Instruction Manual

CARF Models 'Ultra Lightning'

'TAVS Technology'

version: 1.1

'Lightning'

Thank you very much for purchasing our CARF-Models 'Ultra Lightning', made with the revolutionary Total Area Vacuum Sandwich (TAVS) technology.

Please note that a few of the photos in this Instruction manual show certain views from the 3 prototypes, so please don't get confused by the different colour schemes!

Before you get started building and setting-up your aircraft, please make sure you have read this instruction manual, and understood it. If you have any questions, please don't hesitate to contact your Rep, or C-ARF directly. Below are the contact details:

Email: ***info@carf-models.com***

Website: ***http://www.carf-models.com***

Liability Exclusion and Damages

You have acquired a kit, which can be assembled into a fully working R/C model when fitted out with suitable accessories, as described in the instruction manual with the kit.

However, as manufacturers, we at CARF-Models 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 CARF-Models 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.

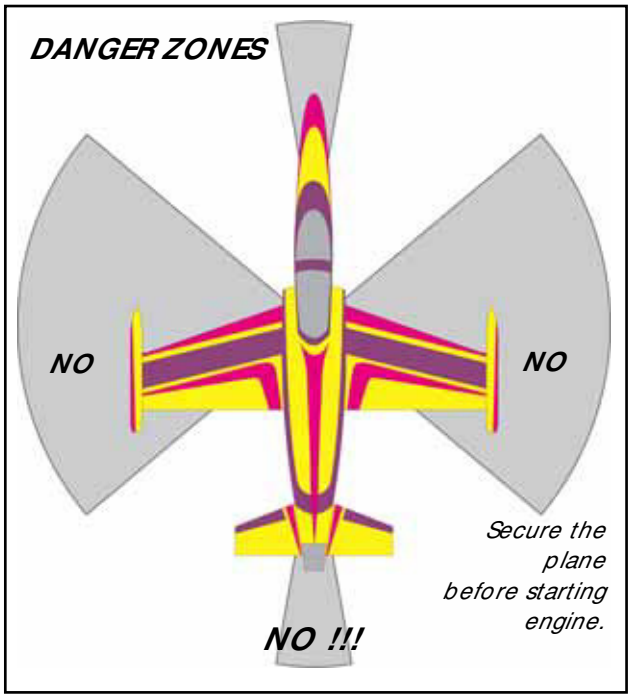
It is important to understand that CARF-Models Co., Ltd, is unable to monitor whether you follow the instructions contained in this instruction manual regarding the construction, operation and maintenance of the aircraft, nor whether you install and use the radio control system correctly. For this reason we at CARF-Models 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.

Attention !

This 'jet' aircraft is a high-end product and can create an enormous risk for both pilot and spectators, if not handled with care, and used according to the instructions. Make sure that you operate your 'Ultra Lightning' according to the AMA rules, or those laws and regulations governing model flying in the country of use.

The engine, landing gear, servos, linkages and control surfaces have to be attached properly. Please use only the recommended servos and accessories. Make sure that the 'Centre of Gravity' is located in the recommended place. Use the nose heavy end of the CG range for your first flights. A tail heavy plane can be an enormous danger for you and all spectators. Fix any weights, and heavy items like batteries, very securely into the plane.

Make sure that the plane is secured properly when you start the engine. Have a helper hold your plane from the nose before you start the engine. Make sure that all spectators are far behind, or far in front, of the aircraft when running up the engine.



Make sure that you range check your R/C system thoroughly before the 1st flight. It is absolutely necessary to range check your complete R/C installation first WITHOUT the engine running. Leave the transmitter antenna retracted, and check the distance you can walk before 'fail-safe' occurs. Then start the engine, run at about half throttle and repeat this range check. Make sure that there is no range reduction before 'fail-safe' occurs. If the range with engine running is less then with the engine off, please DON'T FLY at that time.

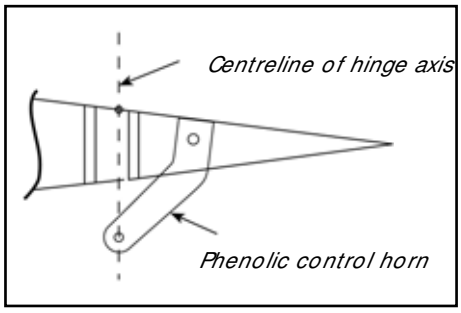
Make sure that your wing spar tube is not damaged. Check that the anti-rotation dowels for the wings are not loose. Check that the wing, stab, fin and nose retaining bolts are tight. Please don't ignore our warnings, or those provided by other manufacturers. They refer to things and processes which, if ignored, could result in permanent damage or fatal injury.

Important/General Notes

Elastic Hinges:

The ailerons, elevators, flaps and rudders are all hinged already for you - laminated in the mould and attached with a special nylon hinge-cloth, sandwiched between the outer skin and the foam. This nylon hinge is 100% safe and durable. You will never have to worry about breaking it, or wearing it out. There is no gap at all on the top side of the surface, and there is a very narrow slot in the bottom surface, where the control surface slides under the skin during 'down' throw. This means that the hinge axis line is on the *top* surface of the wing, *not* in the centre. This is NOT a disadvantage, but you need to program in about 10% NEGATIVE differential in your transmitter. This means that the 'down' throw needs to be about 10% more than the 'up' throw.

Why? Because the axis of the hinge is not at the centreline of the aileron/elevator, so it moves slightly in and out when operated, and the control surface gets a little "smaller" in surface area when moving downwards.



The slot needs some explanation, too. The cut line is exactly in the correct position so that the control surface slides under the wing skin smoothly. If the cut was a few mm forward or backwards, it would not work properly. So, make sure that the lip is not damaged, and that the control surface slides under this lip perfectly. It will *not* lock at any time, as long as the lip is not damaged. If damage occurs, you can cut a maximum of 2-3 mm off the lip on the wing in front of the control surface, but you should *never* cut off more than this.

Servo Choice:

We strongly recommend that you use the high-torque digital JR/Graupner 8511/8611 (or 8811) servos on all the main flight controls, and the milled plywood mounts are specially designed for these. An alternative is the Futaba S9351. Please see the recommended servo list on page 6.

Servo Screws:

Fix the *all* the servos into the milled plywood servo mounts using the 2.9 Ø x13mm or 16mm sheet metal screws provided in the kit, ***not*** the standard screws normally supplied with servos by the servo manufacturer. This is because all the holes in our milled servo mounts are 2mm diameter, due to our CNC manufacturing process, and this is too big for the normal screws.

Take Care:

Composite sandwich parts are extremely strong, but fragile at the same time. Always keep in mind that these contest airplanes are designed for minimum weight and maximum strength in flight. Please take care of it, especially during transport, to make sure that none of the critical parts and linkages are damaged. Always handle your airplane with great care, especially on the ground and during transport, so you will have many hours of pleasure with it.

To protect the finished paint on the outside of the model from scratches and dents during building, cover your work table with a piece of soft carpet, cloth or bubble-plastic. The best way to stop small spots of glue getting stuck to the outside painted surfaces is to give the whole model 2 good coats of clear car wax first, *but* of course you must be sure to remove this 100% properly before adding any additional paint, markings or trim. Alternatively you can cover the majority of the fuselage with the bubble-plastic used to pack your model for shipping, fixed with paper masking tape, which also protects it very well.

Adhesives

Not all types of glues are suited to working with composite parts. Here is a selection of what we normally use, and what we can truly recommend. Please don't use inferior quality glues - you will end up with an inferior quality plane, that is not so strong or safe.

Jet models require good gluing techniques, due to the higher flying speeds, and hence higher loads on many of the joints. We highly recommend that you use a slow filled thixotropic epoxy for gluing highly stressed joints, like the hinges and control horns, into position (eg: Hysol 9462).

The self-mixing nozzles make it easy to apply exactly the required amount, in exactly the right place, and it will not run or flow onto places where you don't want it! It takes about 1 - 2 hours to start to harden so it also gives plenty of time for accurate assembly. Finally it gives a superb bond on all fibreglass and wood surfaces. Of course there are many similar glues available, and you can use your favourite type.

1. CA glue 'Thin' and 'Thick' types. We recommend ZAP, as this is very high quality.
2. ZAP-O or Plasti-ZAP, odourless (for gluing the clear canopy)
3. 30 minute epoxy (stressed joints must be glued with 30 min and NOT 5 min epoxy).
4. Aeropoxy/Loctite Hysol 9462 or equivalent (optional, but highly recommended)
5. Epoxy laminating resin (12 - 24 hr cure) with hardener.
6. Milled glass fibre, for adding to slow epoxy for stronger joints.
7. Micro-balloons, for adding to epoxy for lightweight filling.
8. Thread-locking compound (Loctite, or equivalent)

We take great care during production at the factory to ensure that all joints are properly glued, but of course it is wise to check these yourself and re-glue any that might just have been missed.

When sanding areas on the inside of the composite sandwich parts to prepare the surface for gluing something onto it, do NOT sand through the layer of lightweight glasscloth on the inside foam sandwich. It is only necessary to rough up the surface, with 60/80 grit, and wipe off any dust with acetone or alcohol (or similar) before gluing to make a perfect joint. Of course, you should always prepare both parts to be joined before gluing for the highest quality joints.

At CARF-Models we try our best to offer you a high quality kit, with outstanding value-for-money, and as complete as possible. However, if you feel that some additional or different hard-ware should be included, please feel free to let us know.

Email us: info@carf-models.com.

We know that even good things can be made better !

Accessories

This is a list of the main additional items you will need to get your CARF-Models Ultra Lightning into the air. Some of them are mandatory, and some can be chosen by you. What we list here are highly recommended items, and have been thoroughly tested.

1. Power servos (min. 8). The Ultra Lightning was designed around the excellent JR 8511/8611 range. See recommended servo list below. Another choice is the new Graupner/JR DS8811 which has a little more torque and about 15% more holding power. The Futaba S9351 should also be a viable alternative.
2. Metal servo arms (7 min). Most metal servo arms have a considerable amount of 'slop', due to manufacturing tolerances of the arms and the servo output shafts and splines. The SWB 'Double-Loc' arms clamp on with no slop at all, and we have used them on several C-ARF models with great success, which is why we are pleased to recommend them here. A set for the Ultra Lightning is available as an option.
3. Turbine engine set. Recommended thrust range 13 - 19kg (25 - 40lbs)
4. Retractable Landing gear set. C-ARF have a high-quality precision Landing Gear set, with wheels, struts, brakes, gear door cylinders, tubing etc, available as an option.

5. Retract and brake valves: CARF can supply the proven ‘Jet-tronics’ electronic brake and retract valves as an option and these were used in all 3 prototype Ultra Lightnings.

6. Batteries, switches, extension leads.

7. Powerbus system for servos. CARF can supply the Powerbox range as an option.

Recommended Servos:

Ailerons	2 x	JR/Graupner 8511/8611
Flaps/speedbrakes	2 x	JR/Graupner 8511/8611
Elevators	2 x	JR/Graupner 8511/8611
Rudder	1 x	JR/Graupner 8511/8611
Nosegear steering	1 x	JR/Graupner 8411

If you choose to use alternative servos of similar quality and torque, for example Futaba S9351, you might have to adjust the cnc milled plywood servo mounts a little. With feedback from customers and ’Reps’ we hope to provide more servo recommendations in a future update.

Recommended ‘SWB Double-Loc’ Servo Arms:

Ailerons	2 x	1” half arm
Flaps	2 x	1” half arm
Elevators	2 x	1” half arm
Rudder	1 x	1” half arm

A set of seven SWB 1” arms (JR or Futaba) is available for the Lightning as an option. Please see ‘Related Products’ on the Lightning page on our website for full details.

Did you read the hints and warnings above and the instructions carefully?
Did you understand everything in this manual completely?
Then, and only then, let’s start assembling your CARF-Models Ultra Lightning
If not, please read it again before you continue.

About the 'Lightning'

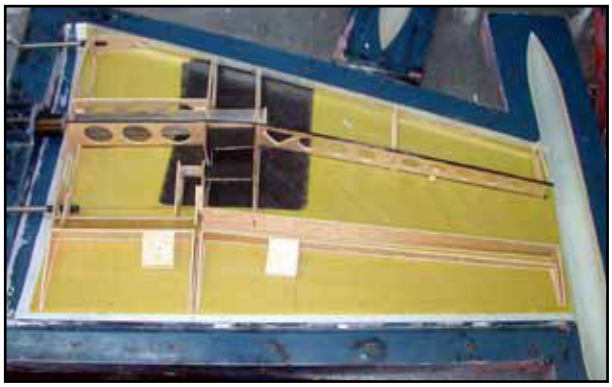
The 'Lightning' was conceived early in 2004, and almost 1 year was taken for careful design, development and testing before the full production commenced. The original concept was to design a no-compromise highly-prefabricated 'Giant Scale' sport jet for precision aerobatics, with 3D capability, for the 15 - 16 kg (30 - 38Lbs) thrust range of turbines.

In addition it had as near to 'ARTF' as possible, very quick to assemble on the field, modular for easy shipping and transport, be grass and short field capable, have easy access to all the important systems for maintenance ... and look absolutely stunning. We have realised our concept - and them some more!

After the first test flights of the prototype, made by Andreas Gietz, he stated that the only limiting factor with this plane was the pilot! Certainly, in the right hands, it is capable of completing a full 'Unlimited TOC' routine .... and we look forward to seeing one of the top aerobatic pilots run thru' their schedule with this plane.

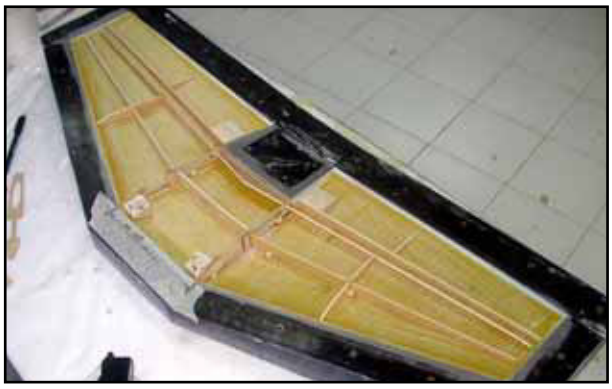
We are happy to say that the Lightning exceeds even our high expectations and original concept. It flies aerobatics extremely smoothly - really *flying* through all the manoeuvres - rather than 'skidding' around them as most jets do. With medium throws it's really easy to fly, and gives great confidence. With full control throws it can perform an 'unlimited' schedule in a very small 'box' - really surprising for a jet of this size. Flying performance like this has never been seen before for a large scale jet.

We have incorporated the same technology and hi-tech materials as used in our world-famous aerobatic planes, like the Yak55SP, Pitts S12 and SuperXtra. The Lighting features an incredibly strong, and torsionally stiff, structure combining kevlar and carbon-fibre with traditional lightweight balsa and plywood structures, all mechanically keyed together and aligned in the moulds before joining to bring you the best balance of strength and weight. Even the wing profiles are based on our aerobatic planes proven sections. The control surfaces are large and extremely powerful, giving you that extra confidence even at very slow speeds and in hi-alpha manoeuvres.



Wings, Stabs and Vertical Fin are all manufactured with 'Total Area Vacuum Sandwich' technology - with the internal structure jig-aligned in the moulds before joining. Extensive carbonfibre and kevlar composites are used in strategic positions.

All the main on-board systems, including the retractable landing gear, fuel system and engine mount and ducting, were fully integrated with the structural design of the aircraft at the initial design stage. It can be very fast for such a large model, but with it's amazingly wide speed range you won't feel worried during short and steep approaches at high angles of attack, when it feels absolutely rock-solid.

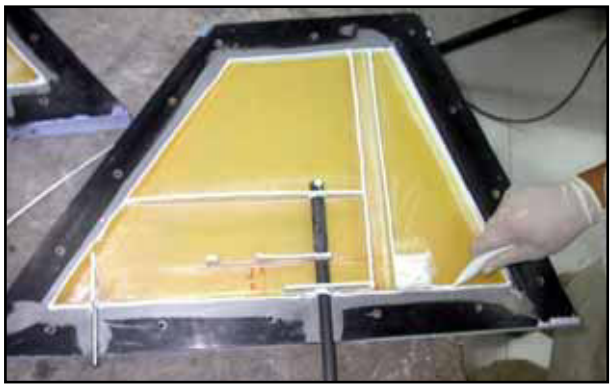


In its final ‘production’ form the Lightning is almost a ‘Ready-To-Fly’ model, and we complete more assembly in the factory for it than for any of our other products.

* Inlet ducts completely fitted and painted.
* Vertical fin and stabilisers completed, including the retention systems.
* All the control horns are jig-installed and all the surfaces are hinged.
* All control surfaces hinged and trimmed.
* All servo mounts installed.
* All the gear doors and hatches are cut and trimmed for you.
* Canopy frame and fixing system all completed for you.
* Pre-moulded gear doors, trimmed ready to fit.
* Wings trimmed, pre-aligned and incidences set.
* Engine bypass ducting pre-installed, and exhaust duct assembled.
* Fully composite, conformal, baffled fuel cells assembled and installed.
* Complete hardware pack with highest quality items included.
* Complete fuel system hardware, including hopper tank, clunks, fuel tubing and Tee’s !
* .... and too much more to list !

There is no doubt that you can finish the assembly and gear installation and have the Lightning ready to fly in 3 - 4 days, and we did this just to check it was possible. Virtually all you have to do is install your R/C, landing gear and turbine and go and punch some holes in the sky.

For sure this has to be the most prefabricated large-scale jet you can get for your $$!



(above) The Vertical fin with cnc milled internal structure and carbonfibre spar tube, ready for joining.

(right) A general view of the complete ducting system. The bypass, tanks and inlets are already installed for you - so is how the fuselage looks 5 minutes after you open the kit box !

Building Instructions

Landing Gear

The Lightning, and the complete landing gear set and it's mounting system, is designed to handle grass runways.

The C-ARF landing gear set is specially manufactured for the Lightning, integrating the very high quality engineering of Behotec (Germany) for the retract units and oleo legs, with the superb reliability of the well-known Intairco (Australia) wheels and brakes, and high quality accessories and connectors. It is incredibly strong and rated for models of 20+ kgs. All spare parts are available.

(above) C-ARF complete Landing Gear set.

The main LG mounts are assembled in the wing moulds from a composite laminated carbon sheet and aircraft-grade plywood. They are fully integrated into the wing and spar structure, locked together with tabs and slots - bringing you the highest strength with the lowest weight.

The nosegear mounting system is also very strong, using 3 laminations of aircraft-grade 3mm plywood, and provides easy access for retract maintenance. If you decide use a different brand of landing gear you should use a 'trailing-link' type of noseleg for best ground handling.

Main Gear

Temporarily assemble the wheels and oleo legs onto your retracts, and trial fit to determine the exact mounting position of the units, using the countersunk M4 bolts and T-nuts supplied. If using our C-ARF retracts, oleos and large 115mm Ø wheels the outer edge of the main retracts should be no more than 5 - 6mm (1/4") inside the plywood rib outboard of the retract mounting bay. To get perfect alignment, centre the wheel in the wheel well, and drill just one of the 4mm holes through the retract unit and carbon/plywood mounting plate. Insert a bolt, and then drill the other 3 holes, one at a time, inserting a bolt after each hole is drilled.

(above) C-ARF retract units are installed 5 - 6mm from the plywood rib outside the LG mount. (below) Set a little 'Toe-in' on both main wheels, using a 90° square aligned on the trailing edge of the wings.

Note: Don't mount the retracts too far towards the wing root, because you might not have enough clearance between the wheel and the door later.

Remove the retract and open the holes up to 5.5mm diameter for the M4 T-nuts. Using a spare M4 bolt with a large washer under the head, pull the spikes of all the T-nuts firmly into the plywood. Refit the retracts to check alignment, and then finally secure the T-nuts with a little 30 minute epoxy.

If using our large 115mm wheels you will need to sand away a curve in the lip at the front and back edges of the wheel well for clearance (photo P1). Now complete the final assembly of the oleos, wheels and brakes to the retract units, grinding small flats as needed for the set-screws and 'Loctiting' all important bolts and set-screws. Set the alignment of the wheels using a large 90 degree square from the trailing edge of the wing, which is exactly at 90° to the fuselage centreline. Set the main wheels with a very little 'toe-in' (front edge of the wheel angles inwards towards the centreline of the fuselage), 1 - 2 mm only, for best ground handling.

Route the air tubes from each retract (and wheel brake) forward, through the large holes in the balsa spar box, to exit in front of the wing tube at the wing root, for connection later using the Robart 'Quick-connectors' included in the optional landing gear set (photo P48).

Nose Gear

Install the nose retract, oleo and wheel in exactly the same way as the main retracts, but with normal M4 x 16mm bolts (not countersunk), into the M4 T-nuts supplied. Depending on which type of retract units you are using make sure that the steering arms clear the back nosegear mount bulkhead, or sand it away a little for clearance.

Depending on the type of retract unit used, you will almost certainly need to install the retract towards the back of the 'U' shape in the mounting plate, so that the steering arms do not touch the plywood bulkhead (photo P2). Steering uses a pair of pull-pull wires to the servo which is mounted in the installed milled plywood mount at the back of the wheel opening. Make up a couple of small hooks (paperclips) with rubber bands on the sides of the fuselage to hold the slack steering cables out of the way of the wheel and oleo leg when it is retracted (P52).

Experience has shown that a trailing link type of nosegear leg/oleo gives superb ground handling and steering with the Lightning, and our new C-ARF units come with complete with a beautifully engineered sprung and damped leg of this style, as shown.

C-ARF/Behotec-Intairco Landing Gear:

If using our C-ARF retracts (Behotec C-50) you will need to countersink the mounting holes in the main retract units only, and use 3mm plywood strips (cut from the 12mm wide ply strips supplied) under the mounting flanges to raise them off the carbon mounts a little for the maximum wheel clearance in the wheel well.

(above) Countersink the main retract mounting holes only. (below) 3mm ply packing strips.

The nosewheel is a 75mm (3") diameter with twin ballbearings, which fits on the 6mm ground steel shaft between the forks of the trailing-link nose oleo. Press the axle in carefully, using a little grease, making sure you don't push the bearing out of the other side of the wheel. There are 2 different length short aluminium tubes supplied to centre the nosewheel on the ground steel axle - make sure to fit them the right way round for perfect centreing. Replacement tyres are available for this wheel.

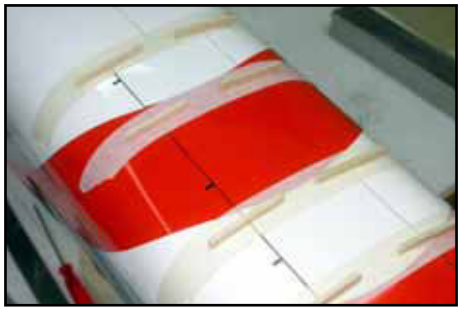
The nosegear retract unit should be installed about 6 - 7mm from the back of the plywood mount, using the M4 x 16mm bolts and T-nuts provided. The steering arms are screwed into the threaded holes on the oleo leg, onto small 'flats' that you must grind in the correct position - and finally Loctited into position.

The steel pin that is fitted in the nose gear retract block to connect the oleo legs is secured with a single 6mm wheel collet on top. Make sure that the steel pin does not project thru' the collet more than about 1 or 2mm, or it will hit the inside of the retract unit when operated.

For Main Gear Door installation - see 'Wing' section, page 19.

Nose Geardoor

You can chose to fit a single, or dual doors. The hinging uses a similar method to the main gear doors, and the door is easily removable for maintenance if needed. The door is laminated from carbon/fibreglass composite, and matches the colour of the fuselage already. It is supplied about 1mm too big all round, and needs final sanding to fit the door cutout. The nosegear opening in the fuselage is also 1mm too small for final sanding. You will see a fine line etched into the moulded parts as a guide.



(above) Balsa sticks CA'ed onto tape to position door .
(below) Hinge wire is installed thru' a small hole in front fuselage flange and bulkheads.

If fitting a single, side-opening, door you will need to install all 4 phenolic hinges, but if you chose to install 2 doors, then omit the 4th (front) phenolic hinge, and cut the door into 2 pieces. For the C-ARF gear the front door should be about 75 - 85mm long, and the back door is closed with a door sequencer when the gear is extended to prevent debris being thrown into the fuselage by the nosewheel.

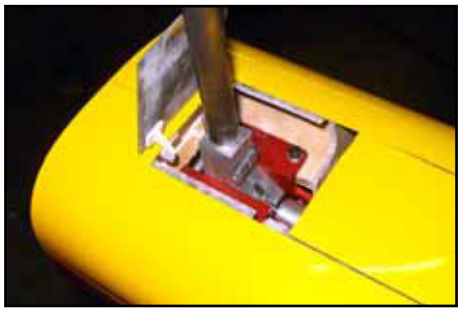
Sand the door and fuselage opening to exact size. With the nosegear installed, determine the exact position of the hinge with the tab on it for connection of the nose door cylinder (for C-ARF gear it should be 185mm from the back of the door). Space the other 3 hinges equally and mark the positions. Prepare the outside of the plastic tube, all surfaces of the phenolic hinges and the positions on the door for the phenolic hinges with a light sanding and cleaning. Also sand a 12mm wide strip on the inside surface of the fuselage, all around the perimeter of the door opening for a good bond of the hinge tube and fibreglass strips later.

File 3 (or 4) small notches (2.5mm wide and 5mm deep) in the fuselage for the knuckles of the phenolic hinges as shown in photo P4 (and above/right). Thread the phenolic hinges onto the 2mm Ø hinge wire, with lengths of the plastic tube in between - cut exactly to suit your slot spacing (photo P5). The hinge wire is inserted from the front of the fuselage through a small hole you must drill thru' the fibreglass flange and the 2 plywood bulkheads. With the nose attached the hinge wire cannot come out (P8).

Tack glue the phenolic hinges and the plastic tube in place with a single drop of CA on each. Keep the hinge wire as close to the edge of the cutout in the fuselage as possible for the widest door opening angle, at least 85 degrees. Check operation, and sand door edges as needed. Secure the hinge tube and hinges with epoxy and micro-balloon mixture.

Supplied are several 10mm wide strips of very thin clear fibreglass sheet, which should be attached around the inside of the fuselage opening to form a lip for the door to sit against when closed. Sand the fibreglass strip well, make the lips about 2 - 3mm wide, and glue on with thin CA. You can add some small 3mm x 6mm high balsa strips around the perimeter of

the door opening for additional stiffening if you wish. Finally secure the 1" stroke BVM door cylinder to the milled plywood sub-former supplied, (photo P6) and route the tubes to suit your retract and door system valve.

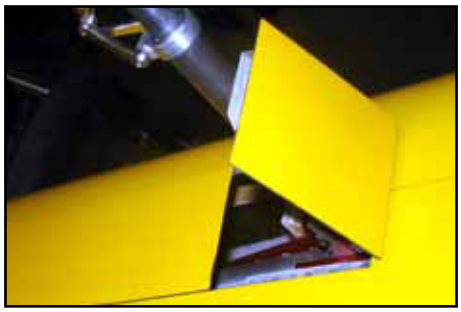


(above and below) A nice neat example of dual nose gear doors from Peter Agnew (Intairco), using offset door hinges.

Alternative Dual Nose Doors

As with all jet models, the nosewheel tends to throw up debris into the cockpit and R/C bay - which is especially dangerous on a damp runway. For this reason it is preferable to install dual nose gear doors, with the main (rear) door on a door sequencer so that it closes again after the gear has been extended - preventing 99% of this problem.

This can easily be done by cutting 85mm off the front of the supplied door, and hinging it at the front either with 'offset' door hinges, or a pair of flat plastic hinges as supplied for the wing outer doors.



Actuation of the front door is simple, using a small plywood block on the door and a cable tie around the noseleg - length adjusted for correct closing. The remaining back part of the door is installed exactly as described above, using 3 of the phenolic hinges and door cyclinder. Note that the front door has a small lip on the back edge, made from the thin fibreglass strip supplied, to provide a closure for the back door when closed.

Nose Section

The removable nose section is totally completed for you at the factory. With it (and the exhaust and tailcone) removed the plane is just 2 metres long and will fit in even a standard station wagon car, or a small box for shipping (photos P7 and P8).

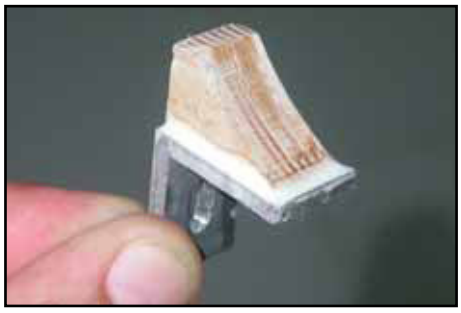
It is held in place by 3 specially designed aluminium dowels that locate in plywood formers, and retained by three M4 x 50mm long allen bolts (with a washer under the head) that go thru' the front nosegear former. It is easiest to use a ball-ended allen key to tighten the 3 bolts from inside the fuselage. If you remove the nose regularly, for transport, then you can make sure the 3 bolts don't get lost by adding a small 'O' ring or length of silicone tube over the bolts.

Engine and Ducting Installation

Turbine installation (& maintenance) is very simple with easy access thru' the large bottom hatch. It is a fully-bypassed set-up, using the new carbon composite bypass duct supplied. We recommend a turbine of 15 - 16kg thrust (eg: Jetcat Titan or P160, AMT Pegasus HP etc.) which give more than enough power for great performance and an easy Centre of Gravity position with the gear in the recommended positions. However, the bypass is 150mm diameter, which does also permit installation of larger turbines like the JetCat P200 or AMT NL Olympus HP.

(above) The carbon bypass ducting is trimmed in the factory, and the 3 rear fixings for the upper half are already completed.

The bypass duct itself is designed as an integrated structural part of the plane, and is incredibly strong when properly installed, in effect giving a 'monocoque' construction and providing extra torsional strength to the fuselage.



(above and below) Glue the shaped plywood blocks to the front angles with 30 minute epoxy and milled-fibre mixture as shown.

Note: The 'upper' bypass is the one that will be at the *top* when the plane is the normal way up, but all the next section is done with the plane upside down - working thru' the hatch in the bottom of the fuselage. Please don't get confused...

The carbon bypass duct is already trimmed at the factory. The 3 back fixings (M4 bolts and aluminium angles) for the upper bypass are already installed, and you only need to install the two M4 x 20mm bolts that fix the front end. All 5 aluminium angles have slotted holes for bolting to the bulkheads, and you can use these to adjust the back 3 (if needed) so that they fit tightly against the surface of the bypass duct.

Glue the 2 shaped laminated plywood blocks on to the top surface of the aluminium angles with 30 min. epoxy and milled-fibre mix. Rough up the aluminium surface first and clean with acetone/alcohol for a good bond. Adjust the height of the angles, using the slots, until the ply blocks are about 1mm from the bypass duct outer surface. Apply plastic tape and/or wax to the outside of the bypass in this area, and a thick mixture of 30 minute epoxy and microballoons to the top of both plywood blocks. Refit the bypass quickly, and tighten the back 3 mounting bolts, and tape the front of the bypass firmly in position.

(above) Mark the final position of all 5 angles for later reference.

When the glue is hard you will have a perfect fit between the blocks and the bypass (P9). Remove the bypass and tidy up the edges of the glue on the blocks. Refit, and bolt in place again with the back 3 bolts. Carefully mark the centrelines of the 2 front blocks on tape on the inside of the bypass, and drill right through the ply blocks and the aluminium angles at an angle of about 30 degrees with a 3.2mm drill (photo P10). Then thread these holes M4, and fix the bypass using the two M4 x 20mm long bolts and washers (photo P11). Drill and thread one hole first, and insert the bolt before drilling and tapping the 2nd one.

NB: We recommend that you carefully mark the positions of all 5 aluminium angles on the bulkheads before finally installing the bypass, because if they are moved later it is difficult to find the right position again ! (see photo above)

When the upper bypass is completed, check the fit of the white fibreglass central duct joiner, and trim the back edge if needed so that it just projects inside the bypass by 9 - 10mm. This duct joiner does not need any additional fixings, as the back edge has a glass or carbon roving on it that prevents it moving backwards when the lower bypass cover is fitted in place (see photos P14 and P15).

Trial fit the other half (lower part) of the bypass to check that everything lines up OK. At this point you should temporarily install the exhaust ducting onto the bypass cone, and slide this

over the back of the bypass duct to check lengths. The fixing tabs on the exhaust duct should be about 10 - 12mm in front of the rear bulkhead. You might find that about 5 - 6mm needs cutting off the back of the bypass.

When satisfied, fit the carbon rear cone over the back edge of the upper bypass, and drill 3 holes of 3mm Ø for the supplied M3 bolts and T-nuts to hold it in place to the upper bypass *only,* approximately in line with the 3 bolts that secure the bypass to the aluminium angles. (The red arrows in photo P13 show positions). Note that the T-nuts are fitted upside-down, with the flat face against the outside of the carbon cone, and the 'spikes' sticking up - which get covered by the epoxy/micro mixture (photo right)

The T-nuts that secure the carbon cone to the bypass (above) and the engine mounting bolts (below) are glued on inverted, and then secured with a thick mixture of epoxy and micro-balloons.

Trial mount your turbine using the manufacturers brackets, with the supplied M4 bolts and T-nuts glued underneath the carbon side rails (fitted upside down), with a thick epoxy/microballoons mixture. Make sure the turbine is exactly straight and in-line with the flying axis of the model (photo P12). The optimum distance between the back of the turbine exhaust nozzle and the front edge of the 45 degree angled 'bellmouth' on the inner tube varies for different turbines, but a good starting point for a JetCat P160 or AMT NL Pegasus is 12 - 15mm. A little adjustment may be needed for lowest turbine EGT's, and exhaust tube cooling, especially after long periods at 'idle'.

3mm ply packing on Jetcat P160 mount to centre it in bypass duct.

Important: Whatever make of turbine you install, please read, and follow, the manufacturers instructions and recommendations before installing your motor.

Some brands of turbine have slightly offset mounting brackets (eg: JetCat), and in this case you should pack them off the ply mounting rails with 3mm plywood spacers to get the turbine in the vertical centre of the bypass, which is very important for the best performance and cooling of the motor and exhaust tube.

Now you can fit the lower bypass (bypass cover) and cut any clearance slots around your turbine mounting bracket, and to clear the cables and fuel/gas tubes to your turbine. The lower bypass is held in place using 2 sheet-metal screws 2.9Ø x 13mm into plywood plates glued under the front flange, and a pair of M3 bolts and T-nuts in the middle.

Note: Remember that carbon-fibre composite is *extremely* abrasive and *all* tubes or wires that pass thru' it *must* be protected, either by fitting rubber grommets in the holes, or wrapping the tubes/wires in plastic 'spiral-wrap' or similar (see photos P14 and P15).

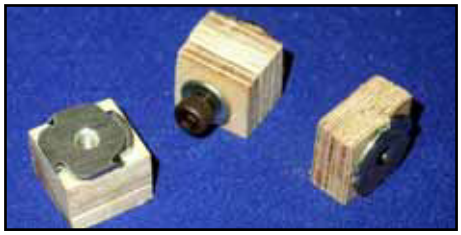
Exhaust Duct/Thrust tube

This is a 'generic' twin-walled system,consisting of lightweight aluminium outer tube, and a 0.25mm thick stainless steel inner tube, spotwelded together. It is designed to work with a wide

range of turbines and it is, therefore, a compromise - but has already been used very successfully with several different turbines including JetCat Titan, P160, P180 and AMT NL Pegasus HP types. If you find that you have a warm fuselage after an extended idle period, then you can increase the cooling air around the outside of the outer tube by making a couple of small additional air inlet holes in the bottom hatch (see photo P19). Although the exhaust tube is preassembled for you, we recommend that you check that all the securing bolts and nuts are tightened and Loctited before installing the duct in your fuselage.

Install the tube in the fuselage, fitted onto the bypass cone tightly. You may need to make 3 small semi-circular cutouts in the rear bulkhead to clear the nuts on the outside of the tube. The aluminium outer exhaust tube should be a tight fit over the back of the carbon cone, but you can sand this if it is a bit tight. It should push over it by about 5 - 6mm (photos P12 & P14.)

The tube is held in place using three M3 x 12mm bolts, washers, T-nuts and 3 small ply blocks on the front face of the rear bulkhead (photo P16). Make up the 3 plywood blocks using the 12mm wide 3mm thick ply strip supplied. Because the rear bulkhead is angled slightly in the fuselage, the blocks at the lower side need to be thinner than the top side. Normally you will need one block of 6mm thick, and 2 blocks of 9mm thick.



Laminate 3 blocks from the ply strip with thin CA, for exhaust mounting to the rear bulkhead.

Glue together with CA, and drill thru' 4.5 mm Ø to accept the M3 T-nuts on the back face of the blocks, against the bulkhead. Drill 3mm holes in the tabs on the exhaust duct for the M3 bolts and washers. Rough sand the back face of the T-nuts, and bolt the blocks to the exhaust duct tabs. Install the duct onto the bypass cone and push into place. Install the upper bypass and bolt in position.Trial fit the fibreglass tailcone onto the fuselage to check that the exhaust tube is centred. When all is aligned, glue the blocks and T-nuts to the bulkhead with slow epoxy and milled fibre, aligned as shown so that you can access the upper bolt with an M3 ball-ended wrench.

Bottom Hatch

The large bottom hatch is 95% completed for you, and only needs the fixings installing. The front is retained with three 6mm Ø carbon pins, and the middle and back of the hatch with 4 allen bolts (M4 x 25mm) into T-nuts glued into the fuselage. The plywood support plates for the bolts and T-nuts are already installed and reinforced with fibreglass cloth.

Important: Please *do not* modify this hatch fixing in any way. The hatch must be fixed onto the fuselage securely to give torsional stiffness to the rear of the fuselage, and if it is not fixed properly it could result in terminal flutter of the fin and stabiliser.

The 3 carbon pins must be glued securely into the front of the hatch, and the plywood bulkhead inside. Drill the 6mm holes in the front of the hatch first, one on the centreline, and one about 135mm either side (photo P17), with the centres about 8mm down from the outer surface of the hatch. Make sure that you drill the holes in the hatch parallel to the fuselage centreline. Transfer the hole positions onto the fuselage (P18).

Drill the holes in the fuselage a bit small to start with, about 5mm diameter, and then open up with a round file to fit. Work on one pin and hole at a time. The carbon pins must project out of the hatch by at least 9mm (3/8") so that they pass through the fibreglass lip *and* the plywood bulkhead in front of the it. Don't forget to prepare the gluing surface of the carbon pins. Finally

when all holes and pins line up and fit nicely, apply a little slow epoxy to each pin, push into the holes in the front of the hatch, and then install the hatch and tape it down firmly until the glue has cured. Additional glue/micro-balloons mixture can be added to the ends of the pins that project inside the plywood in the hatch afterwards, and any excess carbon rod cut off.

(above) Drill holes from the inside, fit the hatch and re-drill from outside to transfer holes to the ply plates in the fuselage.(below) Rear hatch fixing bolt & T-nuts. Also shows a Stab fixing plate and T-nuts, factory installed.

When the front hatch fixing is completed you need to drill the holes for the 4 bolts that secure the hatch. Because it is difficult to drill accurately through the curved outside surface of the hatch, turn it over and drill 4mm diameter from the *inside* thru' the ply plates in the hatch and the fibreglass outer surface. Position the holes about 13mm from the edge of the hatch, and make sure to drill vertically. Tape the hatch firmly in exactly the correct position on the fuselage and drill 4mm Ø back thru' the holes, from the outside, to transfer the positions to the plywood plates in the fuselage. Once again, make sure that you drill accurately and vertically, as any misalignment of the holes will distort the hatch when the bolts are tightened. For best alignment we suggest you complete the back 2 fixing bolts and T-nuts first, before the middle two.

Enlarge the holes in the fuselage plates only to 5.5 or 6mm Ø for the T-nuts. Enlarge the holes in the outside surface of the hatch to 7mm diameter, to fit the bolt heads. Fit the four M4 T-nuts under the fuselage plates and use a spare M4 bolt and large washer to pull the spikes into the ply just a little. Add 30 minute epoxy to secure each T-nut. Before the glue has cured, refit the hatch and insert the M4 x 25mm bolts into the T-nuts and tighten, checking for good alignment. Short lengths of tubing stop the bolts coming out and getting 'lost', as per the wing bolts. You can also add a couple of small location tabs in the side-rails of the hatch to correct any slight mis-alignment, using the phenolic strip supplied, in the same manner as seen on the side-rails of the cockpit canopy frame.

Depending on your turbine set-up and installation, and the ambient temperatures you fly in, you can increase the cooling airflow thru' the fuselage and around the exhaust ducting by cutting a couple of slots (approx. 35mm x 80mm long) in the bottom hatch. Radius the corners to prevent any tearing of the composite skin. You should glue a fine mesh on the inside of the hatch, covering the slots, to prevent stones and debris getting into the fuselage (photo P19).

Tail Skid

If you should accidentally over-rotate during take-off or landing, the tips of the stabiliser, and the elevator horns, could touch the runway due to the stab's anhedral. This especially likely if you use smaller wheels than the ones we supply in our optional landing gear set.

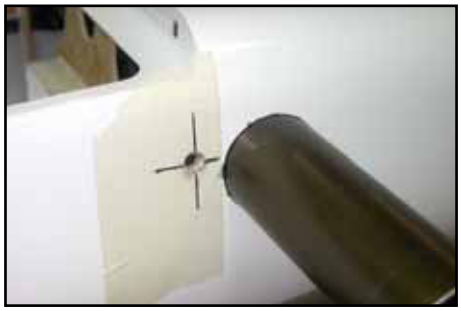
To prevent any possible damage on the prototypes we installed a small 'sacrificial' tailskid, using a length of bicycle spoke that fitted tightly into a short length of brass tube epoxied into the the back edge of the ventral fin. Of course this is just an optional item, and there are many methods of ensuring that the stab tips are not damaged on the runway surface.

Wings

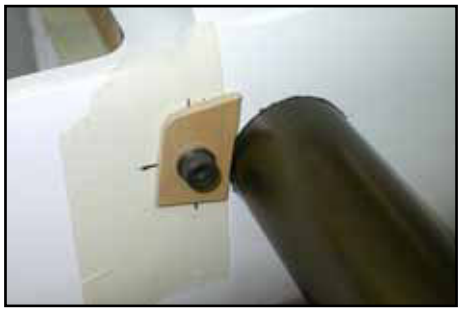
The wings are almost completely finished at the factory. The control surfaces are hinged and trimmed, and the phenolic control surface horns are installed already. The wings are mounted using the anodised aluminium alloy 6061-T6 spar tube (40mm Ø x 990mm long), and a pair of 10mm diameter carbon anti-rotation pins in each wing, which have been installed for you and the wing incidences checked. They are held onto the fuselage with M6 bolts and washers, that pass thru' the plywood root rib and into M6 T-nuts that you need to install in the fuselage.

Wing Bolts

Drill a 6mm hole thru' each plywood wing root rib, exactly 13mm (1/2") behind the back edge of the fibreglass wing tube, about 3 - 5mm *below* a centerline taken between the 2 carbon wing dowels. Fit the wing tube into the fuselage and slide the wings on. The wing roots have been trimmed to match the fuselage already, but you can do a little fine sanding here if needed. Working thru' the landing gear opening with the plane upside-down, mark the centre of the 6mm hole on the outside of the fuselage, remove the wings and drill the holes in the fuselage 7.5mm diameter.



(above) 7.5mm Ø hole in fuselage for wing bolt T-nut, 13mm behind wing tube.
(below) Scrap ply and large washer under the bolt to pull T-nut into plywood inside the fuselage.



Refit the wings and wing bolts, with washers, thru' the holes in the root rib, and screw on the M6 T-nuts *gently* - just enough to hold the T-nuts in the correct position. You will need a 5mm ball-ended hex-wrench to tighten the wing bolts, because of the angle. See photo P31 for a view of the bolt inside the wing, just in front of the gear door cylinder. The T-nut is quite close to the bulkhead in the fuselage, and you may need to grind off the front edge of the nut for clearance.

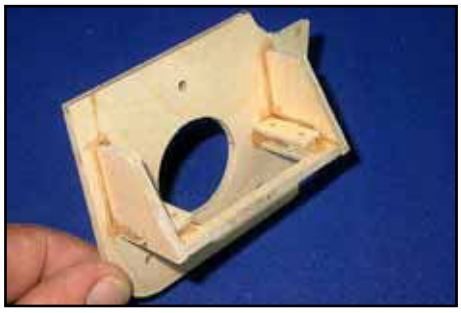
Remove the wings. Then use the M6 wing bolts with a large washer under the head and a scrap plywood plate with a 6mm hole in it to pull the T-nuts tightly into the plywood plate inside the fuselage. Refit the wings and wing bolts to check alignment of the T-nut, and then secure them with a little 30 minute epoxy. There is enough space between the wing root rib and fuselage to put an 'O' ring, or a short length of silicone tube, on the M6 bolt to prevent it falling out and getting 'lost' when the wings are removed for transport or storage (photo P21).

(above) Reinforce the joint between the back of the balsa spar box and root rib with fibreglass if not done at factory. Note the shape of the cutout in the wing skin for the inner gear door.

It is not necessary for the wing bolts to be overtightened when assembling the plane, and this could damage the joint between the root rib and the wing spar box. We advise you to laminate a small piece (60mm x 60mm) of heavyweight (160 - 200 gram) fibreglass cloth in the corner between the ply root rib and back face of the balsa spar box to reinforce this joint, but this will be done in the factory for the next production run. (see photo right)

Ailerons

The aileron servos are mounted on milled plywood mounts, supplied, and these are secured in the wing with three M3 x 12mm bolts and M3 washers onto the pre-installed plates (photo P22). Please don't forget the washers as otherwise the bolts could touch the top wing surface. Make up the servo mounts as shown in the photo here. Glue together with thin CA, and then glue securely with a good fillet of epoxy (photo P23). These are important joints so make sure to prepare the surfaces well before gluing together. Fit the metal servo arms to the servos, and centre them using your transmitter.



(above) Milled plywood aileron servo mounts glued with CA, and then with epoxy when complete.

Mount your servos using the supplied 2.9 Ø x13mm sheetmetal screws. Attach an M3 ball link to the inner side of the servo arms using an M3 bolt (photo P23). If using SWB 1" arms you will need to cut off the last hole, and use the hole that is 22mm (7/8") from the centre of the servo arm securing bolt, and re-drill the hole in the arm 2.8mm diameter. There is a milled hole in the corner of the aileron servo bay to route the extension lead under the retracts, and then forward through the holes in the balsa spar box to the wing root.

Make up the linkages using the 150mm long M3 all-threaded rod, and an M3 ball-link that is sandwiched between the dual phenolic aileron horns with an M3 x 20mm bolt and M3 locknut. Use one plain M3 nut against each ball-link to lock it in position (photo P24).

Important: The plywood plates that the aileron servo mount is bolted to are already installed in the wing for you, with the M3 T-nuts sandwiched between a 3mm plywood plate and a 5mm balsa plate that is bonded to the underneath of the top wing surface at the factory. Do *not* add any extra glue around the curved plywood tabs that hold the T-nuts. If they are glued directly to the top wing surface you will deform it when the three M3 bolts that secure the aileron mount are tightened.

Flaps/Spoilers

The milled plywood flap servo mounts are already installed for you. Fit 1" SWB servo arms to your servos, and centre them with the R/C so that at the flaps 'up' position the arms are both angled forwards the same amount - about 45 degrees. You will need to cut the last 2 holes off the 1" SWB arms and use the 2nd hole out from the centre (18mm or 3/4") of the servo arm, and drill 2.8mm Ø for the M3 x16 bolt and lock-nut that secures the ball-links onto the arms. Fit the servos with the arms towards the top wing surface, at the front of the servo. Secure with 2.9 Ø x 13mm screws provided (photo P25).

The linkage is made up from the M3 all-thread x 75mm, with the ball-link on the servo end, secured with an M3 x16 bolt and locknut, and an M3 aluminium clevise with pin and E-clip to connect to the phenolic flap horn. Adjust the small milled slots in the fibreglass flap glove to clear the linkage at full throw, which is about 45 degrees for landing. You can shape them like a 'keyhole' to clear the linkage and clevise at the top, and just a narrow slot at the bottom for the phenolic flap horn (photo P26).

Flap Hinges

Because of the high loads on the big flaps at large deflections we have installed a pair of phenolic hinges to support them, as well as the elastic hinge. A few early kits were shipped without this improvement, but these phenolic hinges can be easily retro-fitted by you, which we strong-

ly recommend. If your Ultra Lightning does not have these installed in the factory please contact your Rep, or email us directly on: info@carf-models.com and we will send them to you immediately.

The centre of the hinge pin must be exactly on the hinge axis.

The inner hinge support should be glued up against the inside edge of the wing root rib and flap root rib. Prepare all surfaces properly by sanding and cleaning with alcohol before gluing in place. Cut the small square holes (approx. 4mm x 5mm) through the elastic hinge for the knuckle and 3mm Ø aluminium hinge pins with a fine sharp knife and file to size. It is important that the centre of the hinge pin is *exactly* on the axis of the elastic hinge (P27 and right).

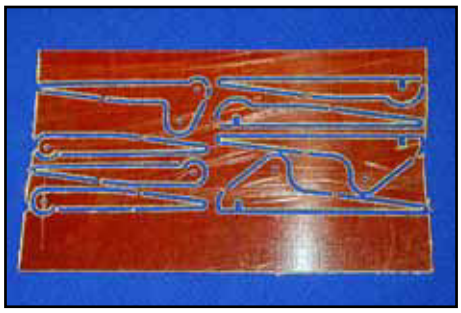
To fit the outer hinge support you need to mill 2 small holes in the fibreglass flap glove and plywood false trailing edge of the wing, and also in the leading edge of the flap and flap glove, as shown in the photo P28. It should be positioned just inside the balsa rib at the outboard end of the flap. Assemble both hinges with the 3mm aluminium pins and E-clips, install and tack in place with a drop of CA. Check alignment and flap operation carefully, and then secure with plenty of slow epoxy and micro-balloons or milled fibre mixture. You can mill a small hole in the flap outer rib for better glue access if needed.

Geardoors

The gear doors are very simple to fit, but need quite a lot of explanation. They are cnc milled from a very strong carbon/fibreglass composite, combined with the wing servo cover, and painted to match the underside of your wings. The hinging is simple and reliable, using a length of 2mm wire and plastic tubes, combined with the milled phenolic hinge plates (right). The opening in the wings for the LG and doors is already cut for you, needing only final adjustment for your chosen wheels.

Inner Doors:

Sand the inner ends of the wheel wells right up to the edge of the moulded lip, using the moulded edge as a guide to keep it straight, and also notch the sides about 15mm long to allow for the inner door to swing inside the wheel well. (see photo @ bottom of page 17 for shape).



Milled phenolic hinges for main and nosegear doors.

Separate the phenolic hinges from the sheet and prepare with a light sanding. Separate the main (inner) door from the rest of the milled sheet, and sand the edges for 0.75 - 1mm gap all round, and also on the inside surface where the phenolic hinges and tubes will be glued. Clean carefully. For each door cut 4 lengths of the supplied plastic tube 20mm long, and pieces of the 2mm Ø wire 55mm long, and put a 90 degree bend in the ends of the wires, as shown. Scuff up the outside surfaces of the plastic tube with 240 grit.

Position both the phenolic door hinges 13mm from the edge of the door (the front one has the tab and hole for the door cylinder), and tack into position with a couple of drops of thin CA. Tack glue 2 of the 20mm lengths of the plastic tube inside the hinges, using the wire for alignment with the milled holes. Slide the other 2 lengths of tube loose over the wire hinge pins (photo P29).

Mill a 4 mm diameter hole in the back of the balsa spar box for the front plastic tube, right up against the inside of the wing sandwich. The hole is oversize to allow for some adjustment. As the wing construction sandwich is a bit thicker than the door thickness you must relieve the sandwich above the hole a little, and also in the position for the back hinge tube, so that the doors close completely flush. A flat Permagrit needle file, that can be bent and then straightened afterwards, is excellent for this job (right).

Trial fit the door and check that it closes completely flush with the wing surface. Tack glue the outer plastic tubes into the holes with a a drop of slow CA, and set the door alignment with the moulded recess on the bottom wing surface before it cures. Add some thickened epoxy and micro balloons to secure the tubes properly, and a small block of hard balsa or ply under the rear tube (photo right). Secure the inner tubes and the phenolic hinge to the door properly now also, again using a small fillet of epoxy and micro. The 'L' shape bend at the inner end of the hinge pins can be secured to the door with a drop of 5 min. epoxy, so that they can be removed for maintenance if required.

(above) Indentation and slot for door cylinder, and hole on back of balsa spar box for plastic tube.

(below) Fit a hard balsa or ply support under back hinge tube.

Bolt the short BVM door cylinder to the back side of the front phenolic horn with a small nut and bolt. This cylinder is only just short enough, and needs to be fitted accurately in quite a small space. You will need to cut a small slot in the wing root rib that the inner 'ear' of the door cyclinder attachment sticks thru' (see photo P20 and above), and you can also carefully mill a small indentation in the foam sandwich to give an extra 1 or 2mm of depth here (see photo above). Make up the fixing block for the door cyclinder with 3 small squares of 3mm plywood glued together with CA (cut from the 12mm wide ply strip provided). Cut or file a slot in the block for clearance of the air tube as shown, and mark and drill the hole for the single securing screw now - it is difficult to do when the block is glued in the wing!

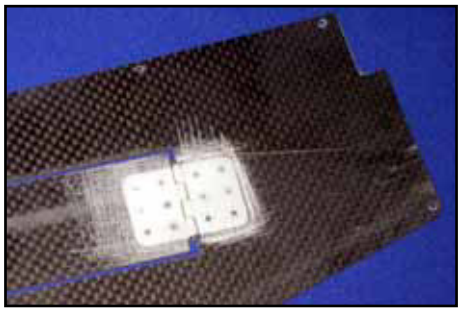
(above) Small block made from 3mm ply for the door cylinder.

Attach 2 lengths of air tube to the door cyclinder, and screw to the securing block. Prepare the area in the wing for gluing the ply block in place. Trial fit in the wing, with the 'ear' of the attachment thru' the slot in the root rib. Tack in place with 1 drop of thin CA and check that the door closes flush with the wing, and also that you have clearance to your wheel when the door is fully open. Adjust if necessary. When satisfied glue the block in place permanently with epoxy and micro-balloons mix.

Outer Doors and Servo Covers:

Separate the outer door from the rest of the servo and LG cover, and clean the edges as needed for a perfect fit. Drill thru' the cover and the lip around the recessed opening in

the wing in 8 positions (as shown in the photo below), diameter 1.7mm for the small 2.2 Ø x 10mm sheetmetal screws. Open up the holes in the cover *only* to 2.2mm Ø. Cut 8 small squares of ply (from the 12mm wide strip supplied) and glue these underneath the wing skin with thin CA to cover the holes as reinforcement for the screws (photo P32). Redrill the wing lip holes thru' the ply pieces Ø 1.8mm. Cut a notch in the corner to clear the aileron linkage and screw the cover in position.



(above) Hinge glued to outer door and servo cover.
(below) A simple outer door connection - parts included in kit.

With the retract and oleo leg installed, check that the door slot in the servo cover plate clears the bottom of the leg when the gear is in the 'down' position by about 5 - 6mm for the knuckle of the plastic hinge used on the outer door. Adjust if needed. Remove the servo cover and file a small notch in it to match the knuckle and hinge pin of the plastic hinge. Notch both corners of the gear door (photo P33), either side of the plastic hinge, so that the door can open a little more than 90 degrees without the door touching the servo cover plate.

(above) Machined aluminium collars for outer door connection - included in LG option pack.
(below) Servo cover is fixed to ply tabs under wing skin with 8 sheetmetal screws (2.2 Ø x 10mm)

Prepare the end of the outer gear door and the inside surface of the servo cover where the hinge will be glued carefully. Rough up both surfaces of both sides of the plastic hinge with 60 grit sandpaper, and then glue the hinge onto the inside surface of the servo cover using 30 minute epoxy and milled fibre mix. You will also need to sand a small notch in the top of the plywood rib outboard of the retract unit so that the servo cover fits flush again, because of the thickness of the hinge and glue (photo P34).

Reinstall the servo cover, retract, oleo and wheel. Check the fit of the outer door, and when satisfied sand and clean the area where the hinge will be glued on to it. With the landing gear in the retracted position, tack glue the hinge onto the door with 1 drop of thick/slow CA, and adjust position so that is parallel with the sides of the opening before it cures. Open the door and ' trap' the hinge in place properly with more 30 min. epoxy and milled fibre.

There are many proprietary door fixing attachments and methods, and our optional landing gear set includes machined aluminium collars that clamp to the leg for securing the outer door. An simple alternative is to use a piece of Ø 1.0mm steel wire bent into a 'hoop' shape, and a short length of brass tube glued to the outer door, as supplied in the hardware pack. (photo above). Adjust the lengths of the sides of the linkage hoop for correct door closing when the gear is retracted. When the final position and length of the wire hoop has been determined, file a very small slot (1mm wide and deep) in the inside surface of the oleo that the wire hoop sits in, and retain it with a 'x' shaped wrap of stainless steel tying wire or very small cable-ties.

Stabiliser

(above) The stabiliser is retained with two 6mmØ carbon pins at the back, and two M4 bolts at the front. All factory-finished.
(below) Cut out the plywood bars across the servo holes, if not already done at the factory.

The stabiliser is 95% completed at the factory. It is held to the fuselage with a pair of 6mm diameter carbon pins at the back, and two M4 x 60 bolts at the front into T-nuts in the fuselage. The dual phenolic elevator horns are also installed for you, and set at the correct angles with a jig.

Remove the fibreglass servo hatch and you will see the 2 pockets in the 6mm thick plywood root rib for the servos, which are sized for JR8511/8611 servos, and they already have milled holes for the servo screws. There is a small plywood bar that joins the 2 parts of this rib together for the production process, and these should be cut out. (The latest kits have these removed at the factory for you). Trial fit your servos, and carefully mark the position in the bottom skins for the cutouts needed for the servo arms. It is a little tricky to fit the servos and arms, but they do fit in there! Make small slots for the servo arms at this stage, exactly in line between the servo arm and the phenolic elevator horns, and enlarge to suit your throws later.

The servos are fitted inverted, so the brass eyelets in the rubber servo grommets should be reversed. Fit the servos using the 2.9mmØ x 16mm long sheetmetal screws provided - *not* the standard screws supplied with the servos, as these are too small (and short) for the milled 2mm Ø holes. It is easiest to use a long X-head screw driver to insert the servo screws, because of the angle (photo P35).

Make up the linkages from the 120mm long M3 all-threaded rod provided, with an M3 aluminium clevise and M3 nut to connect to the 1” SWB servo arm and an M3 ball-link bolted between the dual phenolic elevator horns with an M3 bolt and M3 lock nut. There are 2 lengths of 3mm I.D. brass tube in the hardware, which should be fitted over the outside of the all-thread to further stiffen it - and it is highly recommended that you fit these (photo P36).

IMPORTANT NOTE: As the pin in the clevise is made from aluminium, and it fits tightly into the hole in the aluminum servo arm it is imperative that you apply a little grease or light oil to this joint too make sure that it can swivel smoothly and cannot lock together.

A painted fibreglass servo cover is provided, and this should be fitted in exactly the same way as the wing servo cover (P32) - using 4 small plywood squares glued under the stab surface and 4 of the 2.2mmØ x 10mm sheetmetal screws (photos P37 and 38).

As the servo extension wires are quite close to the bottom of the hot exhaust tube, make the holes for them to exit the servo cover at the outer ends as shown (photo P38), to give the maximum clearance to the exhaust ducting and protected with ‘spiral-wrap’ or similar. Of course they should be routed to the sides of the fuselage when the stabiliser is in place, and secured carefully so that they cannot contact the ducting (photo P47).

Fit the stabiliser, locating it on the 2 short 6mm Ø carbon pins at the back edge that are installed at the factory, and bolt in place using the supplied M4 x 50mm high-tensile steel bolts into the factory-fitted T-nuts at the front, tightened firmly.

Vertical Fin and Rudder

(above) Overview showing the plastic nut at the front and servo cable with spiral-wrap protection. (below) Plastic fairing shown glued over the rudder linkage.

The vertical fin is 99% completed at the factory, and just needs the rudder servo and linkage fitting. The Rudder is elastic-hinged and cut loose for you. The carbon spar tube is shipped fitted into the tube in the fin (for protection and fit checking), but it must be glued into the fibreglass tube in the fuselage - *not* glued into the vertical fin. The front of the fin is secured to the fuselage with the large M6 knurled plastic nut (supplied), onto the threaded aluminium dowel that is already installed in the fin.

With the wings and stabs finished and bolted into position on the fuselage, fit the carbon tube spar into the fuselage, with the bottom flush with the end of the fuselage tube, and mark the part that will be glued in (about 60 - 65mm long). Lightly scuff both the inside of the fibreglass fuselage tube and the outside of the carbon spar tube that will be glued together, and clean the dust off with alcohol for a good bond. Apply plenty of clear wax to just the upper part of the carbon tube that will be exposed, to prevent it getting glued into the fin, and also the bottom surface of the fin around the tube area.

(above) The carbon tube spar must be glued fully into the fuselage tube, shown above. (below) Fin taped in place while gluing the carbon tube into the fibreglass tube in the fuselage

Fit the tube into the fin. It should be a very tight fit, and the wax you applied will help here. Apply 24hr. epoxy resin and milled fibre mixture (or Aeropoxy/Hysol) into the tube in the fuselage and on the exposed part of the carbon tube. Fit the fin and tube in position. Tighten the plastic nut onto the aluminium dowel at the front. Make sure excess glue does not seep out and glue the fin to the fuselage! Some tape on the bottom of the tube in the fuselage stops excess glue dripping onto the top of the Stab. Check that the fin is exactly vertical by eye, using a large 90 degree square, and also by measuring from the tip of the fin to the ends of the horizontal stabiliser. Tape firmly in place until the glue has cured (see photo below/right).

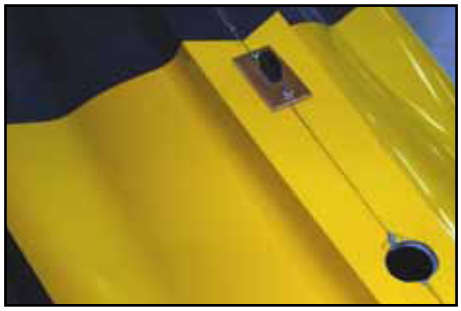
Fit the rudder servo (JR8511/8611) into the plywood servo mount, with the output shaft towards the front end of the servo, and screw into place with the 2.9Ø x 13mm sheet-metal screws provided (photo P39). Cut a small slot in the side of the fin in line with your servo output arm, and enlarge to suit the linkage later. Fit your metal servo arm (1" SWB arm, with outer hole cut off, and re-drill the 3rd hole out from the centre 3mm Ø for the clevise pin) and make up the linkage using the supplied M3 aluminium clevise, pin and E-clip at the servo end, and an M3 ball-link, and M3 x 20mm bolt and locknut to secure the ball-link between the dual phenolic horns (P40).

Adjust the linkage to exact length and then fit the 3mm I.D. brass tube over the threaded rod to stiffen it. The plain M3 nuts at each end of the linkage lock the tube into position, and prevent

the ball-link and clevise from turning. Supplied in the kit is plastic linkage fairing, pre-painted to match the fin colour, which can be glued in place to cover the linkage (see photo page 23).

IMPORTANT NOTE: As the pin in the clevise is made from aluminium, and it fits tightly into the hole in the aluminum servo arm it is imperative that you apply a little grease or light oil to this joint too make sure that it can swivel smoothly and cannot stick together.

Fit the socket of your extension lead from the receiver into a small piece of phenolic or plywood and glue into a slot in the top of the fuselage under the Fin root, to connect the servo lead into (right). We highly recommend that you protect the servo extension lead inside the fuselage with aluminium tape, or equivalent, and check it regularly - as it is directly above the exhaust ducting and could be damaged if you have any accidental wet-starts or similar. You should add a small plate of 3mm balsa underneath the socket in the fuselage, and cover this with aluminium tape, as well as the extension lead where it is routed to the the side of the fuselage. (see photo P47)



(above) Glue the rudder extension lead socket into a small ply or phenolic plate on the fuselage.

Fuel System

Main tanks

Included in the kit are a pair of 'kidney-shaped' composite-kevlar moulded 'baffled' fuel tanks (capacity 2.9 litres each) which have already been joined, fitted with the aluminium sleeves for the cap, checked for integrity and fitted into your fuselage. They are held in position by the spar tube, which makes removal for maintenance simple and quick, but when you remove this tube for transport you can fit a shorter piece of tube (about 350mm long) temporarily to keep the tanks in position. The angled fuel stopper positions allow you to carry out all normal maintenance of the tanks without removing them from the fuselage. All necessary hardware to complete the fuel system is included in the kit (kerosene stoppers, aluminium caps, clunks, tees, brass tube and clear fuel tubing).

Use the supplied lengths of 4mm brass tubing in the aluminium caps and the kerosene stoppers, which are all included. Because the main tanks have a baffle in the middle you need to make the tube inside the tank to the clunk weight from 2 shorter pieces of the flexible tube, with a length of brass tube in the centre where it passes through the baffle. If you don't do this the edges of the hole in the fibreglass baffle will cut thru' the flexible tubing in just 1 or 2 flights.... (photo P41).

The fuel tube supplied is 4mm I.D. and therefore you must definitely add fuel 'barbs' to all the brass tubes to prevent air being sucked into the fuel system. Provided in the hardware are 10 very short lengths of 4mm I.D brass tube which should be soft-soldered over all the 4mm O.D brass tubes where the fuel tube will be connected, about 10 -12mm from the ends. Clean both parts first with 'Scotchbrite' or fine sandpaper for good joints (see photo P42).

You can either use heavy clunks in the main tanks, or you can use 2 of the felt clunks provided in the hardware *with the felt removed*. The extra drag of 3 felt clunks on the fuel system can cause high fuel pump voltages, and in extreme cases insufficient flow to your turbine.

When you finally install the fuel tanks they should not be a loose fit inside the fuselage, and you can add small foam pads to hold them firmly in position if necessary.

We have also included 2 Festo 4mm barbed Tee's for connecting the 2 'feed' and 'overflow' tubes from the main tanks together, in parallel, as shown in the installation photos.

Connect the main tanks together, with *equal* lengths of tube (supplied), in parallel, and then take a single tube from the Festo Tee to the 'fill' inlet at the top of the hopper tank.

Connect the vent/overflow tube from the Tee to a short length of brass tube and fit this in your chosen position in the bottom of the fuselage. You can fit this just inside the back edge of the nosegear opening, so that is hidden in flight (and cannot get damaged) but 'overflow' fuel comes out though the nosegear door when it is on the ground being fuelled, and also if you put the plane on its nose for wing attachment etc. A better choice is to position the 'overflow/vent' tube towards the back of the plane (behind the main tanks) so that no fuel leaks out when you hold the plane on its nose during assembly and attaching the wings etc. for flight.

Important Note: Please wash out your fuel tanks carefully before final assembly and installation in the plane to remove any particles from the manufacturing and joining processes.

Hopper Tank

Also included is a 300ml (10 ounce) hopper tank, and all the hardware required to complete and install it in the plywood sleeve in the bulkhead behind the cockpit, for visibility and easy maintenance. Wrap the plywood sleeve *tightly* around the hopper tank with the bubble on the tank in the 'U' shaped cutout, and temporarily secure with a couple of rubber bands while you join it with CA. Lightly sand the outside of the plywood sleeve and then glue it in the circular cutout in the top of the bulkhead just behind the cockpit with some epoxy/micro mixture (see photo above). The 'U' shaped cutout should be at the top (12 o'clock position). Leave the tank in place while the glue cures to make sure you have a tight sliding fit after afterwards. It is not necessary to secure the tank in any other way.

(above) Hopper tank located in plywood sleeve.
(below) Hopper tank and sleeve installed in bulkhead.

Our preferred method is to have a felt clunk (eg: Webra #1121) fixed to the end of the feed tube that goes to the fuel pump, in the 3-dimensional centre of the fuel tank. In 'IN' tube that goes to the top of the tank is connected to the 2 main fuel tanks, via a 'Tee' piece. If you wish you can fit a 3rd tube for filling the fuel system. Alternatively you can install a quick-connect Festo (or similar) fitting between the

feed tube and the fuel pump and disconnect here to fill, and this has the added advantage that you cannot accidentally fill the turbine with fuel if the manual shut-off valve has been left open, or the fuel solenoid valve allows a small amount of fuel to pass thought it. It's your choice.

Use the same method as for the main tanks to assemble the tubes, with either fuel barbs or small brass tube rings soldered onto them to make sure that there can be no leaks.

Fuelling

Because the 2 main tanks have baffles in them, to prevent fuel surge and Centre of Gravity changes during aerobatic manoeuvres, it is important to remember to fuel the model until the excess comes out of the overflow/vent under the model, and then *wait for a 10 - 15 seconds* before topping them up again. If not, you may end up taking off without full tanks....

Optional 3rd Tank

Also available (as an option) is a 3rd main tank, moulded from kevlar, with a maximum capacity of 2.1 litres, which can be fitted either above or under the ply plate between the inlets. This can be used to hold extra fuel if you fit a larger turbine (eg: P200 or Olympus), or could be used to hold smoker fuel if you wish to fit a smoke system. If used as an additional fuel tank, it should be connected in series between the Hopper and the Tees to the main tanks, and it will be emptied first.

(above) The extra fuel tank can be installed above, or below, the plywood plate between the inlets.

It is supplied in 'kit' form, with all the necessary hardware (stopper, cap and sleeve), and instructions for joining by you. The lower half of the tank is flanged for easy joining, with Hysol 9462 or similar. If fitted above the plywood plate between the inlets you can join it at the maximum size, but if you choose to fit it below the ply plate you will need to cut down the height by about 12mm (1/2") to fit it in place - giving a capacity of about 1.7 litres. Remember to leave enough space above the tank to route all the servo extension leads, air lines and services to your turbine.

Tail Cone

The pre-painted fibreglass tailcone is retained to the fuselage with 6 of the small 2.2 Ø x 10mm sheetmetal screws, into small plywood squares that need to be glued, equally spaced, inside the fuselage flange (photo P46). Because of the slight taper on the inside of the tailcone you might need to chamfer the outside edge of the fibreglass flange on the fuselage a little for a good fit (see photo P45).

The back edge of the fibreglass tail cone is supplied a little bit long, and should be cut off with a disc and trimmed back with a flat block and fine sandpaper until it is the same length as the outer exhaust tube.

Cockpit Frame and Canopy

(above) The front of the canopy is secured with an M4 bolt, thru' a plywood plate into a T-nut in the fuselage - all factory finished! (below) The canopy frame is secured with 2 phenolic hooks into phenolic plates in the side-rails, and 2 location tabs.

The moulded fibreglass canopy frame has already been trimmed at the factory, and the securing method completed for you. It only remains for you to fit the clear cockpit canopy, and optional plastic cockpit tub if you wish.

The cockpit canopy is held in place by a pair of phenolic hooks at the back, located in the middle with 2 small phenolic tabs, and secured at the front with a single M4 allen bolt into a T-nut in the fuselage.

Fitting clear canopies can be a little bit tricky, but this is the method we use: Sand the inside edges of the fibreglass canopy frame (and especially the fibreglass joining tapes) carefully with 240 grit sandpaper, to ensure a perfect fit of the canopy inside. Lay the clear canopy on top of the frame, and mark the rough shape with a felt pen or wax crayon. Cut the outer border of the clear canopy with sharp scissors, about 12mm (1/2") too big all around. When the canopy fits inside the frame, mark the final cut line on the clear plastic. Then cut it to exact shape with a 6 - 8 mm overlap all around. Do this in a warm room to make sure that you don't split the clear canopy.

(above) Make plenty of tape 'handles' to hold the clear canopy in place while gluing into position.

Make several hand-holds with paper masking tape (see photo) to make holding and positioning the canopy easy. Push the canopy up tightly inside the back of the frame and fix the bottom 2 back corners with one small drop of slow CA each (ZAP-O or Plasti-ZAP recommended). **Note:** Do NOT use any CA accelerator/kicker - you will immediately 'fog' the clear canopy!

Visually check from the front and back to make sure sure that the canopy is straight. Tape the front of the canopy to the frame temporarily. Mount the canopy frame to the fuselage and tape the top/back corner of the canopy frame tightly to the fuselage. Using the masking tape handles to pull the canopy outwards firmly against the frame, working from the back towards the front, glue the edges of the canopy in place in 2 more places each side, and to the fibreglass top hoop, with just a single small drop of CA at each position, all the time checking that the edge of the canopy is tight up against the frame at the front.

Visually check from the front and back again to make sure sure that the canopy is straight. Now that the canopy is fixed in position and cannot twist anymore, you can carefully glue the rest of the canopy firmly in place. Continue to use CA (or your favourite canopy glue) around the edges, allowing it to wick into the joint between the frame and clear canopy. When cured, carefully remove the canopy frame from the fuselage and secure the clear canopy to the inside of the frame properly with 24hr epoxy and micro-balloon mixture around all the edges on the inside. Be sure that you make a good job of this, with careful surface preparation, so that there is no risk of the clear canopy coming off in flight which would seriously affect the flying characteristics of the plane.

Cockpit Tub

A moulded ABS plastic cockpit tub will be included in the kits. It consists of 4 pieces, which should be joined with plastic cement and painted/trimmed to your choice, in the usual way. When completed it is glued permanently inside the cockpit canopy frame. The photo here shows the plain, unpainted parts, as supplied in the kit.

(above) Plastic cockpit tub dry-fitted into the cockpit. Add detailing and paint as required.

R/C and Gear Installation

There is lots and lots of space in the cockpit area for your gear layout, and it is a joy to work on the gear in this model! Everything is easily accessible for installation and maintenance. In most set-ups the receiver and turbine batteries will need to be installed in the removable nose section to obtain the correct Centre of Gravity, and you will need to make up balsa supports for these as needed. Be prepared to install some trimming weight in the nose to obtain the recommended CG, depending on your engine and battery choice. You can also fit the air tank for the landing gear/brakes in the nose.

Included in the kit is a milled plywood gear mounting plate, and 2 sub-formers that fit underneath to secure it. It is a generic plate, designed to suit many different set-ups, and can be modified as you wish. Once all your gear is set out on the plate, glue the sub-formers in place. Secure the gear plate to the bulkheads with sheetmetal screws or bolts and T-nuts in plywood blocks on the sub-formers, as you choose, to make it easily removable for maintenance.

Everyone has their own favourite accessories, methods and options when fitting the R/C and gear, but the 4 installations shown in the photos can be used as a guide, and have all proven reliable and easy to maintain and check.

As this is a large model with at least 7 hi-power digital servos we highly recommend that you install a powerbus system for servo control, and dual Rx batteries, and we can supply the world famous ‘PowerBox’ range and their switches. The R/C gear plate has a position specifically for this item, see photos P49 - P52. If you chose not to use a servo powerbus system, we definitely recommend that all servo leads and extensions longer than about 30cms (12”) are fitted with ceramic chokes (ferrite rings) to prevent RF noise, at the receiver end - within 100mm (4”) of the receiver. Wrap the extension cable through them at least 3 complete turns.

Generally the routing of the air lines, servo extension leads and fuel tubes follows normal practices. Note that the 5 air-lines to wing, as well as the extension cables for the flap and aileron servos, all exit through a hole in the side of the fuselage about 50 - 60mm in front of the front edge of the wing tube. Make sure that you protect these from rubbing against the hole in the fuselage skin with ‘spiral-wrap’ or equivalent. Robart ‘quick-connectors’ for the air lines are included in the landing gear option pack (photo P48). We have also included enough connectors for the removable nose, in case you wish to install your air tank(s) in there.

Please take care to protect the rudder and elevator servo extension cables from heat, and make sure that they are secured and cannot touch the exhaust ducting. You can cover the rudder cable socket with a scrap balsa plate, and shield the extension cables with aluminium tape as shown in photo P47.

Important note for UL-Customers:

Please, before you fly, take note of this important information:

Please reinforce the carbon tube which connects the rudder fin to the fuselage. We did have a failure in flight recently. It seems when you snap the plane violently, this tube can break. Please slide in another tube, 12mm OD, into the exiting tube and glue with CA Glue. If you have a carbon rod 12 mm you can use this, too. Even a hard wood dowel will do the job, when you glue this into the tube with resin.

The CG is 15 mm behind the front edge of the gear door. If you want, you can start with a CG slightly forward, and then move it slowly back to the point in the photo. The UL is not very sensitive at all on the CG. (see attached picture)

Throws are pretty much the same then on the classic lightning. For flap deployment, take-off position is 10-15mm flaps down, for landing, about 45 degrees.
You will need some down elevator mixing when flaps are deployed.

CG Position:

Setting Up Your Aircraft

Depending on your turbine and battery choice, and what accessories you use, your completed Lightning (dry) should weigh between 13 - 14.5kgs. The 1st (rather heavy!) Lightning prototype with a Jetcat P160, dual 5-cell receiver Nicads (2400 mAH) and a full Powerbox system weighed just over 14kg. It needed about 300g (10 ounces) ounces of lead in the nose for correct C of G.

Static wing incidence when using the C-ARF landing gear, fuelled, is about +0.5 degree at the wing root.

The throws and rate settings below are taken from the first 2 production planes to be flown extensively, by Ray Labonte (USA) and Marc Froehn (Germany). Marc's plane was set-up by Sebastiano Silvestri for aerobatics, and Ray's settings are a little 'softer', with 2 different rates. You can use either of these different set-ups as a guide for your initial flights - depending on how you like to fly.

Centre of Gravity

Set the Centre of Gravity at 45 - 50mm in front of the centre of the wing spar tube hole, *without the wings on the fuselage*, and with empty main tanks and full hopper tank.

An easy way to do this to to balance the completed model (without wings) on the wing tube on a flat table. This can easily be done single-handed, and is far easier than trying to set the C of G with the wings on!

Control Throws

NB: All control throws are measured at the root - trailing edge of each surface

Elevator:

For neutral the elevator trailing edge should be set about 2mm 'up' at the root.

Marc: 28mm 'up' and 30mm 'down'. 55% Exponential.
Ray: High rate: 24mm 'up' and 26mm 'down'. 40% Exponential.
Low rate: 19mm 'up' and 21mm 'down'. 30% Exponential.

Aileron:

Marc: 30mm 'up' and 32mm 'down'. 45% Exponential.
Ray: High rate: 23mm 'up' and 25mm 'down'. Exponential 55%
Low rate: 18mm 'up' and 19mm 'down'. Exponential 40%

Rudder:

Marc: 45mm both directions. 0% Expo for normal flight, 30% exponential when landing gear is down. Rudder to aileron mix: 6%. Rudder to elevator mix: 2% 'up'.
Ray: 40mm both directions. 25% Exponential.

Flaps:

Set on a 3-position switch.

Marc: 1st position 25mm 'down', Landing position 85mm 'down'. 5% down elevator trim in

both positions. With full flaps reduce elevator Expo to 30% and Aileron Expo to 30%.

Ray: 1st position 15 degrees 'down', Landing position 45 degrees 'down'. Mix in about 2mm 'down' elevator with flaps in both positions.

Ray Labonte's landing circuit comments: "Downwind leg with 1st position flaps deployed and landing gear down, throttle is set to about 45 - 50% for a slow steady approach speed. Full flaps are selected before final turn and throttle is advanced to about 65% giving a very stable approach at about 50 - 60 mph. Once landing on the strip is assured a steady decrease in power leads to an almost perfect spot landing every time. I've been very impressed with how predictable this airplane is to fly on approaches and landings, and it's one of the easiest planes of this type I have ever flown. I really enjoy the landing patterns !"

Don't forget that the flaps also act as spoilers, due to the reflexed top surface, but this has very little apparent effect at small deflections. The flaps and spoilers are extremely powerful when fully deployed on final landing approach. Of course this does make it easier to set your descent angle and ultimate touch down point, with no tendency to 'float' down the runway in the 'ground effect' - and with a higher throttle setting the time to spool-up if you need to make a go-around is much faster than from idle. It is very important to ensure that flaps move the same amount, as they are very effective and would cause a strong rolling tendency if not very similar.

Important: For landing you must remember to rotate the nose up clearly to a positive angle-of-attack to slow the plane down on final approach, as the wing has a fully symmetrical section and will not generate sufficient 'lift' otherwise.

Flying Characteristics

The CARF-Models Ultra Lightning is a precision flying machine. It's the aerobatic answer to 'speed' !

For aerobatics you need a constant-speed flying style. This means that the plane must be 'draggy' in the vertical downlines, but powerful in the vertical uplines. The average speed must not exceed the limits of structural failure - and yes, in aerobatics, size does matter.

Do you want to make a $1^1/_2$ vertical positive snap upwards, pull 180 degrees to vertical downwards with authority, and then still have enough time to make a four or 5-point roll on the vertical downline before you pull out cross-box ?

Do you want to be make a knife-edge to knife-edge snap at about 3/4 throttle without blowing the whole plane apart ?

Do you want to make a horizon-to-horizon slow roll without much roll and pitch compensation ? You want it to look *s m o o o o t h* , and you don't want to correct much.

Do you want to perform tight square-loops, with rolls and snaps in the straight lines, without stalls and fading control authority ?

Do you want to make rolling circles with opposing roll directions without getting out of sight because of too high speed ?

All this is possible with the CARF-Models Ultra Lightning. *ONLY* the pilot is the limit. With the settings given in this instruction manual you can enjoy the whole wide performance envelope as if this were a top class aerobatic plane.

The CARF-Models Ultra Lightning is designed for 'Unlimited Aerobatics'. It combines design fea-

tures common in successful aerobatic planes *and* features common in high-tech jets. This is what makes it so unique... and that's why it takes a little while to get our point, but after just one single flight you will understand !

We are absolutely confident that you already appreciate the level of prefabrication and completeness you've received for the money you paid. Now comes the flying, and this will top it off...

We have tried to make this airplane as complete as possible, and with good feedback from customers you will help us to continue making good things even better. We appreciate your comments very much.

Email: info@carf-models.com

Thank you!
Your CARF-Models Team

Appendix:

Lightning Kit Contents:

Quantity	***Description***
1	Fuselage (with nosegear door taped to fuselage)
1	Main hatch with ventral fin glued on
1	Right wing (with LG doors and servo cover taped on)
1	Left wing (with LG doors and servo covers taped on)
1	Wing tube 40mm Ø anodised x 990mm long
1	Fuel tank kevlar (left)
1	Fuel tank kevlar (right)
1	Canopy frame (with fixings completed)
1	Clear canopy
1	Nose cone (fibreglass)
1	Exhaust nozzle (fibreglass)
1	Stabiliser assembly (with servo cover taped on)
1	Fin assembly (with carbon tube spar 14mm Ø x 200mm long)
1	Middle inlet duct joiner (Fibreglass white)
1	Bypass ducting (carbon) upper half
1	Bypass ducting (carbon) bottom half
1	Bypass rear cone (carbon)
1	Exhaust ducting (assembled)
1	Fuel tank hardware pack
1	Cockpit tub - 3 pieces (moulded plastic, white)
1	Hardware pack
1	Instruction Manual and photosheets (English)

Hardware bag:

Fuselage pack

Quantity	*Description*
3	M4 x 50mm Allen bolt (nose section fixing)
3	Washers M4 (nose section fixing)
1	M4 x 20 bolt - spare (canopy frame fixing)
4	M4 X 16 Allen bolt (nose landing gear fixing)
4	M4 T-nut (nose landing gear fixing)
4	Crimp tubes, inside diameter 2mm (nosegear steering)
1	Steel cable 0.8mm x 800mm (nosegear steering)
4	Sheetmetal screws 2.9 Ø x 13mm (nosegear steering servo)
4	M4 x 20mm allen bolt (engine mounting)
4	M4 T-nut (engine mounting)
4	M3 x 12mm allen bolt (engine bypass cover fixing)
4	M3 T-nut (engine bypass cover fixing)
3	M4 x 12mm allen bolts (upper bypass mount fixing to rear angles)
2	M4 x 20mm allen bolts (upper bypass mount fixing to front angles)
5	Washers M4 (upper bypass fixing)
3	M3 x 12mm Allen bolt (bypass rear cone fixing)
3	M3 T-nut (bypass rear cone fixing)
3	M3 washers (bypass rear cone fixing)
2	M6 T-nuts (wing fixing)
3	M3 x 12mm Allen bolt (exhaust duct fixing)
3	T-nut M3 (exhaust duct fixing)
7	Sheetmetal screws 2.2 Ø x 10mm (exhaust nozzle fixing)
1	Fibreglass tape 20mm wide x 300mm long
3	6mm Ø carbon rod x 50mm long (hatch fixing)
4	M4 x 25mm Allen bolts (hatch fixing)
4	M4 T-nuts (hatch fixing)
1	Phenolic strip 2mm x 15 x 50mm (hatch location tabs)
4	Plywood rectangles, slotted (for phenolic strip)

Wing pack

Quantity	*Description*
2	M6 x 30mm allen bolt (wing fixing)
2	Washers M6 (for wing bolts)
16	Sheetmetal screw 2.2Ø x 10mm (fixing servo and LG covers to wing)
8	M4 x 16mm Countersunk head Allen bolt (fixing landing gear)
8	M4 T-nuts (for fixing landing gear)
16	Sheetmetal screws 2.9Ø x 13mm (fixing servos to mounts)
2	M3 aluminium clevises with pins & C-clips (linkages)
2	All-thread M3 x 150mm (aileron linkages)
2	All-thread M3 x75mm (flap linkages)
6	Ball-link M3 (aileron and flap linkages)
6	M3 x 16mm Allen bolt (for ball-links to servo arms)
2	M3 x 20 Allen bolt (for ball links to phenolic horns)
8	M3 locknut (for ball-links)
8	M3 nut (for linkages)
6	M3 x 9mm Allen bolts (for fixing aileron servo mounts)
6	M3 washers (for fixing aileron servo mounts)
2	Hinge wire 2mm Ø x 200mm (for inner gear door hinges)
1	Plastic tube I.D 2mm x 200mm (for inner gear door hinge wires)
2	Plastic hinges (for outer gear doors)
1	0.8 x 250mm piano wire (for fixing outer gear doors to oleo legs)
1	3mm O.D. brass tube x 50mm (for fixing outer doors to oleo legs)

Vertical Fin/Rudder pack

Quantity	*Description*
2	M6 Plastic Nut (for fin fixing) *includes 1 spare*
1	Ball-link M3 (for rudder linkage)
1	M3 x 20mm Allen bolt (for rudder linkage)
1	M3 lock-nut (for rudder linkage)
2	M3 nuts (for rudder linkage)
1	Aluminium clevise with pin and C-clip (for rudder linkage)
1	Brass tube 4mmØ x 140mm (for reinforcing rudder all-thread)
1	All-thread M3 x 175mm (for rudder linkage)
4	Sheetmetal screw 2.9Ø x 13mm (servo fixing)
1	Plastic linkage fairing (painted)

Elevator/Stabs pack

Quantity	*Description*
2	Allen bolt M4 x 60mm (for fixing stab to fuselage)
2	Ball-Link M3 (elevator linkages)
2	Aluminium clevise with pin and C-clip (elevator linkages)
4	Nut M3 (elevator linkages)
2	All-thread M3 x 120mm (elevator linkages)
2	M3 x 20mm Allen bolt (for ball-links)
2	M3 lock nuts
2	Brass tube 4mm Ø x 90mm (for reinforcing elevator linkages)
8	Sheetmetal screw 2.9 Ø x 16mm (servo fixing)
6	Sheetmetal screws 2.2 Ø x 10mm (for fixing servo cover hatch)

Fuel system pack

Quantity	*Description*
1	Hopper tank (Sullivan R-10)
3	Aluminium fuel tank caps (include M3 x 25mm bolts)
3	Kerosene Stoppers for fuel tanks (Robart #400)
3	Felt clunk (Webra type)
7	Brass tubes 4mm Ø x 90mm long (for fuel tanks)
10	Brass tube barbs (I.D. 4mm x 5mm long)
1	Plywood sheet for hopper tank mount (0.8mm thick)
2	Festo Tee T-PK-4 connectors
1	Fuel tubing 4mm I.D. x 1.5 metres

Wood/Phenolic bag

Quantity	*Description*
3	Fibreglass strip 0.3 x 12 x 300mm (gear door edges etc)
2	Aileron servo mounts (12 pieces) 3mm plywood
1	Phenolic door hinges (Nose and main doors)
1	Fuel pump mount (for Jetcat or similar) 3mm plywood
1	I/O board mount (4 pieces) - 3mm plywood
1	Nose door cylinder mount - 3mm plywood (1 piece)
1	R/C gear mounting plate - 3mm plywood
2	Sub-bulkheads for R/C gear mounting plate - 3mm plywood
2	Shaped triangular blocks (laminated plywood) for bypass front mount.
2	Plywood strips (3mm x 12mm x 350mm) for cutting small pieces
1	Plastic tube 2mm I.D x 350mm (nose door hinge)
1	2mm Hinge wire x 350mm (nose door hinge)

Landing Gear pack (Option)

Quantity	*Description*
3	Retract units (Behotec C50) 1 nose unit and 2 main units.
3	Steel connecting pins for retract/oleo legs (8mm Ø)
1	Wheel collar (8mm I.D) for nose connection pin
2	Main wheels 115mm Ø, with 2 brakes and 2 axles (Intairco)
1	Nose wheel 75mm Ø (Behotec)
2	Oleo legs - main (Behotec)
1	Nose leg with axle and trailing link (Behotec)
2	Steering arms for Nose leg (Behotec)
2	Outer door fixing collars (aluminium)
3	Air tubing 3mm O.D (3 colours) 2 metres each
1	Air tubing 4mm O.D. 1 metre
12	Quick-connectors for air tube (Robart) for wings and nosecone
3	Door cylinders (BVM 1” stroke cylinders)
12	Set screws for oleo legs etc.
2	4-way push-in connectors for 3mm O.D tube (Festo)
1	3-way push-in connector for 4mm O.D tube (Festo)
12	Tees for airline (Festo T-PK-2)
1	Air filler/one-way valve (Festo 4mm)
1	Air Tank and 4mm valve (Behotec)

Additional Fuel Tank (Option)

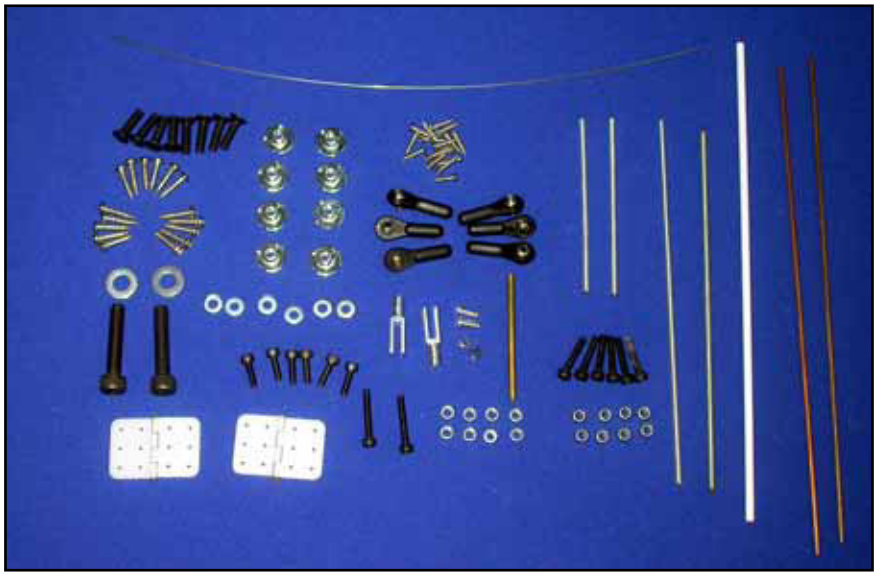
Quantity	*Description*
1	Upper half tank (kevlar)
1	Lower half tank (kevlar)
1	Aluminium fuel tank cap set (includes M3 x 25mm bolt)
1	Aluminium sleeve (for cap hardware)
1	Kerosene Stopper for fuel tanks (Robart #400)
1	Felt clunk (Webra type)
2	Brass tubes 4mm Ø x 90mm long
4	Brass tube barbs (I.D. 4mm x 5mm long)
1	Fuel tubing 4mm I.D. x 600mm

Available Accessories and Options:

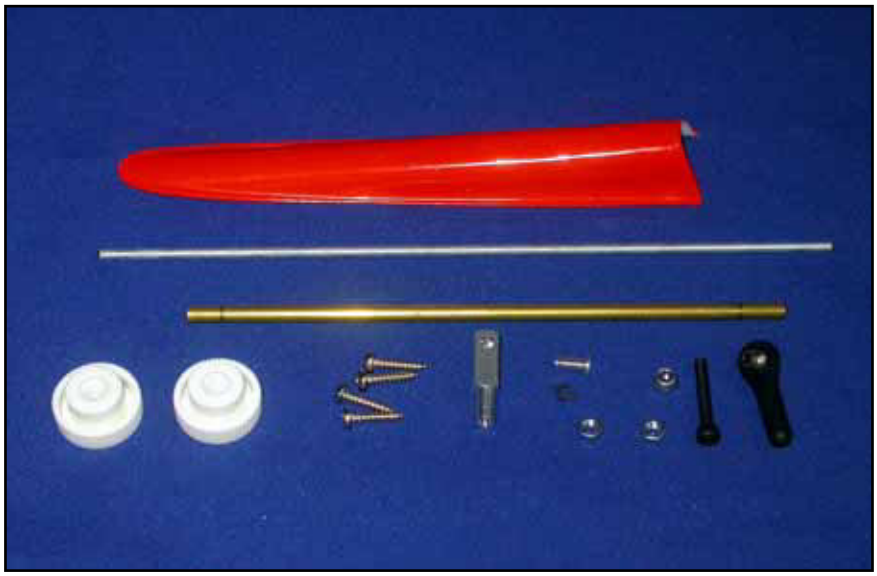
Touch-up paint set for your colour scheme
Jetcat P160 turbine set
Landing Gear and gear door/pneumatic support set
Extra Fuel tank kit - kevlar
SWB double-loc servo arms (pack of 7 pieces, JR or Futaba)
Electronic door, gear, brake and door-sequencing valves (Jetronic)
PowerSwitch for RX dual batteries
Powerbox Competition

(above) Kit Contents

(above) Fuselage hardware bag

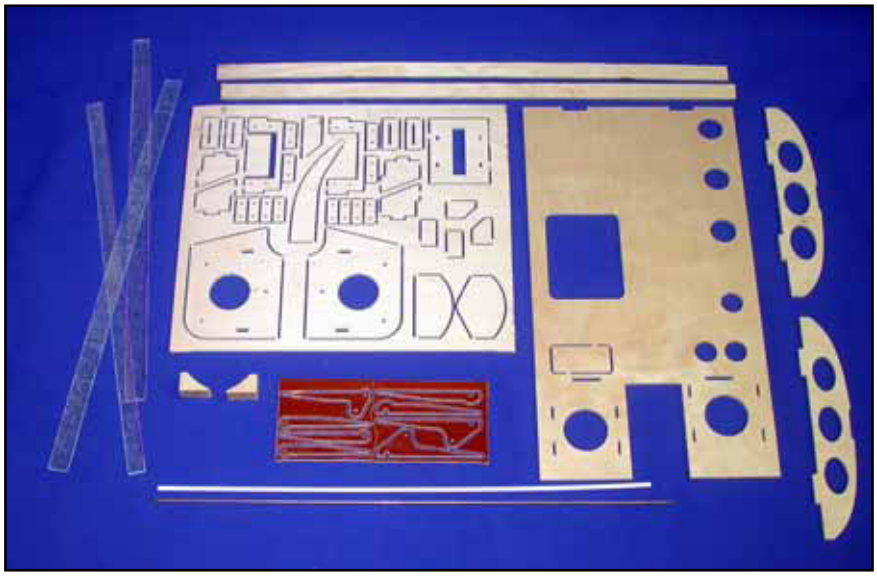


(above) Wing hardware bag



(above) Vertical Fin hardware bag

(above) Stabiliser hardware bag



(above) Wood and Phenolic parts bag

(above) Complete Fuel system set (incl. in standard kit)

(above) Extra Fuel tank set (optional)

(above) Cockpit Tub parts (incl. in standard kit)