landing gear mounts, struts, wheels and all, and still some work is left up to you, as manufacturing tolerances do not allow to preset everything.

There is still a slight amount of “try and error’ to be figured out, and the gear units might have to be supported by thin plywood sheets, acting as spacers and angle adjusters, down to the thickness of thin cardboard, even this can make a difference whether the angles will work out or not.

So please accept, that we will have to ask you for patience again, but hopefully the last time, to set everything right. Do not expect it to be done in a sunday afternoon. It takes more time to do it right, but the result is a very strong, reliable gear system, which is 100% scale in outfit and function.

Also the gear doors are detailed inside and outside as the original ones, and give the plane the 100% authentic look on the ground.

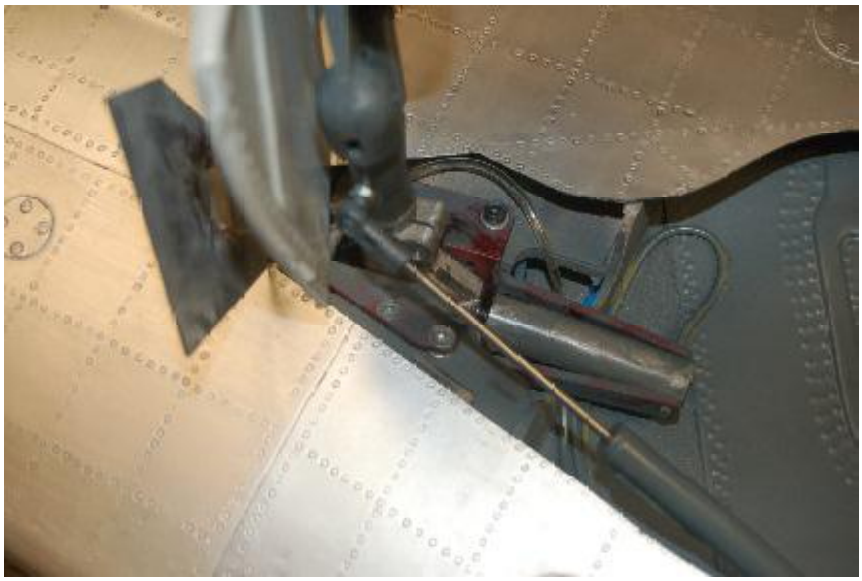


Let’s get started with mounting the gear units. Cut out the gear cutout in the former approx. 10 mm further. (first production run kits only!). Slide the unit in, and see where to girnd off the plywood support rib, to fit the cylinder perfectly.

The cutout in this rib is very small on purpose. Otherwise it could not inserted straight when we assemble the wood parts before joining the molds. It is up to you and your dremel now, within a few minutes to enlarge the cutout to fit the gear perfectly.

After that trial mount the strut and check where else you need to take off some plywood in the mount area.

After that take out the unit again and glue in the rectagular plywood reinforce-ments from the bottom side of the mounting platform, about where the screws will hold the flanges of the gear unit. This means, you double up the thickness of the plywood in that area, to give the T-nuts some more materials to hold in.



Before you finally drill the holes, assemble the gear with strut, wheels and brakes, and check how it fits in the gear wells. If necessary, you might have to grind the cutout in the mounting platform another few milimeters, and move the gear slightly more out.

After it is confirmed that the gear fits the gear well, mark the position of the holes for the mounting screws with a pencil, and take the gear out.

Then drill 5.5 mm holes, insert the T-nuts and trial mount the landing gear.

Now move the gear strut in and out, to simulate a retracting cycle. You see now, how many angles have to be correct, so that the wheel is

- flat and parallel in the gear wells, when retracted
- parallel to the root rib when extended,
- not hitting anything during the retracting cycle

that the strut is

- exactly correct positioned in the gear wells when retracted
- hidden under the bottom wing surface, to accept the gear doors alligned to the bottom wing contour
- exactly vertical in side view, when extended
- exactly vertical in the front view, when extended.

and finally, that the gear unit is low enough, that it can be covered with the outer small gear door, which will have to be connected with the main strut.

The front two monting screws are counter sink screws to allow the small gear door to close propperly, there is not enoungh room for regular allan heads. The 2 rear screws are regular M4x20 allan hed screws.


When the movement of the gear units is exactly as you want it to be, get started with the outer small gear door. The angles of this small gear door are very complicated as well. Basically, it is hinged with 2 Robart hinges, and connected to the strut by a 2mm rod, which has a clevis on on the strut side, and a 90 deg. bent angle on the door side, which slides into a plastic tube, which has to be glued to the door in the exactly right position and angle.



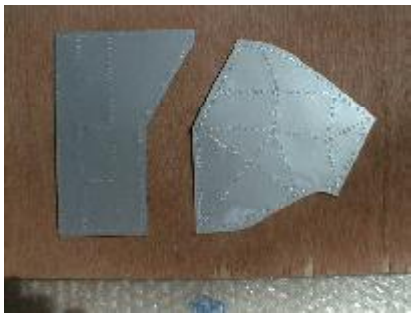
We use a “pull pull threaded end” screwed into the M3 thread of the strut. In that the clevis will be linked.

The linkage is so short, that you even might have to cut the clevis slightly, for sure you will hardly be able to use the thread as a length adjuster. Fix the white plastic tube with a veeery little bit of CA to the gear door and start moving the gear in and out.



Doing this, you will realize quickly, how delicate the setup is, and all angles of the linkage and of the tube are responsible for the correct angel of the gear door in extended and retracted position.

Don’t give up, after 50 attempts you will get it right, and from then on it will always work without any further adjustments.
Finally fill the joints of the hinge with epoxy.

A slightly easier job is mounting the main gear door to the strut. The M3 threads are in already, and you now have to adjust the length of the brass tubes, which are used as spacers between strut and gear door.

You can take off wheel and brakes at that stage.

Mark the holes on the gear door and drill with 3mm.

Mount the gear doors with the M3 screws, and allign everything with the gear well, when retracted.

When you move the strut now in and out, you must check if the outer gear door hits and looks against the main gear door. If so, you will have to readjust the outer gear door again a very little bit, or move the main gear door down a little.

Now you should build a few frame surfaces into the gear door, where the main gear door rests on when retracted. Make sure, that the wheel does not hit these frame parts during the cycle.

After all fits, mount the wheel with brake again, and take the gear door off.

Next step is to glue on the inner door details, made from vacuum formed styrene.

Cut out the styrene parts and sand the shape, so that they fit on the gear doors well. Glue them on with a few drops of CA glue.

If you glue only in the top and bottom center area, you can later bend the gear door a little, to get perfectly matching fit in the wing, and then glue the rest with CA glue. If you glue all in one step, you might warp the door, so that it does not fit anymore.

Assemble all again, and double check all again. At that time you should also take the inner gear door, which is going to be mounted at the fuselage, and hold it in place, to see if you need to sand some more of the main gear door in that area.

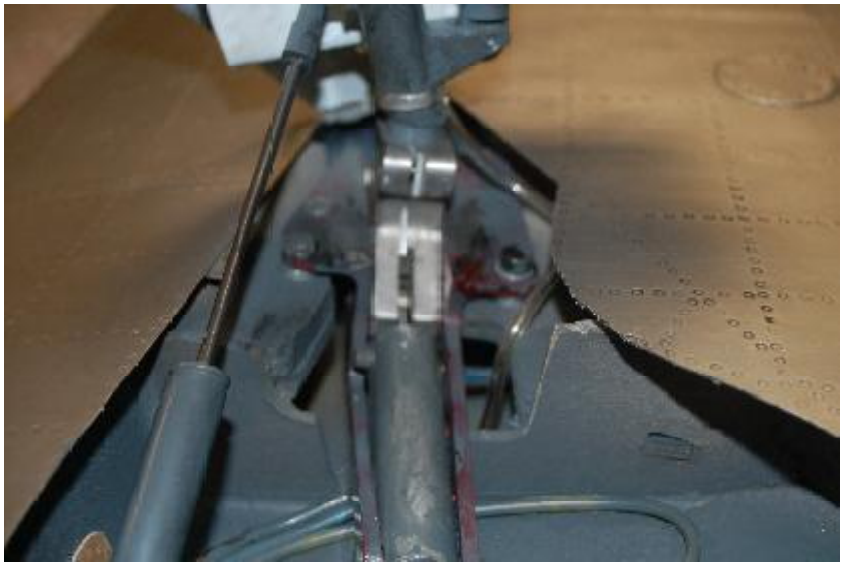
Right now you also can glue in some frame elements, where this inner gear door will rest on, when closed.

Next step will be mounting of the support air cylinder.

The support ar cylinder is not only a dummy for the characteristical scale look, it is s real active cylinder which is needed to safly opperate the landing gear as the strut and wheel are quite heavy for the smal sylinder of the retract unit itself.
It is absolutly nessecary to install this active support cylinder.

First, take off the main gear door again, that you see where you are working.

Mount the “piston end” of the cylinder to the strut. Tap the M3 thread in and use an M3x12 mm allen screw to bolt through the ball link.



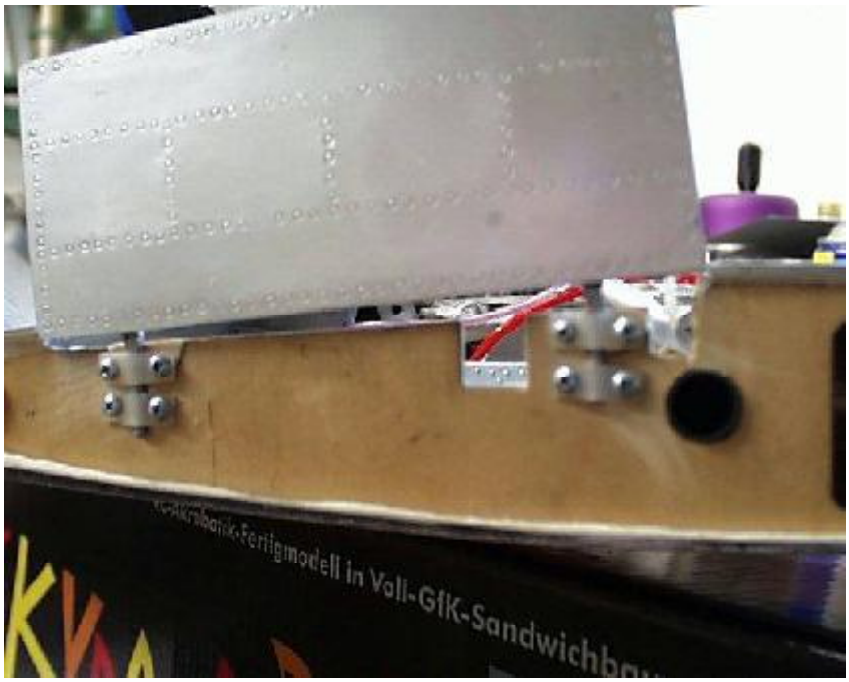
Retract the gear and locate the mounting point of the other end of the cylinder. It is

Once you have found the position, move the gear up and down, to see if the positions are right. You might have to change the position of the bottom mount slightly. After all is confirmed and moves smoothly, finally glue in the monting.

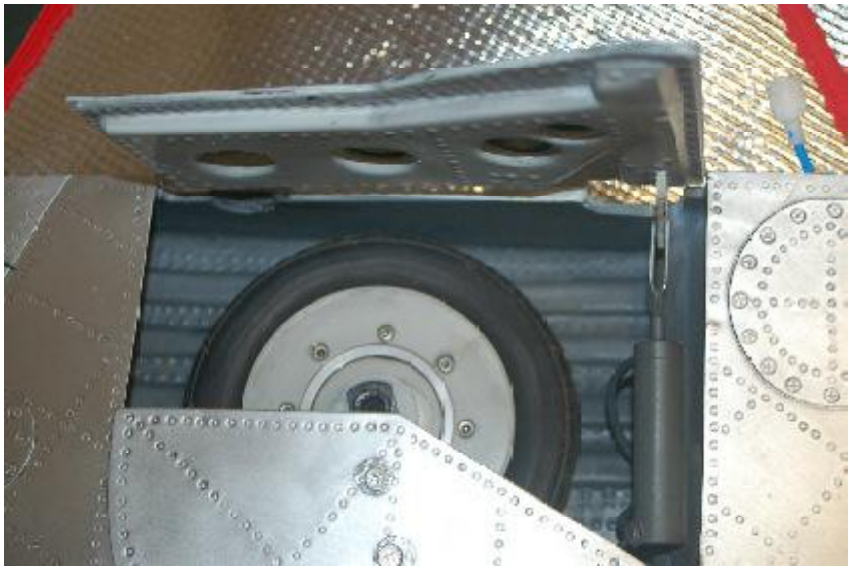
You will not have to remove the cylinder at the bottom mount again, as you can disconnect the cylinder from the ball at the main strut, even if you need to take out the gear.

The inner gear wells usually have a lot of structure inside. We duplicated this for the model airplane as well.

Cut the styrene sheet according to the shape of the gear box, and glue it in with CA glue. Dont use too much , as the CA might wrinkle the top surface of the wing, if it gets hot during curing.



Now, we are installing the gear doors. The hinges are mounted to the outside of the root rib. Therefore the half round cutouts must be filled with plywood.

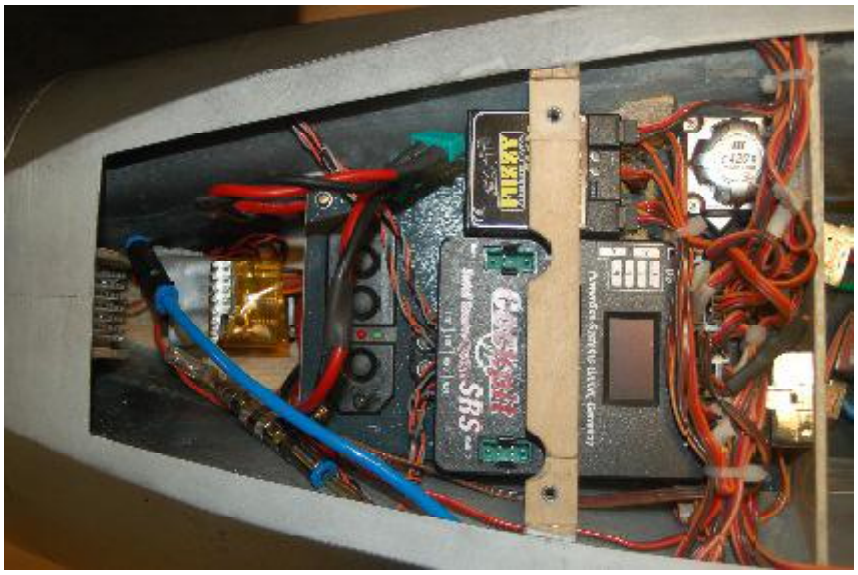


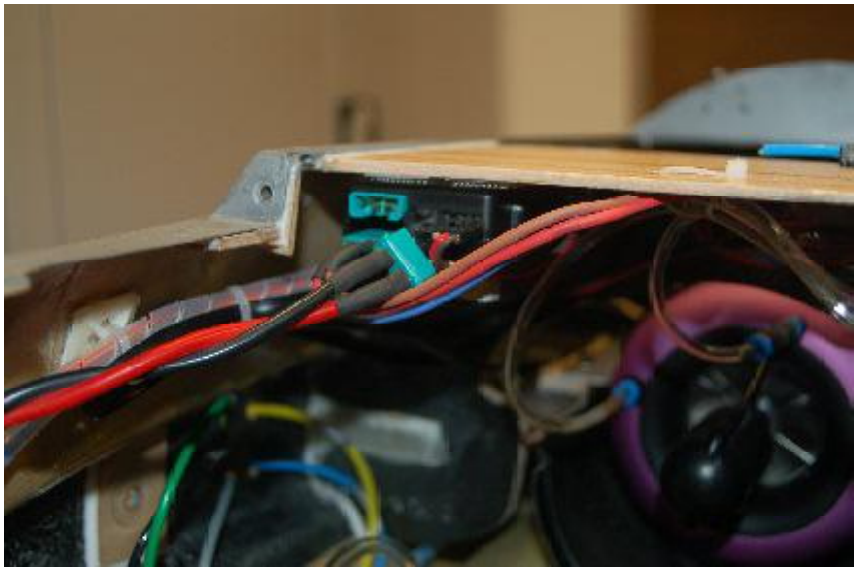
The cylinder is mounted to the front spar, just in top of the wing tube sleeve. the control horn is placed at the very front end of the gear door, so the root rib must be cut out in this area.

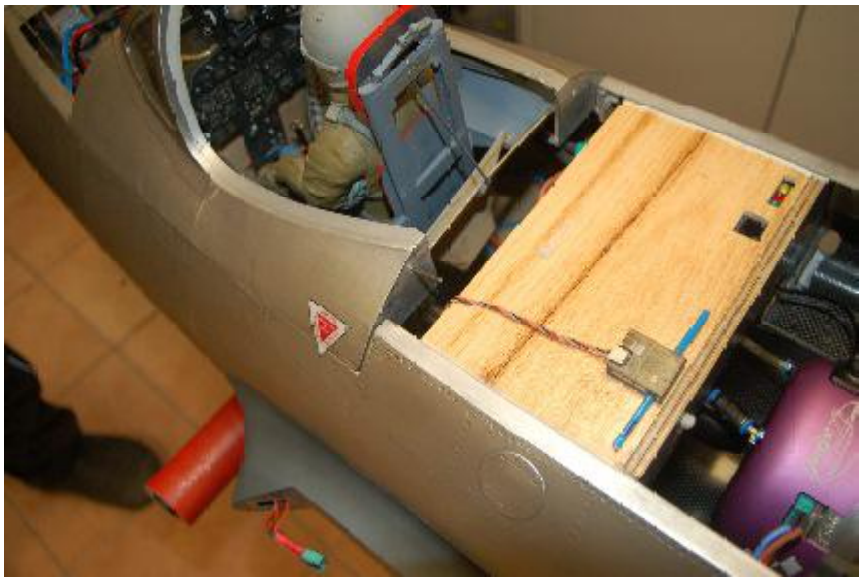
The Robart #165 cylinder is mounted with an M3 Screw to the plywood support wich gets glued to the spar in the correct position so completely open and close the gear door.

Note that the control horn sticks out of the root rip toward the fuselage when the gear door is closed. Make sure to gernerate enough clearance in the root rib and also you will have to grind a hole in the root rib on the fuselage to allow the control horn to stick in when the wing is mounted to the fuselage.

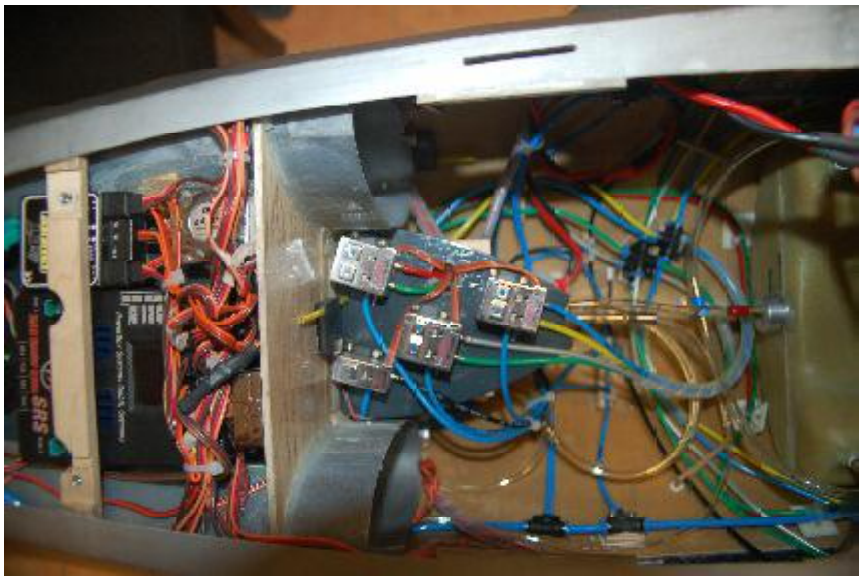
11. Ideas for Elecronic & hardware installation

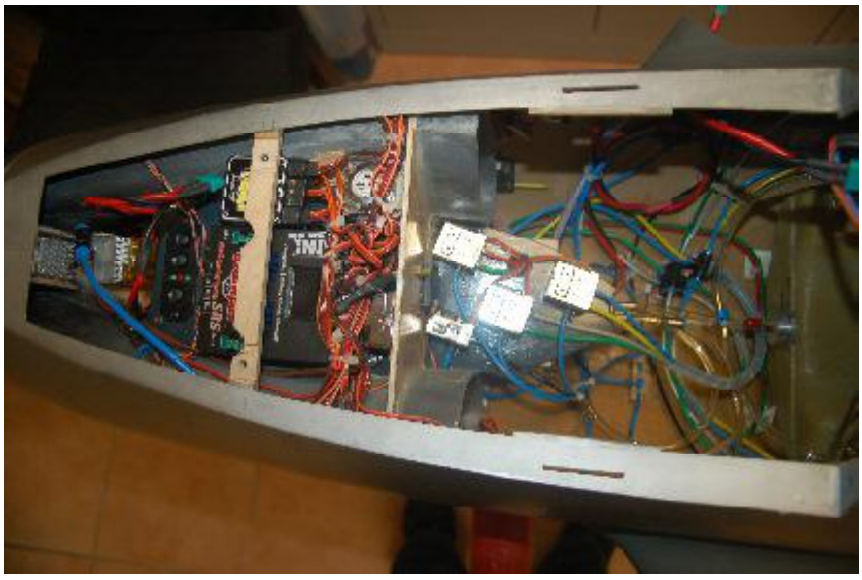






Here are some ideas, how to fit the electronic hardware into your plane. As this plane is not a beginners project, we must leave it up to you, to install all the components you are going to use. We gave you servo specs, recommended engines, fuel cells, and more, at different sections of this instruction manual already. At the end all is your decision, based on all your experience and preferences.

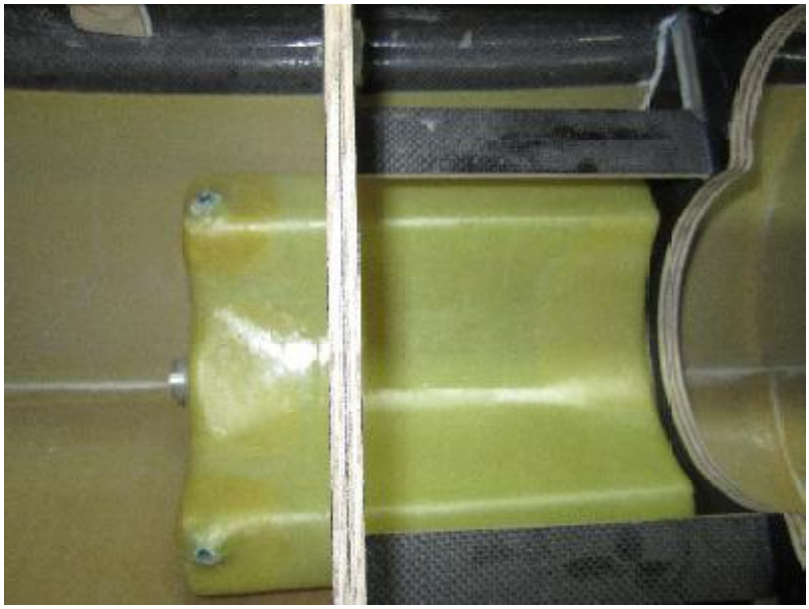




12. Optional fuel tank installation

The Fuel Tank for the Mig-15 is available through CARF as an accessory item whci we highly recommend to use.
With a volume of almost 4 liters it is a ferfect size Tank for long flight times.
It comes with plumbing accessories, clunk and even a hopper tank.

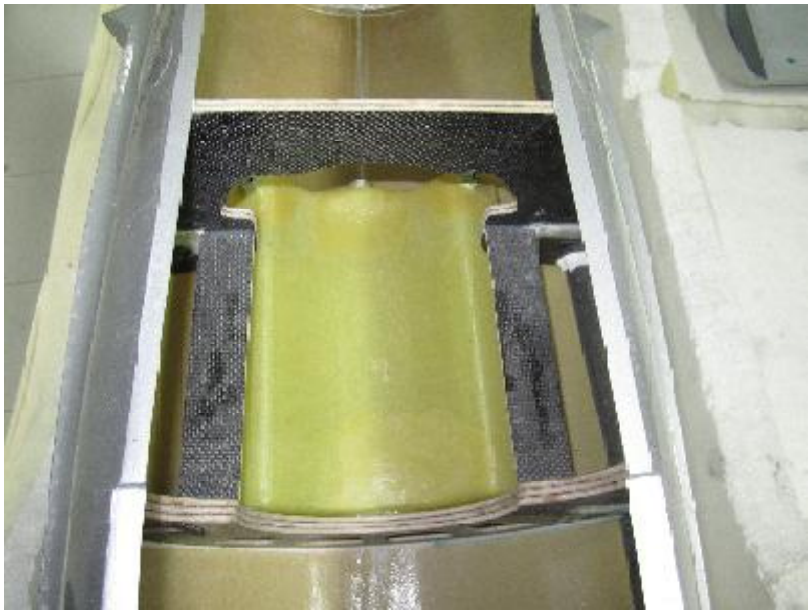
It is designd to be positioned right in the CG so that there is no efect on the CG of the plane once the fuel gets burned throughout the flight.

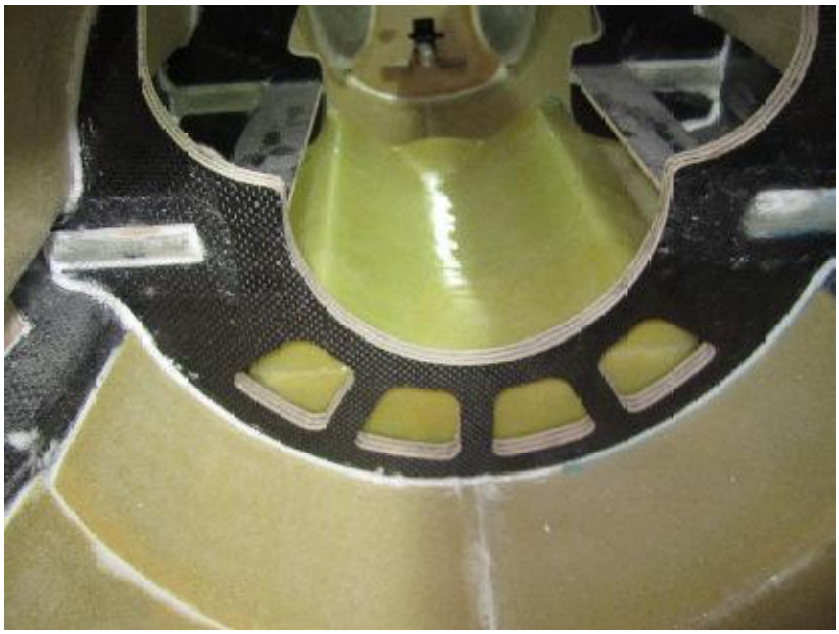


The Tank will be mounted right under the engine ducting ans schon in the following pictures.

The clunk goes in from the center and the 2 vents are in the front top right corner of the tank.

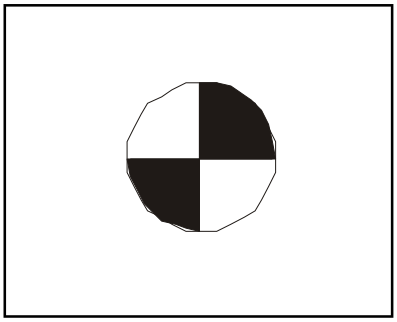
It is important to use the T-Fitting for the 2 ents and bring them together into one single overflow. Do not leave the vents separate!





13. control throws & CG setting

Elevator:	**UP**	**20 mm (1”)**
	DOWN	**18 mm (1”)**
Rudder:	**RIGHT/LEFT**	**50 mm (2”)**
Aileron	**UP**	**25 mm (1”)**
	DOWN	**20 mm (3/4”)**
Flaps	**TAKEOFF**	**25 mm (1”)**
	LANDING	**80 mm (3 1/4”)**
Speedbrakes	**LANDING**	**max. travel**



The CG is 50 mm in front of the rear wing spar

Useful tips for flying

Speedbrakes are very efficient, flaps too, but the plane tends to bounce at touchdown. If a little head wind, try to use only speedbrakes and flaps in takeoff position. With flaps and speedbrakes fully extended the plane can fly incredibly slow. Don’t forget that, when you are in the final approach. If you can fly it slow enough, the plane lands perfectly even with flaps fully down. But, it will be slower than you would EVER think.

Ailerons are very soft. Perfect for scale flying. Do not try to increase the aileron throw, it will kill the overall scale appearance. You might want to think about using a gyro even on the ailerons. It smoothens the flying even more, and the MiG15 appears to be on rails, even in windy conditions.

The rudder should definitely use a gyro. It improves the ground handling characteristics, and it makes the plane tracking just perfectly under crosswind conditions. Put the gyro on both steering nosewheel and rudder. Be careful with the setting, the rudder is very sensitive, and you should better reduce the sesitivity to no more than 25-30%.

Take offs: The full scale MiG-15 is known for very low climb rate at takeoff, same as the F-86 Sabre and other jets of that age. The MiG does it perfectly. Take off with 1/3 throttle, and the plane gets off the ground like a glider. Let it go a few feet high, switch the gear, and climb slowly into the first turn.

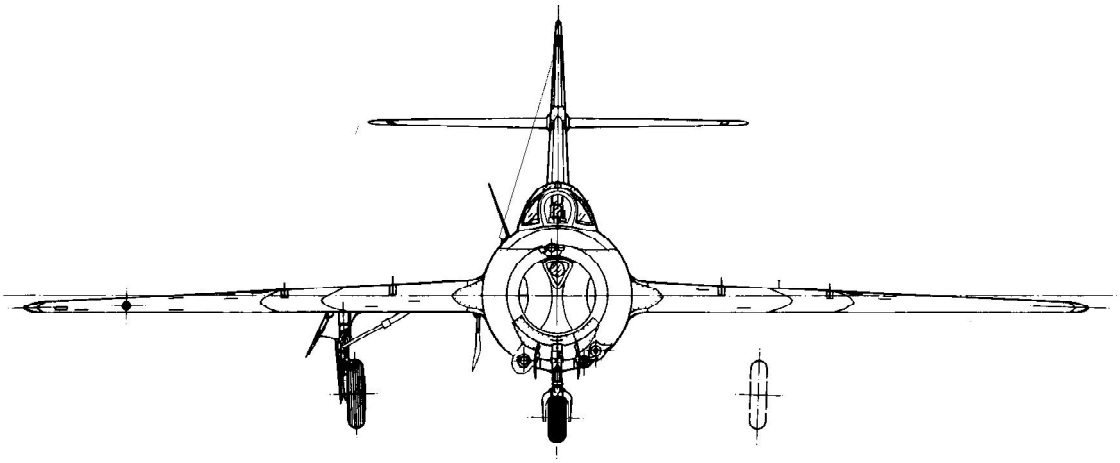
Landings: As said before, the MiG-15 is a very slow landing airplane. It floats forever, nothing can kill the lift. And when yo u think, it’s falling out of the air, then you can still make it slower. It amazed us as well, but these flying characteristics are due to the very low wing loading. A plane with that impressive size and that low weight is capable of manouvers, where others would fail. Of course, bumpy wind is not it’s best friend. But therefore you have the gyros, and they will do it all.

Have great fun with that great airplane.

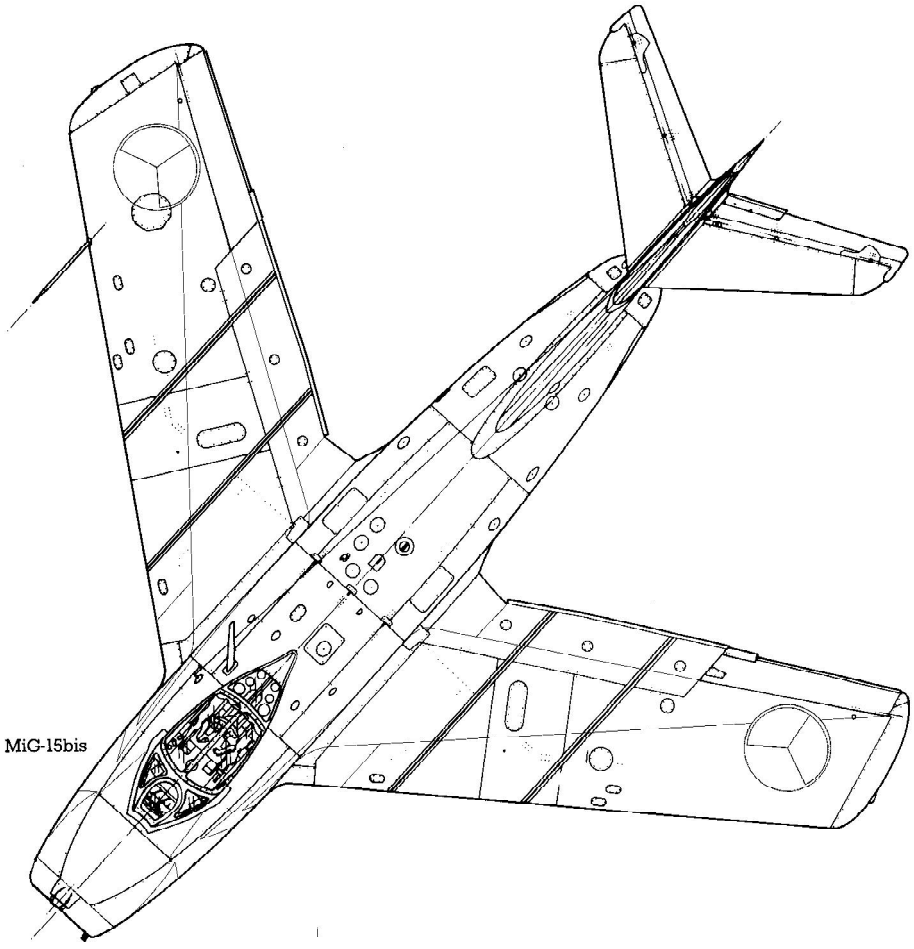
Your CARF Models Team

For questions contact your sales rep or email: techsupport@composite-arf.com

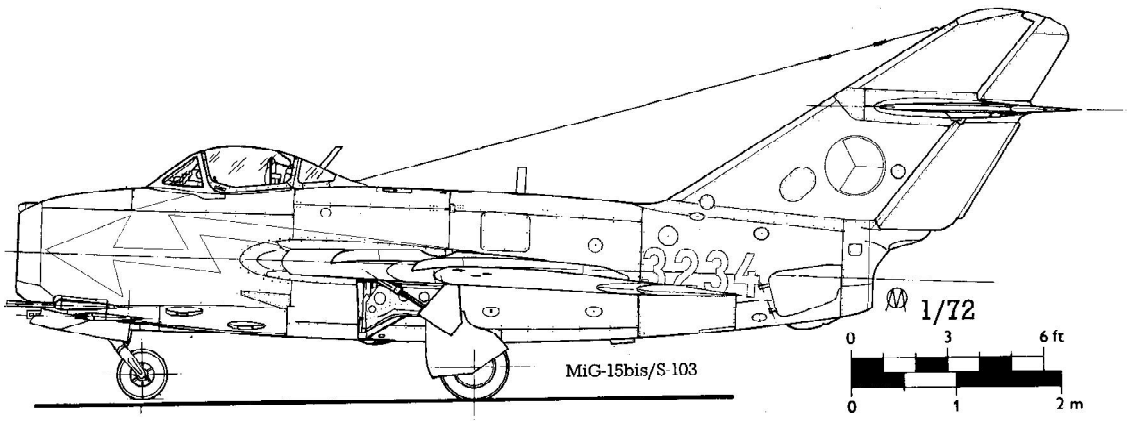
If your plane at the very end looks as impressive as these, you did a good job...



MiG-15, bis



MiG-15bis



MiG-15bis/S-103

14. Appendix

MiG-15 Fagot
parts list

Amount	Description English
1	main fuselage
1	front hatch
1	cockpit hatch
1	engine hatch
1	rear hatch
1	canopy frame
1	nose gear doors
1	stab unit
1	right elevator
1	left elevator
1	bottom rudder
1	top rudder
1	right wing
1	right main gear doors
1	left wing
1	left main gear doors
1	right aileron
1	left aileron
1	large gun dummy
1	small gun dummy
1	set of white vacuum formed parts
1	clear canopy
1	air intake duct joiner
1	set carbon engine ducting, 3 parts
1	double wall stainless/aluminum thrust tube
1	bag milled wood parts
1	hardware bag
1	instruction book english
1	Carbon tube 8 x 6 x 70 mm for the gun
1	Carbon tube 8 x 6 x 120 mm for the gun
1	Carbon tube 12 x 10 x 150 mm for the gun

Hardware / parts list V2.0 - 2011-12-03 MF

Hardware Bag 1, fuselage and fuselage hatches, speed brake

Part-Nr.	Quantity	Description	Remarks
	2	carbon dowel 6x20 mm	hatch mount
	3	allan screw M3x12	hatch mount
	3	T-nuts M3	hatch mount
	1	hatch latch	front hatch mount
	2	aluminum tube OD4x100 mm	speedbrake axle
	2	ball link M2	speedbrake linkage
	4	screw M2x20	speedbrake linkage
	4	sheet metal screws 2.9 x 12	speedbrake cylinder mount
	2	piano wire 2mm x 1m	hatch mount
	2	plastic tubing ID 2mm x 1m	hatch mount
	2	amuminim L-shape bracket 15x15mm	hatch mount

Bag 2, wings

Part-Nr.	Quantity	Description	Remarks
	2	Carbon rod 12 x 220	front wing spars
	2	Carbon rod 12 x 210	rear wing spars
	6	Robart hinge pins	Aileron hinges
	4	plastic nuts	wing mount
	2	all thread M3 x 120	aileron linkage
	2	all thread M3 x 40	flap linkage
	6	nut M3	linkage
	8	devises M3	linkage
	8	sheet metal screws 2.2 x 10 mm	servo covers
	2	phenolic control horns small	aileron
	2	phenolic control horns big	flap

Bag 3, stab

Part-Nr.	Quantity	Description	Remarks
	9	Robart hinges pins	rudder and elevator
	2	carbon dowels 6 x 50 mm	top rudder mount
	1	torsion linkage (double), with 2 ball links	bottom rudder
	1	torsion linkage (single, right), with ball link	right elevator
	1	torsion linkage (single, left), with ball link	left elevator
	4	M2 pushrods	elevator and rudder linkage
	4	devises M2	linkages
	2	sheet metal screw 2.2 x 10	rudder servo hatch
	1	allen screw M4x16	stab fix screw

Bag 4, gear doors, retracts and engine mount

Part-Nr.	Quantity	Description	Remarks
	16	T-nut M4	gear mount + engine mount
	12	allen screw M4 x 20 mm	gear mount + engine mount
	12	washer M4	gear mount + engine mount
	12	Robart hinge pins	aileron and gear doors
	6	devis M2	small, big & nose gear door linkage
	2	collar 4mm	nose gear door linkage
	2	threaded end whnole	small gear door
	2	push rod 2 mm (short piece)	small gear door
	2	Ball link M3	for suppor tair cylinder
	16	sheet metal screws 2.9 x 12	rear Thrust tube / inner gear door
	4	counter sunk screws M3 x 12	main gear door mount
	1	aluminum tube 5 x 50 mm	to cut spacers for main gear door
	4	phenolic control horns small	gear doors
	3	sheet metal screws 2.2 x 10	thrust tube mount
	1	Steel cable 0.8 mm 1 m long	nose wheel steering
	4	Steel crimp tubes	nose wheel steering
	1	Large gun 12x150 mm	for dummy gun
	1	samll gun 8x120 mm	for dummy gun
	1	samll gun 8x70 mm	for dummy gun