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MIG-15
Fagot

Composite-ARF
Museum Scale All Composite Jet Aircraft

MiG-15
Construction Manual
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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 JR 4721 or similar
Elevator: 2x Mini Servos with 50 in/oz or more
Flaps: 2x JR4721 or 8411 or similar
Rudder: 1x JR 4721 or 8411 or similar
Nosegear steering: Powerful and slow servo is best

Additional functions, if driven by servo, should have mini servos because of weight and limited space. We recommend mini servos only, for retract, speedbrake and brake valves. You will run out of space soon in the RC compartment, because of the air intake duct, and for CG reasons.

Engines

We recommend 19 lb thrust engines. JetCat P-80, RAM 750, and similar. To use bigger engines is only recommended, when the pilot really knows how to use the throttle stick. Of course, in vertical manoeuvres it is good to have the power. But - in the horizontal manoeuvres 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 appearance if you fly with too much thrust. The full scale just did not have it either!!!

Other accessories

We recommend to use electronic air valves for retracts, wheel brakes and air brake. These units are getting more and more popular, and we know that they are reliable, small and light weight.

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

You should use only dual conversion receivers, PCM, and, if possible, a dual power supply, a so called power bus. These allow to run the system with 6 Volts.
Chapter 1: Air intake and nose gear door

Work steps:
- fit the Air intake lip to the fuselage
- adjust and mark the right position
- glue the air intake lip to the fuselage
- cut out the nose gear door

You need:
- CA glue, Epoxy
- X-Acto Knife or any other cutter, rough sandpaper
- small saw blade
- fuselage, front hatch and air intake lip

As you want to get started on your MiG-15, get the fuselage and the air intake lip first. Sand the front surface of the fuselage thoroughly with a rough sand paper.

Then trial fit the air intake to the fuselage. The correct position clockwise is given by the marks and panel lines of the gear door. Turn the fuselage upside down to center the half round gear piece marked on the air intake to the gear door marked on the fuselage. Use a felt pen to mark the correct position to air intake and fuselage.

Then turn the fuselage back to the upright position and fix the front hatch to the fuselage with some clear tape. If necessary you might clean out the seams and corners in that area, so that the front hatch fits properly.

Now make sure that the air intake lip meets the outer shape of the front end of the fuselage perfectly, and glue the 2 parts together with thin CA glue. After the glue has set, reinforce the bond from the inside with epoxy. You may add some milled fibre to the epoxy mix to be able to fill the joint nicely.

Now take off the front hatch and double check the fit from the outside.
Now turn the fuselage upside down again. Identify the exact cutting line for the gear door, and use a felt pen to mark it. Make sure that the mark is clear, so that you will not be mistaken when cutting the door out.

Use an X-Acto knife or similar to cut the gear door out.

You might have to use the blade of a small saw to cut the hard areas where the intake lip joins the fuselage.

Take out the gear door and leave it in piece. You will continue working on it when you install the gear itself. Right now you just need the hole to be able to properly install the air intake ducting into the fuselage. At the same time you will install the gear mount formers.

**Tip for the Pro's:**

Cutting fiberglass is basically very easy. In this manual we try to convince you not to use any machine tools, as the risk of damaging the valuable composite parts is very high.

Especially the light weight sandwich material used in most areas of the plane can be cut so easy with just a knife or a small saw blade. It just might take a few minutes more to get it done.

Of Course, you can go ahead and use a dremel disc cutter or other milling tools. But make sure, that your skills with this kind of machinery are really high. Especially the disc cutting needs a lot of experience, and it cuts the light weight composites like butter. *BE CAREFUL!!!*
Chapter 2: Wing tubes, duct and nose gear formers

Work steps:
- installing the main carbon rods for the wing joint
- installing the intake duct front part
- installing the intake duct rear part
- glue in the nose gear formers
- glue in the RC compartment formers

You need:
- a round file, rough sandpaper
- CA-glue and epoxy, preferably some milled fibre
- The fuselage both air intake parts, and the set of ply wood and balsa wood parts show in the pictures

First start with opening and cleaning the 4 holes in the root rib of the fuselage. Slide the two carbon rods through and check parallelity. You might double check by sliding both wing panels on that the directions of the carbon rods are correct.

Slide the rods out of one half and slide on the 4 carbon tube pieces, two on each rod. Then slide the rods in again and glue the carbon tube pieces to the fuselage. Use epoxy with milled fibre, to get a nice strong fillet.

After the glue has set, slide out the carbon rods again and clean out the holes from any access epoxy glue, which might have drained through the joint.

The carbon rods must slide easily with no force at all.

Tip for the Pro’s:
Whenever you need to use a part as a jig, which is supposed to be removed after the work is done, you should wax this with any kind of wax. In this specific case these are the carbon wing rods.

You can use any kind of wax used in a house hold. For example wax to maintain wood floor, or even shoe wax will do. If you don’t have any of these available, rubbing a candle over the areas which should not be glued will do the job already.
This is what you should see in front of you right now. A fuselage with 2 perfectly alligned carbon wing joiners.

Now slide the wing rods out again and insert the air intake ducting. If you slide it into the fuselage from the big top side opening, slide it in turned 90 deg. clock wise. After the intake tube is inserted, turn it 90 deg. back and you will see the tight fit of the air intake inside the fuselage.

After the front part of the air intake is installed, it will not be removable anymore.

Find the right axial position by sliding in the front carbon wing rod. This gives you the exact allignment.

Now use epoxy glue with some milled fibre to glue the air intake to the front intake lip of the fuselage. Fill the gap with a sufficient amount of epoxy.

After the glue has cured, sand the inside of the air intake nicely with sandpaper and file. You might want to use some putty to get the joint perfectly smooth.

Now slide in the rear part of the duct. Mark the location where the wing joiners go through and cut the hole with knife and rounded file. Check the allignment to the engine mount, but DO NOT glue the tube in yet. You will have to remove it for easy engine installation.
Now prepare the wood formers for the nose gear mount and RC-compartment. Trial fit them in according to the dimensions given in the drawing below.

Make sure that all fits nicely. You might have to sand and adjust the shape of the formers slightly. Also, if you find that they do not fit properly, before you start sanding, turn them around and try to fit them in the other way (in mirror). As the plug of the MiG15 is hand made we could not guarantee a 100% symmetry of the fuselage.

After the gear formers fit nicely, glue them in with epoxy and milled fibre. Do the same thing with the balsa former for the RC-compartment. At that stage do NOT glue in the horizontal rails, only slide them in. You will have to take them out later to mount the gear!!!

**Tip for the Pro’s:**

Allways sand any fiberglass surface thoroughly with a very rough sand pater, to assure a strong bond. Additionally scratch the surface with a cutter blade to roughen the surface as good as you can!

*Do NOT glue these rails in yet!*
The rectangular cutout in the radio compartment’s floor is made to mount the steering servo.

**Former positions:**

The REAR nose gear former is placed exactly at the end of the radio compartments floor, so that it is in line with the upper balsa former.

The FRONT nose gear former is placed 15 mm (3/4”) in front of the rear end of the gear door cut out.

Again, do not glue in the plywood rails for the gear mount itself. You will have to take them out, when you mount the nose gear unit later. But, make sure that they fit into the rectangular cutouts. As they are mounted in a 15 deg angle, you will have to sand these cutouts slightly to accept the rails in the requested angle.

Use a good amount of epoxy glue, and if you do not believe in your landing skills 100%, then you should also add some scrap pieces of fiberglass cloth to reinforce the bond additionally.
Chapter 3: Fixing the wing to the fuselage

Working steps:
- install the M6 screws to the wings
- drill the holes to the fuselage
- reinforce the fuselage with plywood
- test mount the wing with the supplied plastic nuts

You need:
- Drill 6mm, round needle file, medium grid sand paper
- CA glue, epoxy glue
- fuselage, wings
- 4 screws M6, 4 plywood reinforcements, 4 plastic nuts

The wings of your MiG15 are held on the fuselage with 4 M6 screws and plastic nuts. The nuts are accessible through the main hatch of the fuselage.

Drill the 6 mm holes into the wing’s root ribs, as shown on the photo. Insert the 4 M6 screws. The front one is accessible through the hole in the root rib, the rear one is accessible through the flap opening.

Glue the screws in with CA glue, and fill the bond from the rear side with sufficient epoxy and milled fibre.

After the bond has set, slide the wings on and mark the holes on the fuselage.

Slide the wings off again and drill the holes with a 6mm drill bit. Double check the correct position of the holes by sliding on the wings again.

If the position of the holes is slightly off, no problem. Use the needle file to enlarge them, until the wing slides in without any force.

The plywood reinforcements do have the correct diameter holes already milled in, and they act like a sleeve for the screws.
Now fit in the plywood reinforcements. Fix them when the wing is on.

Double check the fit of wing and wing fillet on the fuselage. Sand the surface of the wing root smoothly with the medium grid sand paper.

Confirm the fit of the leading edge of each wing with the wing fillet on the fuselage.

If necessary, you can load the leading edge of the wings a little bit up or down, to adjust the last millimeter, while you glue the plywood reinforcement in with CA glue.

After the plywood reinforcements are fixed in the fuselage with CA glue, take the wings off and fill the borders of the plywood with epoxy glue.

After all is cured, slide on the wings a last time to confirm the correct fit.

Tip for the Pro’s:
Be careful with the CA glue in this working step. Waxing of the threads will not help anything here. The wings will be locked and you will have a hard time to remove them, if you use too much CA glue to fix the plywood reinforcements. If it happens, you will do better to remove the screws and replace them by new ones, as the thread will be bad, and you might damage the thread of the plastic nuts as well during the daily use later.
Chapter 4: 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.

Glue 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 understand, 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 aileron into the wing. If you drill the holes and glue in the hinges parallel to the aileron tip this makes the assembly 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 their really 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 bottom 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 aluminum 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.
Chapter 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 especially 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. Use 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 photo shows the internal 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.
Chapter 6: Removable stab mount

Work Steps:
- align and mount the carbon rod
- mount the anti rotation pin
- set the screw for fixing the stab to the fuselage

You need:
- round file, sand paper medium grid, cutter, drill bit 3.3mm, 4mm and 7mm dia., tapping tool M4, hex key 3mm
- Epoxy with milled fibre, CA-Glue
- your fuselage, your one-piece-stab
- carbon rod 12 mm and carbon dowel 6 mm, allen screw M4x16

Start with the anti rotation pin first. Make sure that the 6 mm carbon pin slides in both holes in fuselage and stab easily. Then glue the pin into the fuselage, so that approx. 1/2” (12 mm) stick out.

Next check the fit of the 12 mm carbon rod in both stab and fuselage.

Now you need to cut a oval hole in the balsawood rudder post, exactly vertical below the hole for the 12 mm carbon rod. Slide the rod in carefully and check the angle 90 deg. to the surface. Then you can almost 100 % determine the location and size of the oval hole to be cut in the rudder post. Go ahead and cut this hole by using an X-Acto knife or a dremel milling tool.

Now slide the carbon rod in and mount the stab to check and confirm the hole in the rudder post.

Disassemble the parts and shape the bottom end of the carbon rod so that it matches the angle of the rudder post. Use a saw to cut, and then medium grid sandpaper to finish the cut surface.

Slide the wings on the fuselage as a reference to glue in the carbon rod straight.
Now follow the steps below exactly:
1. Wax the bottom surface of the stab, so that any excessive glue cannot stick to it.
2. Slide the carbon rod into the stab.
3. Apply epoxy glue with some milled fibre to the bottom end of the carbon rod and into the hole of the top surface of the rudder fin, and into the oval hole of the rudder post.
4. Slide the stab part (which has the carbon rod already inserted) slowly into the hole of the rudder fin, until both surfaces are contacting.
5. Align the horizontal stab to the wings by looking from the front on the airplane. You might go a few steps back and look from a distance of 3m (10’) at least.
6. Use clear tape to fix the stab with pressure to the rudder fin.
7. Check the bottom glue joint in the rudder post, if necessary fill with some more epoxy. Moving the carbon rod in that oval hole slightly from left to right will change the angle of the stab referring to the wing.
8. After the Glue has set, take off the stab from the rudder fin. As you waxed the bottom surface of the stab, it should release easily. Now the carbon rod remains in the rudder fin.
9. Clean the bottom surface carefully from any excessive glue and slide the stab back on to confirm the fit.
Now the more difficult part follows: Drilling the hole for the fixing screw.

That screw is a M4 x 16 allen screw.

1. Slide the stab about 1” (25 mm) off from the fuselage and mark the position of the hole to the outer skin. By looking from the side, when the stab is slid off 1” you can easily determine the correct position. Follow the angle of the carbon rod. Make sure that if you drilled the hole right now it would hit the carbon rod exactly in the center.

2. Then take the stab off again. Drill the hole with the 3.3 mm drill bit.

3. Reconfirm the center position of the hole in the tube, slide the stab back on the carbon dowel and THEN drill again through all.

4. Take of the stab again, and drill the hole in the stab with 4 mm again, to enlarge the diameter. After that drill the outer skin with 8 mm to accept the screw head.

5. Now tap the M4 thread into the hole in the carbon rod.

6. Assemble the parts one last time, and fix the screw, to confirm that the screw holds both parts together properly and without clearance or slop.

Now that difficult part of the job is done, and you might relax a bit watching your airplane on the bench...

Note: The point here on the photo is shown too low. Drilling and tapping is so much easier, if you locate the hole 40 mm above the horizontal stab.
Chapter 7: bottom rudder and servo mount

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 or lock at any position.

When all is done and ad-
justed, 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 confirm the free move-
ment 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.*
Chapter 8: 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

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, 2 M2 push rods,
  2 clevises M2, 2 threaded ends M2, 2 elevator mini servos

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.

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 see 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
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 everything 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 permanently.

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 the servo electronically. Adjust the servo arm perpendicular 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!!
Chapter 9: Fuselage hatches

Work Steps:
- mount the main hatch with 6 fix points
- mount the nose hatch with hook and hatch latch
- cut out canopy frame, make decision whether detailed cockpit is demanded or not...

You need:
- sandpaper, small file, cutter, allen key 2.5mm, drill bit 3mm, 4mm, 6mm, counter sunk tool
- CA glue thin and thick, epoxy glue, milled fibre
- 2 carbon dowels, 12 hard wood blocks, 4 counter sunk screws M3x12, 4 T-nuts M3, 1 hatch latch, 1 balsa main board, milled formers for nose hatch mount, 2 balsa side rails.
- Fuselage, main hatch, nose hatch, clear canopy

Start with fitting the main 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.
When the hatch fits the fuselage perfectly, glue in the balsa board in the center area, just behind the cockpit area. See photos.

This board can be used to mount engine accessories or radio equipment. Mainly we need it to stiffen the fuselage in this area. When you glue it in, make sure that the hatch still fits the fuselage shape. Use some drops of CA first, and confirm before you use epoxy to fill the bond.

Above a brief drawing of how the wood parts and the screws and T-nuts have to be placed to achieve a good tight fit, and how to do it that the mount is almost invisible from the outside.

Basically the hatch is held by the fin fillet in the back, and by 2 M3 screws each side. In the center area we need an additional dowel, to assure the correct fit, but this dowel must be very short, otherwise you cannot mount the hatch.
Start with the 4 mounting screws. You need to shape 4 wood blocks for the hatch, and 4 wood blocks for the fuselage, so that they fit into the corners where the screws are going to be. Make sure, that (according to the drawing) the bottom surface of the blocks in the surface is perpendicular to the direction the screw is going to point to. This is naturally perpendicular to the outer surface of the hatch in that area, too.

Glue in the wood blocks now, and also glue in the 2 rails shown on the photo, made from glass sheeted 3mm balsawood. They stiffen the hatch in that area, so that it does not bend open, when you tighten the screws and put a bit tension on the hatch with that.

Drill the holes into the hatch, where the screws are going to be. Make sure that they are perpendicular to the surface and center the wood blocks. Later you will use these holes as drilling template to drill the holes in the fuselage accordingly.

Also glue in the reinforce- ment plywood square pieces, where the dowel has to be placed.
Drill the 6 mm holes for the dowels, and stick the dowels into the holes. Shape the top end of the dowels so that they match the shape of the hatch. Grind the hatch frame in that area to fit the dowels.

Now add some thick CA on the top surface of the dowels, and mount the hatch with tape in place. After the CA has set (wait at least 5 minutes) You can take off the hatch, if everything worked well, the dowels remain now in the hatch, and you can fill the bond with epoxy and milled fiber.

Put the hatch back on, and drill the screw holes through both hatch and fuselage and all the filling wood blocks. Use a 3mm drill bit. Then take off the hatch and enlarge the holes in the fuselage with a 4.5 mm drill. After that insert the M3 T-nuts and mount the hatch with the supplied counter sunk screws.
This is the result of your work so far. If the plane looks like on these photos, you did an important step in finishing your fuselage. Take your time to do everything very carefully, as a well fitting hatch will draw attention at the flying field. If the hatch doesn’t fit well, you will always be unhappy, when you see it. If holes do not match, or a tension occurs when you tighten the screws, take out the wood blocks and just do the whole procedure again. It would take you very little time, to repeat the steps.
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.
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 must make sure that it is warmed up a little. Use a heat gun, or a hair dryer.

Warming up the plastic does NOT mean to make it HOT. You will deform the clear plastic if the heat is too high.

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.

**Tip for the Pro’s:**
We are currently developing a detailed cockpit for the plane. This includes a separate fiberglass canopy frame. If you decide to use the detailed cockpit, you can cut off the complete rear canopy frame, about 2 mm inside the frame border. The cockpit kit will include a set of slides, to open and close the canopy by a pneumatic cylinder, supplied with the cockpit detail kit as well. Check out whether this kit is available already!
Chapter 10: Speed brake doors

Work Steps:
- cut out the speed brake doors
- build up the mount and axle
- install pneumatic cylinders
- detail the inside of the doors

You need:
- cutter, sandpaper, needle file, small phillips screw driver, 4mm drill bit, and PATIENCE...
- epoxy glue, milled fibre, CA glue thick + thin, scrap glass pcs.
- All milled wood parts from Speed brake package, 2 aluminum tubes, 2 air cylinder, vacuum formed inner details, sheed metal screws for cylinder mount, 2 ball links 2mm
- fuselage

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

BUT: 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 fuselage 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.

**Tip for the Pro’s:**
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 smoothly 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 might 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!
Chapter 11: Engine installation

Work steps:
- assemble the turbine shroud and thrust tube
- mount turbine shroud, thrust tube and engine
- decide where to put engine accessories, and fuel cells

You need:
- drill bit 4mm and 5.5 mm, sandpaper, needle file, phillips screw driver
- thin CA glue
- 4 screws M4 x 16, 4 T-nuts M4, 3-4 small sheet metal screws
- 3 part turbine shroud, thrust tube assembly, fuselage, turbine 8.5 - 12 kg thrust, engine accessories

First of all, we show the installation of a RAM 1000. If you use other engine brands, go ahead. Any engine between 8.5 and 12 kg 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. We have to assume that this is NOT your first time Jet, so we expect that you install these components up to your own preferences. CG-matters might require to move these components around in the fuselage, so we recommend to install these as the very last. Anyway, there is almost no place where they should NOT be mounted, so you will find a lot of space to install everything wherever you need it.
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.

If it is hard for you to get the whole unit assembled into the fuselage, you can slide in the thrust tube first, then insert the carbon shroud, and joint both inside the fuselage.

Check allignment!
Chapter 12: Nose Gear

Work steps:
- mount the nose gear unit in the rails
- install the gear doors
- mount gear door cylinders and steering servo

You need:
- Drill bit 5.5 mm, sand paper, flat file, needle file,
- CA glue thin and thick, epoxy glue, milled fibre,
- 4 screws M4 x 16, 4 T-nuts M4, 4 Robart hinges, 2 control horns, pull pull wire setup, steering servo, 2 door cylinders
- fuselage, cut out gear doors, nose gear unit

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 following photos.

Take out the mounting rails, you remember, you were supposed to slide them into the slots before, but NOT glue them in....

Drill the 5.5 mm holes and insert the T-nuts. After that slide the rails in the cutouts, and then mount the gear unit.

Check the movement of the gear carefully, check the angles and, especially, the fit of the wheel inside the air intake, when retracted. You still have a chance to move the wooden mounting rails slightly.

After all is confirmed, glue the rails into the formers with Epoxy glue.
Wheel should touch slightly

15 mm
3/4”

Cut out for strut
Tip for the Pro’s:

After trying many different methods of hinging gear doors, we came to the conclusion, that all kinds of so called “off set hinges” do not work well enough. They are easy to break, and hard to replace and re-align. So we tried the standard Robart hinge pins, with very good results. You have to make sure, that the areas where the hinges are to be mounted, receive a square cutout of 5x5 mm, and the point of rotation must be in the center of this cutout. See the drawing for your understanding.

Now cut the nose gear door in half, and check the fit in the gear door cutout. Mark the position of the hinges at both 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 below.

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.
Now glue the gear doors to the other end of the hinges. Apply a drop of CA to the hinge tips, and press the gear door with both hands against the hinges.

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.

After all is OK, reinforce and fill the bond with epoxy, and add some milled fibre to it.
The gear door cylinders 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 determine the correct position, take the cylinder and extend it to full. Fix the control horn with a drop of CA to the gear door. (see fotos next page).

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.

**Tip for the Pro’s:**

When using pneumatic cylinders for gear door movement, you always must decide which position needs to be confirmed first. Piston fully out, or piston fully in. Basically you should confirm the OUT position as a scale for any other movements.

Some applications cannot use the full pressure (force) on the rod in the end position. They might need a lock position. For example, the gear door might bend or over-center, if the full pressure were applied in the end position. So you move the piston out to the end, and the cylinder gives you a 100% confirmed travel out. Travel “piston in” can always be limited or locked by using a small wheel collar on the rod. In case of a gear door, we even want the pressure fully applied on the gear door in the closed position!
Now finally fill the bond of the control horn to the gear door and mount the clevis to the pushrod.

See the photos, which will give you an idea how everything is designed to work.

On a side note: Do not intend to use more hinges than 2 per gear door, as the hinges would not be in one axis and the door would lock, due to the rounded shape of the hinge line.
Chapter 13: Main Gear + Doors

Work steps:
- fit the gear units into the mounts
- modify and reshape the cutout (first kit production run only)
- install struts, brakes and wheels
- mount the gear with each 4 M4 screws
- 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

You need:
- 5.5 mm drill bit, cutter, sandpaper, flat file and needle file, dremel milling tool
- CA glue thin and thick, epoxy glue, milled fibre
- small hardware: 8 allen screws M4 x 16, 8 robart hinges, 2 control horns, 4 spacers and mounting screws for main gear door, full set of vacuum formed inner gear door details, 2 plastic tubes 2mm ID, linkage hardware for small outer gear door, milled plywood parts for cylinder mounts, 2 gear door cylinder, 4 sheet metal screws
- main gear units, main struts, dummy cylinder with mounting hardware, wheels and brakes, gear doors, wings, fuselage

Additionally shown is a 2nd mounting solution for the inner gear doors, developed by Wolfgang Kluhr (optional)

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 grind 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 rectangular plywood reinforcements 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 millimeters, 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 aligned 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.

OUTCH!!!!
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 very very 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 align 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 assembly and mounting of the dummy cylinder.
to make the photos in this instruction book, we still used a brass tube and a carbon rod 6 mm dia. for this purpose. The later landing gears might have a readily assembled aluminum dummy cylinder, either way it will work quite well.

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

Mount the “piston end” of the dummy cylinder to the strut. The M3 thread is already in. 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 dummy cylinder. It is close to the edge in the gear door cutout, where main and inner gear door join. It has to be mounted in the center of the balsa spare on top of the wing tube liner.

Use an M3 x 16 screw to mount it, and 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, harden the balsawood in that area with thin CA glue, and glue in the screw to mount the ball link. You will not have to remove it again, as you can disconnect the cylinder from the ball at the main strut.
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. Don't use too much, as the CA might wrinkle the top surface of the wing, if it gets hot during curing.
Here just some more photos of how to mount the wheel and the hub cover.

The wheel mounts on the axle with an E-ring, and the hub cover is just glued on top of the hub with CA glue.
Next step is the installation of the inner gear doors, which have to be mounted to the fuselage. Later in that instruction book we show a different way of installation, too. This mounts the gear doors to the wing. But in that case the cylinder has to be mounted in the wing, too. This results in 4 more airline quick disconnectors, which might create hassle and leaks. But it is admitted, that the general installation that way is easier, so we might let the decision up to you.

In this manual we are explaining the method of installing the gear doors to the fuselage.

So, first slide the wings on the fuselage and determine the position for the hinges, then drill holes in the root rib with a dremel tool. Slide hinges in to see whether they fit. Here, too, (which is not clear on the photos) cut out a square area 5x5 mm on top of the hinge axis, so that the gear door lifts over the corner. Otherwise it will lock.
First glue the hinges with a drop of CA glue to the gear door (only at the hinge tip), then glue the unit in the fuselage root rib. Fill the bond from the inside with epoxy and milled fiber, do the same with the hinges at the gear door itself.

See the photos below for the cycle the have to perform without locking or hitting anywhere.
After that determine the position of the cutout for the cylinder push rod.

Cut this hole and clean it out with a small file, and then try to fit the control horn for the gear door in place. Do not glue at that time. First you have to make the inner detailing of the gear door, which also contains a balsawood block inside to hold the control horn.

So, cut out the styrene inner structure for the gear door and fit it to the gear door itself. You will have to cut out the areas where the hinges are mounted.

Now glue in a scrap piece of balsawood to reinforce the area where the control horn is going to be mounted.

When all is done, glue the styrene part to the gear door. Use CA glue. After that cut the slot for the control horn and glue this in as well.

See the drawing below:
the photo left shows again the control horn and the cylinder. We might decide to use similar but different in shape, for the future, so don’t get confused by looking at the pictures.

Also the photos show the milled wood parts, which are used to build up the cylinder mount. We modified these as well a little bit, but they work the same, are only wider and stronger.

This mount is installed inside the root rib.
Glue the wood parts together, and check the position inside the fuselage. The mount has to be just behind the hole for the cylinder push rod.

After everything fits, mount the cylinder to the mount with sheet metal screws, insert the unit in the fuselage and glue it in with a few drops of CA first, and then with epoxy. You should also use some pieces of fiberglass to reinforce the bond.
Once you installed the cylinder, everything should look like at the pictures at the left.

Finally you have to cut out the root rib of both wings slightly, so that the linkage of the gear door and the control horn have enough clearance to move.
These photos show a complete gear up cycle, and finally the last one shows, how the gear doors should look like, when all is done.

It will be hard, to finish everything that perfect, so that you do not have larger gaps or slots between the doors itself and the wing, try your best, and the result will please you.
Now, here is the different idea of 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 disadvantage of this setup is, that you will have to use another 4 more airline quick disconnectors, which can cause trouble and leaks.

But, it DOES work, and you decide by yourself, which way you want to go.
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.

If your plane at the very end looks as impressive as the one on the right, you did a good job...
scale drawing 3-view

MiG-15, bis
**control throws / CG settings**

<table>
<thead>
<tr>
<th>Control</th>
<th>Up Throw</th>
<th>Down Throw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevator</td>
<td>25 mm (1”)</td>
<td>25 mm (1”)</td>
</tr>
<tr>
<td>Rudder</td>
<td>50 mm (2”)</td>
<td></td>
</tr>
<tr>
<td>Aileron</td>
<td>25 mm (1”)</td>
<td>20 mm (3/4”)</td>
</tr>
<tr>
<td>Flaps</td>
<td>TAKEOFF</td>
<td>25 mm (1”)</td>
</tr>
<tr>
<td></td>
<td>LANDING</td>
<td>80 mm (3 1/4”)</td>
</tr>
<tr>
<td>Speedbrakes</td>
<td>LANDING</td>
<td>max. travel</td>
</tr>
</tbody>
</table>

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 sensitivity 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 you 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 manoeuvres, 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 FiberClassics Team
Appendix

- packing lists
- identification photos for hardware
- identification photos for wood formers

Kit Contents:

<table>
<thead>
<tr>
<th>Amount</th>
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<th>Remarks</th>
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<td>hatch mount</td>
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<td>T-nuts M3</td>
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<td>1</td>
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<td>M2 pushrods</td>
<td>elevator and rudder linkage</td>
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<td>4</td>
<td>clevises M2</td>
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<td>stab fix screw</td>
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<td>16</td>
<td>T-nut M4</td>
<td>gear mount + engine mount</td>
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<td>16</td>
<td>allen screw M4 x 20 mm</td>
<td>gear mount + engine mount</td>
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<td>12</td>
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<td>clevis M2</td>
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<td>threaded end w/hole</td>
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<td>push rod 2 mm (short piece)</td>
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<td>allen screw M3 x 20 mm</td>
<td>dummy cylinder mount</td>
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<td>cylinder mount speed brake, inner gear door</td>
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<td>main gear door mount</td>
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<td>to cut spacers for main gear door</td>
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<td>4</td>
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<td>gear doors</td>
<td></td>
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<tr>
<td>3</td>
<td>sheet metal screws 2.2 x 10</td>
<td>thrust tube mount</td>
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<tr>
<td>1</td>
<td>allen screw M3 x 12</td>
<td>thrust tube mount</td>
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Hardware bag contents

Set of carbon balsa formers
<table>
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<th>Amount</th>
<th>Description English</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>balsa stringers 10x10x700 mm</td>
<td>for flap and speed brake reinforcement</td>
</tr>
<tr>
<td>2</td>
<td>servo mount ply 3 mm</td>
<td>for flap servo mount</td>
</tr>
<tr>
<td>1</td>
<td>set of plywood formers 3mm, complete</td>
<td>CNC milled, see ident. photo</td>
</tr>
<tr>
<td>1</td>
<td>set of balsa formers 3mm, complete</td>
<td>CNC milled, see ident. Photo</td>
</tr>
<tr>
<td>1</td>
<td>balsa 100 x 135 x 3 mm</td>
<td>for center fuselage reinforcement</td>
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<tr>
<td>1</td>
<td>balsa 100 x 120 x 3 mm</td>
<td>cut speed brake details and other details</td>
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<tr>
<td>4</td>
<td>square wood blocks 20x20x20 mm</td>
<td>cut 45 deg. for hatch mount</td>
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<td>1</td>
<td>plywood 0.8 mm sheet 100 x 320 mm</td>
<td>speed brake inside and other details</td>
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<td>2</td>
<td>plywood 0.8 mm strips 10 x 200 mm</td>
<td>door frames</td>
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<tr>
<td>1</td>
<td>set of carbon balsa formers, 3mm</td>
<td>canopy and cockpit frame, see ident. photo</td>
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</table>
We tried hard, to meet your expectations by creating this instruction book. For sure, nothing is perfect. You will help us, if you let us know your impression of the kit and the instructions. Give us your comments. This is the only way, to make good things better, and you will help yourself and all other modelers interested in purchasing this outstanding scale kit. We will continously update the instructions with all your ideas. Anyway, we will have to add a few sections to this one, as we ran out of time finishing the plane of which the instruction photos were taken.

Send us your feedback by email to feedback@composite-arf.com

We would like to thank you for your interest in our product, and we will continue to improve our standard and to add exiting airplanes to our range of kits.

With best regards,

Your Composite-ARF Team

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**Missing sections in this Version 1 Instruction Book:**

- nose gear steering servo installation
- internal canopy framing
- installation of scale accessories as guns and antennas
- finish / weathering

The addition will be available by April 15th to every customer. The addition can be downloaded from the internet by that date. Version 2 instruction book will have also some photos exchanged.