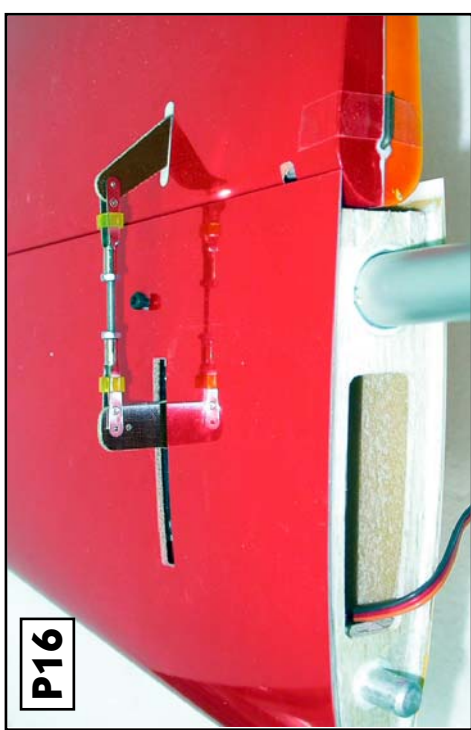
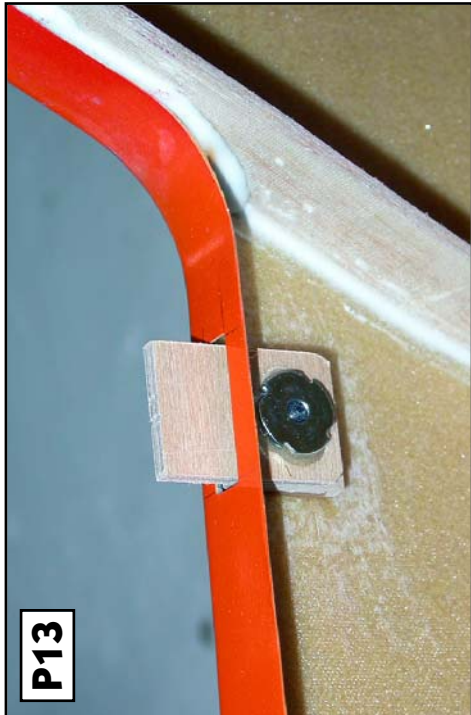
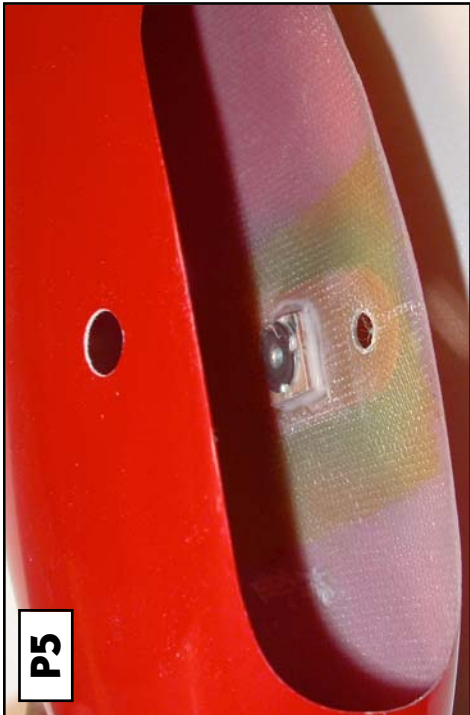
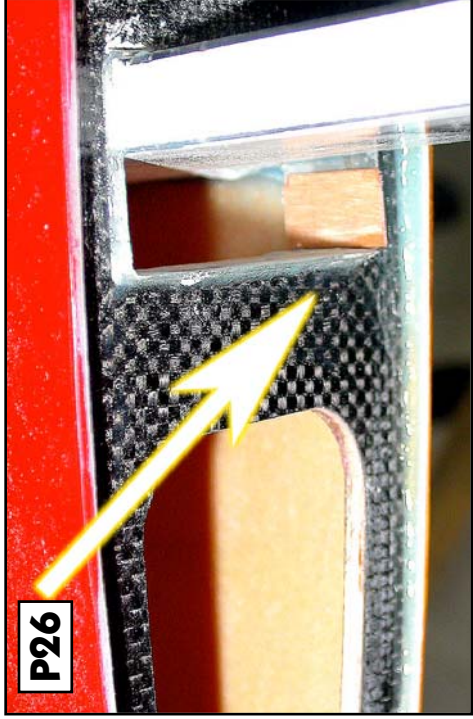
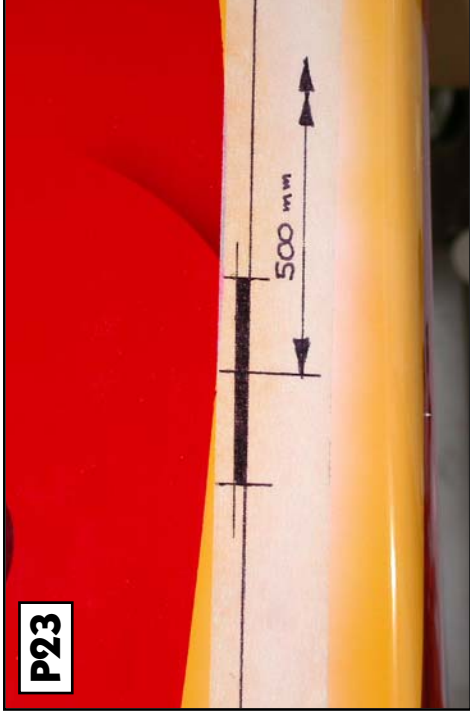
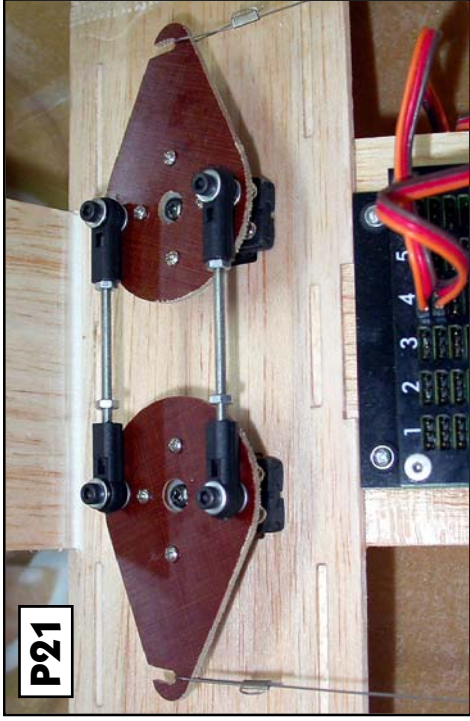
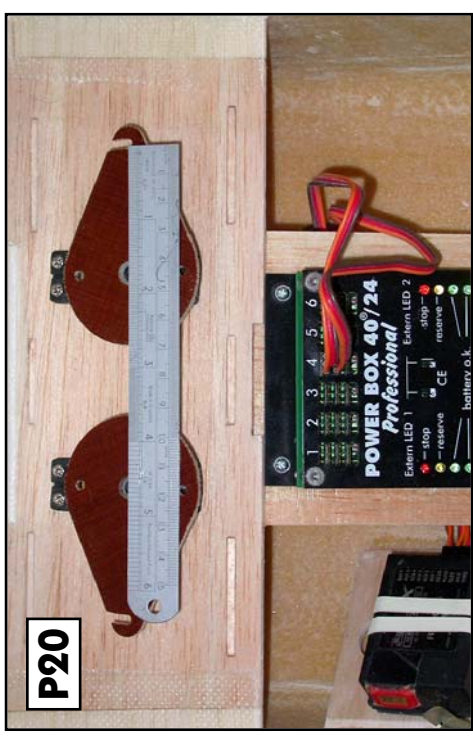
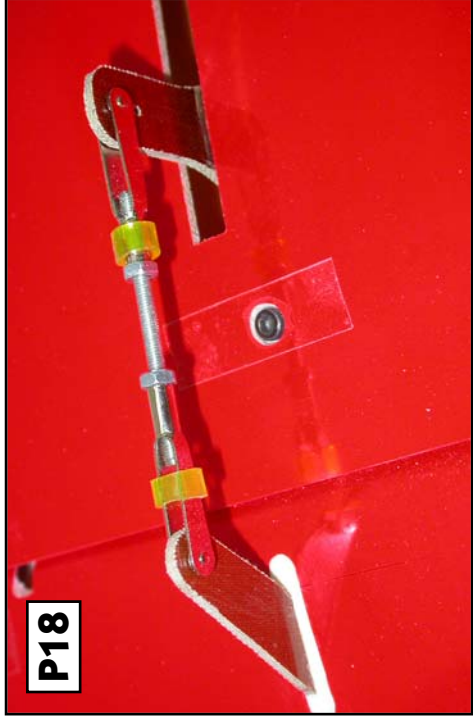
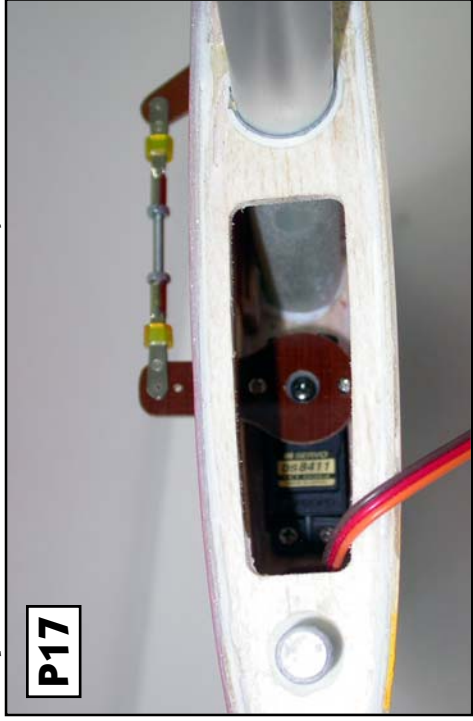
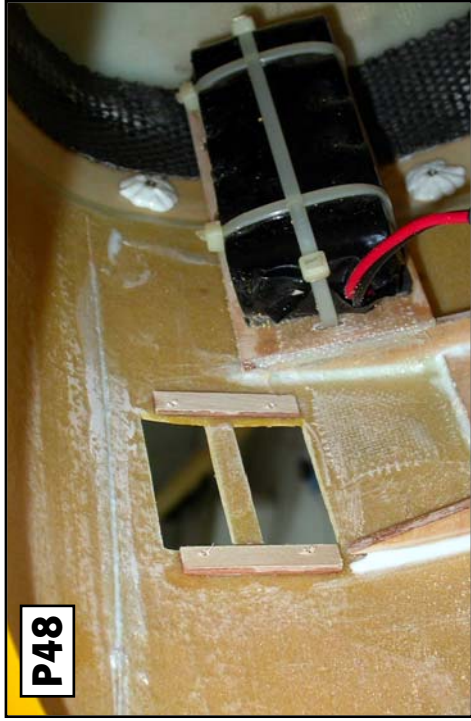
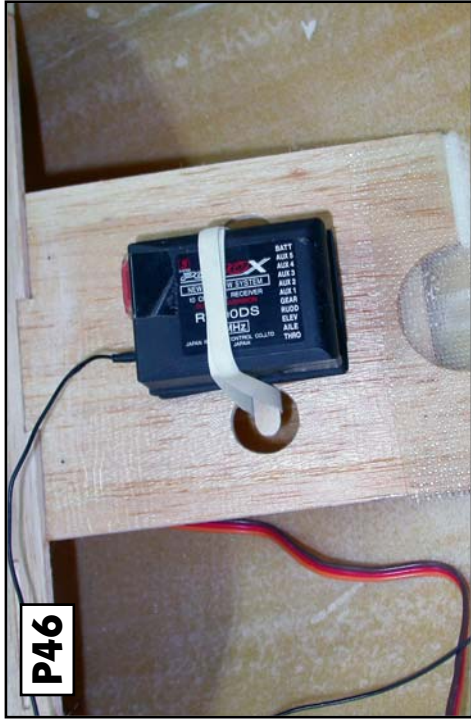
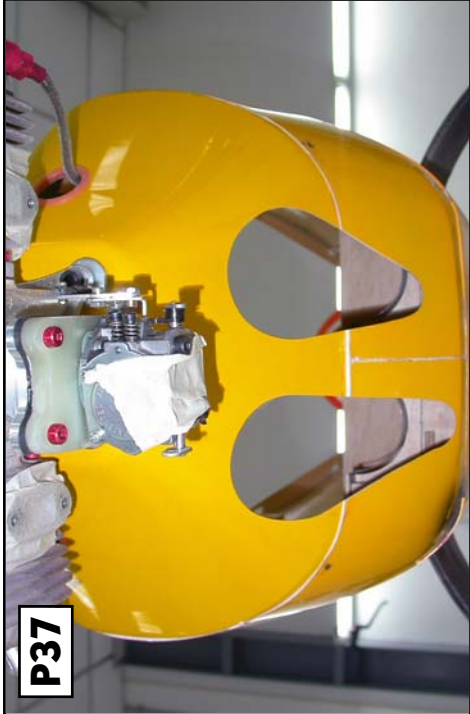
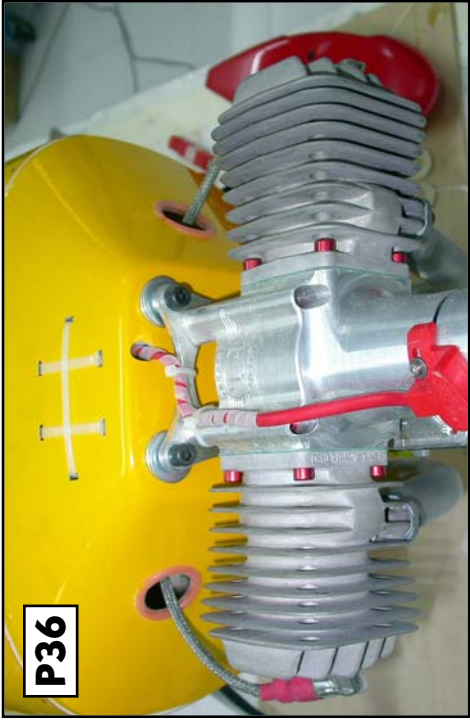
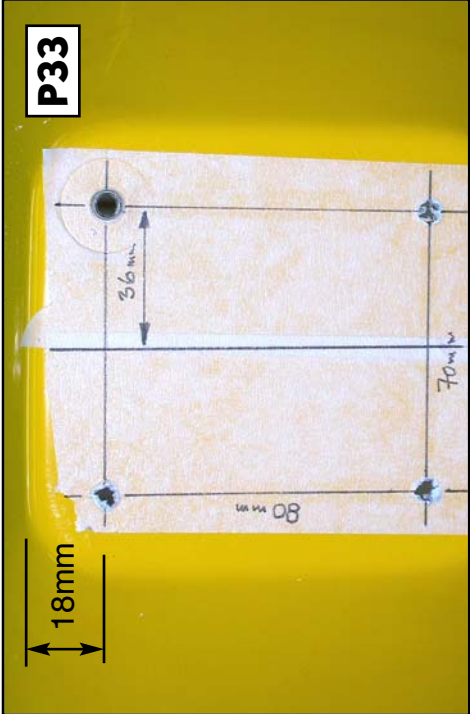


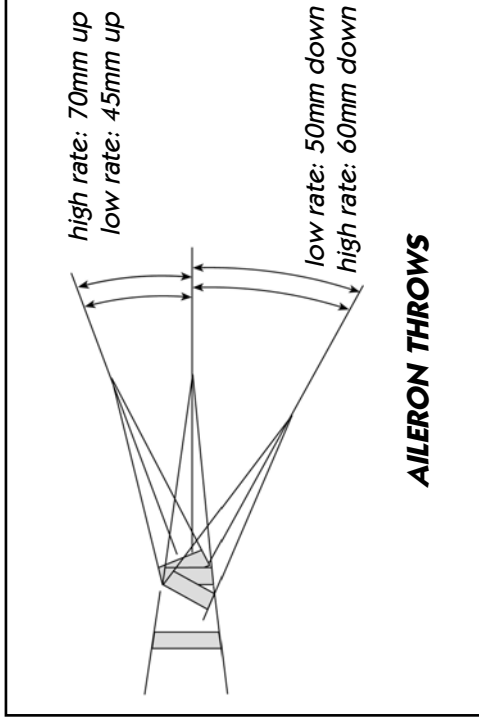
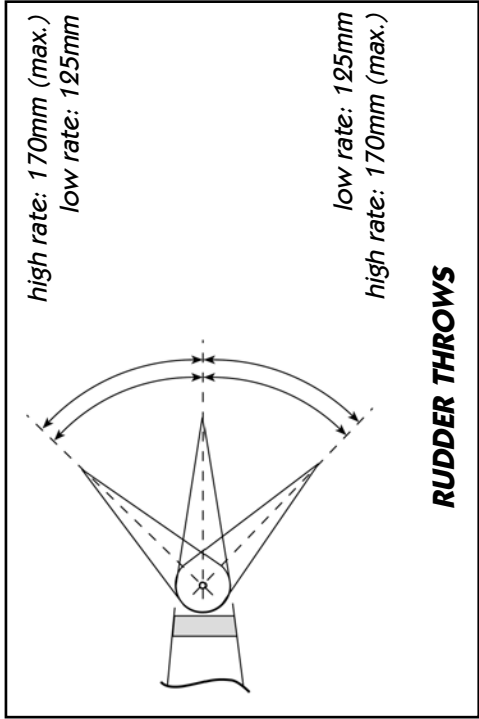
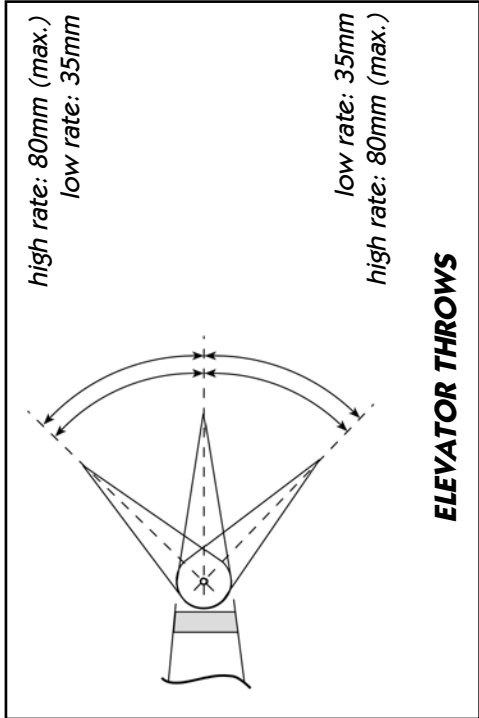
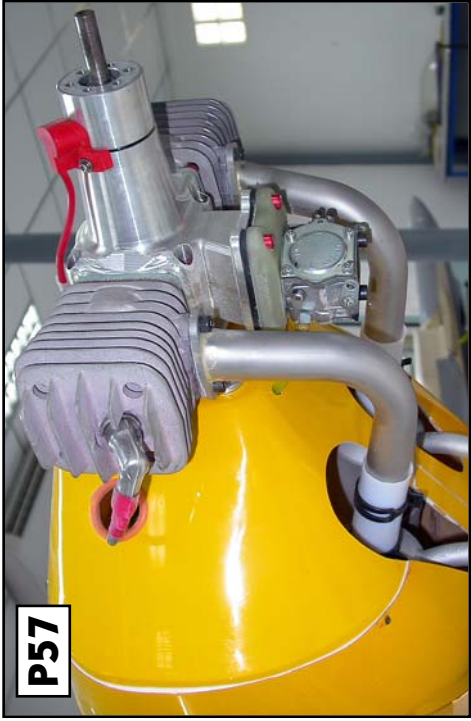
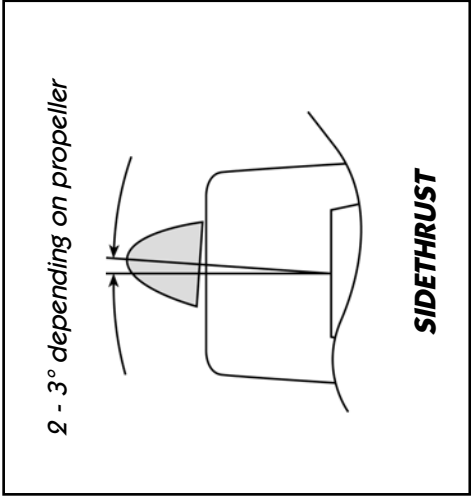
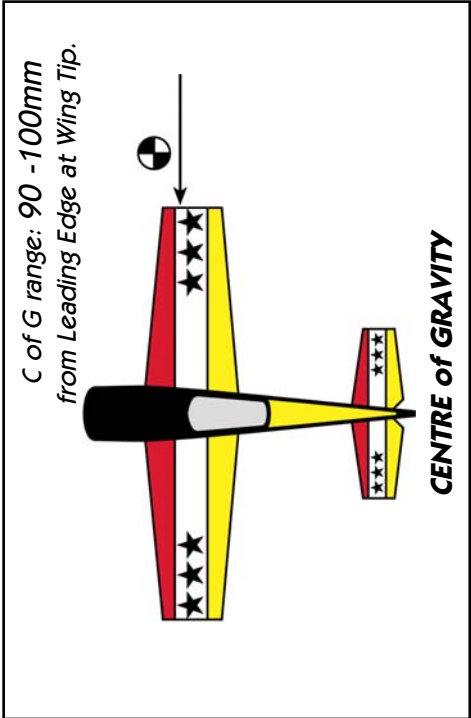
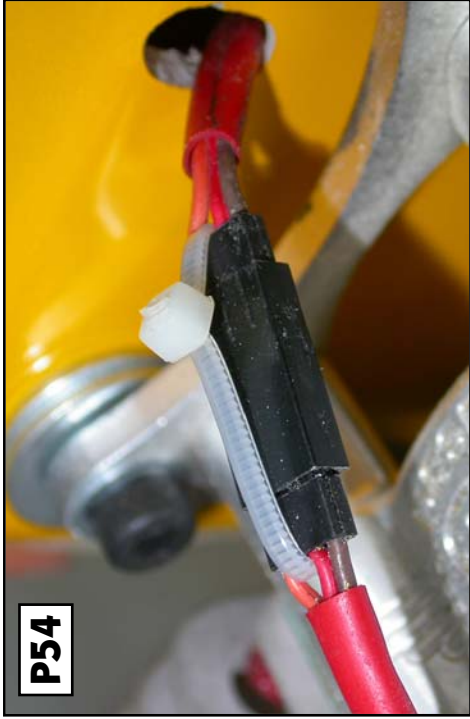
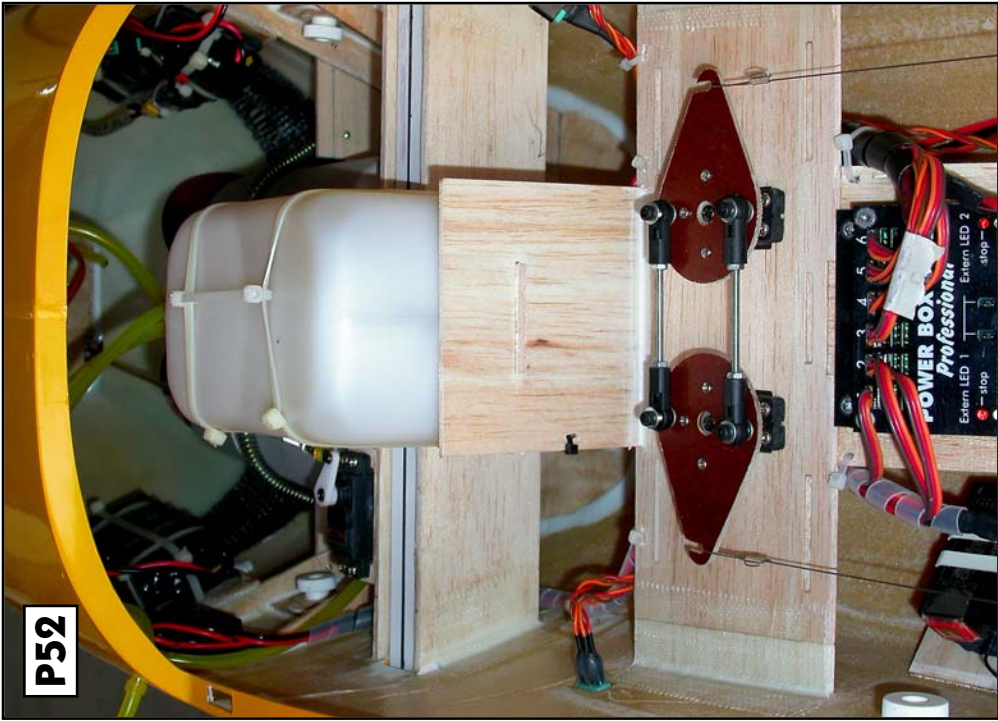
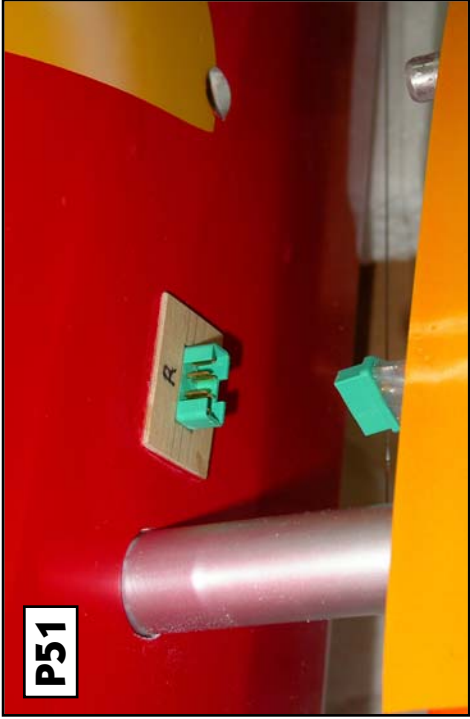
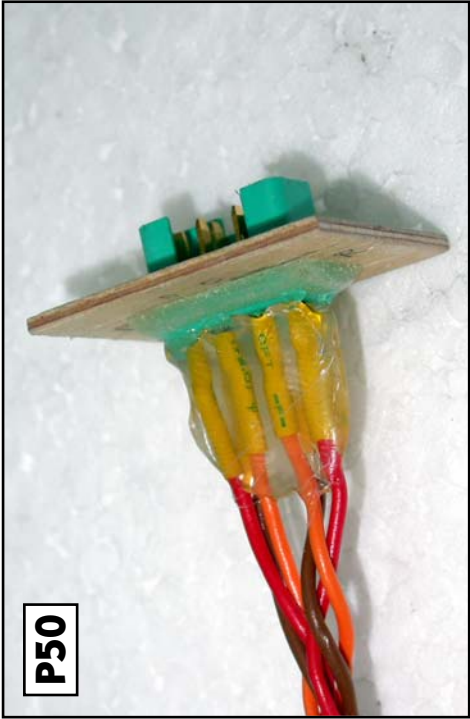
Instruction Manual
Composite-ARF Extra 330L, 2.6 m











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>

This instruction manual aims to do 3 things:

- 1) Show you how to build your aircraft accurately and properly.
- 2) To explain about your fully-composite aircraft, and how to handle and maintain it.
- 3) How to set up and trim your finished IMAC type aircraft perfectly to give you the most enjoyment from it.

Below are a few of the TOC pilots who helped to design and modify our 3m Extra 330S to the championship-winning standard it is now at. And your 2.6m span Extra 330L is based on the design of that plane and the experience of these experts.



Sebastiano Silvestri

Mike McConville



Ivan Kristensen

Jason Shulman



Composite-ARF would like to thank all of these 4 very experienced pilots for their co-operation and help, which has made this 330 Extra aeroplane as good as it is today.

Of course all four of them are also Rep's for C-ARF, and if you want to ask them any questions you can email them (see our website for links) directly, or email your questions to us at 'feedback@composite-arf.com' and we will forward your comments to them. We are sure that they will answer you right away.



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 and radio 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 !

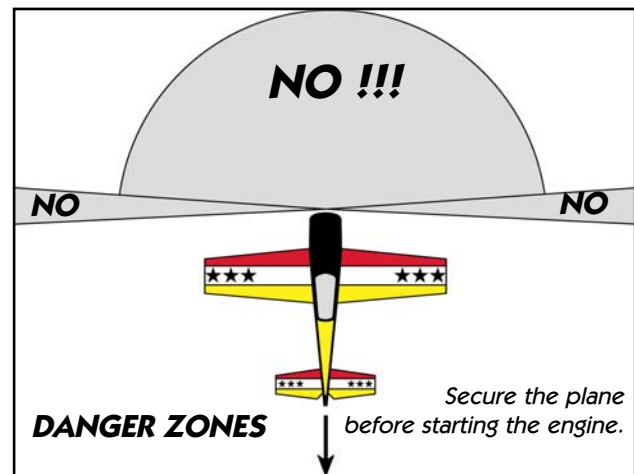
This IMAC-Aircraft is a high-end product and can create an enormous risk for both pilot and spectators, if not handled with care, and used according to the instructions. Make sure that you operate your Extra according to the AMA rules, or those laws and regulations governing the model flying in the country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

The engine, servos and control surfaces have to be attached properly. Please use only the recommended engines, servos, propellers, and accessories supplied in the kit.

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, before you start moving the CG back to a more critical position for 3D-maneuvers. If you find that you need to relocate your batteries or even add weight in the aircraft to move the CG to the recommended position, please do so and don't try to save weight or hassle. 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 to the plane.

Make sure that the plane is secured properly when you start up the engine. Have at least 2 helpers 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 first 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 you feel that the range with engine running is less than with the engine off, please contact the radio supplier and the 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 light-weight 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 main spars are not damaged. Check that the front and rear anti-rotation pins for the wings and horizontal stabiliser are located correctly in their holes, and are not loose. Check that the 4 plastic wing retaining nuts are tight, that the M3 bolts retaining the horizontal stabilisers on to the aluminium tube are installed and tight, and that the hinge wires for the rudder and elevators cannot come out.

If you carefully checked all the points above and followed our advice exactly, you will have a safe and successful first flight - and many hours of pleasure with your Composite-ARF Extra 330L.

General information about fully-composite aircraft structure and design

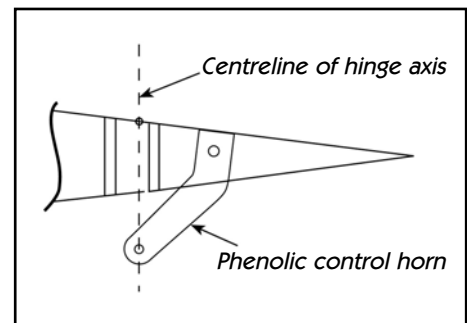
All the parts are produced in negative molds, manufactured using vacuum-bagged sandwich construction technology. All parts are painted in the moulds, either single colour or designer colour schemes. A new production method, called TAVS (Total Area Vacuum Sandwich), enables us to present this aircraft 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. Because of this TAVS technology no additional structural parts are needed except for main spars, which are the fully-floating, full depth, carbon reinforced blade type.

The ailerons are hinged already for you. They are laminated in the wing mould and are attached to the main 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 hinge setup is the cleanest you can ever obtain, but you have to take some care during assembly for proper installation and servo set up.



First, the hinge line is on the top surface of the wing, not in the centre. This is NOT a disadvantage, if you set in about 10% **NEGATIVE** aileron differential in your transmitter program. 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 it travels, and the aileron gets a little "bigger" in surface area when moving up, and "smaller" when moving down. This is why you have to set the negative differential in your transmitter to compensate for the size changing. 10% is a good starting point, and you will find out the exact setting during the first flights, doing fast vertical rolls and watching the fuselage rolling in a perfect line. You can set it perfectly, this is guaranteed.

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, as long as the 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.

Make sure that the control horns are glued into the ailerons properly. The hole in the phenolic horn for the quick-link needs to be exactly perpendicular to the hinge axis line, and in this manual we show you a simple way to ensure that the horns in all pairs of control surfaces will be identical, making it easy to set up your R/C for accurate flying manoeuvres.

The wings are already set-up with servo covers and hatches for 2 servos per aileron, and we recommend a pair of high-torque servos, like the JR D8411, in each wing. Our servo covers and milled plywood mounts make both installation, and exchange if necessary, very quick and easy and provide a rock solid servo mounting and linkage system.

The wings are attached to the fuselage with the 4 threaded aluminium dowel anti-rotation pins, with 4 plastic nuts inside the fuselage. If the aluminium dowels come loose in the wing, the wing will slide outwards, away from the fuselage, and the main spars will definitely break. So take great care to inspect the glue joints of these anti-rotation dowels in the wing **REGULARLY**. Excessive vibrations or hard shocks can cause the glue joints to weaken or break. Monitor these joints whenever you set up your plane. Never forget to tighten the nuts inside the fuselage. Your flight will end after 100 ft and you will have to fix a hole in your club's runway. Please **DO NOT** modify these attachment dowels in any way, their perfect function is proven for many years.



The Fuselage:

The fuselage is also made in negative moulds, and it is all constructed using TAVS technology. All the loadbearing internal parts are glued in during manufacture, to ensure accurate location and reduce the assembly time for you. The pockets in the wings to receive the other ends of the fully-floating blade spars, the stab spar tubes, and the holes and reinforcement plates for the anti-rotation dowels, are already installed. 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. No glue joint needs to be stronger than the materials that it is attached to, as it would just result in increased weight for no advantage. 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 motordome and firewall are preinstalled, and provide plenty of strength for any engines up to 100cc on the market today. See the Engine Installation section for details of engine and setting thrust angles.

The engine cowlings and canopy frame should be attached using the method shown. It is only a little work and this mounting has been tested and proven for many years.

The Stabilisers:

The stab parts are also vacuum bagged



sandwiched. The rudder and elevator control surfaces are hinged with 2mmØ steel wires, fitted through phenolic hinge bearing plates which are installed during manufacture for perfect alignment.

The rudder and elevator design allows for at least 50 degrees throw. For the Extra it is mandatory that the tail area is extraordinarily light weight, so the stab is designed for one powerful servo installed in each half. All the structural parts are preinstalled. The horizontal stabs are mounted with one 20mm tube and one aluminium anti-rotation pin each. Please remember during assembly of the plane that every gram of weight should be saved in the tail area.

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 when it is being transported, 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.



The lightweight fin-post has the phenolic rudder hinges already installed at the factory ensuring perfect alignment.



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

The 'Paint Job'

Occasionally customers notice 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 the high-end composite technology?

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.



(above) One of our 2.6m Extra's, in the popular 'Fantasy red/yellow' paint scheme ... all painted in the moulds !

Paint flaws:

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

(below) One of our customers with the 3m Extra 330S practising his tail-in hovering !

A negative paint job is very complicated to make. The painter never sees the result of his job. He 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 against time, 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 to be 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.



Extra 330L (2.6m span) in Shulman 2000 scheme, painted in the moulds.

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... !



This is the FiberClassics (now 'Composite-ARF') force at the TOC 2000, with all models painted in the moulds.

Tools and Adhesives

Tools etc:

This is a very quick and easy plane to build, not requiring difficult techniques or special 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. Small spirit level, or incidence meter.
10. Dremel tool (or Proxxon, or similar) with cutting discs, sanding tools and mills.
11. Sandpaper (various grits), or Permagrit sanding tools (high quality).
12. Carpet, bubble wrap or soft cloth to cover your work bench (most important !)
13. Car wax polish (clear)
14. Paper masking tape
15. 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. ZAP-O or PlastiZAP, odourless (for gluing on the clear canopy)
3. 5 minute-epoxy (highest quality seems to be Z-Poxy)
4. 30 minute epoxy (stressed joints must be glued with 30 min and NOT 5 min epoxy).
5. Epoxy laminating resin (12 - 24 hr cure) with hardener.
6. Milled glass fibre, for adding to slow epoxy for strong joints.
7. 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

Here is a list of the things you may need to get your Composite-ARF Extra 330L 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. 8 required). We recommend JR 8411's for the ailerons and rudder, and either 8411 or 8511/8611 for the elevators.
2. Throttle servo (1) Any standard servo will do (eg: JR/Graupner 4041)
3. Aluminium Spinner 125 mm dia (5"), eg: Tru-Turn.
4. Main wheels 115 - 125 mm (4.5 - 5"). Kavan Light or Dubro wheels are recommended.
5. Engine DA-100. This is the recommended engine for your Extra 330L. The instructions refer to that engine several times, but you could use any other 80 - 100cc engine.
6. Mini-Pipe Muffler Set. (Consists of 2 cannisters, 2 aluminium headers, 2 Teflon couplers, 4 spring clamps, and mounting hardware. MTW # DT75K)
7. Standard exhaust muffler. (optional, if noise is not a problem at your field)
8. High quality heavy-duty servo extension cables, with gold connectors. High quality receiver and ignition switches, 'Y' leads, ceramic/ferrite chokes etc.
9. Receiver battery. Either one 2800 mAH pack, or 2 x 1800/2400 mAH packs if preferred.
10. Powerbox 40/24 and dual powerswitches for dual batteries if preferred.
11. Fuel tank (900 - 1000 ml) with gasoline stopper. We use Dubro.
12. Cable ties in various lengths.
13. Propeller. Carbon Meijzlik or Menz 28 x10.

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.***

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 wings and stabs can be done at almost any point, and only need servos and control horns installing anyway.

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 of the fuselage 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 decals or markings. Additionally 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 any areas of the 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 or equivalent, and wipe off any dust with alcohol (or similar) before gluing to make a perfect joint.

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: 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.

Landing Gear

The 1st job is to fit the landing gear legs (wheel pants can be done later) - and you can leave these in place, as they will protect the bottom of the fuselage during assembly.

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

Mark the centreline on each landing gear, and drill 2 holes with a sharp 6.5mm Ø drill as shown in the photo. The centres of the holes are measured from the bend in the leg that will be flush with the outside of the fuselage. The outer hole is 35mm from the bend, and the inner hole is 58mm (2 5/16") from the 1st hole.

Note the the bend on the underside of each landing gear leg must be flush with the *inside* surface of the fuselage skin, and therefore you need to chamfer the bottom edges

Finished in 2.5 hours



(above) The main parts used to assemble the Landing Gear.

(below) drill 2 x 6.5mm Ø holes for bolting in the Landing Gear.



of the slots in the fuselage a little with a file to make sure that there is no interference. This is because the part that bolts inside the plane is quite short, and otherwise the end bolt would be too close to the end of the carbon moulding. C-ARF will make longer legs in the future production.

Fix the legs into the plane with the M6 x 20 bolts and 13mm Ø washers into the blind nuts that are installed during manufacture. Both main legs are identical, and can be used either side.

Fit the wheelpants to the legs as follows: Set the fuselage on a level surface with the tailwheel in place. Pack the bottom of the landing gear legs up by a bit less than half the diameter of the wheels used (approx. 50mm/ 2"). Rough sand the bottom of the carbon legs where the milled plywood parts will be glued, to ensure a good bond. Fit the 2 plywood pieces to the legs, using an M6 bolt and nut to hold loosely in place. Hold the wheelpants against the milled plywood pieces and adjust the angle of the plywood parts so that they fit into the recesses in the moulded wheelpants, and the bottom of the wheelpants are parallel to the ground and each other. Tack glue the milled plywood parts to the bottom of the legs with a drop of CA. Then glue the plywood parts to the legs properly with a slow epoxy and milled fibre mixture.

To keep the wheelpants at exactly the correct angle and flush against the carbon leg, glue a small square (approx. 15mm x 15mm) of scrap 3mm plywood inside the wheel pant 25mm above the axle hole and glue an M3 blind nut to it. Then secure the mainleg to the wheel pant by using an M3 bolt through the leg. Do *not* use a bolt larger than M3, as the larger diameter hole in the leg can weaken it.

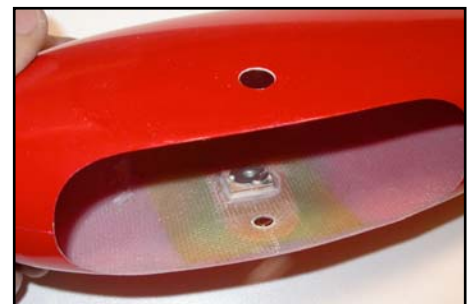
The wheel axles are M6 x 70mm hardened steel bolts, fitted through 6mm holes that you need to drill in the bottom of the landing legs. Use the small dimple moulded into the legs for the exact location.

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, 2 x 6mm wheel collars, M6 nut, washer, carbon landing gear leg, and finally another washer and the M6 locking nut. You may need to adjust the thickness of the wheel collar, or add a couple of extra washers to get the wheel exactly centred in the wheel pant. A drop of loctite on the M6 lock-nut is good insurance.

It is *just* possible to assemble all the spacing washers on the axle and wheel and squeeze it all into the wheelpant carefully, but it is far easier to drill an 9mm (approx. 3/8") Ø hole in the outside of the wheelpant (directly opposite the

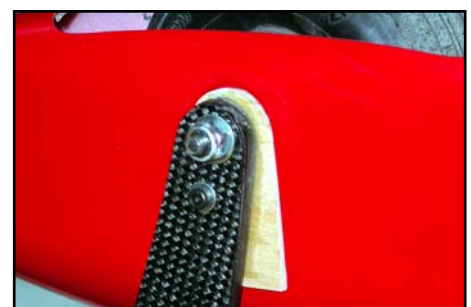


(above) Note: This photo shows the older type of front bulkhead, for the single mini-pipe system !



(above) Shows scrap 3mm plywood plate and M3 blind nut fitted inside wheelpant.

(below) View of Leg showing M3 bolt and M6 axle bolt with locknut.



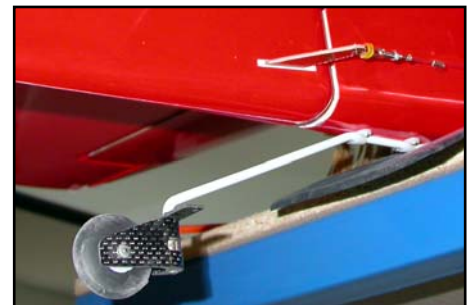
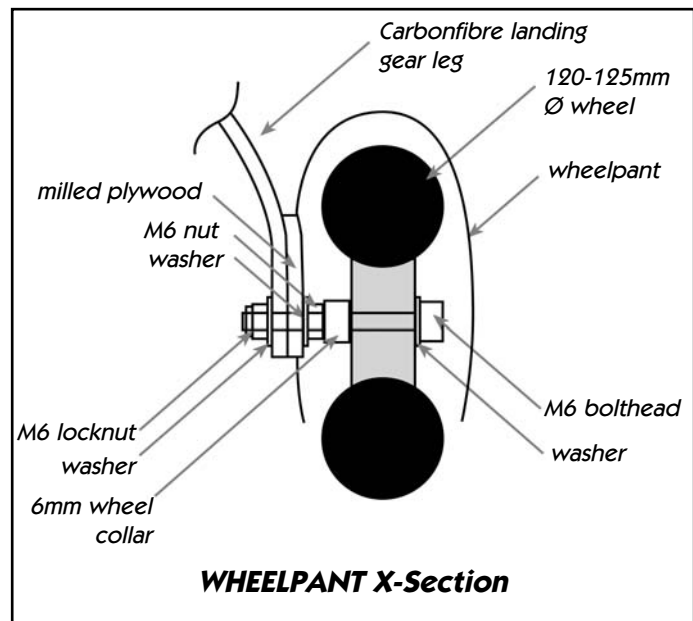
hole for the axle on the inner face) and insert the axle bolt through this hole.

The order of fitting the wheelcollar, washers and wheel onto the axle, to centre the wheel in the wheelpant, is shown in the diagram here - but of course it will vary slightly depending on the size and type of wheel used. You can use any 4.5" - 5" main wheels. Kavan wheels are very lightweight, but not very durable on asphalt runways, and Dubro wheels are a little heavier but much more solid.

Any standard tailwheel assembly from a good hobby store is suitable for your Extra. The tail wheel setup shown in these photos is an optional part available from C-ARF, and is mounted with 4 sheet metal screws and 2 plastic 'U' brackets under the fuselage, screwed into the plywood reinforcement installed in the fuselage at the factory.

You do not need to make the tailwheel steerable, a simple castoring action is fine. However, for asphalt runways you may prefer to connect it to the rudder horn with 2 springs as shown. It's easy to make these by winding some 0.8mm or 1.0mm Ø piano wire around a 5mm drill bit, turned slowly in a battery-drill, with a small hook in each end to connect to the tailwheel steering arms and the rudder horn.

Remember - keep it lightweight at the tail end!



Optional tailwheel assembly from Composite-ARF.



Cowling

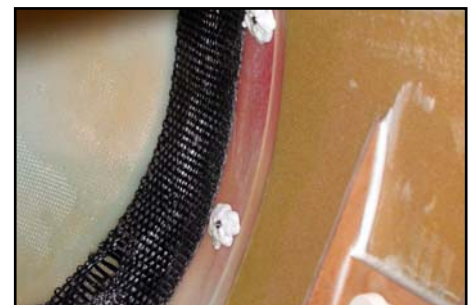
Attaching the 1 piece cowling is quite easy, as it is already cut and trimmed at the factory, and should need almost no adjustment for a perfect fit. With the main undercarriage legs bolted into place, install the wings, and place a small spirit level on top of the wing blade spars to set the plane is exactly level (side to side). Shim under the undercarriage legs as necessary to get it level on your building table.

If necessary, sand the inside back edge of the cowl slightly to get a perfectly flush fit between the cowling and the fuselage. Trial fit the cowling, and use the spirit level or an incidence meter, on the flat part of the cutout to make sure that it is level and properly centred. Mark a centreline on the top of the cowl and the fuselage, on small pieces of masking tape, and then tape the cowling firmly in position.

The cowling is held in place with 9 bolts M3 x 12mm and blind nuts. Drill one 3mm diameter hole at the top/centreline of the cowl, approx. 8mm from the back edge of the cowl, and insert an M3 x 12mm bolt and then glue an M3 blind nut inside the fuselage with one drop of thick CA glue. Note that the blind nuts are fitted *reversed*, with the spikes pointing inwards! Check alignment again, and then drill and fit the other 8 bolts in the same way, securing the blind nuts to the inside of the fuselage with a single drop of thick CA. Don't forget to wax, or oil, the M3 bolts first, to make sure that you don't accidentally glue any of the bolts to the cowling or into the blind nuts! Space the bolts about 105mm (4.2") apart, so that the lowest 2 bolts will be about 15mm from the edges off the square cutout in the bottom of the cowling, which retains it properly.

Finally remove all the bolts and cowling, and glue the 9 blind nuts in place properly using a thick mixture of 30 minute epoxy and micro-balloons, as shown.

Finished in 1.5 hours

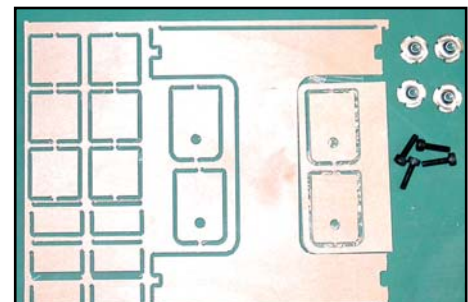


Canopy Frame

The canopy frame fits the fuselage already. It is important to finish the mounts step by step as advised below. The parts shown in the photo here are from the prototype, and production versions may look slightly different.

Mill 6 slots (3mm wide x 20mm long) into the canopy frame in the positions shown, with the outside edge of the slots approx. 3 - 4 mm inside the outer edge. Then tape the canopy frame to the fuselage in the correct position, and mark through these slots onto the fuselage with a felt pen. Take off the canopy frame and mill the slots in the fuselage, making them about 4.5mm wide (1.5mm wider towards the

Finished in 3 hours



Milled plywood parts for the canopy frame fixing. The 'H' shaped part is used for reinforcing under the fuel tank base later.

centre of the fuselage).

Now glue all 6 of the 20mm square milled plywood pieces to the inside of the fuselage directly below 6 slots, making sure that the inner faces are exactly vertical. Because of the shape of the fuselage you will need to thicken the epoxy (30 minute type with some milled fibre and microballoons), especially for the front mounts. Make sure that these are properly glued in place and that the space between the plywood plates and fuselage is completely filled with epoxy.

Drill a 3mm hole through the side of the fuselage in the centre of the 4 front and rear mounting plates only (not the middle 2 plates). Take the 4 plywood rectangles with the milled holes, and glue the four M3 blind nuts in place with 30 minute epoxy. Bolt the 4 plates inside the plywood plates that are glued inside the fuselage with M3 x 12 bolts, so that the top of the plates stick up through the milled slots in the fuselage by 5mm. Cut off excess length if necessary.

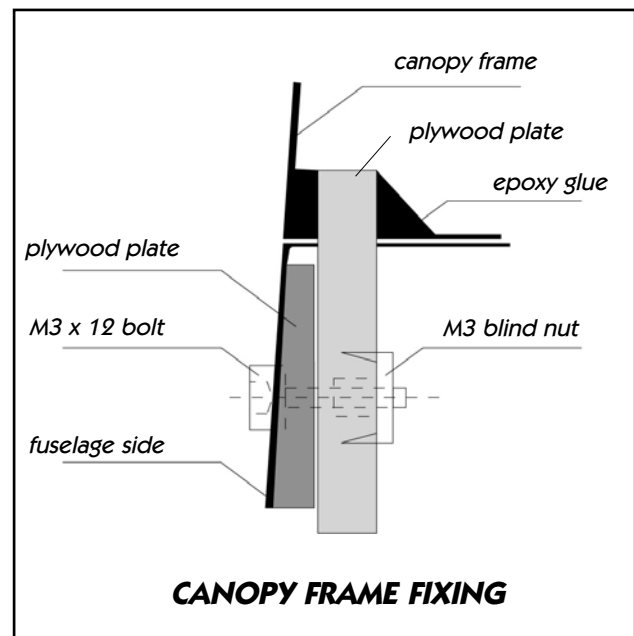
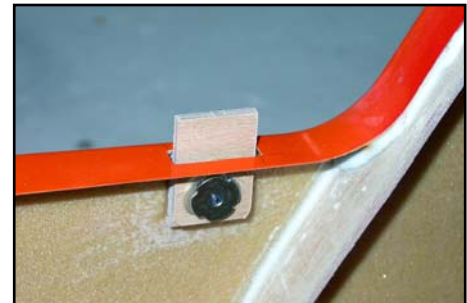
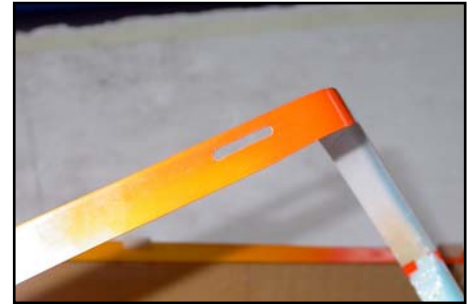
Put some clear tape around the slots on the fuselage and frame and wax these areas carefully, without getting wax on the plywood plates. Sand the areas around the slots inside the canopy frame with rough sandpaper. Clamp and tape the canopy frame in place and then glue the 4 plywood parts to the canopy frame with 30 minute epoxy and some milled glassfibre. If the joint area was waxed carefully, you can take off the canopy frame in about 1 hour.

Slide in the 2 centre guides (shorter plywood parts, no hole) and glue them in with 30 min epoxy also. These centre guides make sure the middle of the canopy frame stays aligned properly with the fuselage.

Fitting the clear canopy into the frame is a little bit tricky, but this is a step by step guide of how to do it successfully:

Sand the inside edges of the canopy frame carefully with rough sandpaper, to ensure a perfect fit of the canopy inside. Lay the 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. Unless you are in a very warm room, we recommend that the canopy is slightly warmed up with a hair dryer to prevent cracking - but be careful not to melt or deform it! When the canopy fits inside the frame roughly, mark the final cut line on the clear plastic. Then cut it to exact shape with a 6 mm overlap all around.

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 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!

Tape the front of the canopy to the frame temporarily. Mount the canopy frame to the fuselage (use all 4 bolts), and tape the back 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, 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.

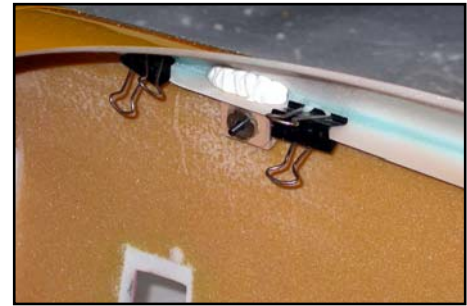
Then make visual check from the front and back to make sure sure that the canopy is straight. Now that the canopy is fixed in position and cannot twist or warp anymore, you can carefully glue the rest of the canopy firmly in place. You can either complete the gluing from the outside, allowing the CA glue to wick into the joint between the frame and the clear plastic or, if you prefer, you can carefully remove the canopy frame from the fuselage, and use a 30 minute or 24hr epoxy and micro-balloon mixture for gluing all the edges to the frame on the inside surface. Even if you use the CA glue method, we recommend that you also glue the inside edges with the the epoxy mixture to be sure that the canopy cannot come off in flight.

If you wish you can tint the inside of the canopy using one of the aerosol spray paints used for painting the inside of polycarbonate car bodies (eg: the Tamiya or Lexanit ranges). Use many very light coats to get even coverage.

Finally the 4 holes for the heads of the M3 bolts that hold the canopy frame in place need to be 'counterbored' into the outside surface of the fuselage, so that the boltheads do not squash the relatively soft foam cored vacuum moulding.

Counterboring means making a larger hole for the bolthead to go in, so it sits flush with the outside surface of the fuselage, and the head sits against a *flat* surface inside the hole - not an angled surface like that made with a normal countersink. The easiest way to do this is with a Dremel and a small mill. Make the counterbored bored holes 6mm Ø and about 5mm deep, so that the bolt head sits against the plywood squares in the fuselage. Even better is to glue metal washers into the holes for the bolts to sit flat against.

Note: This 'counterboring' technique also needs to be used in the bottom surface of both horizontal stabs for the M3 bolts that hold them onto the 20mm aluminium tube.



(above) Clamp canopy frame securely in position while the epoxy/microballoons mix dries.

(below) Use masking-tape handles to pull the clear canopy tightly against the canopy frame while gluing it in position with a few small drops of thick CA.



(above) Finally secure the canopy to the frame with an epoxy and microballoons mixture inside.



(above) Counterbore the 4 holes for the canopy bolts so that the heads sit against the plywood plates in the fuselage.

Horizontal Stabs

The stabs are 99% finished at the factory, and only need the servos, horns and linkages installing. Insert the 20mm aluminium tube spar in the fuselage sleeve, and install both stabs to check the fit between the root ribs and the fuselage. You might have to sand the root of the stabs slightly to make a perfect joint. If the tube is too long you will have to shorten it a little.

Attach the elevators to each stab using the 2mm steel hinge wires provided. Make a 90° bend in one end of them, about 10mm long, and file a small point on the other end to make it easier to insert them through the holes in the phenolic hinge plates. Be careful inserting the hinge wires, and if they are a bit stiff, then use a little grease on the wire. Don't use too much force, otherwise some of the phenolic plates inside might break loose. Leave the hinge wires a bit long during construction, and cut them to length during final assembly. During final assembly, retain the ends of the wires with a small piece of clear tape at the root end, over the bend in the wire. (see photo).

Fit the servos in the stabs, and screw in place using the 2.8mmØ x 14mm screws we supply in the kit, instead of the standard screws that come with the servos. The ribs are milled for a standard sized servo, just slide the servo in from the root and screw in place. Because of the thin profile you must install servo arms through the slots in the btm. of the stab, and you might need to make the slots 1mm wider when using C-ARF servo arms.

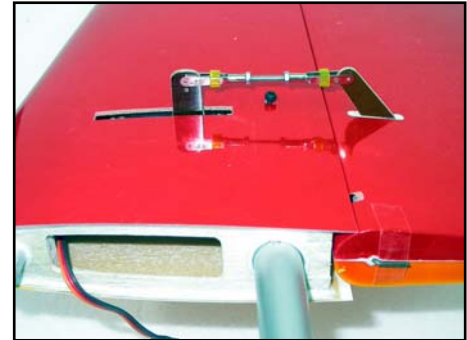
Next the elevator horns. The slots are already milled in the elevators for you, but may be adjusted easily if required. Put a layer of masking, or clear, tape over the area of the milled slot, wax it carefully, and then cut through the tape with a very sharp knife to allow the horns to be glued into the slots. This stops the glue getting on the surface of the elevator. Place a strip of masking tape on the btm. surface of the elevator, and mark on it the exact position of the hinge axis.

Make the horn alignment template from thin scrap plywood (see photo) and mark the position for the quick-link hole in the horn exactly perpendicular to the hinge axis line on the tape. The hole should be about 22 - 24 mm from the bottom surface of the elevator. Drill a 1.5 mm Ø hole in the alignment template, and glue in a short piece of 1.5 mm wire with a drop of thin CA.

Trial fit the horn in the slot, and make sure that the wire in the alignment template fits into the hole that is milled in the horn. Mark the part of the horn that will be glued inside the elevator, and then remove it and scuff up both sides with coarse (60 grit) sandpaper or a Permagrafit tool. Protect the template with clear plastic tape so that it does not get glued to the horn or elevator!

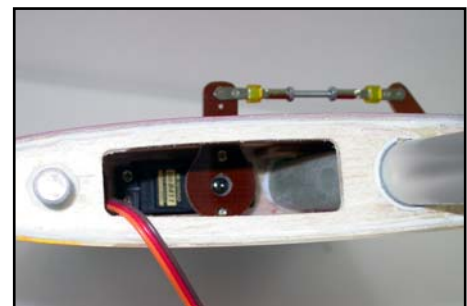
Glue the horn in place with slow epoxy (minimum 30 min. cure) mixed with milled fibreglass, or a filled thixotropic epoxy (eg: Loctite/Hysol 9462 or BVM Aeropoxy). Check that horn is at 90° to the surface of the elevator, and wipe excess glue off before cure. Repeat for the other elevator horn. This method makes sure that both surfaces have identical control movements, and a sim-

Finished in 3 hours



(above) Completed linkage, stab retaining bolt, 20mm aluminium spar and anti-rotation pin. Note the clear tape over the hinge wire on the elevator root.

(below) JR8411 servo fitted into stab with phenolic C-ARF horn.



ilar method is also used for the aileron horns.

Servo choice: The elevators can travel more than 50 degrees, and it is up to you whether you want to use this throw or not. The throw defines the kind of servo. If you are going to use the maximum throw for 3D manoeuvres, we definitely recommend digital servos like JR8411, or even better the 8511/8611. 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.

When using the powerful digital servos and larger throws we highly recommend that you use our Composite-ARF phenolic servo arms, designed for this kind of aircraft and included in the kit (see photo). These must be fixed to the standard (25 mm/1" Ø) plastic output arms supplied with the servo with 2 small sheet-metal screws each. Rough up the bottom surface of the C-ARF servo arm and the top surface of the standard servo arm. With servos installed, centre the standard servo arms (using your R/C) at 90° to the btm. surface of the stabs.

Then glue the phenolic C-ARF arms in place with a couple of drops of thick CA, making sure they are centred on the servo arm bolt in the shaft and also at 90° to the stab surface. Finally remove them from the servo and secure the phenolic arms to the standard plastic arms with at least 2 of the very small (2.2mm Ø x10) sheet metal screws provided in the kit. Make up the linkages from the 45mm long M3 threaded rods, with 2 quicklinks and 2 x M3 locknuts for each stab. Don't forget to 'Loctite' the quick-link and locknut on one end of each linkage. 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**.

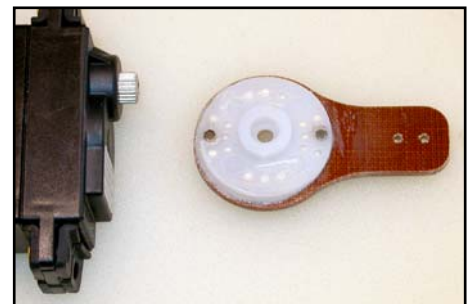
The last job is to fit the M3 stab retaining bolts. Look inside the stabs and you will see the small plywood reinforcement plates between the spar sleeve and the bottom surface of the stab. Mark the bottom of both stabs in the centre of this plywood. Install the aluminium tube into 1 stab, and drill a 2.4mm hole right through the stab surface, the plywood plate, sleeve and into the 20mm aluminium tube. The centre of the hole should be about 34mm from the trailing edge of the stab. Thread the hole with an M3 tap and secure it with an M3 x 16 bolt. To be really safe, you can glue an M3 blind nut inside the stab spar tube, with some 30 minute epoxy and micro-balloons. Wax or oil the bolt first!

Fit both stabs to the fuselage, check that they fit tightly to the fuselage at the roots, and then drill the hole in the other stab and spar tube, thread as before, and secure with



(above) Shows the stab retaining bolt, with clear tape over it to prevent it coming out in flight. The small pieces of tubing stop the quick-links from opening.

(below) Elevator horn alignment template from scrap plywood. Line is hinge axis. Use for both elevators to ensure same throws.



(above) Shows C-ARF servo arm glued and screwed onto standard 25mm diameter servo output arm.

(below) M3 blind nut glued into elevator spar tube.



another bolt. Counterbore the holes in the bottom surface of the stabs for the boltheads so that they fit flush (see canopy frame section).

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

Rudder

Trial fit the the double-sided phenolic control 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 milled fibre, making sure that it is perfectly centred in the rudder. Fit the rudder to the vertical stabiliser with a 2mm steel hinge wire, in the same way as the elevators. Check for smooth movement.

The 2 rudder servos are fitted to a mounting plate in the fuselage that is not installed yet - but we included the instructions for it here so you can find them later!

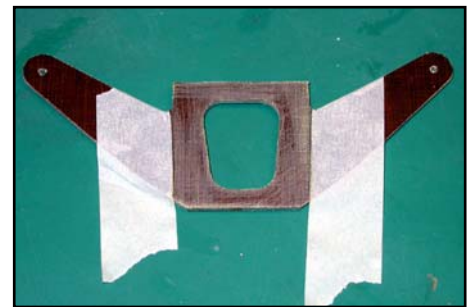
Once the Rudder servo mounting plate (and the fuel tank plate) have been installed, at a later stage, you can install the servos as follows:

Fit the 2 servos into the tray, and screw in place, using the 2.8mm Ø x 14mm long sheet-metal screws supplied with the kit. The milled plywood reinforcing pieces that are glued underneath the plate make it strong and stiff enough, and you do not need any extra strengthening.

Rough sand the top surface of 2 standard 25mm (1") diameter plastic output arms (or the larger 35mm/1.5" Ø types) with 60 grit, or a Permagit, and the bottom surface of the 2 phenolic rudder servo arms to ensure good glue adhesion. Then fit the plastic output discs to the servos and connect the servos to your R/C to centre both servos.

With the R/C still switched 'ON' place the C-ARF rudder servo horns on top of the servo output discs, with both 'hooks' facing forwards, and align them exactly using a steel ruler as shown in the photo above. Make sure that the back of the hook slots and the output disc securing screws are all aligned perfectly. Then glue the C-ARF phenolic arms on top of the plastic output discs with a few drops of thick CA or slow epoxy and milled fibre. When the glue has cured, remove and secure the phenolic arms to each output disc with 4 of the small (2.2mm Ø) sheet-metal screws supplied.

Finished in 2 hours



(above) Rudder horn roughed up with coarse sandpaper. Glue in with slow epoxy and milled fibre.



Note: If you use the larger (35mm Ø) plastic servo output discs you will need to notch them to clear the nuts that secure the ball-links, as shown in the photo here.

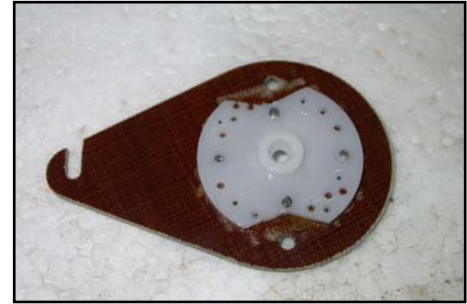
Fit 4 ball-links to the phenolic horns as shown, through the holes that are milled during manufacture, using M3 x 16 mm bolts and washer under the bolt heads, and an M3 nut under the plate. Add a drop of Loctite to the nut before tightening to make sure it is secure.

Join the 4 ball-links with 2 lengths of M3 x60mm threaded rod, not forgetting the M3 locknuts. Adjust the lengths very carefully so that there is no buzzing or humming from the servos at idle, or at full throw.

To find the position of the slots in the fuselage for the pull-pull wires, take a long straight edge and hold it against the bottom of the horn in the rudder, with the other end in line with the bottom of the hole in the fuselage for the rear anti-rotation pin. The centre of the slots that you must cut for the cables are on this line, and approx. 500mm (20") forward of the back edge of vertical fin-post. Mark the slots on a piece of masking tape stuck to the fuselage, and cut out with a very sharp knife, and adjust with a small file. The slots need to be about 3mm (1/8") high and 50mm (2") long.

Make the pull-pull 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' 2 times before squashing flat with 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.

Servo choice: The rudder is a huge surface on the Extra 330L and, just like the elevators, the choice of servo is up to you. A pair of JR4421 would probably be sufficient for pattern flying and normal manoeuvres, but if you plan to fly more radical 3D Freestyle, please fit high quality digital servos such as the JR8411 or 8511/8611 for the maximum precision and power. You will be pleased you did!



(below) Pass rudder cable thru' crimping tubes 2 times for safety, and prevent the quick-links from opening by putting small pieces of tubing over them.

Wings

Like the stabs, the wings are 95% finished at the factory, and have already been installed on your fuselage to check the alignment. Slide the wings on and check for a perfect fit. You can sand the edges of the wing roots a little if needed. Fit the 4 plastic wing retaining nuts onto the M6 threaded wing dowels. We have already installed plywood reinforcement rings inside the fuselage for the back nuts, but you need to glue on the 2 small rings of milled 3mm plywood (supplied in kit) for the front nuts. Make sure they are vertical and perpendicular to the wing dowels to give a flat surface for the nuts to seat on (see photo below). Chamfer the plywood ring so that it is only 1mm thick at the bottom edge. Use 30 min epoxy and micro-balloons and fit the front nuts loosely while curing. Don't forget to wax or oil the front dowels first to prevent them being glued in permanently!

Next check for a perfect fit of the ends of the fully-floating blade spars into the pockets in the opposite wing. Occasionally there is a little vertical play here, and this should be adjusted with a small piece of very thin plywood packing, or printed-circuit board, glued into the top of the pocket and sanded for a perfect sliding fit. (see photo)

Each wing has 2 servos for each aileron, and the servo hatches are already pre-cut in the wing for you, and supplied with matching servo covers and milled plywood servo mounts. The 4 slots are already milled in the ailerons for the phenolic control horns, which should be prepared and glued in using exactly the same method as described in the Stabiliser section. Please use slow epoxy (at least 30 minute) and a little milled fibre for this.

Important Note: The distance between the quick-link holes in the phenolic horns to the hinge axis line (*top surface of the wing*) must be the same for the inner and outer horns. However, because the wing/aileron is 7mm (5/16") thinner at the position of the outer horns, these outer horns must stick out of the aileron 7mm more than the inner horns.

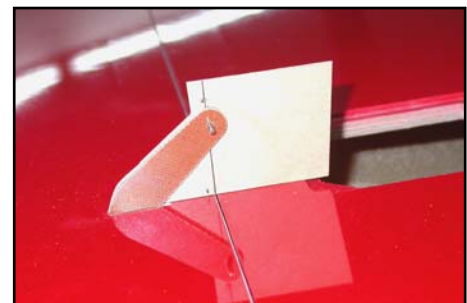
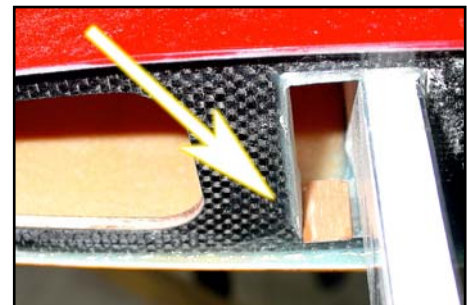
Make a horn alignment template from thin scrap plywood, as shown, to check that the distances from the quick-link hole to the hinge axis are exactly the same. Because of the difference between the inner and outer horns, the easiest way to do this is to make the template for the inner horns and glue them both in place first, and then drill another hole in the template 7mm higher, exactly on the line drawn on the template, perpendicular to the hinge axis. The hole for the quick-link in the inner horns should be about 25mm from bottom surface of wing.

Finished in 3 hours



(above) plywood rings glued in vertically for front wing nuts.

(below) Use very thin plywood packing to reduce any play in blade spars, if necessary.



(above) The aileron horn template used to position the inner horns for gluing in place. The line is perpendicular to the hinge axis.

(below) Same template, with an extra hole drilled exactly 7mm higher, for installing outer horns.



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. This is very important ! We recommend that you mark the 4 hatch covers now so that they are always fitted in the correct positions (eg: Starboard inner/outer etc).

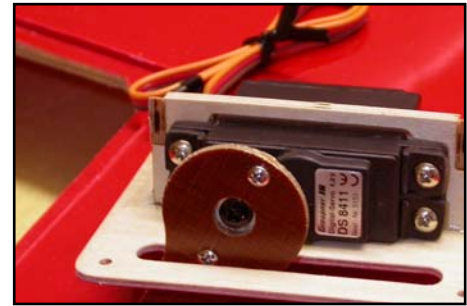
Assemble the servo mounts from the 3 CNC milled plywood parts supplied for each servo, using CA. Fix the servos into the mounts with the 2.8mm Ø screws provided in the kit, and place them on the hatch covers to check the alignment so that the servo arms are in the centre of the slots milled in the hatch covers, and also align with the aileron horn slots. Don't forget to 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.

Glue the servo mounts to the hatch covers with CA, and 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). This is an important joint!

Rough sand the top surface of the 4 standard 25mm Ø plastic servo arms, and one side of 4 C-ARF servo horns to prepare for gluing. Then refit all 4 servos to the completed hatch covers and install in the wing in the correct positions. Connect all servos to your R/C and centre them. With the servos centred, insert the C-ARF servo horns through the slots in the hatch covers and glue them to the plastic servo arms with one or two drops of thick CA, making sure that they are all at 90° to the btm. surface of the wing using a small 90° set-square. When the CA has cured, remove them and glue and screw onto the plastic servo arms properly using the small sheet-metal screws provided, in the same way as the elevator and rudder servo horns.

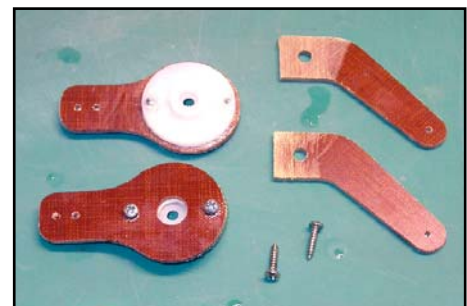
The servo covers are fixed to the underside of the wing with of the 4 small sheet-metal screws provided. This kind of servo mounting allows changing of a servo within a few minutes, if needed, easily within the time between 2 flying rounds of a contest.

Finally make up the linkages from the M3 x 45mm threaded rods supplied, with 2 quicklinks and 2 x M3 locknuts for each linkage. Don't forget to 'Loctite' the quick-link and lock-nut on one end of each linkage. Please use the quick-links and hardware supplied - 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**.



(above) Adjust position of servo mounts so that C-ARF servo output arms align perfectly with the phenolic aileron horns.

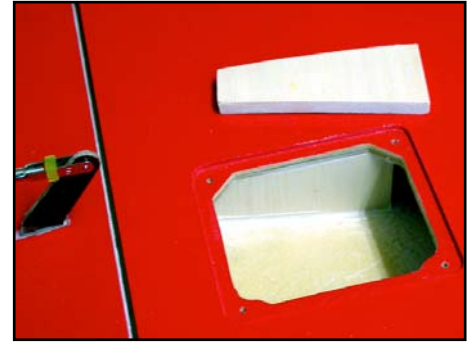
(below) The completed aileron linkage. Note locknuts used at both ends of linkage. Tygon safety tubes missing in this photo!



(above) View of the C-ARF servo horns, shown fitted to standard 25mm Ø servo arms, and also a pair of the standard C-ARF phenolic control surface horns. Note gluing surfaces roughened up with coarse sandpaper to ensure good bond.

Servo choice: We recommend using 2 high quality servos (eg: JR/Graupner 8411) per aileron as the surfaces are very large. The ailerons have enough torsional flexibility to prevent servo damage if each pair is not perfectly matched.

Attention: To prevent severe wing damage during any possible aileron flutter, we recommend that you box the servo cutouts between the bottom and top wing surfaces with scrap 6mm balsa, along both sides, to stiffen the bottom wing skin. (see photo on right)



Spar Box

Finished in 0.5 hour

The spar box takes the weight of the full fuel tank under 'G' loads during flying, so it should be strongly fixed in place. As well as supporting the fuel tank, it also protects the blade spars from any heat produced by the mini-pipe or internal exhaust system. It consists of 3 pieces of milled 5mm thick composite balsa parts that are included in the kit.

With the wings held firmly in their proper position with all 4 plastic nuts tight, adjust the exact length of the parts for a good sliding fit - not too tight or they could deform the fuselage. The top of the side pieces should be approx. 5mm (1/4") above the top of the spars. You can view through the fin post to ensure that they are level and parallel to the spars. Tack glue the sides in place with a couple of drops of thick CA, using some scrap 3mm thick balsa to space them away from the sides of the spars. Then remove the wings and glue the bottom piece in place the same way. Then glue all in position properly with 30 minute epoxy, and finally reinforce the joint between the sides and the fuselage with some small patches of glasscloth and slow epoxy.



Note the 3mm scrap balsa spacers used while gluing in the spar box.

Don't forget the all-important engine test-run, with both 'engine running', and 'engine-off' range checks before the first flights.

Here you see the preparation for range checking for the 1st flight of the 2.6m Extra 330L built for these instructions, made on our runway in front of the factory.



Engine and Exhaust Installation

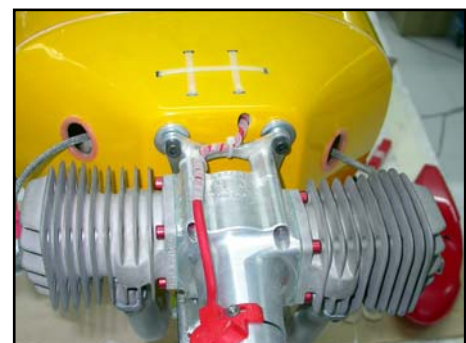
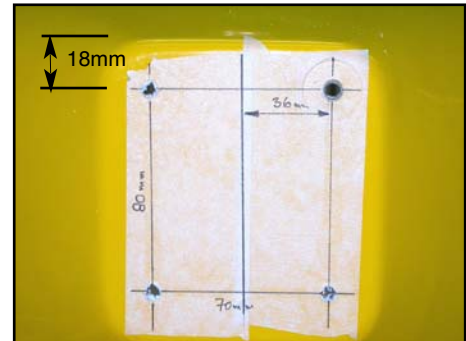
Finished in 4-5 hours

It is definitely best to do the motor and exhaust installation before the fuel tank base and rudder servo plate are permanently installed. Here we show the installation of a Desert Aircraft DA-100 and TDK75 mini-pipes from MTW (Germany), a highly recommended combination with lots of power and lightweight, so all measurements shown are according to that set-up. Additionally this motor fits fully enclosed in the cowling, and no cutouts or holes are needed in the cowling. Of course many other engines in the 80 - 100 cc range are suitable as well.

The moulded motor dome is reinforced inside with plenty of carbonfibre tows and does not require any additional strengthening, and the plywood reinforcement plate is also already installed during manufacture. The firewall already has about 2° - 3° sidethrust built into the moulding, and is nominally set at 0° downthrust. However, due to the mould joining process it is possible that the downthrust can be off by 1° or so, but this can be checked easily by setting the wing at 0° incidence and checking the vertical face of the fibreglass firewall with an incidence meter if you wish. No downthrust is required if using a 28 x 10 2-blade carbon propeller.

To set the positions for the 4 mounting holes for the DA-100 engine), first accurately mark a vertical centreline on a piece of masking tape on the front of the firewall. Then mark a horizontal line across it 18mm down from the top of the firewall (measured from the *top* of the radiused edge). The 1st hole (top left hole in pilot's view) is positioned on the horizontal line, 36mm to the left of the vertical centreline. Drill *only* this hole 7.5mm Ø and fit an M6 blind nut inside the firewall and fit the engine in place using only by the one bolt to check alignment. You will need to pack the engine mount off the firewall by about 5 - 6mm, using a couple of large washers, so that the spinner backplate does not touch the cowling.

Bolt the cowling in place and put the spinner backplate (125mm/5" Ø) on the motor. Ideally the spinner backplate should be in line with the centre of the cowling, and the edge of it should be in the middle of the curved radius on the top edge of the cowling. If the position is OK, or close enough, then remove the cowling and drill the other top mounting hole, and fit the blind nut and bolt in place. If you need to increase the moulded in sidethrust a little, use a slightly thinner pack of washers on the 2nd bolt. Again fit the cowling and spinner backplate to check alignment.



(above) The three cable-ties behind the motor secure the ignition system inside the motor dome. Note split silicone tubes used to protect the ignition cables where they pass through the fibreglass motor dome.

If correct, then drill the last 2 holes and bolt the motor in place, adjusting the thickness of the washer packing to leave a minimum 3mm (1/8") gap between the back face of the spinner backplate and the cowling. The centres of the 4 mounting holes of the DA-100 are 70mm horizontally, and 80mm vertically, and with the first 2 holes drilled it is easy to mark the other 2, using a 90° square and offsetting from the 1st two holes.

NB: In the instance that your 1st hole was not in the correct place you can enlarge it a little with a file to correct it, and refit the blind nut, or plug the hole with a piece of hardwood dowel, glued in with slow epoxy and redrill in the correct position. Finally glue the 4 blind nuts to the firewall with a little 30 minute epoxy.

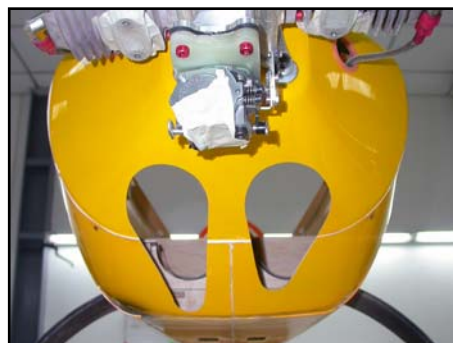
Adjustments to sidethrust after the first flights, if needed, can be made by adding or removing washers between the back of the engine mount and the firewall. In the future we hope to add the mounting hole dimensions for other popular motors to these instructions, or on the website.

Standard Mufflers: If you are using a standard muffler just mount it onto the engine and check if you need to cut clearance holes in the bottom of the cowl for the exhaust outlets.

Mini-Pipes: An internal mini pipe installation is a little more complicated than the use of a standard muffler, but sometimes you don't have any choice, especially if you have noise problems at your club field. In Europe noise is always a problem, so Composite-ARF had to find a quiet and powerful solution, and we recommend the MTW TD75K short mini pipes with the VA25 stainless steel headers as shown in this installation. They come complete with teflon joiners and swage clamps (S25 and T25) and this complete package can be order from Composite-ARf as an option. This set-up gives the engine a nice throttle response, a perfect mid-range, and also increases the top end power slightly.

Mount the 2 headers to the motor and use these to mill the cut-outs in the bottom of the motor dome for the mini-pipes. Keep them small at this time, and enlarge them later for a perfect fit and sufficient cooling.

The main plywood bulkhead in front of the landing gear already has the 2 semi-circular cut-outs for the twin mini-pipe system. The twin mini-pipes seat on a steel strap (supplied in the kit with a template for bending), and are held in place with 2 springs. The springs are hooked over three M3 bolts that are screwed into 2.5mm-Ø holes drilled in the 3 small plywood blocks that are securely glued to the front of this bulkhead. The 3 photos here, showing the complete assembly on a dummy bulkhead out of the model, and the photo showing the installation in the model, should make the construction clear.



(above) Muffler mounting shown on a 'dummy' bulkhead for clarity



If you don't have any suitable springs to retain the mini-pipes it is very easy to make them. Just clamp a length of 1.0mm piano wire and an old screwdriver (about 5mm Ø shaft) into a battery drill, and hold the other end of the wire in a glove while spinning it on *slow* speed. Bend 2 hooks in the ends to finish the job. Please take care doing this.

This simple mini-pipe retaining system has been proven for several years in all our planes, and holds the pipes securely enough, while still being flexible enough to prevent them breaking under normal vibrations.

Note: Older kits had a single cutout in the bulkhead for a single exhaust system, but we will offer an update kit with templates, parts & instructions for customers to update their models to the twin system shortly. Check the 2.6m Extra page on the C-ARF website for news and availability.

If using internal mini-pipes, C-ARF recommend that you protect the upper surface of the moulded carbon-fibre main landing gear legs by covering them with a thin sheet of 1mm plywood, attached with silicone adhesive. No other heat protection is necessary to the fuel tank base, when using the DA-100 and mini-pipes as shown.

The last job to do, an important one, is to cut out the 2 slots in the bottom of the fuselage to let the warm air from the exhaust system escape from the fuselage. These slots should be about 35mm (1.5") wide and 125mm (5") long, and it is best if you make nice rounded corners to reduce any chance of tearing in the composite skin.

Depending on your motor, you may need to make a simple 3mm thick balsa baffle plate inside the cowling to make sure that enough cooling air is directed around the engine cylinder heads, instead of just going directly out of the opening in the bottom of the cowling. See photo here for an example of the baffle (3.1m SuperXtra shown in photo here), which improves the cooling considerably. In any event, check that your motor is not overheating when you make the "engine-running" R/C range checks before flying.

Fuel proofing: 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 30 - 40 grams (1 1/2 oz) of epoxy to fuel proof all the wood in the whole area in the front of the plane.

Note: Please call your Composite-ARF Rep. or email us at: techsupport@composite-arf.com, if you need any additional help with the motor and mini-pipe installation.



(below) Another view of the steel strip and blocks with M3 bolts taken thru' the firewall.



(above) Ensure enough cooling air can enter around the mini-pipes. Make the holes at least 12mm (1/2") bigger than the exhaust diameter.

(below) Don't forget the 2 slots to allow the warm air from the mini-pipes to exit the fuselage.



Fuel Tank Base and Rudder Servo Plate

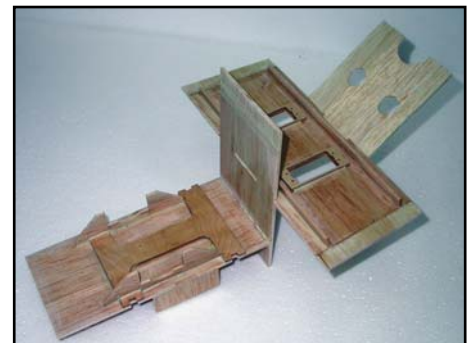
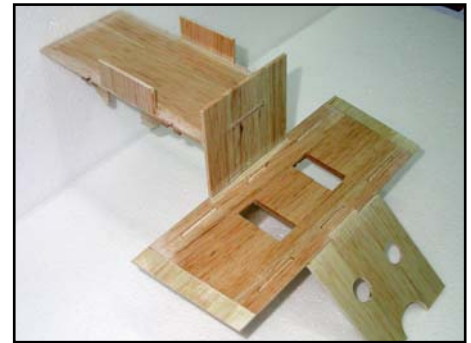
The rudder servo plate and the fuel tank base are assembled from CNC milled balsa and plywood parts that have been laminated both sides with glasscloth, and vacuum-bagged, at the factory. This material gives exceptional strength with low weight and is more than adequate for this structure - so please don't modify it in any way. (prototype parts shown in photos)

The top photo shows the completed tank base/rudder servo plate, which can be tacked together with CA inside the model and then removed for proper gluing. These 2 photos should make it clear where all the milled balsa and plywood parts fit. Sand all the mating surfaces to ensure a good glue joint, and glue together with 30 minute epoxy, checking the fit in the model as you go. Don't forget to give all the bare edges of the milled balsa and plywood 1 thin coat of epoxy to fuel proof them before gluing in the model. Note that you must cut 2 small slots (6mm x 6mm) in the supports under the fuel tank base for the forward cable-ties that hold in the fuel tank. Don't forget the 'H' shaped milled plywood reinforcement under the tank base, and the 2 plywood doublers under the 2 rudder servo mounts. Depending on the size of your fuel tank, glue a scrap balsa block at the front of the tank base to stop the tank moving forwards. A 960cc Dubro tank (part #690) fits the base perfectly.

Once completed glue the whole assembly in place with 30 min. epoxy and milled fibre, and add 5 short pieces of 1" wide glass tape and slow epoxy to reinforce the joints to the fuselage sides and bottom. The rectangular cut-outs on the bottom of the tank base should be glued on to the top of the main wing spar box with epoxy and milled fibre.



Finished in 1.5 hours



(left/below) The assembly glued in position on top of the spar box.

4 short pieces of glasstape and 24hr epoxy secure it to the fuselage, and a 5th tape is on the bottom of the vertical plate between the rudder servo plate and tank base and cannot be seen here.



R/C & Gear Installation

Finished in 5 - 6 hours

Everyone has their own favourite methods when fitting the R/C and gear, but the installation shown here is a guide, and has worked perfectly in all of our planes flown by C-ARF factory staff, and many of our customers.

You can either install a simple R/C system with a single receiver NiCad and switch, or fit twin NiCads and switches with a single receiver and a high-quality servo powerbus system for the ultimate in safety and security. It's your choice, but the dual Nicad and powerbus installation does give extra 'peace of mind' and protects your investment, and therefore this is what C-ARF recommend and have shown here. The full 'PowerBox' range is all available from C-ARF as an option. Visit our website for more details.

Simple installation

For a simple installation the receiver can be fitted to the angled composite balsa plate behind the rudder servos, as shown in the photo here, which keeps it (and the antenna) as far away from the high current motor ignition system as possible. Place it on a thick foam anti-vibration pad, and hold in position with 2 rubber bands looped around the ends of a plywood stick glued under the holes in the balsa/composite plate. Run the antenna wire along the side of the fuselage and then vertically through the top of the fuselage just behind the cockpit and back towards the vertical stab. Keep it as far away as possible from the cables for the elevator servos and the closed-loop rudder wires.

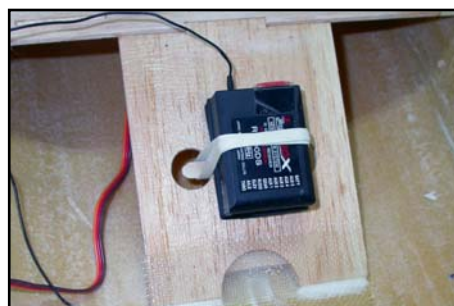
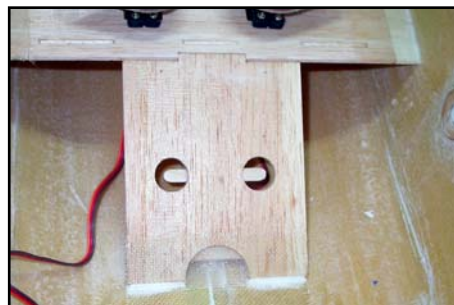
The single Rx NiCad should be a 5-cell pack of 2400 - 2800mAH and will probably need to be fitted one the side the fuel tank, with the ignition battery the other side, to obtain the correct C of G. To hold the battery packs we glue a couple of 4mm plywood plates to the inside of the nose, as shown, and fix them securely in place to the fuselage sides and bulkheads with 100gram (3ounce) glasscloth and 24hr epoxy. Cut a few slots in the edge of the plates before gluing them in, so that the Nicads can be fixed easily with cable-ties. Don't forget to put a piece of rubber sheet behind the batteries to protect from vibrations. *(Please double-check the manual for your R/C system if the use of 5-cell NiCads is recommended, or not)*

Please make sure that all the Nicad batteries are fixed very securely in the plane, as the forces on these heavy items during high 'G' manoeuvres is extremely high.

When fitting the battery mounting plates, make sure you will still have easy access to the plastic nuts that go on the front wing mounting dowels during assembly of the plane.



This general view shows the dual Rx Nicads and Powerbox installation, fuel tank fixing and hi-amp extension cables and sockets fitted into the fuselage sides for the ailerons.



Dual NiCad and Powerbox installation

We recommend using two 5-cell 1800 - 2400 mAH NiCad packs when fitting the Powerbox 40/24 system, as shown in the installation described here.

The PowerBox power control unit is designed especially for large models and provides dual battery inputs with hi-amp connectors, multiple outputs for 6 channels/24 servos (no 'Y' leads needed), automatic voltage regulation and stability, built-in servo amplifiers for those long servo cables, as well as dual visual LED battery displays. It comes complete with hi-current connectors and is fitted with anti-suppression chokes on all channels.

The Powerbox is screwed to the angled plate behind the rudder servos, which will need a couple of small scrap 3mm plywood strips behind it for the mounting screws, and the receiver is mounted on a small balsa plate to the side, as shown. This makes for a very neat installation, with no unnecessary extensions and loose cables in the plane.

With the R/C installation described here and this motor/mini-pipe set-up, you will not need any additional ballast in the nose to obtain the correct 'Centre of Gravity' for pattern flying. Actually the 2.6m Extra shown here, built for these instructions, actually finished a little nose-heavy. If using a heavier motor that then DA-100, consideration should be given to the position of the Rx batteries early on, and it may be that they will both need to be installed very close to the models nominal Centre of Gravity.

We also highly recommend the high-quality PowerBox powerswitches for the dual batteries, and we even use one of these in the ignition circuits of all our planes. Remember the high current that 8 digital high power servos can draw during 3D and Freestyle manoeuvres when making your decision on R/C equipment.

If fitting the switches into the outside surface of the fuselage, as shown, please 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, making it easy to cut the slots in the fuselage accurately. We fitted the 2 Receiver switches on the left side, and the single Ignition switch on the right side. These powerswitches are available as options from C-ARF, please see our website for current details.

Composite-ARF advise you to keep all the cables between the motor ignition battery, ignition switch, and high voltage ignition unit as far away as possible from the receiver and R/C system.



(above) NiCad packs are fitted to plywood plates on a thin rubber sheet, and secured with cable-ties.



(above/below) Powerswitches are used for both the dual Rx & single Ignition Nicads, and fitted into the fuselage sides as shown here.



Servo extension leads etc.

Please make sure that you use good quality twisted-cable extension leads, of heavy gauge wire with gold-contact connectors, to all the servos. Certainly we 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 - normally within 100mm (4") of the receiver. Of course, if you are using a 'Powerbox' this unit is already fitted with all the ceramic chokes etc, and comes with the required high-quality switches. Also no 'Y' leads are needed, as the powerbox provides 4 inputs for each channel.

At C-ARF we hard-wire all our servos with twisted cable leads of the exact length required and Multiplex 6-pin connectors (see photos). For the 2 aileron servos you can use 1 pin for each wire, and for the elevators you can gently squeeze pairs of adjacent pins together and use a pair of pins for each cable. We glue the female connectors into small plywood plates in the sides of the fuselage for connecting the stabs and ailerons when assembling the plane. Making up the proper extension cables and connectors is only a little work, if you are proficient with a small soldering-iron, and makes assembly of the model at the airfield very quick and easy! Once all wires are soldered to the gold-plated pins, fit a short length of heat-shrink tube over each one. Finally protect all the connections from vibrations etc with a nice blob of glue from a hot-glue gun. Job done.

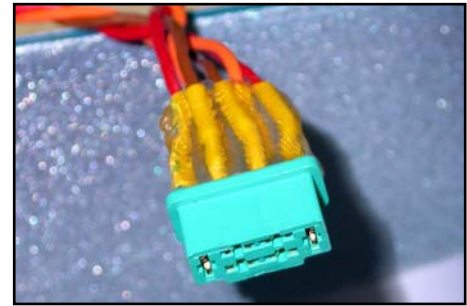
Throttle servo

You can install the throttle servo anywhere you want, using the milled plywood mount that we supply. We have installed it on the spar box to the left of the fuel tank, because it makes installation and maintenance very easy.

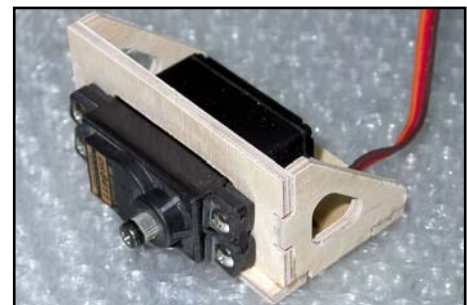
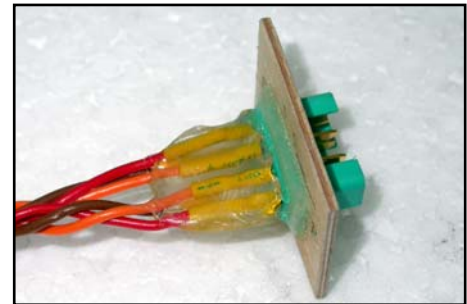
However this position does need quite a long linkage to the carburettor, and therefore we recommend that you use a lightweight 'snake' type (cable inside a plastic tube) which must have the outer tube glued securely to the fuselage/tank base at several points.

Note that all DA motors need quite a lot of servo throw to get the full throttle range, so make sure you can fit a long output arm on the servo.

Make up a wire lever so that you can operate the 'Choke' for starting thru' the cut-out in the front of the cowling.



6-pin MPX connectors are used for extension leads, with one half mounted in the fuselage sides.



(above/below) Throttle servo mount assembled from milled plywood parts, and glued to the front of spar box on left of the fuel tank.



Motor ignition system

The ignition unit is fixed to the underside of the cowling on a foam pad, retained with 3 cable ties, as shown in the photo on page 25.

At C-ARF we recommend a 4-cell 1200 - 1400 NiCad for ignition power, and we a Powerswitch for the cut-off. Add a very small cable tie, or a 'safety clip', around the cable from the motor pick-up to the ignition unit for extra security.

**Fuel tank**

The fuel tank is held to the tank base with 3 large cable-ties (see photo on page 29). 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 motordome with a couple of cable-ties or equivalent, 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, you can be sure it will come off at just the wrong moment and your engine will quit ! Therefore please 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 also secure with a fuel-line clamp or cable-tie. Don't miss this small detail - it could cost you your plane !

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).

If you want to fit a smoke system the smoke tank can be fitted alongside the fuel tank but you will need to make an extra platform for it. Follow the manufacturers instructions for fitting the smoke system.

Final check

Now check that you have fixed all components securely. Keep in mind that all the components inside the aircraft are loaded with the same G's as the wing and the wing spar during aerobatic manoeuvres. 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 and cannot come loose when subjected to high 'G' forces during flight.
- Are all tubes and wires protected from chafing where they pass thru' the holes in fibre glass parts or bulkheads with rubber grommets, or short lengths of split silicone tubing?
- Especially if you have installed the internal mini-pipe set-up, you also must make sure that no fuel tubing or wires can come into contact the exhausts. Use the plastic spiral-wrap to tidy up groups of cables and make sure that they cannot move around in the plane under high 'G' manoeuvres by fixing them to the sides with small cable ties. If using

the easily-available cable-tie plastic fixing plates, please do not trust the double-sided tape that they usually have on them which can fail under vibrations. Peel it off, rough up the back face with coarse sandpaper and glue to the fuselage sides with 30min. epoxy.

- Did you fit small Tygon or silicone tube pieces over all the quick-links?
- Did you tighten the M3 locknuts against all the quicklinks to make sure they cannot turn?
- Are the swages crimped up nice and tight on the rudder cables?
- For added security add one small drop of loctite/thread locking compound on all the bolts 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.

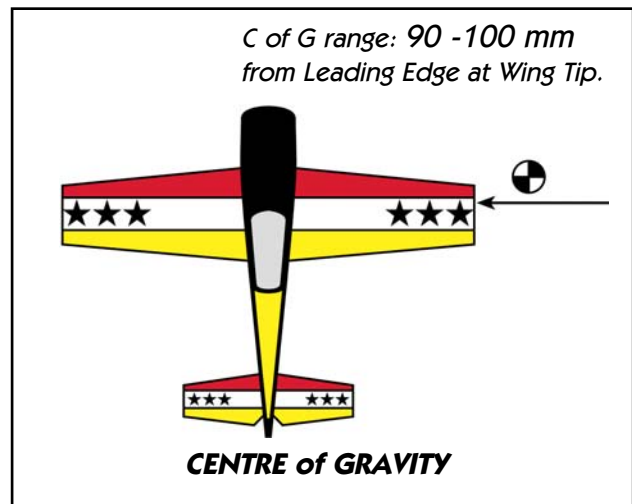
The assembly of the model should be completed in about 25 - 28 hours.

Setting Up Your Aircraft

CG:

Set the Centre of Gravity to 90 - 100mm (3.5 - 4") from the leading edge **at the tip** for the 1st flights. Hold it with a helper at both wing tips in this position and make sure the plane balances horizontally. This is the 'pattern' CG position.

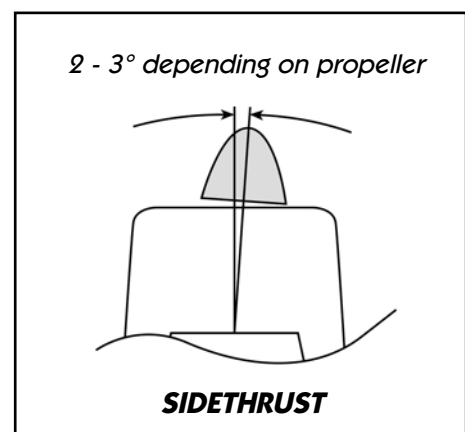
After you are confident with the plane, you can move it backwards by up to 30mm (1.25") maximum, but this is definitely a '3D/Freestyle' CG setting and should not be used for the first flights. With this rearward CG you will need to use the high rate control throws shown below.



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 to make it track correctly.

Engine Thrustline:

Already given in the instructions, down thrust should initially be set at 0° degrees and right thrust 2 - 3 degrees, depending on the prop used. We recommend a 28 x10 carbon prop for any 100cc engine. It is a very quiet and powerful solution. They are normally CNC-designed, so the prop is balanced perfectly statically, dynamically and aerodynamically, which keeps the vibration down to a minimum.

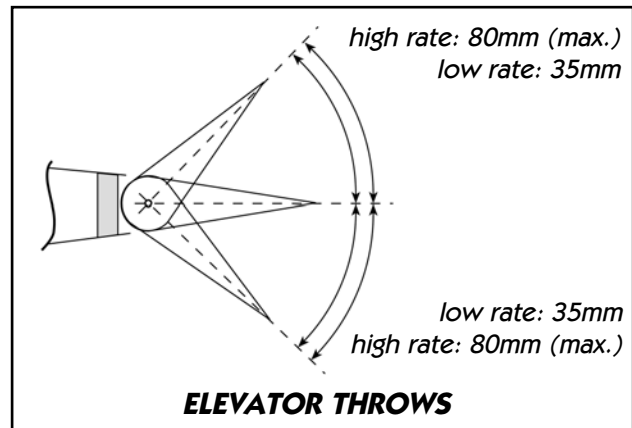


Control Throws:

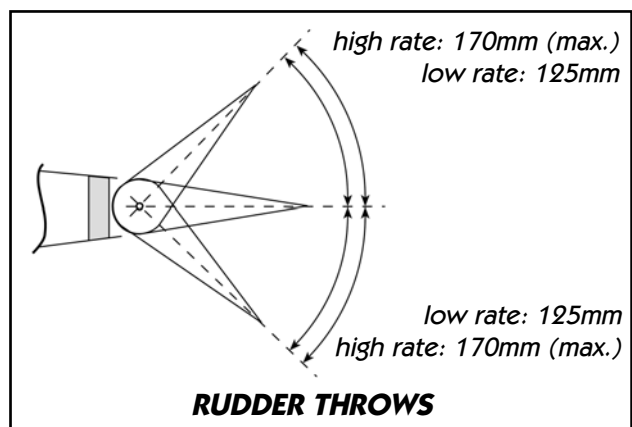
All measurements are at the root/trailing edge position.

Elevator

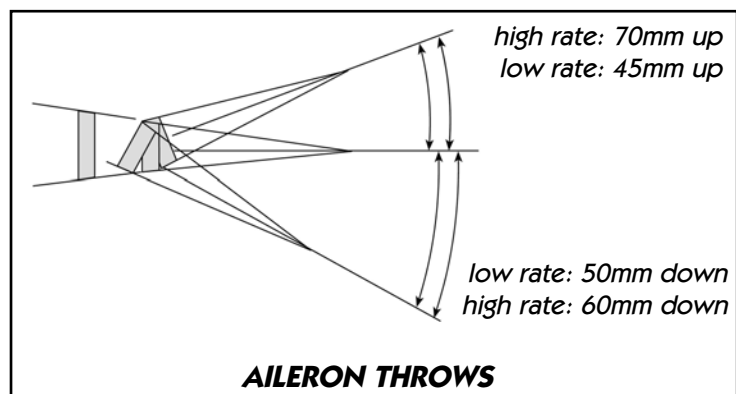
All controls should be set with a dual rate switch. On high rate the elevator should really be at maximum, up to 50 degrees both sides (approx. 75mm), but in this case with 50% exponential. Low rate should be no more than 30mm (1 1/4") both sides. This is the perfect throw for nice and crisp snaps. If you like you can add about 20% exponential to the low rate setting as well.

**Rudder**

Set the high rate to maximum throw (about 150mm) both sides, and at low rate reduced to about 100mm. 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.

**Ailerons**

Aileron throw for high rate is 70 up - and 60mm down (measured at root) . Use at least 30% exponential at high rate. For low rate you should decrease the throw to the TOP to 45mm, to the BOTTOM to 50mm. Yes, you're right - 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 manoeuvres, 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. You may need to lengthen the slots in the servo hatches by 2mm or so at the front to obtain these high rate throws.

**In General**

Your Extra has very large control surfaces. This 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. The design is so strong that even a flutter will not damage the structure of the plane. But if a servo gear strips, the flutter will not stop until the plane

slows down (or hits the ground...).

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. To prevent this for sure, we recommend reduced control travels (reduced by using short servo arms, not by using electronic settings). Using 2 servos per control surface as described in this manual will never overload or damage high quality servos, even if the maximum travel of each servo is slightly off. The aileron control surfaces have enough torsion flexibility so that damage to the servos should not occur.

The Composite-ARF TOC 3-Metre Version of the Extra 330S is known for very good and crisp 'snapping', and we think that the 2.6m 330L version snaps even better. It's like an explosion ... and it still stops immediately that the sticks are released. Be aware of this fact when you try it for the first time. The trick for nice crisp 'snaps' is to stall the plane with a quick hit of 'up' elevator, and then release the elevator to zero, while you give full rudder and aileron together. But of course, you know this needs some practice to make it perfect every time !

Perfect knife edge tracking is achieved by mixing in slight up elevator and opposite aileron to the rudder movement. From our experience as little as 6 - 7% 'up' elevator and 2 - 3% of opposite aileron are needed.

Now your Extra seems to be ready for the first flight. Always keep in mind, that you have a rock solid, but still sensitive, contest tool in front of you, which, if used as it is designed will give you many hours of pleasant flights. The performance of this aircraft is unlimited, and if maintained regularly and carefully, you will enjoy it's performance for many, many hours. With this aircraft you have the potential to move up to the unlimited "cracks", it's up to you now! You can't blame it on the aircraft anymore....

Have Fun!

Notes:

We hope that you enjoyed building your Extra 330L. This manual is the start of our attempt of a new standard of Composite-ARF instructions, and we would like to complete all our products with this style of manual in the future. Please let us know whether you like this all new instruction manual, and if you have any ideas to improve it ?

Also let us know, if you think that any hardware is missing or inadequate. We tried to make this airplane as complete as possible. 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:

Extra 330L, 2.6m Kit Stückliste / Packing List

Art.-Nr.	Anzahl Beschreibung Deutsch	Description English
1	Rumpf	Fuselage
1	Fläche rechts	Right wing
1	Fläche links	Left wing
1	Höhenleitwerk rechts	Right stab
1	Höhenleitwerk links	Left stab
1	Höhenruder rechts	Right elevator
1	Höhenruder links	Left elevator
1	Seitenruder	Rudder
1	Motorhaube	Cowling
1	Kabinenhaubenrahmen	Canopy frame
1	Radverkleidung rechts	Right wheel pant
1	Radverkleidung links	Left wheel pant
1	Fahrwerksbein rechts	Right landing gear, carbon
1	Fahrwerksbein links	Left landing gear, carbon
1	Kleinteilebeutel mit gefrästen Zubehörteilen	Small parts bag "milled parts"
1	Leitwerkssteckungsrohr 20x300mm	Stab tube 20 x 300 mm
1	klare Kabinenhaube	Clear canopy
3	Stahl-Pin 2mm x 600 mm	Steel pin 2 mm x 600 mm
1	Kleinteilebeutel	Hardware bag
1	Bauanleitung Englisch	Instruction book English

Kleinteilebeutel / Hardware bag:

Art.-Nr.	Anzahl Beschreibung Deutsch	Description English
2	Radschrauben M 6 x 70mm	Bolts for axles, M6 x 70mm
2	Stopmuttern M 6	Lock nuts M6
2	Muttern M 6	Nuts M6
4	Unterlegscheiben M 6,4	Washers 6.4 mm
4	Stellringe 6 mm	Wheel collars 6 mm
2	Blehschrauben 3,5 x 16 mm	Sheet metal screws 3.5 x 16 mm
4	Inbusschrauben M 6 x 20	Allen screws M6 x 20 mm
9	Inbusschrauben M 3 x 16 mm	Allen screws M3 x 16 mm
9	Inbusschrauben M 3 x 12 mm	Allen screws M3 x 12 mm
13	Einschlagmuttern M 3	Blind nuts M3
6	Gewindestäbe M3 x 45 mm	All thread M3 x 45 mm
2	Gewindestäbe M3 x 60 mm	All thread M3 x 60 mm
1	Packung 0.8 mm Stahl-Litze	Pack steel cable 0.8 mm dia.
2	Schraub-Ösen M3	2 thread ends for steel cable 0.8
4	Quetschhülsen Messing, id 2mm	Crimp tubes, 2 mm inside dia.
4	Kugelköpfe M3	Ball links M3
4?	Stopmuttern M3	Lock nuts M3
14	Muttern M3	M3 nuts
14	Gabelköpfe M3	Spring steel clevises M3

Frästeile-Beutel / Milled Parts:

Art.-Nr.	Anzahl Beschreibung Deutsch	Description English
1	Fräsplatte Sperrholz 3mm, Kleinteile	Milled plywood, 3mm, small parts
1	Fräsplatte Novotex 2mm, Servo/Ruderarme	Milled phenolic 2mm, control/servo horns
1	Fräsplatte Sperrholz 3mm, Kleinteile	Milled plywood, 3mm, small parts
4	Servoaufnahmen Querruder	Servo mounts ailerons
4	Farbige Servodeckel	Coloured servo hatches

Lieferbares Zubehör / Available Accessories:

Art.-Nr.	Anzahl Beschreibung Deutsch	Description English
-	Spornfahrwerk mit Rad 50 mm	Tail gear setup with 50mm Ø wheel
-	Desert Aircraft DA-100 motor	Desert Aircraft DA-100 motor
-	PowerSwitch 20A (for dual NiCads)	PowerSwitch 20A (for dual NiCads)
-	PowerBox 40/24 (Dual Nicad crossover unit)	PowerBox 40/24 (Dual Nicad crossover unit)

Hardware and parts for 2.6m 'Update' pack:

1	Steel strip for muffler mounting and template
5	M3 Blind nuts for spring attachment and wheelpant attachment
3	M3 x 16 bolts for spring attachment
12	3mm milled plywood 15 x 15mm (for spring attachment)
2	M3 x 20 bolts for wheelpant attachment
4	M6 x 40 bolts for engine mounting
12	Large M6 washers for engine mount packing
3 pieces	Milled balsa parts for spar box (5mm and 3mm thick)
30cm	1" wide fibreglass tape (for attaching rudder/tank base)
32	Sheet metal screws 2.8 x 14 mm (for servo mounting)
1	Throttle servo mount (milled plywood parts)
2	3mm plywood rings for front wing anti-rotation pins
1	Milled plywood and balsa tank and rudder servo base set (13 pieces)