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Instruction Manual

Composite-ARF Extra 330L, 2 x 2m

TAVS Technology **version 1.0**

Instructions for Extra 330L IMAC-Airplane

Thank you very much for purchasing our Composite-ARF Extra 330L all composite aircraft, made with the revolutionary Total Area Vacuum Sandwich (TAVS) technology

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

Email:	**feedback@composite-arf.com**
or	**techsupport@composite-arf.com**
Telephone:	**Phone your C-ARF Rep!!! He will be there for you.**
Website:	**http://www.composite-arf.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 Composite-ARF are not in a position to influence the way you build and operate your model, and we have no control over the methods you use to install, operate and maintain the radio control system components. For this reason we are obliged to deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect application and operation of our products, or which are connected with such operation in any way. Unless otherwise prescribed by binding law, the obligation of the Composite-ARF company to pay compensation is excluded, regardless of the legal argument employed.

This applies to personal injury, death, damage to buildings, loss of turnover and business, interruption of business or other direct and indirect consequent damages. In all circumstances our total liability is limited to the amount which you actually paid for this model.

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

It is important to understand that Composite-ARF 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 Composite-ARF are unable to guarantee, or provide, a contractual agreement with any individual or company that the model you have made will function correctly and safely. You, as operator of the model, must rely upon your own expertise and judgement in acquiring and operating this model.

Supplementary Safety Notes

Pre-flight checking:
Before every session check that all the model's working systems function correctly, and be sure to carry out a range check.

The first time you fly any new model aircraft we strongly recommend that you enlist the help of an experienced modeller to help you check the model and offer advice while you are flying.

He should be capable of detecting potential weak points and errors. Be certain to keep to the recommended CG position and control surface travels. If adjustments are required, carry them out before operating the model. Be aware of any instructions and warnings of other manufacturers, whose product(s) you use to fly this particular aircraft, especially engines & R/C equipment.

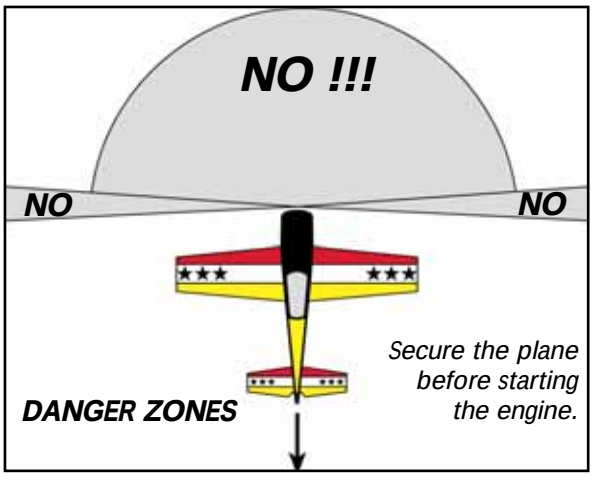
Please don't ignore our warnings, or those provided by other manufacturers. They refer to things and processes which, if ignored, could result in permanent damage or fatal injury.

Attention !

This IMAC-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 Extra according to the AMA rules, or those laws and regulations governing model flying in the country of use.

The engine, servos and control surfaces have to be attached properly. Please use only the recommended engines, servos, propellers, 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, in a first flight, 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 up the engine. Have a helper hold your plane from the tail end or from behind the wing tips before you start the engine. Make sure that all spectators are 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 up the engine, run it at about half throttle and repeat this range check with the engine running. Make sure that there is no range reduction before 'fail-safe' occurs. Only then make the 1st flight. If the range with engine running is less then with the engine off, please contact the radio supplier/engine manufacturer and DON'T FLY at that time.

Check for vibrations through the whole throttle range. The engine should run smoothly with no unusual vibration. If you think that there are any excessive vibrations at any engine rpm's, DON'T FLY at this time and check your engine, spinner and propeller for proper balancing. The lightweight sandwich composite parts don't like too much vibration and they can suffer damage. The low mass of all the parts results in a low physical inertia, so that any excess vibrations can affect the servos and linkages.

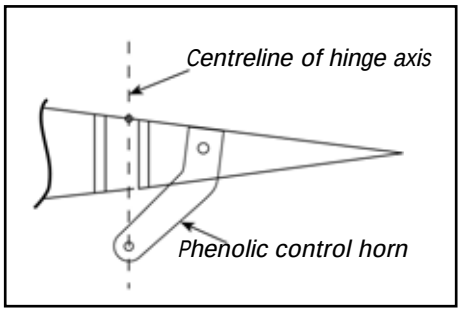
Make sure that your wing and stab spar tubes are not damaged. Check that the anti-rotation pins for the wings and stabiliser are not loose. Check that the plastic wing retaining nuts are tight, that the M3 bolts retaining the horizontal stablisers onto the carbon tube are tight, and that the rudder hinge wire cannot come out with a piece of clear tape.

General information about fully-composite aircraft structure and design

All the parts are produced in negative molds, manufactured using vacuum-bagged sandwich construction technology. All parts are painted in the moulds, either single colour or designer colour schemes. A new production method, called TAVS (Total Area Vacuum Sandwich), enables us to present this aircraft with incredible built-in strength, while still being lightweight, and for a price that nobody could even consider some years ago. This production process has huge advantages, but a few disadvantages as well. These facts need to be explained in advance for your better understanding.

Description of Parts

The Wings:
Both wing halves are made in negative moulds, and fully vacuum bagged, using only 2 layers of 2 oz. cloth in combination with a very hard 2 mm foam sandwich form a hard and durable outer skin.



The ailerons are hinged already for you - laminated in the mould and attached to the wing 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 wing surface, and there is a very narrow slot in the bottom surface, where the aileron slides under the main wing 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, if you program in about 10% NEGATIVE aileron 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, so it moves slightly in and out when operated, and the aileron gets a little "bigger" in surface area when moving up, and "smaller" when moving down.

The bottom slot needs some explanation, too. The cut line is exactly in the correct position so that the aileron slides under the wing skin smoothly. If the cut was a few mm forward or back, it would not work properly. So, make sure that the lip is not damaged, and that the aileron slides under this lip perfectly. It will NOT lock at any time, if lip is not damaged. If damage occurs to the lip, you can cut off 2-3 mm, but you should NEVER need to cut off more than this.

The Fuselage:
The fuselage is also made in negative moulds, constructed using TAVS technology. The main internal parts for the landing gear, wing and stab spar supports are glued in during manufacture, to ensure accurate location and reduce the assembly time for you. There is no need to even check the incidences - you can be assured that these are already set in the moulds so that no adjustment is necessary.

The landing gear mount is strong and doesn't need any extra reinforcement. You have an extremely light weight fuselage, and the gear loads need to be led into the structure gently. The landing gear is a fairly flexible design, which works very much like shock absorbers. This plane

is not made for crashing, but the landing gear will take some hard landings without problems. Do not change or modify it, as the results would only be negative. We had plenty of time and experience to engineer the strength needed in this area - and we did !

The Stabilisers:
The stabiliser parts are also vacuum bagged sandwich. The elevator control surfaces are elastic-hinged, and the rudder is hinged with a 2mm Ø steel wire, fitted through phenolic hinge bearing plates, allowing perfect alignment.

The rudder & elevator design gives at least 45 degrees throw. The horizontal stabs are mounted on a 14mm carbon tube and one 6mm Ø glassfibre anti-rotation pin each, and controlled by one powerful servo installed in the fuselage for each elevator. Please remember during assembly of the plane to save every gram of weight in the tail area. The rudder is adequately powered by a single JR8411 servo in the fuselage with a closed-loop system.

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.

A couple of views inside the factory, showing a small part of the Finishing area, the vacuum/oven tables and the Quality Control/Assembly areas.

The 'Paint Job'

Occasionally customers see certain problem areas with composite parts. But the question is: Are these real problems, or are they just a misunderstood sign of high-tech construction, proving high-end composite technology?

(above) One of our 2.6m Extra's, in the popular 'Fantasy red/yellow' paint scheme ... all painted in the moulds. (below) A customer with a 3m Extra 330S practising his tail-in hovering !

Seams:
ALL composite parts have seams. They are there today, and they will be there forever. You will have to get used to them ... or you'll have to touch up the paint yourself !

But what is a seam? A seam on the fuselage, especially already painted in the mould, proves that this is a vacuum-bagged high-tech part, made in negative moulds. Our seams are fine and straight, no negative impression at all ... but they are there. When possible we include 5mm wide strips of self-adhesive vinyl, painted in exactly the same colour as the plane for you to cover the seams if you want.

Paint flaws:
If a plane is painted in the moulds, you can save a lot of weight. At least 2 lbs ... and that is worth saving !

A 'negative' paint job is very complicated to make. The painter cannot see the design growing and developing - he is painting 'blind'. He even cannot see little mistakes and flaws, and even if he COULD, he could not correct them. The maximum time to apply a designer paint scheme in the mould is no more than 20 minutes. It is a big rush, because even if it is just few minutes too slow then the masking cannot be removed without pulling off the paint itself ! This is a BIG challenge, but the result is extraordinarily impressive. Even with slight flaws the general appearance of these one-of-a-kind paint jobs is unique. In a 'positive' paint job some effects can never be done. Just think about the shadows, peel backs, highlights, and 3D effects - and all with a perfectly flat and uniform surface for optimum airflow and aerodynamics.

Truly hard to do, but still possible, are the paint jobs which seem so simple at first glance: Schemes with straight lines and stripes. Quite easy with positive painting, but it's very hard masking the lines in the negative moulds, because we cannot assemble the parts before masking. To get the stripes lining up exactly at the rudder, wing and cowling joints is therefore almost impossible. This is why we suggest using thin vinyl trim to make sure that these stripes line up perfectly. Sometimes it is necessary to do that, and it is definitely not a quality problem or a "flaw". It comes back to what is possible, and what is impossible.

If you want to have a really perfect paint job, then you might decide to have a single colour version and have it painted by yourself or your friend.

But don't forget: Consider the additional cost, consider the additional weight, consider that even if it is painted 'positive' there will be areas you won't be happy with. Of course you won't complain, because you created these flaws yourself… !

Tools and Adhesives

Tools etc:

This is a very quick and easy plane to build, not requiring special techniques or equipment, but even the building of Composite-ARF aircraft requires some suitable tools. You will probably have all these tools in your workshop anyway, but if not, they are available in all good hobby shops, or hardware stores like "Home Depot" or similar.

1. Sharp knife (X-Acto or similar)
2. Allen key set **(metric)** 2.5mm, 3mm, 4mm & 5mm.
3. Sharp scissors
4. Pliers (various types)
5. Wrenches **(metric)**
6. Slotted and Phillips screwdrivers (various sizes)
7. M3 tapping tool **(metric)**
8. Drills of various sizes
9. Dremel tool (or Proxxon, or similar) with cutting discs, sanding tools and mills.
10. Sandpaper (various grits), or Permagrit sanding tools (high quality).
11. Carpet, bubble wrap or soft cloth to cover your work bench (most important !)
12. Car wax polish (clear)
13. Paper and clear tape
14. Denaturised alcohol, or similar (for cleaning joints before gluing)

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.

1. CA-Glue 'Thin' and 'Thick' types. We recommend ZAP, as this is a very high quality.
2. 5 minute-epoxy (highest quality seems to be Z-Poxy)
3. 30 minute epoxy (stressed joints must be glued with 30 min and NOT 5 min epoxy).
4. Epoxy laminating resin (12 - 24 hr cure) with hardener.
5. Milled glass fibre, for adding to slow epoxy for strong joints.
6. Microballoons, for adding to slow epoxy for lightweight filling.

At Composite-ARF 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 hardware should be included, please feel free to let us know. Email us: feedback@composite-arf.com. We know that even good things can be made better !

Accessories

This is a list of the things you may need to get your Composite-ARF Extra 330L 2 x 2m in the air. Some of them are mandatory, some of them can be chosen by you. What we list here are highly recommended parts, and have been thoroughly tested.

1. Power servos (min. 5). We recommend JR 8411's for the ailerons, elevators & rudder.
2. Throttle servo for gas/methanol motor. Any standard servo will do (eg: JR/Graupner 4041)
3. Aluminium Spinner 82 - 86 mm dia (3.25 - 3.5"), eg: Tru-Turn.
4. Main wheels 65 - 70mm (2.5 - 3"). Kavan Light or Dubro wheels are recommended.
5. Engine DA-50, or electric Hacker 50 or Plettenberg Xtra 25-13. These are recommended engines for your Extra 330L. The instructions refer to these engines several times, but you could use any other 35 - 50cc gas engine, like a Zenoah 38 or ZDZ 40 - or a big 4 stroke (eg: OS140/160, YS140/16).
6. Exhaust system, muffler or minipipes if using gas or methanol engine. C-ARF can supply headers and mini-pipes for the DA-50 as an option.
7. Speed Controller and Flight Batteries if using Electric power
8. High quality servo extension cables, with gold connectors. High quality receiver and ignition switches, 'Y' leads, ceramic/ferrite chokes etc.
9. Receiver battery. Either one or two 1200 -1800 mAH NiCad packs.
10. Fuel tank (500 - 700 ml) with gasoline stopper for gas/methanol motor. We use Dubro.
11. Cable ties in various lengths.
12. Propeller, to suit motor choice.

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 Composite-ARF Extra 330L.
If not, please read again before you start the assembly.

About the 2 x 2 Extra

The new Composite-ARF Extra 2 x 2m is not quite so 'ARF' as our other 'planes, as there are so many possible different building options - especially for the motor choice - and a special option pack is available for Electric power.

However, as usual, we have included a full set of CNC milled wood parts and all the hardware required for the completion of all the Landing gear, Flying surfaces and control surfaces. Also included are a generic motor firewall (6mm plywood), with support former, exhaust mounting bulkhead, Fuel tank support, rudder servo plate and throttle servo mount, which can be used for installation of your motor choice, and/or modified as necessary. This instruction manual shows the typical installation of a DA-50 using these parts.

This still allows us the offer a fully-composite moulded aerobatic 2m span plane, painted in the moulds, with such a high pedigree for a truly incredible price. As technology advances and customer requirements change Composite-ARF will continue to design and manufacture new aircraft and follow our customers wishes and the latest trends.

We hope you will enjoy your 2 x 2m Extra and look forward to feedback on the different power units used in this unique aircraft.

Building Instructions

General Tips:
We recommend that you follow the order of construction shown in this manual for the fuselage, as it makes access to everything easier and saves time in the end.

The first thing to do is protect the finished paint on the outside of the model from scratches and dents during building - so 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 paint, decals 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.

When sanding areas inside of the fuselage to prepare the surface for gluing something onto it, do NOT sand right through the layer of 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 alcohol (or similar) before gluing to make a perfect joint. It is very important to prepare the inside of the fuselage properly, by roughing up and cleaning the surface, before gluing *any* parts to it.

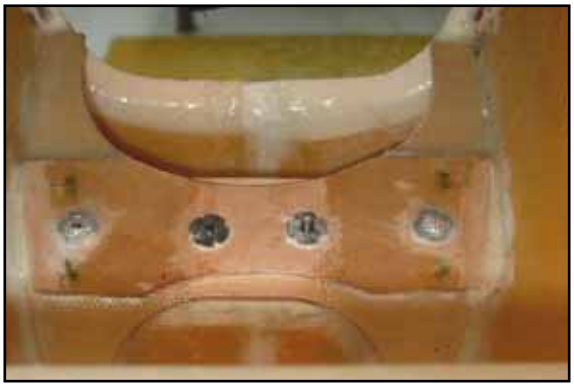
Before starting construction it is a good idea to check inside the fuselage for any loose glass fibres that could cut your hands, and a quick scuff over any of these with a coarse Scotchbrite pad will remove them.

Note: The photos in these instruction show the 2nd 'Pre-Production' prototype and some parts in the 'Production' kit might vary slightly in shape or material.

Landing Gear

The 1st job is to fit the landing gear legs and you can leave these in place to protect the bottom of the fuselage during the rest of the assembly.

Composite-ARF developed a new carbonfibre landing gear for our Extras. It consists of 45° laminated carbon cloth and a huge number of carbon tows inside, all made under vacuum and heat-cured. However it is still light weight, and is flexible enough to take the shock of any landings that are less-than-perfect!



The plywood supports for the landing gear are already installed at the factory, and reinforced with fibreglass cloth. Both main legs are identical and can be used either side. Fit the landing gear in place on the fuselage as shown, and drill through 4 holes Ø 4mm for M4 bolts and washers. Remove the carbon legs and open up the holes in the fuselage and ply supports to 5.5mmØ. Fit the 4 blind nuts inside the fuselage and fix with 30 min epoxy.

Drill 4mm Ø thru' the moulded mark in the bottom of the carbon legs, and the mark in the inside of the wheelpant for the M4 x 45mm axle bolt. Drill 6.5mmØ at the mark on the outside of the wheelpants, opposite the axle hole, to insert the bolt.

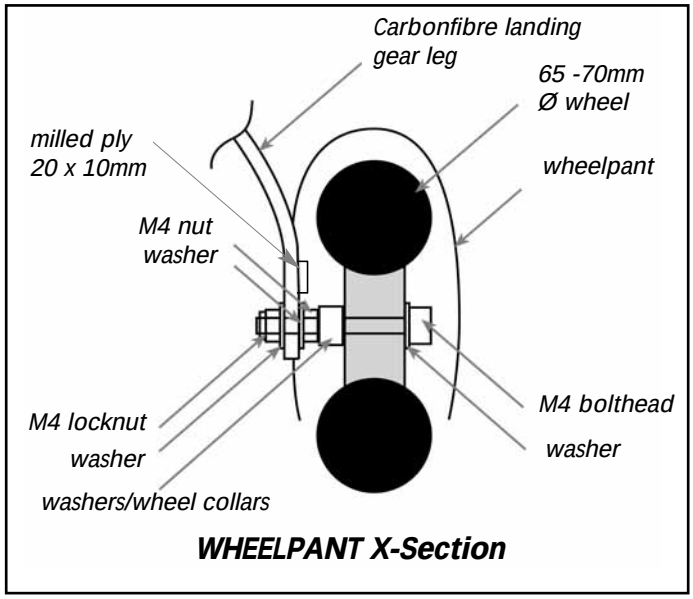
Glue a small milled plywood part (20mm x 10mm) inside the inner surface of each wheel pant, about 6mm above the 4mm Ø hole for the axle bolt. (see drawing). This part is for the sheetmetal screw that holds the wheelpant at the correct angle to the carbon leg. (see photo)

Insert the wheels of your choice (65 - 70mm Ø) in the wheelpant. The head of the bolt goes on the *outside* of the wheel, inside the wheel pant. The order of the items on the bolt is: Bolthead, washer, wheel hub, washer, washers or wheel collars to centre the wheel in the wheelpant, M4 nut, washer, fibreglass wheelpant, carbon landing gear leg, and finally another washer and the M4 locking nut. A drop of Loctite on the bolt before tightening the locknut is good insurance.

To set the correct angle of the wheelpants in relation to the ground, set the fuselage on a level surface with your choice of tailwheel in place. Eye through both wheelpants so that they are about level, and secure with a 2.9Ø x13mm sheetmetal screw in each, as shown, into the plywood plate in side the wheel pant.

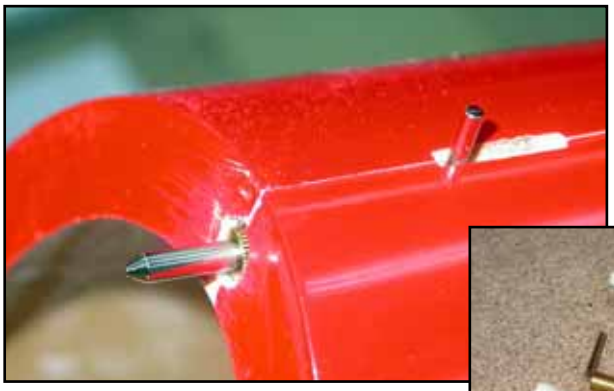
At the moment C-ARF do not supply an optional tailwheel assembly for the 2 x 2 Extra, but any 25mm/1" Ø lightweight wheel assembly from a hobby store will do. You do not need to make the tailwheel steerable, a simple castoring action is fine. A milled 3mm plywood plate (15mm x 60mm) is supplied in the kit for you to glue in the bottom of the fuselage in front of the fin post to secure the tailwheel assembly to.

Remember - keep it lightweight at the tail end!



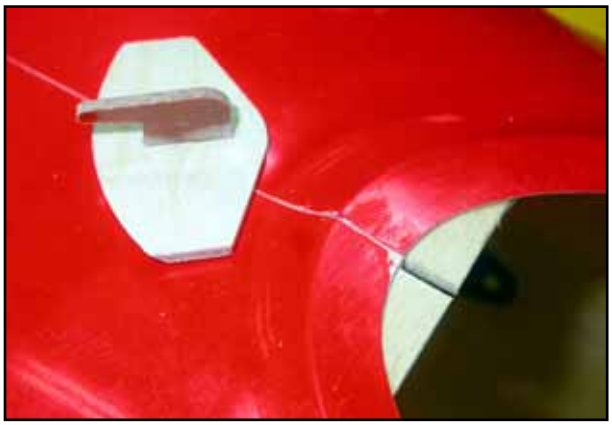
WHEELPANT X-Section

Canopy



A painted moulded fibreglass canopy is provided in the kit, and at this time a clear cockpit is not available. Fitting is simple, and with care the canopy fit can be perfect.

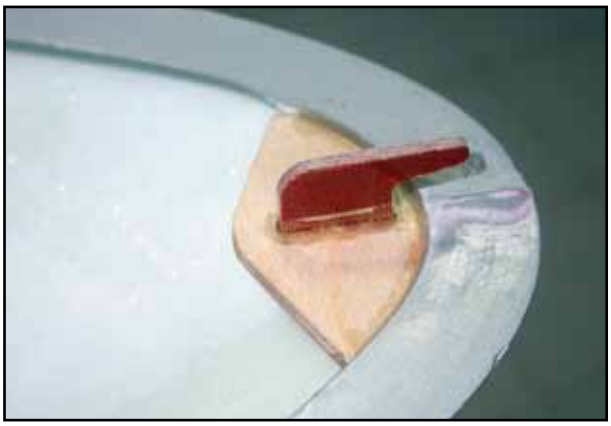
Sand any seams on the fuselage and canopy that prevent it sitting perfectly flush. Mill and file the slot on the fuselage centreline for the handle of hatch catch. The slot should be 2.5mm wide x 15mm long, and the front of the slot is about 18mm behind the edge of the fuselage moulding.



Fit the hatch catch into the white moulded plastic part. You might need to drill out the hole in the plastic part a little for a good fit. Chamfer the front and top edges of the plastic moulding to match the fuselage shape. Drill a 3mm Ø hole in the fuselage flange for the pin of the catch. Apply a little light oil or grease to the mechanism of the hatch catch to prevent it being glued together, and use thin CA to glue it into the plastic moulding, then glue the whole assembly inside the fuselage with 1 or 2 drops of thick CA. When the canopy is finished this must be secured properly with some epoxy/microballoon mix. Mark the hole on the back lip of the canopy and drill 3mm. Fit the canopy to the fuselage and check the fit.

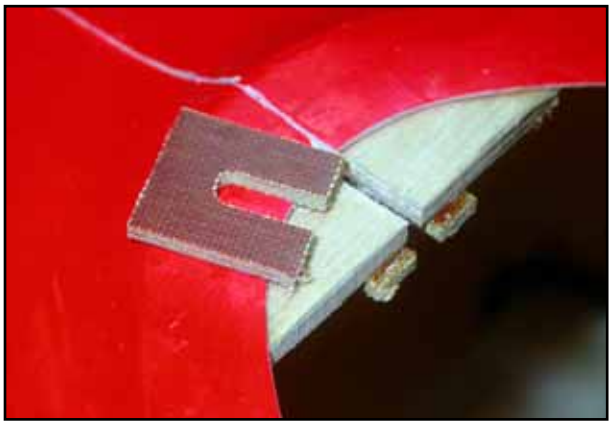
Sand under the front lip of the fuselage, and then use a drop of thick CA to glue in the 3mm milled plywood part in centrally as shown, with the front edge of the slot in line with the fibreglass fuselage edge.

Glue the phenolic hook into the other milled ply part (with the curved edge to the front), as shown, with one drop of thin CA. The top of the hook should be almost flush with the surface of the plywood. Test fit in the ply part in the fuselage. Now carefully wax the mating surfaces of the fuselage and canopy in case you should get some glue on there during the next step.



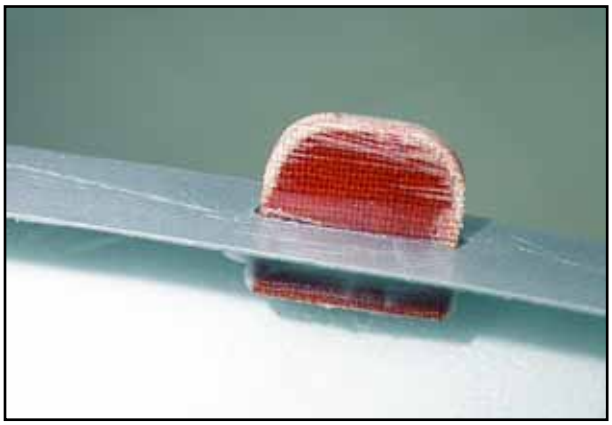
Sand the inside of the front of the canopy where the hook plate will be glued in preparation. Slide the hook plate into position on the fuselage part and then apply a little 5 min epoxy to the edges of the hook plate. Quickly slide the canopy into

place, and tape in position until the glue has cured.



Remove, check the fit, and reinforce all the joints properly with some 30 minute epoxy and micro-balloon mixture. Finally you can glue the phenolic 'U' shaped plate under the slot in the fuselage ply plate and use this to adjust the final canopy fit. Filing the slot at a slight angle to match the phenolic hook gives the final fine adjustment.

To make sure that the sides of the canopy match perfectly with the fuselage shape you can add a couple of small phenolic tongues, as shown, and file matching slots in the fuselage lip. We have included a spare strip of phenolic plate (15mm x 50mm) for this purpose.

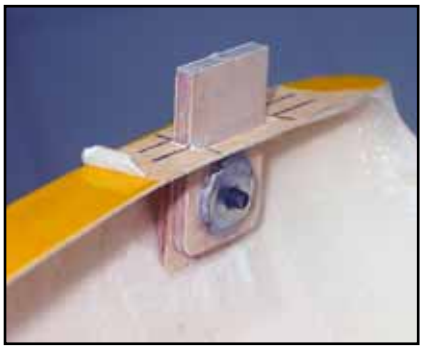


Note: If you fit a gas or glow engine with higher vibration levels, we advise you to also fit 2 plywood tongues with blind nuts and M3 bolts to retain the canopy, in a similar manner as the cowling fixing system shown below.

Cowling

Attaching the 1 piece cowling is quite easy, as it is already cut and trimmed at the factory, but be careful not to deform the fuselage in this area later when fitting the bulkheads for your choice of motor/power unit. No bulkheads should be a tight fit in the fuselage, sand as needed to make them a gentle sliding fit.

Sand any seams on the fuselage and cowling that might prevent it sitting perfectly flush. Now carefully wax all around the mating surfaces of the fuselage and cowling in case you should get some glue on there during the next steps.



The cowl is secured to the fuselage with four M3 bolts and blind nuts, fitted into 3mm milled plywood plates which are glued into the fuselage. Additionally you should add 2 small phenolic tongues at the back lower corners of the fuselage lip to maintain alignment, and prevent any rubbing or damage due to vibration.

Mark the positions of the 4 plywood tongues on masking tape on the cowling lip, and mill and file the slots to take the plywood parts that have a milled hole in them. The outside edges of these slots should be about 5mm from the outside edge of the cowling lip. Make the slots 5mm wide to easily accept the thickness of the plywood tongues with the blind nuts glued on.

Sand a matching chamfer on the 4 milled plywood squares (20 x 20mm), and glue them into the cowling sides below the slots, with the inner face as vertical as possible. Tack in place with a drop of CA, and secure properly later with 30 minute epoxy/microballoons mix to fill any gaps between the ply squares and the fibreglass.

When glue has cured drill a 3mm Ø hole through the centre of these 4 ply squares and the fuselage sides. Using M3 x 16mm bolts from the outside, fit the 4 milled ply parts with the holes in, with blind nuts on the inner faces. Check that the ply tongues are vertical, and adjust as needed.

Remove the ply tongues, and tape the cowling in position on the fuselage. Transfer the positions of the 4 tongues onto the fuselage and mill or file the slots in the fuselage lip for the tongues. Make the slots a fairly tight fit on the tongues.

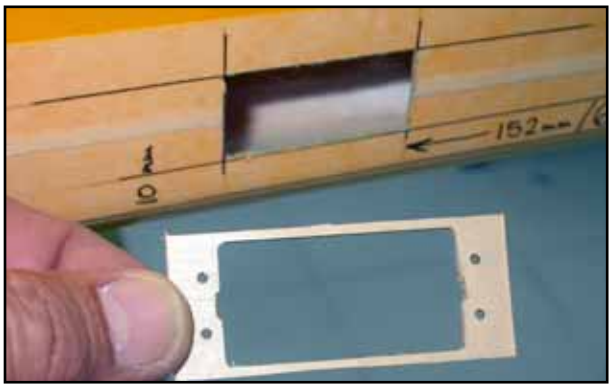
Check that you waxed all the mating surfaces, sand the 4 gluing areas inside the fuselage carefully, and apply a drop of thick 30 minute epoxy and microballoons mix in each position, under the slots. Bolt the 4 tongues into position on the cowling again, and tape it into position, checking alignment carefully, and then turn the fuselage over quickly so it is the correct way up. After the glue has cured you can remove the cowl, and fill any gaps between the tongues and the fuselage sides with a thick epoxy/micro-balloon mix.

Cut and glue in 2 small phenolic tongues in the back lower lips of the fuselage with CA, and file matching slots in the cowling flange for alignment. These tongues only need to project from the fibreglass lip about 4 - 5 mm, otherwise you cannot get the cowling on and off easily.

When satisfied with the cowling fit, counterbore the 4 holes in the cowling so that the heads of the M3 bolts sit almost flush with the surface, and they bear on the plywood plates that you glued in - *not* the surface of the fibreglass.

Horizontal Stabs

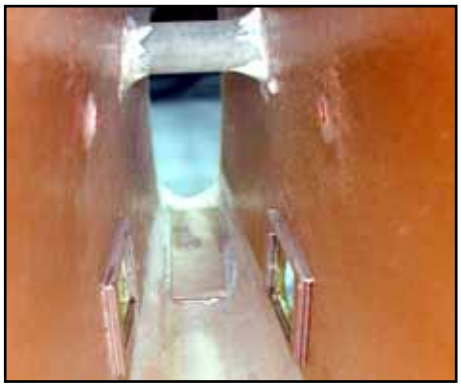
The stabs are 95% finished at the factory and are elastic-hinged during manufacture, so you only need to install the servos, horns and linkages. The fibreglass tube inside the fuselage that accepts the stab spar is also installed at the factory in a jig.



Insert the 14mm Ø carbon spar in the fuselage sleeve, and install both stabs with the 50mm long 6mm Ø fibreglass rod anti-rotation pins at the front. Check the fit between the root ribs and fuselage, and if you need to sand the root of the stabs slightly to make a perfect joint use the same method shown in the 'Wing' section of these instructions. The carbon tube may need to be shortened a little to 275mm long.

The positions of the holes in the fuselage for the anti-rotation pins are made in the mould and give 0° stab incidence. Drill them out 6mmØ and glue the small plywood/carbon reinforcing rings to the inside of the fuselage with a little 30 min. epoxy and microballoons mix. Then fit the anti-rotation pins into the holes in the stab roots, wax the ends that will go into the fuse and ply rings, and glue them into the ribs securely with epoxy.

Servo choice: The elevators can travel more than 45 degrees, and if you are going to use the maximum throw for 3D manoeuvres, we definitely recommend hi-torque digital servos like JR8411. It is not just that the torque of a standard servo is not enough - it is the play in the gears which could cause problems centering, and high speed flutter might be the result.

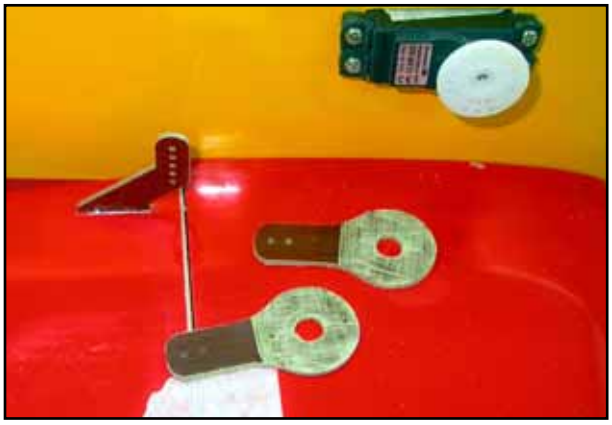


The elevator servos are installed in the fuselage, due to the thin stab profile. Put some masking tape on the fuselage, as shown, and cut the 2 holes to size for your servos. If using a standard sized servo, like the JR/Graupner 8411, then the back of the servo cutouts should be 152mm (6") from the back of the fuselage, and the bottom edge 10 - 12mm above the lower chine (angled corner) of the fuselage. Use the 3mm milled plywood reinforcing plates to mark the holes accurately and file to shape with a Permagrit file or similar. Rough up the inside of the fuselage carefully, and glue the ply plates in place with 30 min epoxy and micro-balloons mixture.

NB: Screw the servos into place with the 2.9Ø x 13mm screws provided in the kit - ***not*** the standard screws that come with the servos.

The slots are already milled in the elevators for the horns. It is important that the horns are both in identical positions in relation to the hinge axis - which is on the top surface of the stab - to be sure that you have equal elevator movements.

Put a layer of tape over the area of the milled slot, wax it, and then cut through the tape with a sharp knife to allow the horns to be glued into the slots. This stops excess glue getting on the surface of the elevator. Adjust the slot in one elevator so that the holes for the clevise are exactly perpendicular the hinge axis, rough up the gluing surface of the horn, and glue it in with 30min. epoxy and microballoons.



When the glue has cured on the first horn, remove the tape, and make a horn alignment template from thin plywood (see photo in wing section) and a 1.6mm drill or piece of wire, and use it to install the horn in the other elevator. This ensures identical elevator throws.

Make up the extension leads for the 2 elevator servos, with ceramic chokes/ferrite rings on the servo ends, and centre both servos with your R/C. Rough up the outer surface of two 25mmØ plastic servo output discs with a Permagrit or 60 grit, and do the same on the inner surface of two of the phenolic C-ARF servo arms supplied. Tack glue the phenolic arms to the plastic discs, making sure that they are both exactly at 90° to the bottom surface of the stabs. Remove both and secure with 2 of the small sheetmetal 2.2Ø x 10mm screws supplied.

Make up the elevator linkages from the 60mm long M3 threaded rods, with 2 clevises and 2 x M3 nuts for each stab. 'Loctite' the quick-link and lock-nut on one end of each linkage. Add a couple of short lengths of silicone tube over the clevises to prevent them opening accidentally. Do ***NOT*** use ball-links on the servo arms or the control-surface horns, because they will twist the servo arm/horn and cause flutter. This is a solid experience and you should consider it a ***FACT***.

Next fit the M3 stab retaining bolts. Inside the stabs you will see a small plywood reinforcement plate between the spar sleeve and the bottom surface of the stab. Mark the bottom of both stabs in the centre of this plywood. Install the carbon tube into 1 stab, and drill a 2.4mm hole right through the stab surface, the plywood plate, sleeve and into the carbon tube. The centre of the hole should be about 26mm from the trailing edge of the stab. Thread the hole with an M3 tap and secure with an M3 x 16 bolt. Then glue an M3 blind nut inside the stab spar tube, with a little 5 minute epoxy and micro-balloons, but be careful of adding weight here. Wax the bolt first!

Fit both stabs tightly to the fuselage, and then drill the hole in the other stab and spar tube, thread and secure as before. Counterbore the holes in the bottom surface of the stabs for the boltheads so that they fit flush (see cowling section). Put a piece of clear tape over the bolt heads for flight.

Note: Try to always leave the stab tube fixed in one stab, and never remove that one bolt, as it is difficult to find the right position for the stab tube again if it is removed from both stabs!

Rudder

The rudder is hinged to the fin with a 2mmØ wire which passes thru' 3 phenolic plate hinge posts that you glue into the CNC milled balsa fin post supplied in the kit. After hinging, the complete assembly is glued into the back of the fin.

Important: You must complete the Stabiliser section and glue the tailwheel support plate into the fuselage before doing the rudder section, because access is very difficult afterwards!

Trial fit the double-sided phenolic rudder horn in the slot that is already milled in the base of the rudder, and mark the part that will be glued in. Remove it, mask the exposed parts and scuff the centre part on both sides with coarse sandpaper. Glue in place with slow (*not* 5 minute!) epoxy and microballoons mix, making sure that it is centred in the rudder. The front edge of the phenolic horn should be flush against the back of the balsa false leading-edge.

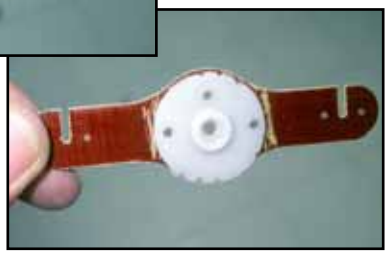
Prepare the 3 phenolic hinge posts by sanding both surfaces where they will be glued into the 10mm thick balsa fin post. The balsa false-leading edge has a 2mm hole milled thru' it ready for the hinge wire. Open up the milled slots for the 3 hinge posts as needed. File a point on one end of the wire, and a small 90° bend on the other end and push it through the rudder from the top, capturing the 3 phenolic hinges on the way.

Trial fit the balsa fin post in the back of the fin, and fit the rudder with 3 - 5mm gap between LE of rudder and the fin post. Check alignment and free movement for at least 50° both ways, and then glue the phenolic hinges into the fin post with thin CA. A little epoxy/micro mix on the front face of the fin post where the hinges stick thru' ensures that they cannot come loose. Trial fit into fin, and make sure there is 1mm gap between top of fin and bottom of rudder mass-balance. Sand the seams smooth if needed. Rough sand and prepare the inside surfaces of

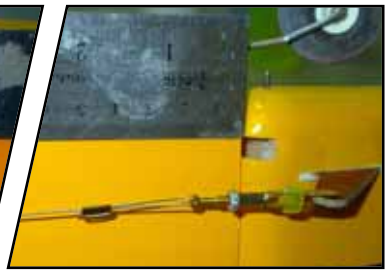
the back of the fin and glue the fin post in with slow epoxy and micro-balloons mix. Tape rudder in position with a 1mm spacer on top (see photo), and clamp fin to fin post until cured.

Servo: The rudder is a huge surface on the Extra which definitely needs a hi-torque power servo, and we highly recommend the digital JR/Graupner 8411 for this important surface.

The servo is mounted in a CNC milled composite balsa plate, with the milled 3mm plywood reinforcement underneath, in the fuselage under the canopy area. Glue the ply plate to the bottom of the balsa with CA and mount the servo with the 2.9Ø x 13mm screws provided, *not* the standard ones that come with the servo. The composite balsa rails are glued into the milled slots under the front and back of the plate with CA. Rough up the fuselage sides before gluing the complete assembly into place with 30 min. epoxy, and then reinforce these important joints with the glassfibre tape provided in the kit, and 24hr laminating epoxy (see photo).



Note: Fit the wings to the fuselage before gluing in the rudder servo mounting plate - so that you cannot accidentally deform the fuselage.



We have left the milled balsa parts for the rudder mount a bit long, so you can chose the position to suit your motor, and help to set the correct C of Gravity. If you are using a lightweight set-up, like a glow engine (or the Plettenberg electric motor and LiPo cells) then you should move the rudder servo mounting plate as far forward as possible, so that the front of the plate at the position of the rear wing anti-rotation pins.

The top of the rudder mounting plate should be 88 - 90mm above the fuselage floor. Do *not* mount it lower, or the rudder closed-loop cables may touch the elevator servos. With servo mounted as shown, the slots (40mm x 3mm) for the cable exits need to be approx. 380mm (15”) from the back of the fin, and approx. 65mm above the chine (angled corner) of the fuselage.

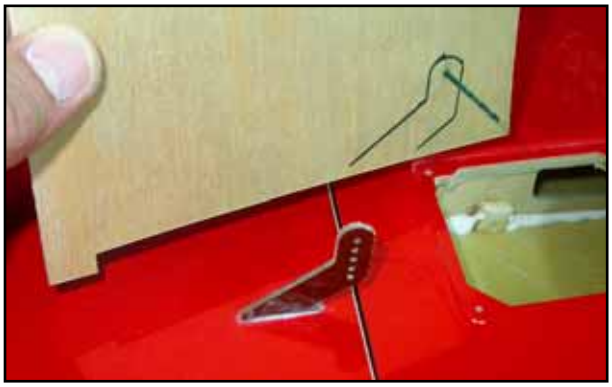
Rough sand the top surface of a standard 25mm (1”) Ø plastic output disc with 60 grit, or Permagrit, and the bottom of the phenolic rudder servo arm. Centre the servo using your R/C and glue the phenolic horn in place perpendicular to the servo. Then remove the assembly and secure the phenolic arm to the disc with 3 of the 2.2Ø x 10mm sheetmetal screws supplied.

Make up the closed loop wires for the rudder from the hardware supplied, with a loop at the front that goes over the hooks on the output arms, and a quick-link with turnbuckle and locknut at the rudder end. For security pass the closed loop cable through the supplied ‘crimping tubes’ 3 times before squashing flat with large pliers (see photo). Make sure that the wires are tight, and check and adjust after the first few flights as the cables straighten out. Even a small amount of slop will prevent your Extra from perfect tracking.

Wings

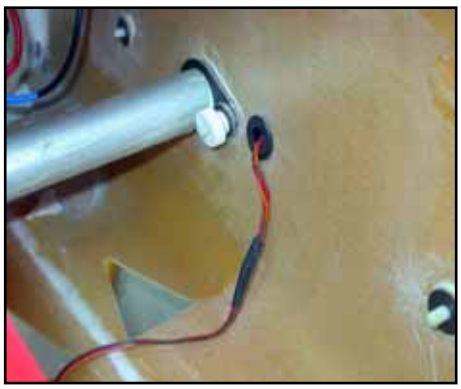
The wings are 95% finished at the factory, and have already been installed on your fuselage to check alignment. They fit on a 30mm Ø aluminium alloy spar tube, with 6mm Ø glass rod anti-rotation pins at the front and back.

Each wing is secured to the fuselage with an M6 plastic bolt (glued into the wing root) and a large plastic nut. The fibreglass spar sleeve and carbon-ply reinforcing plates have also been installed in the fuselage at the factory, and the positions of the holes for the anti-rotation pins is set in the mould to ensure correct alignment.



Drill 6mmØ thru' the 4 positions for the anti-rotation pins and also for 2 wing retaining bolts. Slide the wings on, temporarily insert the four 50mm lengths of 6mm glass rod, and check for a perfect fit between the root and fuselage. You can sand the edges of the wing roots a little if needed by protecting the fuselage with masking tape and using 240 grit sandpaper (see photo)

Wax the outside surface of the fuselage around the wing root area, and sand the fuselage inside where the anti-rotation pins will stick thru'. Lightly sand the around the heads of the two M6 plastic bolts and insert them into the holes in the root ribs so that the threaded part projects as shown. Do not glue in place yet.



Rough up about 25mm of end of each of the 6mmØ glass anti-rotation rods and glue them into the holes in the wing roots with a thick 30 min epoxy/micro-balloon mix. At the same time apply a little epoxy mix around the heads of the plastic bolts to secure. Quickly push the wings into position on the spar tube, making sure that the glass rods project inside the fuselage about 10 - 12mm, and tighten the plastic nuts on the plastic bolts. It's helpful to have a 2nd person to help with this. After about an hour you can remove the wings. Check the glue joints around the 6mmØ anti-rotation pins carefully - these are important glue joints !
Wax the exposed anti-rotation pins and re-fit the wings. Glue the 4 milled plywood washers (carbon shown in these photos) onto the inside of the fuselage to retain each pin, using a epoxy/micro-balloons mix.

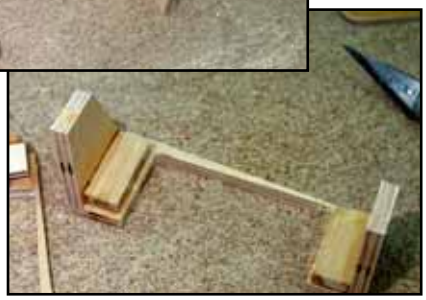
Cut two small sub-ribs from 3mm scrap balsa and glue in the wing on the inner side of each servo cutout to stiffen the wing here using epoxy/microballoon mix (see photos). Glue the phenolic aileron horns into the milled slots in the same way as the elevator horns, making sure that the clevise holes are perpendicular to the hinge axis. As before, we advise you to fit one horn

first, then make a template to ensure that the other horn is positioned the same.

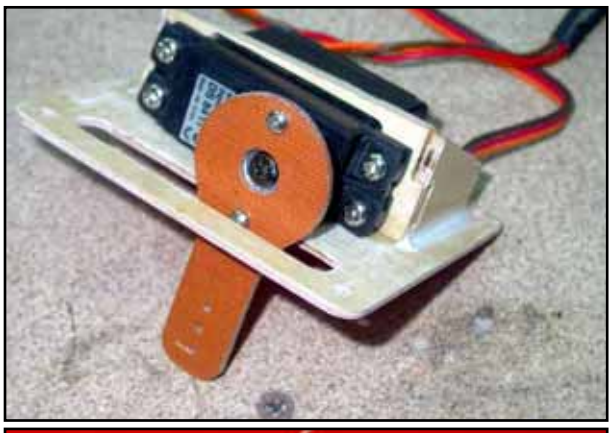
Servo choice: We highly recommend using a hi-torque digital servo (eg: JR/Graupner 8411) for each aileron as the surfaces are quite large.

The servo hatches are pre-cut in the wing, and supplied with matching servo covers and CNC milled plywood servo mounts. Sand the inside surface of the servo hatch covers and the milled plywood parts that make up the servo mounts to make sure you have a good gluing surface.

Assemble the servo mounts from the milled plywood parts for each servo, using thin CA and a 90° square. Fix the servos into the mounts with the 2.9Ø x13mm screws supplied in the kit, and place them on the hatch covers to check that the servo arms are in the centre of the slots milled in the hatch covers, and aligned with the aileron horns. Allow for the extra thickness of the C-ARF servo horns that will be fixed onto the standard plastic servo arms. You may need to make the slots in the servo hatch covers a little wider, by 1mm or so.



Tack glue the servo mounts to the hatch covers with CA, then remove the servos and reinforce the glue joints between the servo mount and the servo cover plate with slow (min. 30 minute) epoxy and milled fibre, with a nice glue fillet all around (see photo). These are important joints!



Centre the servos using your R/C and fit the C-ARF phenolic servo arms to the plastic output discs using the same method as for the elevator servos. Secure with 2 screws each, as for the elevators. Fix the covers to the wing with 4 sheet-metal screws 2.9Ø x10mm provided.

Finally make up the linkages from the M3 x 60mm threaded rods supplied, with 2 clevises and 2 x M3 locknuts for each linkage. Don't forget to 'Loctite' the clevise and lock-nut on one end of each linkage, and fit short lengths of tube to prevent clevises from opening accidentally. Do ***NOT*** use ball-links if you use these C-ARF servo arms, because they will twist the servo arm and cause flutter. This is a solid experience and you should consider it a ***FACT***.

Motor Installation


DA-50 installed

The new Composite-ARF 2 x 2m design allows so many different choices of power unit that it's impossible to provide mounting bulkheads & hardware for all of them! Therefore, depending on your choice of gas/methanol, engine you need to modify the 'generic' milled plywood parts we have included, or even make a few of your own.

The original prototype was flown with a DA-50, probably the top end of the power range that anyone could possible want ... and it had *lots* of vertical performance! There are many other gas engines that would be suitable, for example the Zenoah 38 or ZDZ 40, and ready-to-fly weight with these will be in the range of 7kg (15.5 LBS)

You could also use a powerful 2 or 4-stroke glow engine, like the OS140/160 or YS140/160 - which will give excellent, and quiet, flight performance and very light weight.

Note: No engine mounting hardware is included in the kit, because of the many different set-ups and engine choices.

We have also done extensive flight testing with Electric power, as this is becoming a very popular choice in many countries now due to stricter noise regulations ... and we can tell you that the performance of our 2 x 2 Xtra with Electric power is absolutely stunning. We already have a special 'Electric option' pack available, which will be an extremely common option and this can be used for the Hacker 50 or Plettenberg 25-13, or modified for other similar units. Ready to fly weight with these units, using LiPo flight batteries, is just under 6kg (13.2 Lbs). See end of this section for details.

DA-50 (gas engine installation)

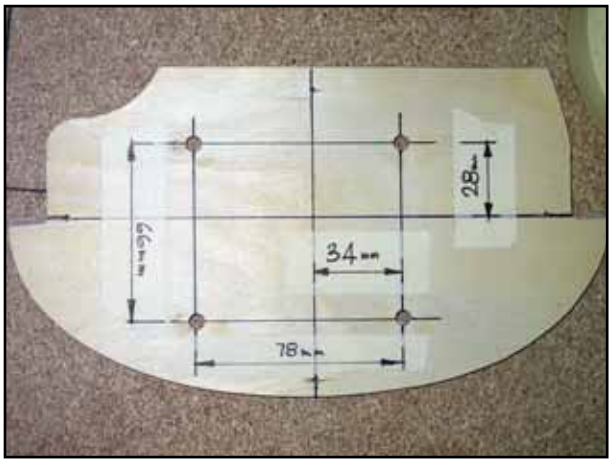
Installation of gas or methanol engines will vary considerably, depending on your motor choice, but here we show a typical set-up of the DA-50 and mini-pipe.

Supplied in the standard kit are a pair of 3mm plywood CNC milled bulkheads which have to be glued together with epoxy to make a 6mm thick firewall. These fit at the back of the cowling cutout (as shown), but the shape can be modified to fit in the correct position for your motor. Also supplied are a 3mm support bulkhead, which is glued horizontally behind the firewall, and a 'blank' 3mm plywood exhaust bulkhead for fitting vertically immediately in front of the Landing gear mount. These can be modified and shaped as needed to make a support for your mini-pipe or exhaust muffler if needed.

NB: The dimensions and positions below assume you are fitting a DA-50 engine.

The main firewall should be installed at approx. 3° sidethrust, but perpendicular to the cowling flanges (which are at 0° incidence). If using the standard DA stand-offs (65mm/2.5" long) you can set the approx. sidethrust for the DA-50 with the front face of the firewall (pilots left side) is 151mm from the front of the fuselage lip, and the right side is 157mm. Fine tuning of the sidethrust and upthrust is set by using an incidence meter and adding washers between the plywood firewall and the stand-offs.

4 small holes have been milled in the firewall to give you a reference point for setting the correct position of your engine. Mark accurate lines between these holes to use for setting your engine position. The photo shows where the 6mm Ø holes must be drill for mounting the DA-50, to give the correct sidethrust, and still have the spinner central with the radiused top of the fuselage. The dimensions shown on the firewall in this photo suit the DA-50 and 3.5" spinner, with 3.5° sidethrust and 0.75° upthrust - adjust for spinner diameter of your choice.



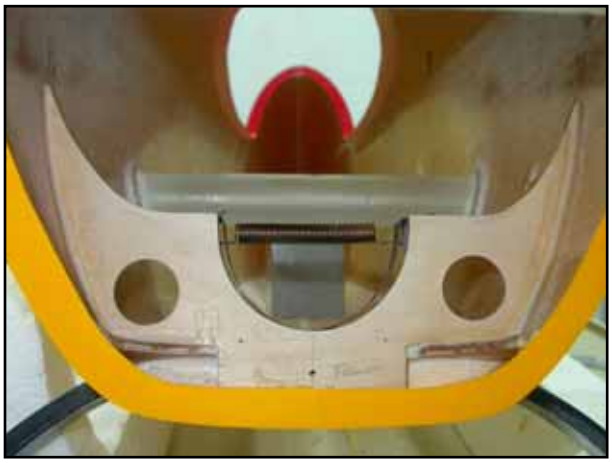
The stand-offs should be mounted to the firewall with M6 bolts and large diameter washers. Fit the spinner backplate to the motor to set final position, so that the outside edge of the spinner is exactly in the middle of the radiused curve on the top of the fuselage.

You will need to make a cut-out in the bottom of the cowl as the DA-50 cylinder head sticks out a little, but this gives excellent cooling and no internal baffles are needed in the cowling.

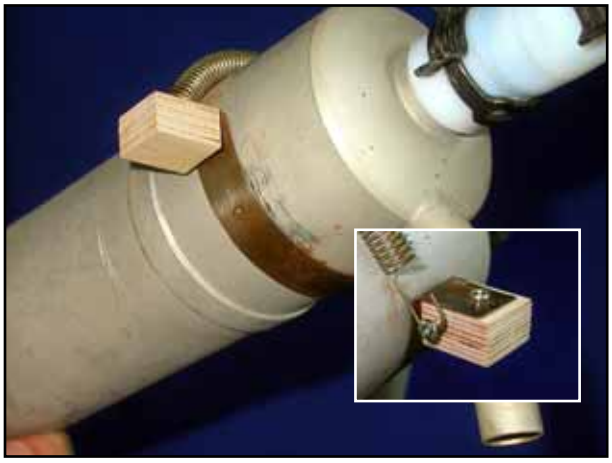
With the DA-50 and a carbon 23 x 8 Mejzlik prop we needed 3.5° right thrust and almost 1° upthrust for correct tracking, but this will vary a little depending on your motor/prop combination. A TD75K mini-pipe and header from MTW is shown fitted, and these are available as an option from Composite-ARF, with the DA-50. This set-up gives the engine a nice throttle response, a perfect mid-range, and also increases top end power slightly.

You can see from the photos here how to cut out the exhaust support bulkhead for a MTW TD75K mini-pipe, and make a steel strap and spring to retain the mini-pipe to the bulkhead with a little flexibility. It just fits with about 5mm

clearance above to the wing spar tube, and 4mm below to the landing gear fixing bolts/blind nuts. An alternative is the MTW TD75 mini-pipe which is smaller diameter and gives more clearance, but is a bit longer. If you chose this then the cooling exit hole for the pipe will be further back in the fuselage. You may need to bend the header a little to suit whichever mini-pipe you chose. This simple pipe retaining system has been used for many years in all our planes, and holds the pipes securely, while still being flexible enough to prevent them breaking under normal vibrations.



The air exit hole in the bottom of the fuselage should be at about 65mm wide and 110mm long for both pipes. Round the corners to reduce any chance of tearing in the composite skin.



The header, and both the TD75K and TD75 mini-pipes are available from C-ARF as options.

Note: Please call your Composite-ARF Rep. if you need any additional help with the motor and mini-pipe installation.

Fuel Tank Base

Included in the kit are CNC milled balsa/composite parts to make up a fuel-tank base, which also incorporates a receiver mount. The photos show how the parts are assembled, and the completed unit is then glued on top of the fibreglass wing spar tube in the centre of the fuselage with epoxy and micro-balloons mix.

Reinforce the joint where the vertical balsa support is glued to the fuselage bottom with a short piece of 1” glassfibre tape and laminating resin. The tank base is designed for fitting a Dubro 24 oz tank/700 ml (Part#424) and this is more than big enough even for a DA-50.

If you wish to mount your receiver on the vertical support at the back of the tank base, then glue the milled 3mm plywood stick to the inside surface, centred on the 2 large holes, wrap the receiver in thick foam and and fix it in place with 2 No.#80 rubber bands.

The fuel tank is held to the tank base with 3 cable-ties (see photo on page 23). Drill a hole in

the motor firewall where necessary for the fuel feed tube from the tank to the carburettor, and protect it where it passes through the hole using a rubber grommet or similar. Fix the tubing securely to the underside of the top of the fuselage to make sure that it cannot come in contact with the hot exhaust.

Fit the correct stopper to the fuel tank for the fuel type used. (If using Dubro tank the gasoline stopper has a small 'O' moulded in the top of it). We use the excellent 'Tygon' brand of fuel tubing for all our models. It is totally gasoline and kerosene-proof, and does not go hard and crack with age.

Secure the feed tube inside the tank to the clunk with a small cable tie. If the tube is even a little loose on the brass tubes though the stopper it will come off at just the wrong moment and your engine will quit. So solder some small rings onto both ends of the brass tubing (easily made from the soft wire of a paperclip wrapped around a small screwdriver) and secure with a fuel-line clamp or cable-tie. Don't miss this small detail - it could cost you your plane !

Throttle servo mount

We use the normal 3-tube plumbing system, one from the clunk to feed the motor, one out of the bottom of the plane (vent/overflow - leave open) and one at the top for filling (close for flight).

Throttle servo

Included in the kit is a CNC milled plywood throttle servo mount, and you can fit this in any suitable position for your motor set-up. However, we advise you *not* to mount it directly on the back of the firewall as engine vibrations can damage a servo quite quickly. Rather mount it on the fuselage side near the wing spar tube and use a lightweight 'snake' (cable inside a plastic tube) to connect to the carburettor linkage, securing the outer plastic tube at several points.

Motor ignition system

The ignition unit can be secured onto the firewall support plate with 3 cable-ties, on a foam rubber pad to protect from vibrations. At C-ARF we recommend a 4-cell 1000 - 1200 NiCad for ignition, and we use a Powerswitch for the ignition cut-off. Add a very small cable tie around the plug/socket connectors from the motor pick-up to the ignition unit for extra security.

Glow Engine Installation

If fitting a 2-stroke or 4-stroke glow/methanol engine, for example OS140/160 or YS140/160) you can generally use the same techniques as shown above for the DA-50 (gas engine) set-up.

These will give a very lightweight aircraft, but for sure you will need to install all components, including the receiver battery, as far forward as possible to achieve the correct Centre of Gravity. The Rudder servo mounting plate should also be installed as far forward as possible, and you can save some weight in the tail by using hi-torque digital mini servos for the elevators, of at least 5kg torque each.

Of course you will need to reposition the firewall to suit either a solid F3A type 'beam' engine mount, or a 'Hyde' mount, as necessary. The fuel tank base, made from the milled composite-balsa parts included, can be used and will accept a fuel tank up to720ml if required. You can also install the receiver on the vertical bulkhead at the back of the tank base, as for the gas engine (see photo)

The exhaust system, or mini-pipe, can still be installed internally - but make sure that there is sufficient cooling as described, and make a balsa baffle inside the cowling if needed to direct cooling air over the cylinder fins and prevent it just going out of the bottom air exit. If you chose to fit a full-length tuned pipe you can make a tunnel from thin balsa sheet if you wish.

Electric Power

* **If you are fitting a gas or glow motor, skip to page 31**

Our 'Electric Power' Option pack includes all the main bulkheads and battery support parts required to install either the Plettenberg Xtra 25-13 motor, or the Hacker 50 geared unit, both powered by LiPo batteries. Considerable flight testing and demonstrations have been carried out with the Hacker, which is the most powerful of these 2 units, and we can *highly* recommend this combination.

The 'Electric Option' pack includes bulkheads and parts to install both Plettenberg Xtra 25-13 or Hacker C50 geared units.

Hacker 50 (Geared 6.7:1)

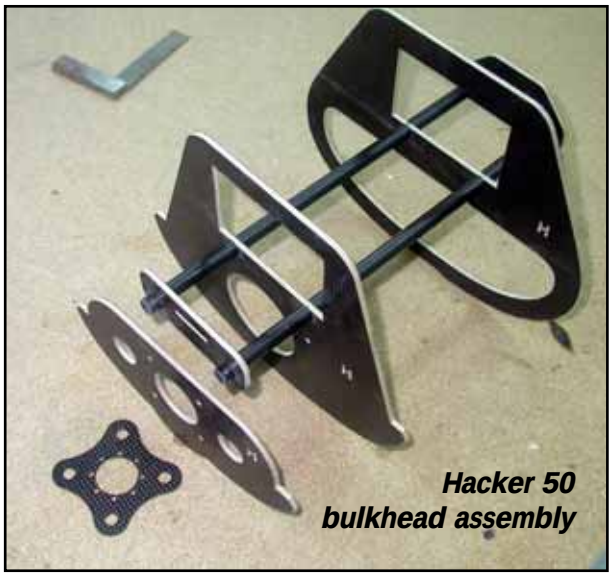
A Hacker 50, fitted with an APC E22 x12 propeller and LiPo cells (as shown here) is the perfect match for this plane. 'Prop hanging' needs only about 40% throttle, and the plane will accelerate straight up from that with ease. Flight times are an easy 8 or 9 minutes, depending on your schedule. The Speed Controller used is Hacker's own Master 0-90-Acro unit, which performs very well and gives nice throttle response. The batteries used were a pair of 'Thunder Power' 6000 mAH Lipo's, connected in series, which give about 9+ minutes duration. The complete motor/battery/speed controller combination weighs just under 2kg.

We did not use a BEC unit with this set-up, preferring a separate Rx battery (1400 mAH 5-cell), which was needed to achieve the correct Centre of Gravity anyway.

The speed controller was fixed on a ply plate above the LiPo's, behind the motor and secured with double-sided foam tape and a cable-tie. Make sure there is enough cooling airflow over the heatsink.

The photos show how the 3 bulkheads are installed. The front of the motor is mounted to the

2mm thick C-ARF carbon motor mount, with the standard fibreglass circular plate that is supplied with the motor sandwiched underneath it, using the four M3 bolts supplied with the motor. The whole assembly is then fitted to the *front face* of the front bulkhead with four M4 bolts, which pass though the plastic grommets with a 2mm thick carbon washer either side (included in the Elec-option pack), into M4 blind nuts.



Hacker 50 bulkhead assembly

Note: The front bulkhead *must* be glued in the fuselage with approx. correct 3° sidethrust.

The rear of the motor fits tightly into the 3mm milled plywood plate with the 3 'ears' for thrust-line adjustment, and this is secured onto the back face of the middle carbon/ply bulkhead with three M3 bolts and blind nuts. This middle bulkhead is fitted perpendicular to the centreline of the fuselage - *not* at the sidethrust angle. Adjustment of the position of the holes in the 3 ears of this ply part allows fine tuning of the side-thrust and up/down thrust, although this is already set approximately by the position of the front carbon/ply bulkhead. The back bulkhead is also fitted perpendicular to the fuselage centre-line, and it's position is not critical - just set it for your battery mounting.

Don't forget to add a drop of Loctite on all the front and rear engine mounting bolts !

The middle and back bulkheads already have rectangular cut-outs (50mm x 85mm) for typical sized flight batteries and these can be adjusted for your battery choice.

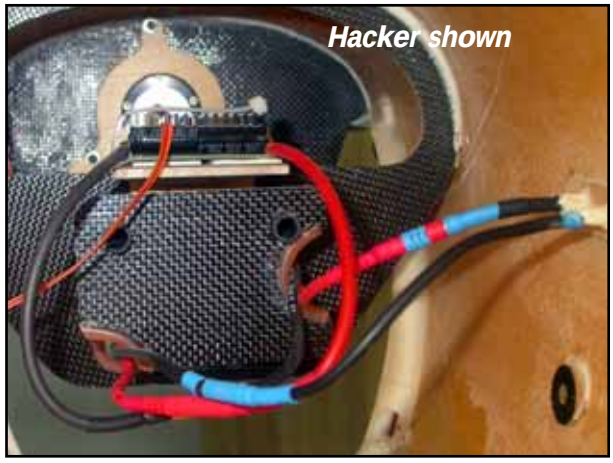
Note: All Hacker bulkheads are marked with a milled 'H'.

The batteries are supported on a pair of 10mmØ carbon tubes (included), which has a sheet of composite foam-board CA'd onto it, and retained with double-sided velcro straps provided. At the front of the tubes you just slide on the carbon/plywood part supplied to stop the batteries moving forward in flight, and secure with the Velcro. The carbon/ply part for the back is glued onto the carbon tubes permanently. The batteries are inserted from the front, by removing the cowling. The photo showing the parts assembled outside the model should make construction clear.

Important: Don't forget to protect *all* bare carbon edges with a length of the supplied silicone tube, split with a knife and glued in place with CA as shown. This is *very important* as any wires or insulating material rubbing on the carbon will be cut thru' in 1 flight - which can cause a dangerous short circuit.


Plettenberg Xtra 25-13 shown

It is important to note that the front bulkhead is glued into the fuselage with a 0° up/down thrust setting, but with the 3° sidethrust. An easy way to set this is to put the fuselage on it's side, with the wing spar in place and use a spirit level to make it absolutely vertical (see photo - Plettenberg motor shown). Then use an incidence meter (Robart shown) on the centreline seam of the fuselage to set the zero thrust line - adjusting the height of the back of the fuselage to get the 0°. Install the motor in the front bulkhead and fit the incidence meter to the shaft of the motor, and adjust until you have the required 3° sidethrust. Tack glue in position with thick CA, also checking that the bulkhead is perpendicular to the cowling flanges which are at 0° incidence.


Hacker shown

Remove the motor carefully, and glue the bulkhead in securely with slow epoxy and micro-balloons. Tack glue the the middle bulkhead in place in the same way, but with NO sidethrust, and fit the motor again, using the plywood part with the 3 'ears' to fine tune the upthrust and sidethrust angles. Mark the holes for the M3 bolts and fit with blindnuts to secure the motor. The slight flexibility allowed by the plastic grommets used to mount the motor to the front bulkhead will allow about 0.5 - 1° thrustline adjustment.

The middle and rear bulkheads can be tacked glued in position with a little thick CA, using the carbon tubes for alignment, and then fixed securely in the same manner as the front bulkhead with 30minute or 24hr epoxy and microballoon mix.

Plettenberg Xtra 25-13.

The Plettenberg motor is mounted in a similar manner, except that there is no bulkhead in front of the motor - as the *outside* of the motor turns.


Plettenberg Xtra 25-13

This installation is a little more lightweight than the Hacker set-up, with only 2 main bulkheads and a support plate. We also used an Emcotec DPSI LR voltage regulator to take power from the flight batteries (Emcotec LongGo 10S2P 4000mAH LiPo's) to supply the receiver, saving the extra weight of a separate Nicad. To get the correct 'C of G' with this set-up you must put all components as far forward in the plane as possible, including the rudder servo, and be very

careful to keep the weight down at the tail end.

Generally you can use the same methods as described above in the 'Hacker' installation, to set the correct sidethrust and upthrust etc, and for gluing in the bulkheads and battery supports. However you should set both the correct side-thrust *and* upthrust when installing the motor mounting bulkhead.

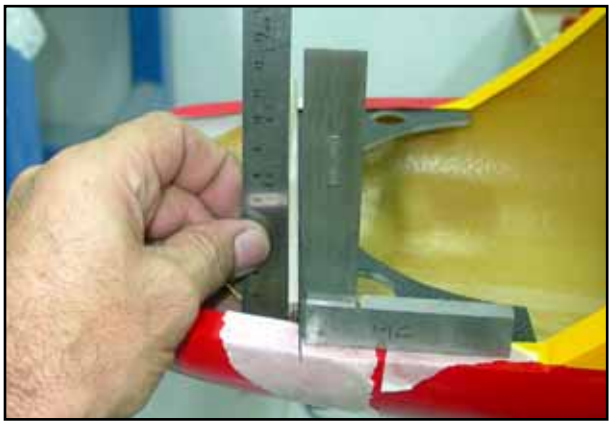
The Plettenberg motor is mounted at the back onto a CNC milled 2mm carbon plate supplied in the Elec-option pack with three M4 x 6mm bolts, and then the completed assembly is bolted to the front carbon/ply bulkhead using 3 plastic grommets (with carbon washers on both sides) and an M4 bolt through the grommet, into M4 blind nuts on the back face of the bulkhead. Fit one carbon washer on the front of the grom-mets, and 2 washers on the back to give clear-ance for the 3 bolts that secure the motor to the 2mm thick carbon plate. Add a drop of Loctite on these engine mounting bolts !

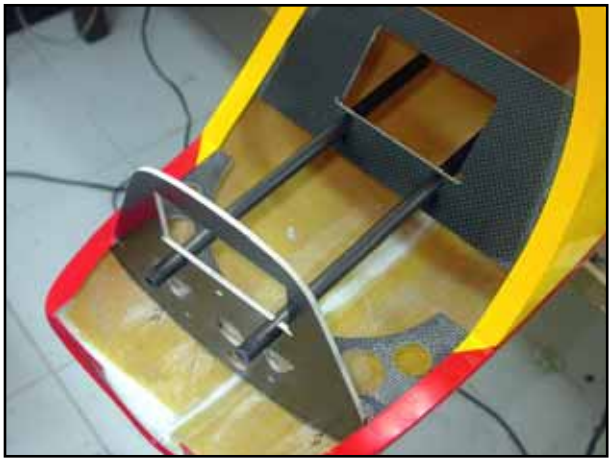
The front bulkhead (at the back of the motor) must be glued into the fuselage with about 0.5° upthrust setting, and with the 3° sidethrust using the same method as the Hacker front bulkhead. Very small (+/- 0.5°) thrustline adjustments can be made by adding additional washers between the carbon washers and the bulkhead.

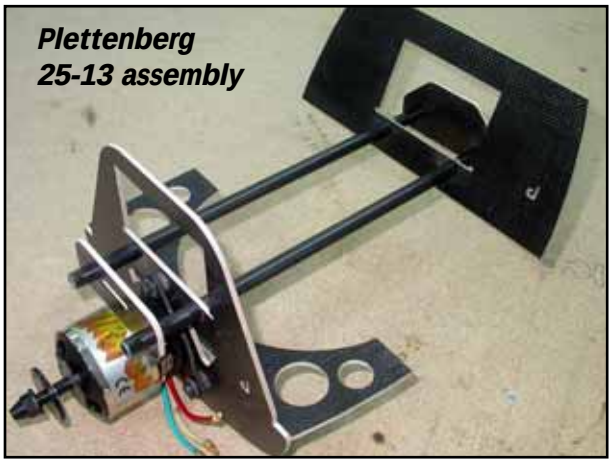
The horizontal support plate (3mm balsa/car-bon) is fitted behind the front bulkhead, secured to the top of the side flanges. This plate can only be fitted one way round - as the front is milled at a 3° angle to suit the right sidethrust.

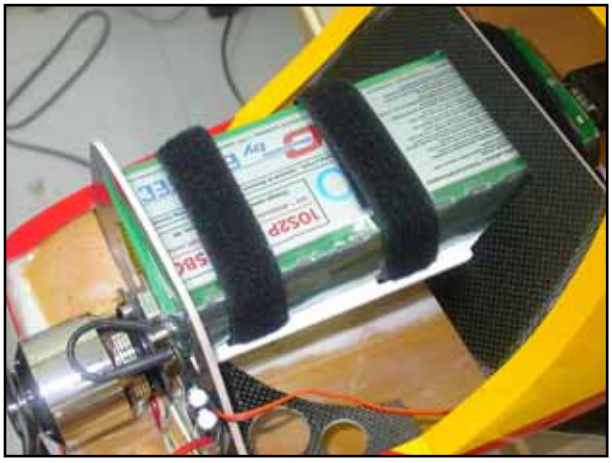
The back balsa/carbon bulkhead is glued inside the flanges at the back of the engine bay, at an angle (see photos), using the carbon battery mounting tubes for alignment. The holes for the 2 carbon tubes have been milled a little small in this back bulkhead, and you must open them up at the correct angle with a round file. Tack glue both bulkheads with a drop of thick CA, and secure with slow epoxy and microballoons as above after checking the thrustline angles.

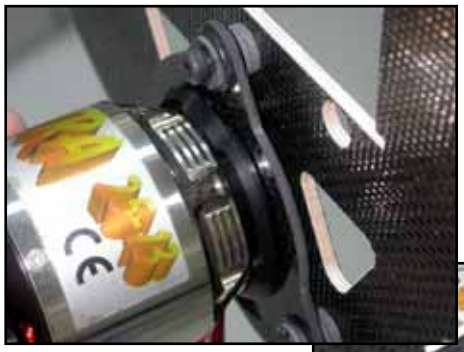
Note: All 3 Plettenberg bulkheads are marked with a milled 'P'.

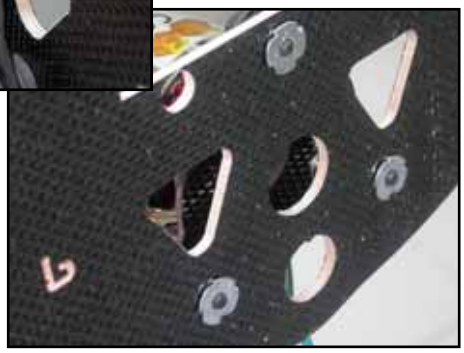










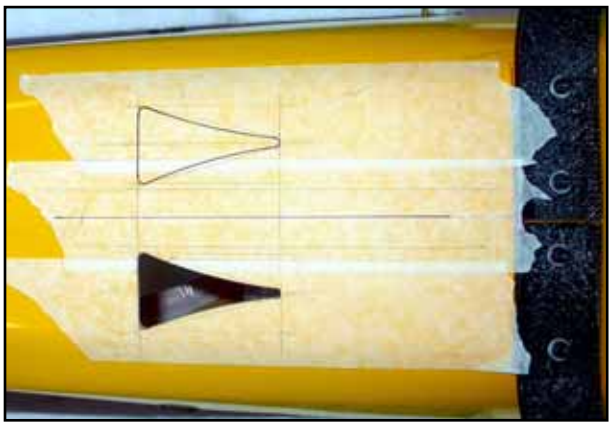


The batteries (Emcotec LongGo LiPo's 10S2P 4000 mAH) are mounted in a similar way as for the Hacker, with a small piece of foam-board glued onto the carbon tubes, and retained with Velcro straps provided in the E-option pack.

The speed controller used with the Plettenberg was a Schulze 'Future 32.55', which is a very nice light-weight unit, but has short connecting wires to the batteries. Therefore it was mounted on the side of the front bulkhead next to the motor (with Velcro), and the connections to the LiPo cells are made at the front. Make sure that sufficient cooling air is directed to the speed controller in this location.

Plettenberg recommend a RASA 18 x12 carbon prop for this motor.

Cooling:



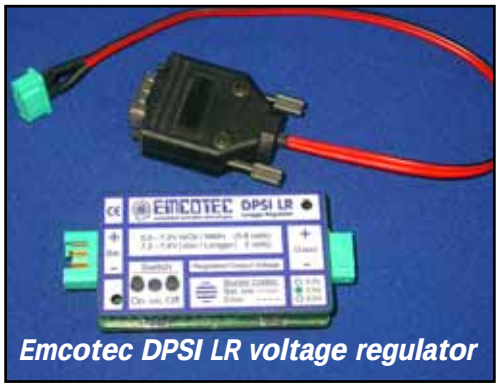
Depending on your choice of motor, battery and speed controller you will need to make provision for enough cooling to all these components during flight. All 3 components will get warm during use, but must not get too hot to prevent damage and possible damage or fire.

This is ***most important***, and if this is your 1st electric model we ***strongly*** recommend that you follow the advice of the manufacturers, and this instruction manual. Different power unit and battery combinations will operate at different temperatures in different ambient climates, so it is not possible to give you the exact areas and positions of the cooling required for every set-up. However, the cooling cut-outs shown in the photos here, in addition to the large air exit in the bottom/rear of the cowling, have worked well with the installations we have tested.

You should go towards *more* cooling, rather than less, and pay particular attention that the area of the *exit* area for the cooling airflow is at least 20% bigger than the air entry area. Open up the cooling entrance in the lower front of the cowling to it's maximum width (about 40mm) and make it V-shaped about 90mm long as shown in the photos. Cut out the full oval shape in the front of the cowling around the spinner, as shown in the Hacker installation, and make sure to have some holes in the bulkheads to allow the air to pass freely around all components. We also made 2 (70mm long) NACA style air outlets in the bottom of the fuselage (see photo), just behind the landing gear, to ensure that warm air is able to get out of the fuselage. Don't cut through the 1"

glassfibre joining tape in the centre of the fuselage. Immediately after flight the Hacker motor and batteries are only warm to the touch, and the heat sink on top of the speed controller can also be touched without burning your fingers.

If using the Plettenberg Xtra 25-13 motor and LongGo flight packs, you can use the Emcotec DPSI LR voltage regulator (see photo) to supply regulated current to your receiver, instead of a separate battery, and it also incorporates a failsafe electronic switch. Available as an option from C-ARF.



Emcotec DPSI LR voltage regulator

Battery Handling:

As battery technology advances at a rapid rate, the use of LiPo flight and receiver batteries is becoming quite common, but (like with all batteries) there are still dangers and it is ***most important*** that you exactly follow the battery manufacturers advice on storage and charging, and use the charger and charging rates that they recommend. Do ***NOT*** leave your LiPo batteries un-attended during charging.

Important: When installing the battery(ies) in the model before a flight, make sure that no connectors can touch each other and cause a short circuit. To be safe apply a bit of masking tape to *all* connections while installing them in the plane, and glue a short length of clear silicone or plastic tube over each male and female connector (see photo) to make sure they cannot accidentally touch in flight.

So that you can make the final connection between your batteries and the motor just before your flight, after you have switched on your R/C system, we use a pair of the standard 4mm gold connector pins glued into the outside of the airframe and use a very short thick cable with opposing connectors to 'arm' the system without having to remove the canopy or cowling (see photos).

Please note:
The Electric-Flight scene, and it's technology, are advancing so rapidy that new Motors, Speed Controllers and Batteries become available all the time. At the time this manual was written the Hacker C50, Plettenberg 25-13 and other components mentioned here were top-of-the-line products suited to this aircraft. However we already know, for example, that Plettenberg will shortly release a slightly larger motor than the Xtra 25-13, which should be even more suitable for this airframe. So don't be surprised when some of these parts are already outdated by the time you receive you Extra 2 x 2 !

R/C & Gear Installation

Everyone has their own favourite methods for fitting the R/C and gear, but the installation techniques shown here can be used as a guide and they have worked perfectly in all of our planes flown by C-ARF factory staff, and many of our customers. The advice below applies to whatever engine type you chose to fit; gas, glow or electric.

With a plane of this size it is important to keep everything lightweight to ensure the best performance and flying characteristics, and the Hacker 50 electric power version shown only weighs 5.9kg ready to fly. The DA-50 powered version is quite a bit heavier at about 7kg, dry. Of course, the final weight of your model will depend a lot on the power plant used, and if you decide to add any trim or paint to the model.

Receiver and Antenna
The receiver can be fitted anywhere you like, but the 2 choices shown minimise the number of extension leads required. Please protect it from vibration and shocks (even if you chose to use electric power) by mounting it on some foam rubber, and don't forget to secure the receiver crystal with a piece of clear tape.

With electric power it can be installed on the side of the fuselage as shown, or if using a gas/glow motor you can use the mount provided on the vertical back face of the fuel tank base. Run the antenna wire along the side of the fuselage in the cockpit area, taped in place, and then vertically through the top of the fuselage (in a piece of silicone tube) behind the cockpit and back towards the vertical stab (see photo). Keep it as far away as possible from the cables for the elevator servos and the closed-loop rudder wires.

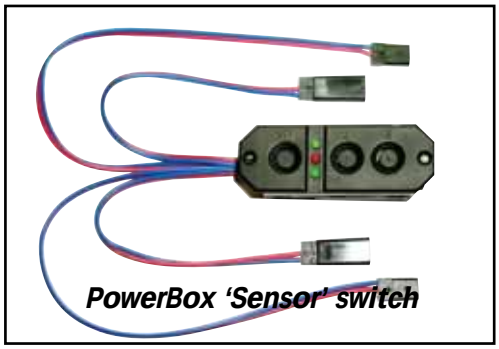
Composite-ARF strongly advise you to keep all the cables between the motor ignition battery, ignition switch, gas-engine ignition unit, or electric motor and speed controller, as far away as possible from the Receiver and Antenna.

Receiver Batteries
As this model only has 5 or 6 servos, even if they are all digital types as we have used here, a single receiver battery pack of 5 cells x 1400 mAH is normally quite sufficient. Wrap the Nicads in foam, to protect the soldered joints from vibrations and shocks. Of course, if you need more weight in the nose of the 'plane to achieve the correct Centre of gravity, it is better to install a larger Nicad - rather then add lead.

The location of your batteries will depend on your motor choice and where they need to be for correct C of Gravity. Shown here is a 1400 5-cell pack in the nose for the Hacker set-up.

NB: *Please double-check the manual for your R/C system if the use of 5-cell NiCads is recommended, or not.*

Switches
When using a gas engine we highly recommend a 'Powerswitch' for the ignition cut-off, which is available from C-ARF. If fitting the switches into the outside surface of the fuselage, as shown, you should reinforce the area inside with a small patch of 3mm thick plywood to reduce vibration transmissions to the switches. The switches come with paper templates for cutting the slots.


PowerBox 'Sensor' switch

If using a separate Rx battery(ies), instead of a BEC system, we can highly recommend the Powerbox 'Sensor' switch as used here. This unit incorporates both dual battery inputs and outputs to the receiver, as well as a voltage regulator for 5-cell packs which regulates the voltage to 5.9 volts. You can use this switch with 1 or 2 Nicad packs. An excellent lightweight unit that is available from Composite-ARF as an option. See website.

No switch is normally used for the Flight batteries if fitting an electric motor, due to the very high current. Instead use a simple arming system to connect the battery to the speed controller, as shown in the 'Electric option' section.

Servo extension leads etc.
We advise you to use good quality twisted-cable extension leads, of heavy gauge wire with gold-contact connectors. Certainly we recommend that all servo leads and extensions longer than about 30cms (12") are fitted with ceramic chokes (ferrite rings) at the receiver end to prevent RF noise, within 100mm (4") of the receiver.

Secure all loose wires and extension leads - remember that when you are pulling those 10G manoeuvres everything in the plane has 10 times more force than usual! Be very careful to fix your flight batteries/Rx Nicads securely.

A short length of plastic spiral-wrap every 150mm/6" or so over the cables, and a small blob of 'hot glue' works well - and is easy to remove if necessary for maintenance etc. Make extra sure that no fuel tubes or cables can come in contact with hot exhausts. If using an electric motor with high current batteries it is extremely important to make sure that no battery wires/connectors can touch each other, either during battery installation, or flying.

Fuel proofing:
If fitting a gas or glow motor we highly recommend that you protect all the bare wood parts and edges inside the front of the plane with one thin coat of 24 hr laminating epoxy, or similar, brushed on. Be careful not to add excess weight here - it only needs about 25 - 30 grams (1 oz.) of epoxy to fuel proof all the wood in the whole area in the front of the plane.

Final check

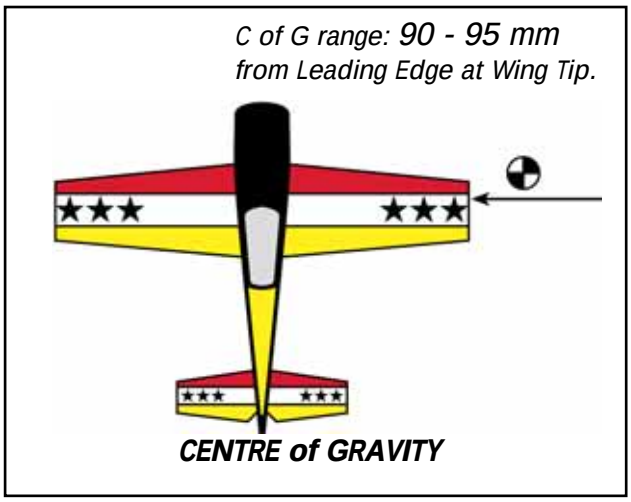
Check that you have fixed all components securely. Keep in mind that everything inside the aircraft is loaded with the same G's as the wing and the wing spar during aerobatic maneouvres. Check engine, cowling, wing and stab mounts carefully again.

- Are all extension leads, cables and fuel tubes securely fixed to the side of the fuselage ?
- Are all tubes/wires protected from chafing where they pass thru' the holes in fibreglass parts or bulkheads with rubber grommets, or short lengths of split silicone tubing?
- Make sure that no fuel tubing or wires can come into contact the hot exhaust.
- Did you fit short Tygon or silicone tube pieces over all the clevises?
- Did you tighten the M3 locknuts against all the clevises?
- Are the swages crimped up nice and tight on the rudder cables?
- Have you put clear tape over the end of the rudder hinge wires and on the stab bolts ?
- For added security add one small drop of loctite/thread locking compound on all engine mounting bolts, and those that hold the servo arms to the servos, especially important with digital types.

Then you can go on set up all the linkages, control throws and R/C system as described below.

Setting Up Your Aircraft

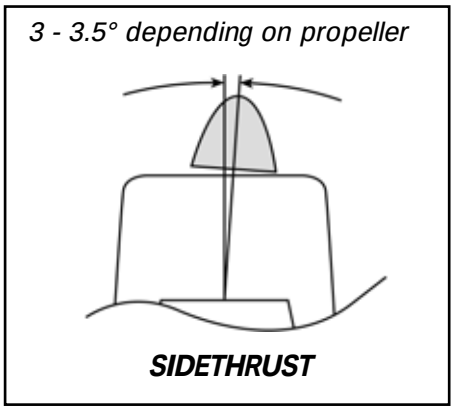
Centre of Gravity:
For the 1st flights set the Centre of Gravity at 90 - 95mm (3.55 - 3.75") from the leading edge ***at the wing tip***. Hold it with a helper at both wing tips in this position and make sure the plane balances horizontally, or slightly nose-down. This is the 'pattern' CG position.



CENTRE of GRAVITY

After you are confident with the plane, you can move it backwards up to 100mm from the leading edge at the ***wing tip***, but this definitely a '3D/Freestyle' CG setting and should not be used for the first flights. With this rearward CG you will need to use the high rate control throws shown below.

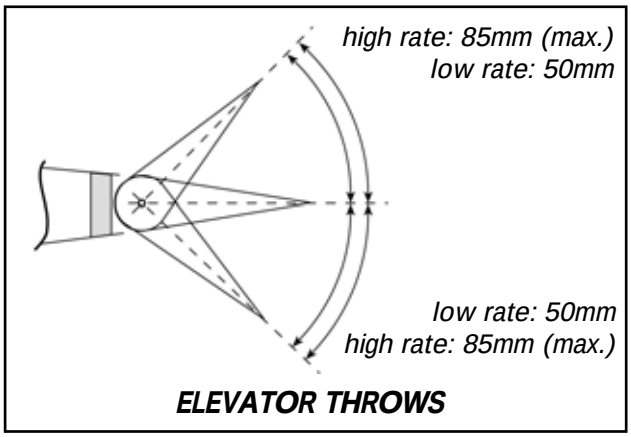
Don't forget to balance the plane laterally, holding the spinner central bolt and a fingertip under the rudder, and if needed add a small weight to the light wing tip.



SIDETHRUST

Engine Thrustline:
UPthrust should initially be set at 0.5 - 0.75° degrees and right thrust 3 - 3.5 degrees, depending on the power system and propeller used. With the DA-50 and carbon Mejzlik 23 x 8 prop we needed 1° upthrust and 3.5° right thrust, but with the Hacker 50 and APC E22x12 only about 0.5° upthrust and 3° sidethrust is required. Of course, final settings can be fine-tuned to your liking after the first few flights, and will ultimately depend on your motor/propeller set up.

Control Throws:
All measurements are at the root/trailing edge position.

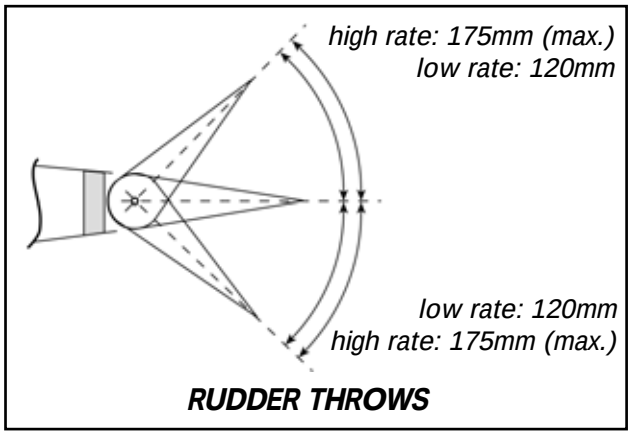


ELEVATOR THROWS

Elevator
All controls should be set with a dual rate switch. On high rate the elevator should really be at maximum, up to 50 degrees both sides (approx. 85mm), but in this case with 50% exponential. Low rate should be no more than 50mm (2") both sides. This is the perfect throw for nice and crisp snaps. If you like you can add about 20% exponential to the low rate setting as well.

Rudder
Set the high rate to maximum throw (about 175mm) both sides, and at low rate reduced to about 120mm. The Extra needs quite a lot of rudder for nice stall turns, so you should at least add 25% exponential for smooth tracking corrections. At the same time you should remember that the

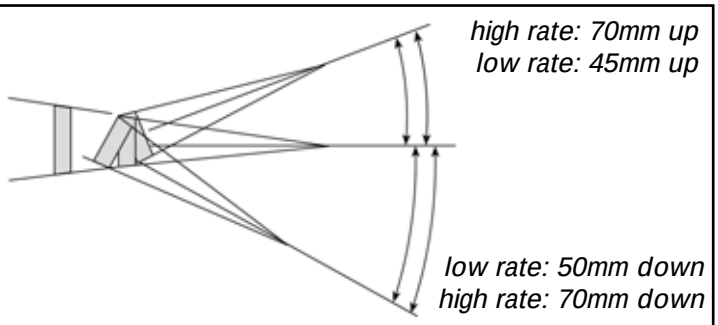
Extra rudder is VERY sensitive, and the plane starts shaking at high speed if the rudder linkage is not really rock solid. So check your linkages and closed-loop cables again and make sure that there is NO slop at all ! On the other hand these characteristics are also the reason for best rudder sensitivity at the slowest 3D-speeds.



RUDDER THROWS

Ailerons

Aileron throw for high rate is 70mm up and down. Use at least 30% exponential for high rate. For low rate you should decrease the throw to the *top* to 45mm, and the *bottom* to 50mm. Yes, this is a reversed differential due to the hinge line being in the top skin instead of on the centre line. You will have to finalise this differential figure during flight, as mentioned earlier in this instruction book. At high rate, for 3D maneouvres, this doesn't effect the rolling too much, so you can maximize the throws to whatever is mechanically possible, even more up than down if you wish.



AILERON THROWS

In General

Your Extra has very large control surfaces, which makes it very sensitive and reactive. It is always possible that these huge control surfaces can flutter at high speeds if the assembly, servo installation and linkages are not made perfectly. So please do yourself a favour, and make sure that you only use the best servos available, and take the utmost care making your linkages. Check every linkage for slop, and rather reduce the maximum throw than risking a high speed flutter due to sloppy servo gear or linkages.

We hope that you enjoyed building your Extra 330L. Also let us know, if you think that any hardware is missing or inadequate. 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: feedback@composite-arf.com

Thank you!
Your Composite-ARF Team

Appendix:

Packing List

Extra 330L, 2 x 2m Kit

Main Items

Art.-Nr.	*Quantity*	*Description English*
	1	Fuselage
	1	Right wing
	1	Left wing
	1	Right stabiliser
	1	Left stabiliser
	1	Rudder
	1	Cowling
	1	Canopy
	1	Right wheel pant
	1	Left wheel pant
	1	Right landing gear, carbon
	1	Left landing gear, carbon
	1	Aluminum Wing tube 30Ø x 1.4 x 735mm (wing spar)
	1	Hardware bag
	1	Milled wood parts bag
	1	Instruction manual (English)

Wing Pack - Hardware

Art.-Nr.	*Quantity*	*Description English*
	2	Aileron horns - phenolic
	2	Servo arms - phenolic
	2	All Thread M3 x 60mm
	4	Clevise (spring steel) M3
	4	Nut M3
	4	Screws 2.2Ø x 10mm (for servo arms)
	8	Screws 2.9Ø x 13mm (for servos)
	8	Screws 2.9Ø x 10mm (for servo hatches)
	2	Plastic bolts M5 x 50mm
	4	Plastic nut M6
	4	Fibreglass rod 6mmØ x 50mm
	2	Milled plywood servo mounts (3mm plywood)

Landing Gear - Hardware

Art.-Nr.	*Quantity*	*Description English*
	2	Bolts M4 x 45mm (axles)
	4	Bolts M4 x 16mm
	4	Blind Nuts M4
	12	Washers M4
	2	Stop Nuts M4
	2	Nuts M4
	2	Screws 2.9Ø x 13mm

Stab Pack - Hardware

Art.-Nr.	*Quantity*	*Description English*
	1	Carbon Stab tube 14Ø x 1 x 280mm (stab spar)
	2	Elevator horns - phenolic
	2	Servo arms - phenolic
	2	M3 All-thread x 60mm
	4	Clevise (spring steel) M3
	4	Nuts M3
	2	M3 x 12mm bolts
	2	M3 Blind nuts
	2	M3 washers
	8	Screws 2.9Ø x13mm (for servos)
	2	Glassfibre rod 6mmØ x 50mm
	4	Screws 2.2Ø x 10mm (for servo arms)

Rudder Pack - Hardware

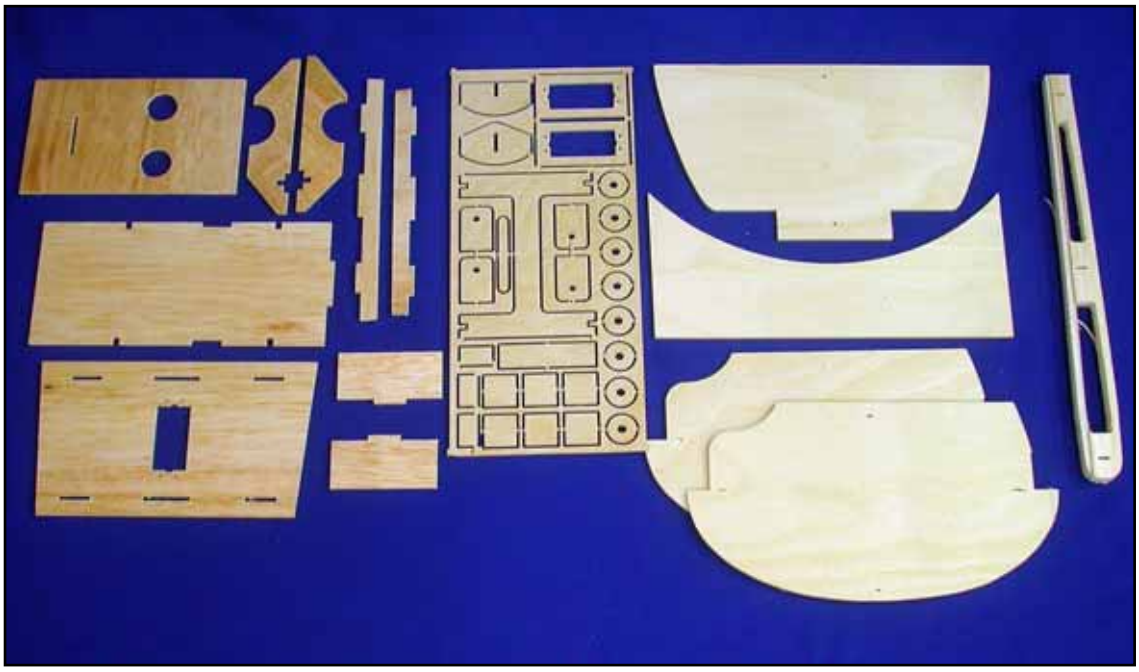
Art.-Nr.	*Quantity*	*Description English*
	1	Rudder Horn - phenolic
	1	Servo arm for Rudder servo - phenolic
	1	Pull-Pull cable 0.8 mm Ø x 2 metres
	3	Screws 2.2Ø x 10mm (for servo arms)
	4	Crimping tubes for cable
	2	Cable adapters with eyes for cable M3
	2	Nut M3
	2	Clevise (spring steel) M3
	1	Hinge wire 2mm Ø x 400mm
	3	Hinge posts (small) - phenolic
	4	Screws 2.9 Ø x 13mm (for servos)
	1	Fibreglass tape 1” x 200mm long
	1	3mm milled plywood servo mount reinforcement

Canopy and Cowling - Hardware

Art.-Nr.	*Quantity*	*Description English*
	1	Hatch Catch
	1	Plastic moulding for Hatch Catch
	2	canopy hook - phenolic
	1	U-shaped plate for canopy hook - phenolic
	2	Phenolic plate 15mm x 60mm (for canopy/cowling tongues)
	4	Bolts M3 x 16
	4	Blind Nuts M3
	4	Washers M3

Lieferbares Zubehör / Available Accessories:

Electric Power option pack (bulkheads etc)
Desert Aircraft DA-50 motor
MTW Mini-pipe or Tuned-pipe systems for DA-50 motor
Powerbox ‘Sensor’ switch with regulator a dual inputs/outputs
Powerbox Power and Sensor switches for Ignition or receiver Nicads



Standard Wood parts included in the kit

Standard Hardware included in the kit