Instruction Manual

Composite-ARF YAK 55SP, 3m

Instructions for YAK 55SP Airplane

Thank you very much for purchasing our Composite-ARF YAK 55SP all composite aircraft, made using Total Area Vacuum Sandwich (TAVS) technology. It is based on our original 3.3m version of the Yak, but reduced in size to better suit the most popular 150cc engine sizes, and now has a standard 50mm diameter 6061 alloy wing tube which saves weight and simplifies storage and transport.

Note: Version 1 Instructions *only* reflects the changes in the wings, so that Customers have the choice of installing 2 or 3 servos (Futaba or JR) for each aileron - instead of only the 2 very powerful JR servos that were recommended in the 'Preliminary' instructions for the first few kits. The hardware pack for the wings now includes the phenolic mounting plates and additional linkage parts required for both makes of servo (see page 7 for servo details). There are no other changes to the instructions.

You will notice that the photos in this instruction manual show both 'Butterfly' color schemes, and that the prototype has some fibreglass balsa sandwich parts in the cockpit area - whereas the production versions have carbon composite-sandwich parts in the complete fuselage.

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

Email:	**feedback@composite-arf.com**
or	**techsupport@composite-arf.com**
Telephone:	**Phone your C-ARF Rep!!! He will be there for you.**
Website:	**http://www.composite-arf.com**

Liability Exclusion and Damages

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

However, as manufacturers, we at CARF-Models Co. Ltd. are not in a position to influence the way you build and operate your model, and we have no control over the methods you use to install, operate and maintain the radio control system components. For this reason we are obliged to deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect application and operation of our products, or which are connected with such operation in any way. Unless otherwise prescribed by binding law, the obligation of the CARF-Models company to pay compensation is excluded, regardless of the legal argument employed.

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

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

It is important to understand that CARF-Models Co., Ltd, is unable to monitor whether you follow the instructions contained in this instruction manual regarding the construction, operation and maintenance of the aircraft, nor whether you install and use the radio control system correctly. For this reason we at CARF-Models are unable to guarantee or provide a contractual agreement with any individual or company that the model you have made will

function correctly and safely. You, as operator of the model, must rely upon your own expertise and judgement in acquiring and operating this model.

Supplementary Safety Notes

Pre-flight checking:
Before every flying 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.

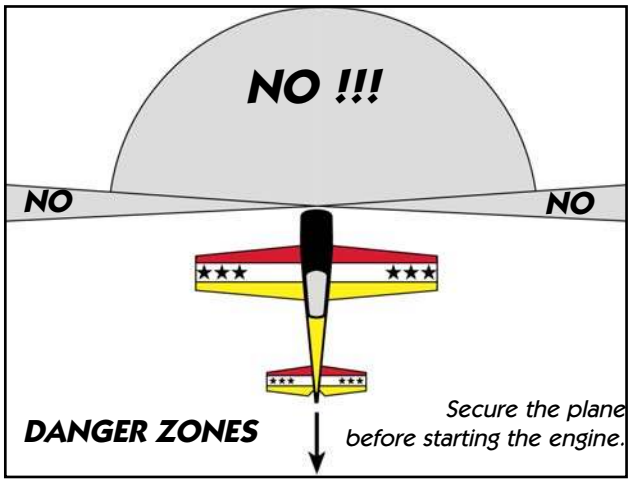
Be aware of any instructions and warnings of other manufacturers, whose product(s) you use to fly this particular aircraft, especially engines and radio equipment.

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 model 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 Yak 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-maneouvers. 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 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 then 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 and stab tubes 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 stablisers on to the aluminium tube are installed and tight, and that the hinge tubes 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 Yak.

General information about fully-composite aircraft structure and design

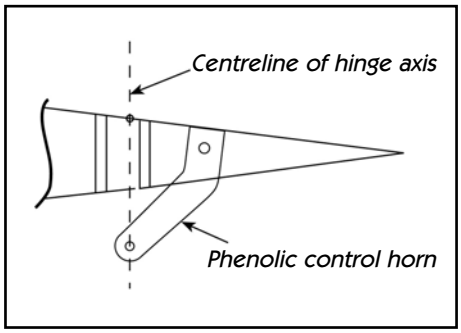
All the parts are produced in negative molds, manufactured using vacuum-bagged sandwich construction technology. All parts are painted in the moulds, either single colour or designer colour schemes. A revolutionary production method, called TAVS (Total Area Vacuum Sandwich), enables us to present this 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, fully vacuum-bagged, using only 2 layers of cloth in combination with a hard 2mm foam sandwich to form a hard and durable outer skin. Because of this TAVS technology no additional structural parts are needed except for the main spar tube.

The ailerons are already hinged 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 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 disadvan-

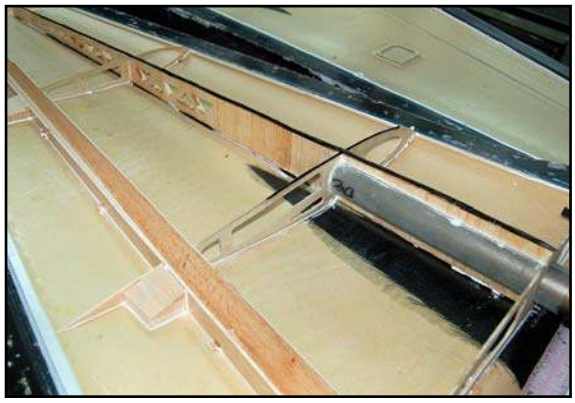


tage, if you set in about 10% NEGATIVE aileron differential in your transmitter program. This means that the 'down' throw needs to be about 10% more than the up throw.

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.

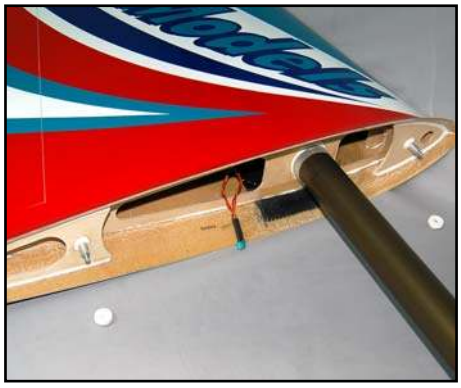
The wings are already set-up with servo mounts milled in the plywood ribs, and a milled servo access hatch for the outer servos, and we recommend a pair of high-torque digital servos (eg:JR DS8511 or 8611) in each wing. Our servo covers and milled plywood mounts make installation, and exchange if necessary, very quick and easy and provide a rock solid servo mounting and linkage system.



(above) The internal wing structure, showing the carbon roving and cloth reinforcement.
(below) The wing root, showing the 50mm Ø 6061 alloy wing tube and the aluminium anti-rotation dowels in the root rib.

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 spar tube 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 assemble your plane before flying it. Never forget to tighten the nuts inside the fuselage. 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 is all constructed using TAVS technology. All the loadbearing internal parts are installed during manufacture, to ensure accurate location and reduce your assembly time. The fibreglass tubes in the wings and stabs to receive the spar tubes, and 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. The fuselage is extremely light weight, 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 well proven design, taken from our 3.3m Yak, and the slight flexibility helps to smooth any less-than-perfect landings. 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, firewall and molded exhaust system tunnel are a fully integral parts of the fuselage, and provide plenty of strength for any engines up to 170cc on the market today. See the Engine Installation section for details of engine and setting thrust angles.

The Stabilisers:
The stab parts are also vacuum bagged sandwiched. The rudder and the elevator control surfaces are hinged with 4mmØ tubes, fitted through phenolic hinge bearing plates which are jig-installed during manufacture for perfect alignment.

The rudder and elevator design allows for at least 45 degrees throw. For the Yak it is mandatory that the tail area is extraordinarily light weight, so the stab is designed for one powerful digital servo installed in each half. All the structural parts are preinstalled. The horizontal stabs are mounted with one 20mm aluminum tube and one 10mm carbon anti-rotation pin each.

(above) The lightweight fin-post has the phenolic rudder hinge posts already installed and aligned at the factory. The corresponding tubes are also installed in the rudder for the hinge tube.
(below) The elevator and rudder hinging uses 4mm diameter tubes, inside phenolic hinge posts that are factory-installed and aligned.

Servo Screws:

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

All stabiliser and aileron servos must be secured into 6mm thick plywood mounts, and we have included plywood doublers for you to add in any places where there is only 1 layer of 3mm plywood present.

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.

Accessories

Below are the things you may need to get your Composite-ARF Yak 55SP 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 (9 - 11 required). The elevators are specifically designed to have a single JR 8711 or JR8811 fitted into each, and we strongly recommend that you do *not* substitute any other servo (eg: JR8411/8511/8611) for these control surfaces. For Futaba users a single S9152 should be fine for each elevator, and mounting plates for these are included. We do *not* recommend fitting single S9351's in the stabs for the elevators.

   We highly recommend that the rudder is controlled by three JR 8511/8611 (or better) ser vos. Futaba users can install 3 x S9152's, which also fit in the rudder tray.

   You have a choice of 2 or 3 servos for each aileron, depending on the servos used, which should be installed in the phenolic mounting plates provided. JR users can install either two or three 8511/8611 (or better) in each wing. If using JR/Graupner 8411's you must install 3 servos per aileron. Futaba users should install 3 servos for each aileron - either 3 of the larger S9152's, or 3 of the standard sized S9351's.
2. Aluminium servo arms (6-8 pieces) for ailerons and elevators, and Aluminium servo out put discs for the rudder servos (3 pieces). It is mandatory to attach the included phenolic servo extension arms for all 3 rudder servos to metal servo output discs (eg:'Hangar 9' #HAN3520), or use full metal servo arms (eg: SWB 'Double-Loc' type)
3. Throttle servo. Any standard servo will do (eg: JR/Graupner 4041/5391)
4. Aluminum Spinner 125 - 150 mm/5 - 6" dia. eg: Tru-Turn.
5. Main wheels 125 mm (5"). Kavan Light or Dubro wheels are recommended.
6. Engine 150cc. The DA-150 is probably the most commonly used engine for our 3m span planes, and the mounting dimensions are shown for this motor. another option would be the 3W 157cc twin, which also fits completely in the cowl and is even more compact than the DA-150.
7. Muffler/Canisters, and headers (80 - 90mm drop). A complete set for the DA-150, includ ing headers, teflon connectors, spring clamps and MTW TD110 canisters is available from us as an option. (Product #910150)
8. Tailwheel assembly. (Available as an option from C-ARF. Product # 801001.)
9. High quality heavy-duty servo extension cables, with gold connectors. High quality receiver and ignition switches, etc.
10. Receiver and Ignition batteries.
11. Powerbox and powerswitches for dual batteries (available from C-ARF as an option)
12. Fuel tank (1200 - 1500cc/50 fl.oz) with gasoline stopper. We used a Dubro #692.
13. Cable ties in various lengths.
14. Propeller. Carbon Meijzlik or Menz 32 x 10 or 30 x 12 for DA-150.

Tools

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 should be 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. Drills of various sizes
8. Dremel tool (or Proxxon, or similar) with cutting discs, sanding tools and mills.
9. Sandpaper (various grits), or Permagrit sanding tools (high quality).
10. Carpet, bubble wrap or soft cloth to cover your work bench (most important !)
11. Car wax polish (clear)
12. Paper masking tape
13. Denaturised alcohol/acetone, or similar (for cleaning joints before gluing)

Adhesives and Solvents

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.

High performance models require good gluing techniques. We highly recommend that you use either a slow (minimum 30 minute cure) epoxy resin and milled fibre mixture, or a slow filled thixotropic epoxy for gluing highly stressed joints (eg: Hysol 9462). The self-mixing nozzles make it easy to apply exactly the required amount, in exactly the right place, and it will not run or flow onto places where you don't want it! It takes about 1 - 2 hours to start to harden so it also gives plenty of time for accurate assembly. Finally it gives a superb bond on all fibreglass and wood surfaces. Of course there are many similar glues available, and you can use your favourite type.

1. CA glue 'Thin' and 'Thick' types. We recommend ZAP, as this is very high quality.
2. ZAP-O or Plasti-ZAP, odourless, or ZAP canopy glue 560 (for clear canopy)
3. 30 minute epoxy (stressed joints must be glued with at least 30 min & NOT 5 min epoxy).
4. Loctite Hysol 9462 or equivalent (optional,, but highly recommended, for stressed joints)
5. Epoxy laminating resin (12 - 24 hr cure) with hardener.
6. Milled glass fibre, for adding to slow epoxy for stronger joints.
7. Micro-balloons, for adding to slow epoxy for lightweight filling.
8. Thread-locking compound (Loctite 243, ZAP Z-42, or equivalent)

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

have been missed.

When sanding areas on the inside of the composite sandwich parts to prepare the surface for gluing something onto it, do NOT sand through the layer of lightweight glasscloth on the inside foam sandwich. It is only necessary to rough up the surface, with 80/120 grit, and wipe off any dust with acetone or de-natured alcohol (or similar) before gluing to make a perfect joint. Of course, you should always prepare both parts to be joined before gluing for the highest quality joints. Don't use Acetone for cleaning external, painted, surfaces as you will damage the paint.

TIP: Lighter fluid is excellent for cleaning small marks, clear wax, uncured glue, or similar off the painted surface of the plane - without damaging the paint.

Tip: For cleaning small (uncured) glue spots or marks off the painted surfaces you can use old-fashioned liquid cigarette-lighter fuel, like 'Ronsonol' or equivalent. This does not damage the paint, as Acetone and many other solvents will, and this is what we use at the factory.

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 !

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 Yak 3m

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 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% completely 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, and you can leave these in place if you wish to protect the bottom of the fuselage during assembly and gear installation.

The Composite-ARF landing gear for the Yaks consists of 45 deg laminated carbon fibre and fibreglass cloth and a huge number of rovings 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 imperfect landings.

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

The legs are fitted through the glassfibre sleeves that are installed at the factory, and bolted to the composite plywood bulk-heads and plates as shown here with the M6 x 20mm bolts and large washers. The spacer blocks on the underside of the plywood mounting plate are factory-installed.

The carbon legs should be quite a tight fit in the fibreglass sleeves, but if they are too tight you may need to scrape the joining seam with a sharp knife for a smooth fit. 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 tail-wheel (optional tailwheel assembly available from C-ARF) in place.

Drill a 6mm Ø hole centrally right thru' the rounded part of the wheelpant. Fit the wheel-pants over the M6 x 70mm axle bolts, and also temporarily fit the wheels, and screw the bolts into the threaded inserts that are mould-ed into the legs during manufacture.

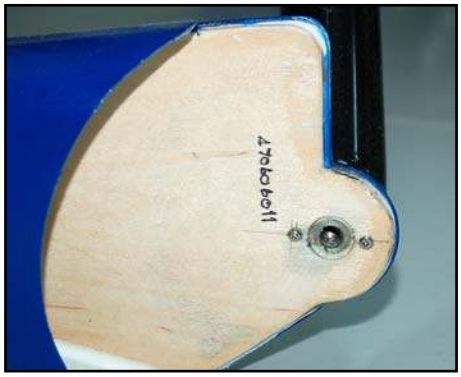
(above) The carbon legs are secured using the M6 x 20mm bolts and large washers.
(below) Wheel axles are M6 x 70mm bolts, which fit into the threaded inserts in the moulded carbon legs. The supplied washers are used as spacers, with a plain nut against the outer plywood face of the wheelpant.

Looking from the side view, adjust the angle of the wheel pants so that the tops of both are parallel with each other, and the bottom edges angle upwards a little, as shown in the photo below. When satisfied with the angle, temporarily tack the wheelpants to the carbon landing gear legs with a small drop of thin CA. Remove the wheels and axle bolts very carefully, and then secure the wheelpants to the legs with 2 small sheet-metal screws (2.2 x 10mm), into 1.8mm Ø holes drilled into the ends of the carbon legs.

You can use any 5" main wheels of your choice. Kavan wheels are very lightweight, but not very durable on asphalt runways, and Dubro wheels are a little heavier but much more solid, and this is what we use at C-ARF.

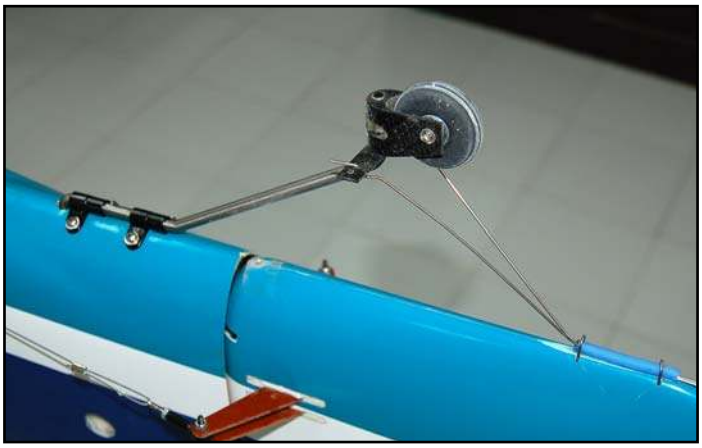
The order of the items on the axle bolt is: Bolthead, wash-er, wheel hub, 2 or 3 washers, M6 nut (with Loctite), wash-er, fibreglass wheelpant, carbon landing gear leg. You may need to adjust the number of washers, or even add a 6mm wheel collar behind the wheel to maintain free wheel move-ment and centre the wheel against the wheelpant, depend-ing on the actual wheels used. A drop of loctite on the M6 axle bolt where it goes into the threaded insert in the leg is good insurance.

(left/below) Completed wheelpant with 5" Dubro wheels. The angle of the wheelpants to the legs is set with 2 small sheetmetal screws, thru' the wheelpant into the car-bon leg.



Tailwheel

The tail wheel unit shown is an optional part available from C-ARF (# 801001), and is mounted with 4 sheet metal screws and 4 plastic 'U' brackets under the fuselage, screwed into the plywood reinforcement that's installed in the fuselage at the factory.

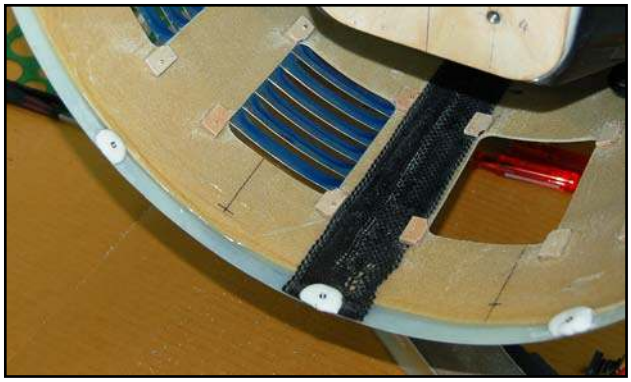


You don't need to make the tailwheel steerable if flying from grass surfaces; a simple castoring action is fine.

However, for hard runways you may prefer to connect it either to the rudder horn with 2 small springs, or a thin 'V-shaped' piano wire into a tube glued to the bottom edge of the rudder, as seen here. 'Z-bends' secure the wires into the tailwheel tiller arm. Because of the geometry of the Yak fin and rudder, the method shown above is a highly recommended solution for operating the steerable tailwheel, and gives accurate steering.
Remember - keep it lightweight at the tail end!

Cowling and Air Vents

The 1 piece cowling is already cut and trimmed at the factory for you. Secure it to the fuselage with 8 equally spaced (approx. 153mm centres) M3 x 12mm bolts, washers and T-nuts (fitted inverted) that are glued inside the fuselage (photo right).



(above) Cowl is secured to fuselage with eight M3 bolts and T-nuts, glued to the inside of the fuselage with the spikes facing inwards.
(below) The 8 punched aluminum louvres are secured to the cowl with the small sheetmetal screws, into small ply blocks glued on the inside of the cowl with thick CA.

Tape the cowl into position, and drill the Ø 3mm holes 7mm from the back edge of the cowl, inserting a bolt in each after you have drilled it to maintain perfect alignment. Remove all bolts and add a drop of light oil, or wax, to the threads. Sand the inside of the surface in the positions that the T-nuts will be secured.

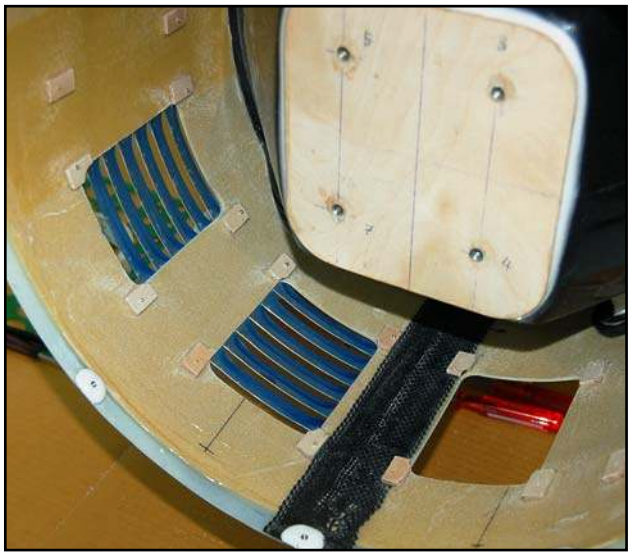
Reinstall the bolts, and screw on the T-nuts with the spikes facing inwards, reaching thru' the front of the cowling. Secure each T-nut with one drop of thick CA, then remove the bolts, and fix the T-nuts properly with some 30 minute epoxy and micro-balloon mixture. Mark the top of the cowling (on the inside) so you always fit it in the correct orientation.

The Yak has 8 cnc pressed and punched aluminum air vents included in the kit, already painted to match your fuselage. The cutouts in the fuselage for the lower 4 vents are factory-

cut for you, and the upper 4 vents should not have cutouts - in effect they are just 'dummy' vents. This is so that all the air coming in through the front of the cowl must go thru' the engine cylinder fins and out of the lower vents for the most efficient cooling effect.

The air vents should all be equally spaced 40mm apart, with the front edge of the metal vent 55mm from the step in the molded flange on the front of the fuselage (see photo).

These vents are all fixed to the fuselage using the small 2.2 x 10mm sheetmetal screws included in the hardware pack, which go through the fuselage skin into small (10 x 12mm) plywood blocks cut from the 12mm wide ply strips included. Sand the area in carefully and glued the blocks to the inside of the fuselage with thick CA, at the corner of each air vent.



(above) Only the lower 4 louvres have cutouts, the top 4 louvres are just 'dummy' air vents, and should not be cut out.

Canopy Frame

The fibreglass canopy frame mountings are already completed for you at the factory. It is secured to the fuselage with four M4 x 12mm allen bolts, fitted from the outside of the fuselage, through the plywood tongues that are glued to the canopy frame, into M4 T-nuts. This system has been very well proven on all of our aerobatic planes, and is a strong and rigid solution.

(above) The fibreglass canopy frame has the 4 fixing tongues, the 2 alignment tabs and the bolt fixings all factory-finished for you.

Fitting the clear canopy into the frame can be a little bit tricky, and this is a step by step guide of how we do it. Of course you can also use own your favourite glue and method.

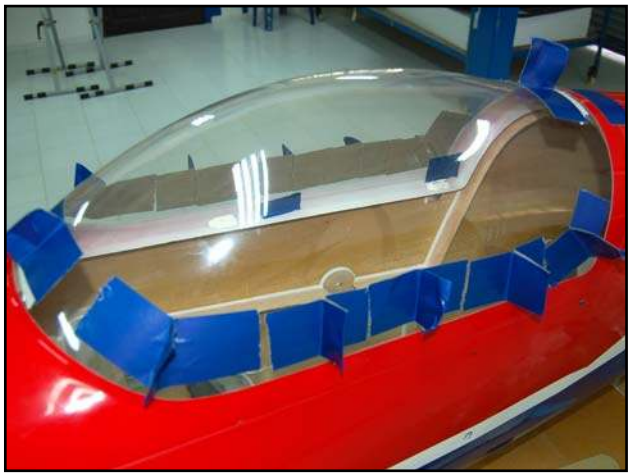
Sand the inside edges of the canopy frame carefully with 120 grit sandpaper, especially the fibreglass joining tapes, to ensure a perfect fit of the canopy. Fit the canopy frame on the fuselage and secure with all 4 bolts. Roughly cut the canopy molding to shape, and lay it on top of the frame, view from the front to check that it is centred and symettrically positioned, and then mark the approx. shape with a felt pen or wax crayon. There is an approx. 'cut-line' molded into in the edges of the canopy to assist you, and you should start by trimming 4 - 6mm outside this line.

(below) Detail of the factory-finished canopy securing tongues, which are secured with M4 x 12mm bolts & T-nuts

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, tape it into position temporarily, and accurately mark the edge of the frame on the canopy with a wax crayon. Remove the canopy and trim exactly to shape, leaving about 6mm overlap outside the line all around.

Tape the clear canopy into position on the inside of the frame, and refit the frame to the fuselage and bolt into position. Make visual check from the front and back to make sure sure that the canopy is straight. Make several handles with strong tape, as shown, to make holding and positioning the canopy easier.

(below) Duct-tape handles used to pull the clear canopy against the canopy frame while gluing it in position with a few small drops of odorless-CA. Remove canopy and secure the edges of the clear canopy with a bead of epoxy to trap it in place (see photo above)



Using the tape 'handles', pull the canopy up tightly inside the back of the frame and fix the bottom 2 back corners with one very small drop of odorless CA each (ZAP-O recommended). Check again that the canopy is straight, viewing from the back and front.

Using the 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 odorless CA at each position, all the time checking that the edge of the canopy is tight up against the frame at the front.

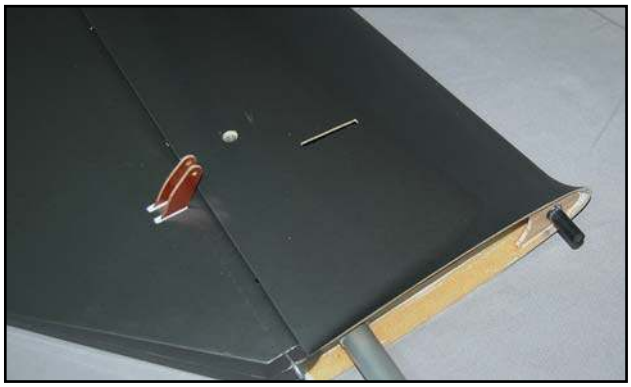
Note: Do NOT use any CA accelerator/kicker - you will immediately 'fog' the clear canopy!

Now that the canopy is fixed in position and cannot twist or warp anymore, you can carefully remove the canopy frame from the fuselage, and use a specialised canopy glue (eg: ZAP Formula 560) or slow epoxy and micro-balloons mixture for gluing all the edges to the frame on the inside surface (see photo above). It is most important that the canopy cannot come off in flight, so make sure that the bead of glue traps the clear canopy firmly in place. Re-secure the canopy frame onto the fuselage with all 4 bolts while the epoxy-microballoons mixture is curing to prevent any warps or twists.

If you want a completely rattle-free canopy, you can fill any slight gaps at the front and back of the frame with a bead of clear silicone. Apply shiny brown plastic tape to the front and back edges of the opening in the fuselage and wax twice with clear car wax. Sand lightly, and degrease edges of canopy frame where the silicone will be applied. Apply a small bead of clear silicone to the front end of the frame *only,* and secure the frame into position with all 4 bolts until cured. Remove frame, and trim off excess silicone with a very sharp knife. Then repeat for the back edge. Do *not* try to do the back and front at the same time - or you will find it very difficult to get the canopy frame off the fuselage!

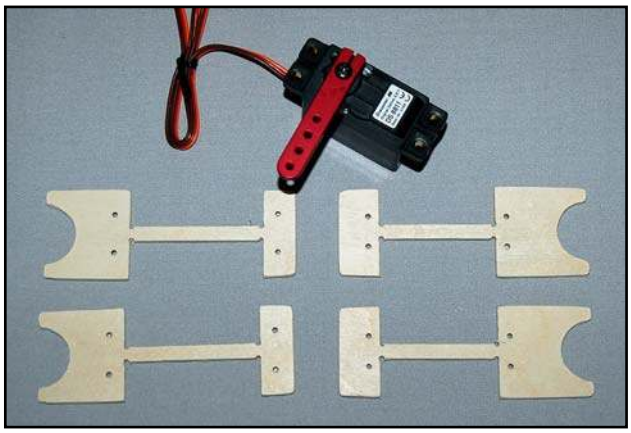
Horizontal Stabs

The stabilisers are finished at the factory, and only need the servos and linkages installing. Insert the Ø 20 x 435mm long aluminium tube spar in the fuselage sleeve, and slide on both stabs. The 10mm carbon anti-rotation dowels fit into the carbon tube in the fuselage and the alignment and incidence has already been set in a jig at the factory for you. The stabs are retained on the aluminum tube with an M3 x 16mm allen bolt thru' the bottom surface of each stab, and these are already factory -finished.



(above) Elevator horns, spar tubes, stab securing bolts, anti-rotation dowels and servo arm slots are all factory-finished.
(below) A single JR8711 or 8811 servo is installed in the milled mount in the ply rib, and connected using a 1.5" SWB metal servo arm, and the linkage hardware supplied.

(below) Milled 3mm thick plywood doublers are included for both the JR8711/8811 and the Futaba S9152 servos. JR8811 and SWB 1.5" servo arm shown here.



The elevators are hinged to each stab using the Ø 4mm aluminum tubes provided. Make sure there is no burr on either end of the tubes, and chamfer one end slightly with fine sandpaper to make it easier to get them through the holes in the phenolic hinge plates. Be careful inserting them, and if they are a bit stiff, then use a little grease on the tubes. Don't use too much force, otherwise a phenolic hinge post inside might break loose. Leave the tubes a bit too long during assembly, and cut them to exact length when the model is finished. We supply the hinge tubes with quite a tight fit in the phenolic hinge posts - but after the first 2 or 3 flights they will free up completely and give smooth movement.

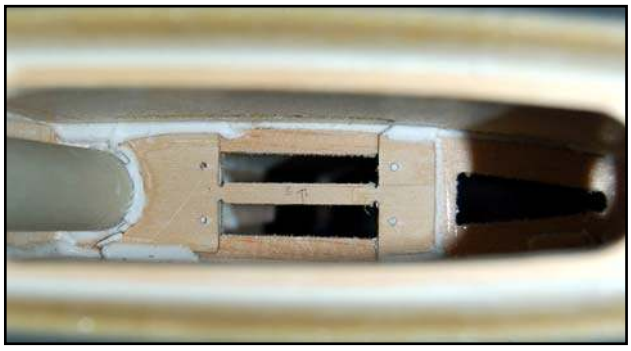
During final assembly, secure the inboard ends of the hinge tubes with small pieces of clear tape on the root end of the elevators before flight.

Servos

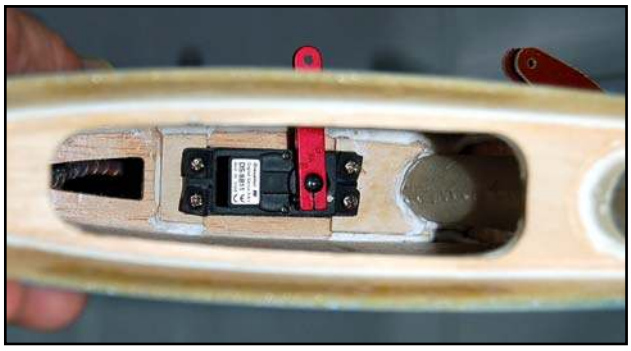
The elevators are designed specifically to be controlled by a single very high torque digital servo in each stab, and we ***strongly*** recommend that you *only* use a JR8711 or JR8811 servo. Do *not* substitute a servo with lower torque, such as a 8511 or 8611, as it might not be sufficiently strong enough to prevent flutter.

If using Futaba servos, we recommend that you use S9152's (or better), but you will need to open up the milled cutouts in the plywood ribs as these are a bit wider than the 8711 or 8811 servos. The Futaba S9351 is *not* strong enough to be used in the stabs. The servos should be installed with the output shafts nearest to the trailing edge of the stabs.

The 3mm thick plywood inner rib in the stabs is already milled with a cutout to suit the JR8711/881 servo, but it is ***mandatory*** that the very powerful stab servos are screwed into 6mm thick plywood, using the Ø 2.9 x167mm long screws provided. For this purpose we have included 3mm plywood doublers (2 to suit JR8711/8811 and 2 for Futaba S9152), which must be glued securely to the inside face of the plywood rib. If fitting the JR servo all you need to is glue one 3mm doubler into each stab with thick CA, aligning the screw fixing holes carefully with some pins, and then cut out the temporary 'spacer' bar in the middle when the glue has cured.



*(above) Servo is screwed into the milled cutout in the inner rib, which **must** have the included plywood doubler glued to the inside face to give a total 6mm thickness.*
(below) JR8811 servo & SWB 1.5" servo arm.



If you are fitting the S9152 servo then, after gluing the doubler into place and cutting out the spacer bar, you will need to enlarge the original milled cutout in the rib a little to suit the slightly larger Futaba servo. A coarse Permagrit needle file, with an extension handle, makes this a quick job.

Servo arms

It is ***mandatory*** to use full metal servo arms for the elevator control, and we always use the SWB 1.5" double-loc arms (shown here) which provide full deflection throws without having to electronically reduce the end-points, to ensure the highest torque and mechanical advantage. These arms clamp onto the servo output shaft with no lost movement (play) at all. They are high quality, properly engineered arms, and are available from many good hobby stores.

(above) You may need to sand the ends of the SWB arms a little for smooth movement of the clevises. Remember to add a little grease to the clevise pins.

If using the SWB arms you may need to reduce the thickness of them a little at the end so that the supplied aluminium clevises fit without binding, and this is easily done on a belt sander. Drill the outer hole to 3mm diameter for the clevise pin, and apply a little grease to the hole to make sure there can be no binding of the Ø 3mm pin in the servo arm.

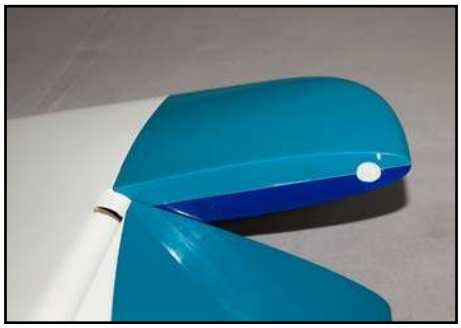
Whatever brand of metal servo arms you use, make sure that they are a tight fit on the splines of the servo output shaft, with no slop or lost movement at all - otherwise you increase the risk of flutter!

Centre both your servos using the R/C, and secure the metal servo arms tightly before installing them into the stabs. Add a drop of Loctite to the bolt that secures the arms to the servos.

Make up the linkages as shown, using the M3 x 70mm threaded rod supplied, with the aluminum clevise and a plain nut at the servo end, and the M3 ball-link at the elevator end. Make sure that the threaded rod is screwed fully into the shank of the plastic ball-link. The ball-link is secured

between the dual phenolic elevator horns using the M3 x 20mm allen bolts and lock-nuts provided in the hardware pack. Add a drop of Loctite for extra safety.

It is allowed to fit a single-sided ball-link onto the metal servo arms to adjust the line of the linkage if necessary - but you ***must not*** fit a ball-link to a single-sided phenolic or plastic servo arm.



(above) Insert 15-20 grams of lead thru' a hole into the front of the counter-balance of each elevator.
(below) You can increase available throws by lengthening the slots in the leading edge of the elevators, especially the 2 outer slots.

Static balance

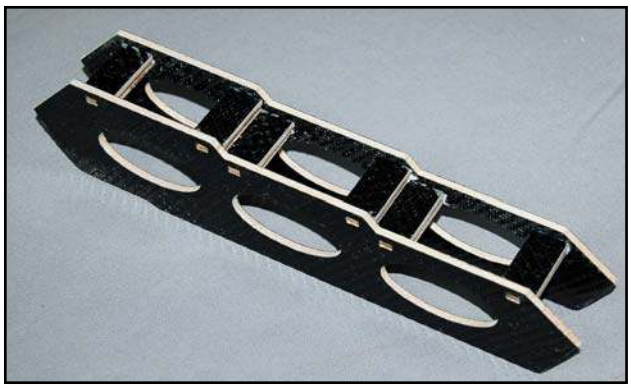
Because the Yak elevators have very large counterbalances, it does help to reduce loads on the servos if you add 15 - 20 grams of lead into each one, inserted through a small hole drilled as shown, and epoxies into place.

Throws

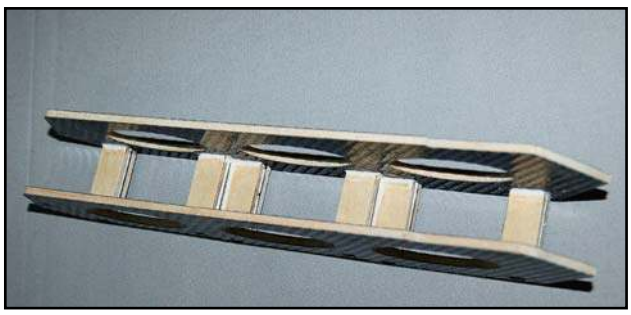
If you need more travel on the elevators than the factory assembly allows (about 40°) you will need to increase the length of the slots in the composite/balsa 'false' leading edge of the elevators with a small file. The outer 2 slots in particular will need to be longer, and you can extend them almost right out to the composite skin. Unfortunately it's not possible for us to mill these slots longer during manufacture - as the L.E. spar would fall apart on the CNC milling table. However, this is a very quick job with a Permagrit file, or similar (see photos right), and you can easily achieve 50 degree throws if you wish.

Rudder

The rudder is completely finished at the factory, with the dual phenolic rudder horns glued in, and the phenolic hinge posts aligned and secured - ready to accept the Ø 4mm brass hinge tube. Fit the brass tube in the same way as for the elevators, sanding a small chamfer on one end to ease insertion - and tape the lower end in place before flight.



(above/below) Assemble the rudder tray with thin CA, as shown, with the plywood strips glued underneath with epoxy.



Assemble the tray from the milled parts and install the servos and phenolic arms outside the model, as shown. Lightly sand all composite balsa milled parts first, and glue together with thin CA. Add the 3mm thick plywood strips underneath each servo rail, cut from the 12mm wide ply strips provided. Then reinforce all joints with 30 minute epoxy. The length and angles at both front and back can be sanded, if necessary, to fit exactly between the back of the muffler compartment and the bulkhead at the back of the cockpit opening (see photo below).

Servo Choice

The milled composite rudder tray is designed for 3 JR servos (8511/8611) or better. If using Futaba you can also fit the large S9152 servos, although you will need to sand about 2mm from the edges of the servo rails.

Fit the 3 rudder servos into the tray, with the output shafts nearest to the tailplane, and screw into position using the 2.9mm Ø x 13mm long sheet-metal screws supplied.

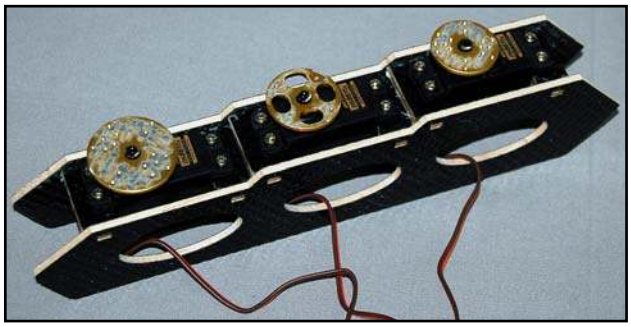
Servo arms

The supplied phenolic rudder servo output arms ***must*** be bolted to 1" or 1.25" diameter metal servo output discs. We used 'Hangar 9' # 3520's. Please do ***not*** use the standard plastic discs for this, as there is a chance that the internal plastic splines can be stripped by the current hi-torque servos - causing instant rudder flutter, and probable loss of your plane.

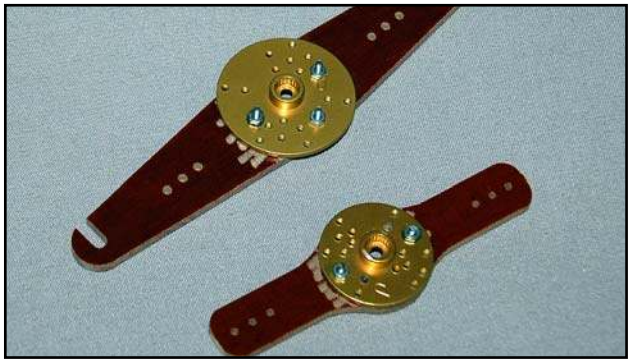
Fit 3 metal output discs to the servos, and rough sand the top surfaces of the metal discs and the underside of the phenolic arms. Centre the servos with your R/C, and then glue the phenolic arms onto the discs with epoxy, aligning them carefully so that they are exactly parallel and at 90 degrees to the sides of the tray in the neutral position. Make sure that the slots are facing forward on the rear phenolic arm.

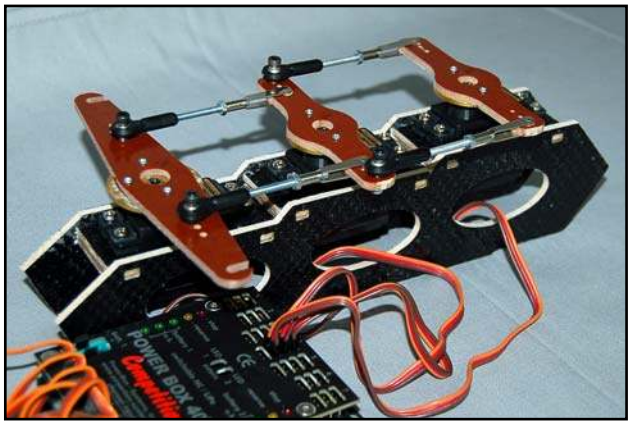
When the glue has cured drill thru' the arms and discs and secure with 2 of the M2 bolts and nuts on the front 2 servos, and 3 bolts for the rear arm.

Make up the linkages from the hardware supplied, joining the servos together as shown with the threaded rods, ball-links and steel clevises. Enlarge the holes in the phenolic arms to Ø 3mm where the ball-links are secured with the M3 x 16mm bolts and stop-nuts. Fit just one of the linkages between the phenolic arms at a time, and adjust the length of the linkage very carefully until so that there is minimal buzzing or humming from the servos at idle, and at full throw. When satisfied, add the next linkage and follow the same method of adjustment.

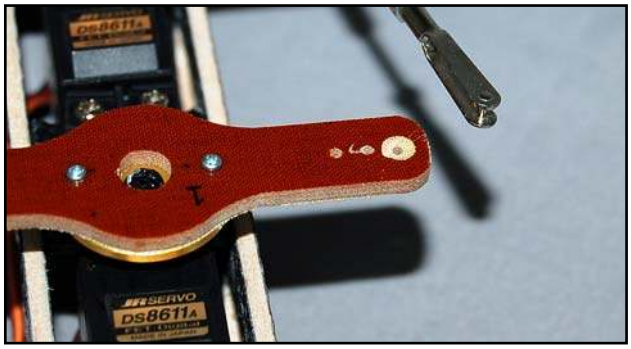


(above) Centre the servos with the R/C, and bolt the metal discs to the servos. Rough sand top surface before gluing on the phenolic arms.
(below) You must bolt the phenolic arms to metal servo output discs, using the M2 bolts and nuts provided.

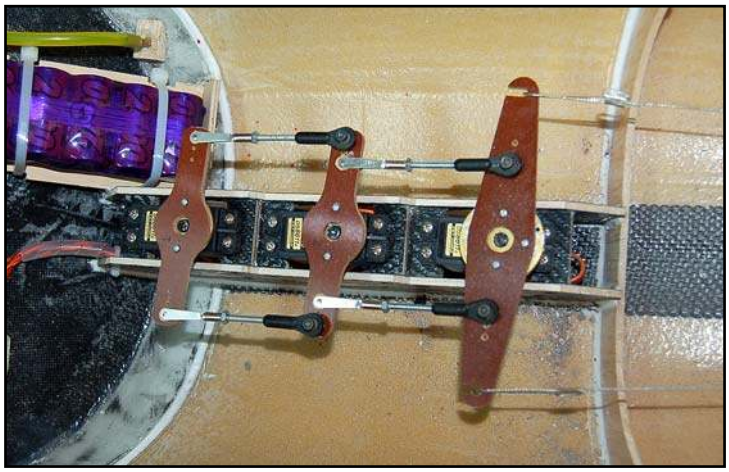




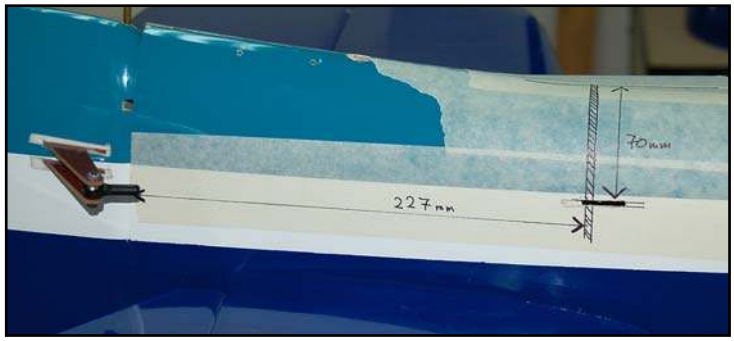
(above) Completed rudder servo tray.
*(below) Sand small rounded dimples about 0.5mm deep for proper clearance of the M3 steel clevises, **only** on one side of each phenolic horn, as shown here.*



Due to the manufacturing tolerances of the phenolic material you may find that you need to sand small dimples in the top surface (only) of the phenolic arms where the steel clevises are fitted, to make sure that they close completely and have free movement. A drum sander with a rounded end (eg: Permagrit) in a Dremel or similar, makes this a quick task. The dimples only need to be about 0.5mm deep. See photo above.



(above) Rudder servo tray glued into the fuselage between muffler compartment & rear cockpit bulkhead. (below) The slots for the cables are immediately in front of the rear bulkhead, 230mm from the back of the fin.



The servo mounting tray should be glued securely to the bottom of the fuselage between the angled back face of the muffler tunnel and the ring bulkhead at the back of the cockpit. Sand the ends of the tray if necessary for a perfect fit, sand the inside of the fuselage, and then glue in securely with slow epoxy and micro-balloons mixture, or Hysol.

The pull-pull cables that connect the rear arm to the rudder horn should be crossed, so that they exit under the stabs. The slots that you need to cut for the pull-pull cables to the rudder are 230mm (9 1/8") forward of the back edge of vertical fin (immediately in front of the rear bulkhead) and 70mm from the bottom seam of the fuselage. Cut out a small slot first with a very sharp knife, check the position using the pull-pull wire, and then adjust and open up the slots with a small file as needed. The slots should be about 3mm high and 35mm long.

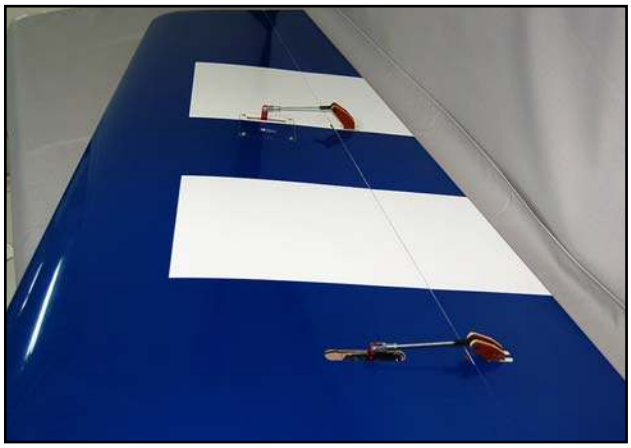
Make the pull-pull wires from the hardware supplied, with a loop at the front that goes over the hooks on the output arms, and a quick-link with threaded extender (turnbuckle) and locknut at the rudder end. The ball-link is bolted in between the dual rudder horns with the M3 x 20mm bolts and stop-nuts.

Pass the closed loop cable through the supplied 'crimping tubes' 2 times before squashing flat with pliers. 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 Yak from perfect tracking. You can glue a very small scrap of ply or balsa across the front of the slots on the servo arms with a drop of CA to prevent the wires coming out of the slots accidentally, for example when the rudder is removed for transport.

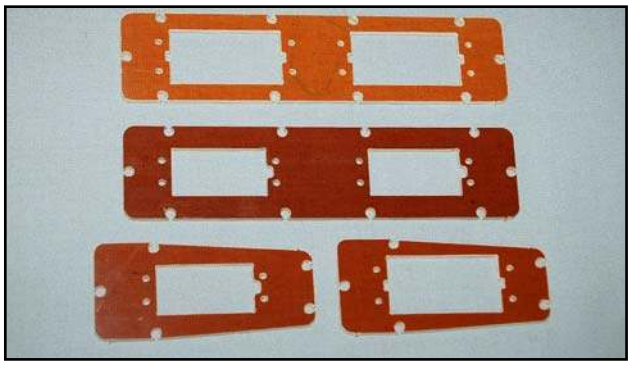
You can increase the lengths of the slots in the rudder L.E. in same way as for the elevators to achieve extra throw if necessary.

Wings

The wings are 95% finished at the factory, and have already been installed on your fuselage to set the alignment. Dual phenolic aileron horns are already pre-installed for you at the factory. Slide the wings onto the 50mm diameter alloy wing tube, and fit the 4 plastic wing retaining nuts onto the M6 threaded aluminium wing dowels. Each aileron has 2 or 3 servos (depending on your servo choice) fitted into cnc milled phenolic mounting plates that are screwed into the cutouts in the inner and outer plywood ribs. For easier access we have included a milled servo hatch to fit in the recess over the outer servo position, and you will need to mill the slot in it to suit the exact position of your chosen servo arm.



(above) Each aileron is controlled by two or three servos installed in phenolic mounts that are screwed to the plywood ribs in the wing. (2 x JR 8511 servo set-up shown here)
(below) Included in the kit are phenolic servo mounting plates for both JR and Futaba servos.



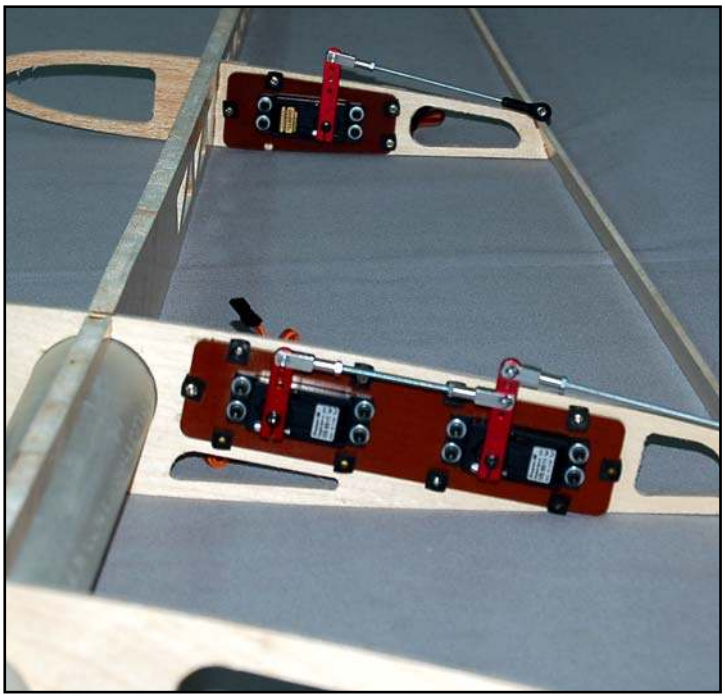
(below) Phenolic servo mounts and 3 x JR 8511 servos installed in the milled cutourts in the wing internal structure.

Wing Tube

The wing tube is a 50mm Ø T6 alloy, which slides inside a fibreglass sleeve in each wing, and it should be 1035mm (38.5”) long. Please check the length to make sure that it passes through the inner plywood ribs in each wing, that are about 355mm (14”) from the root, otherwise the wing could fail in flight.

Servo Choice

If you chose to use only 2 servos for each aileron then one of these must be installed in the rear position of the inner phenolic mount, and the other in the outer phenolic mount. Any slight mis-match of the servos will not cause servo damage damage due to the slight torsional flexibility of the large ailerons.

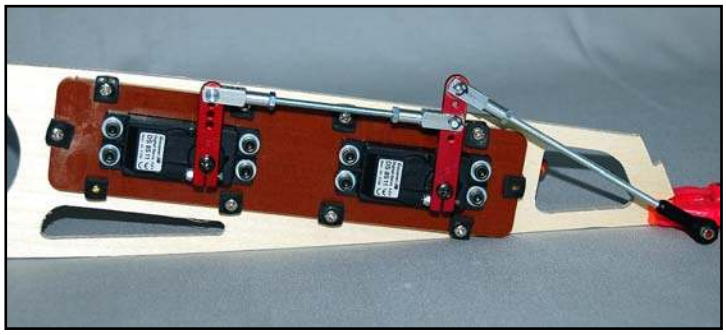


If fitting 3 servos for each aileron, then the inner pair are ganged together as shown in the photos here. Fitting 3 powerful servos to each aileron does make the snaps a little ‘crisper’, and if you chose lower power digitals, like the JR8411 or Futaba S9152/S9351 then you ***must*** install 3 servos per wing.

JR/Graupner: 2 x 8511/8611’s are quite sufficient for each aileron, as used in the prototype. Even better is a pair of 8711/8811 servos - one

installed at the back of the inner phenolic mount and the other in the outer mount. For the ultimate response fit three x JR 8511/8611 or 8711/8811 servos.

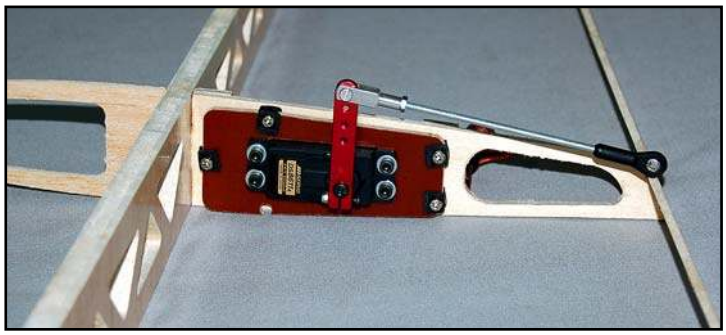
Futaba: We strongly recommend that you only install 3 servos, *not* 2. Either 3 x S9351's or 3 of the larger S9152's, and special phenolic mounting plates are included for these.



(above) Dual inner aileron servos installed in the phenolic mounts provided, 'ganged' together with metal servo servo arms using the hardware provided in the kit.
(below) The single outer servo installed in the phenolic mount, and screwed to the plywood rib.

Servo Mounting

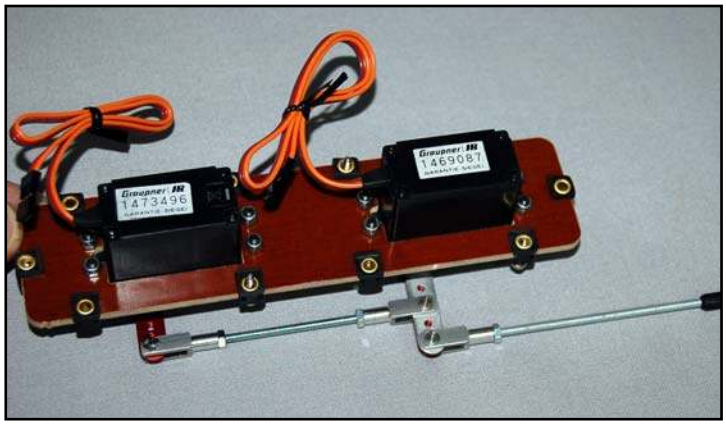
Secure the servos to the phenolic plates (without using the rubber grommets and brass ferrules) as shown, using the supplied M3 x 12mm allen bolts, washers and M3 lock-nuts.
Align the servo cases exactly parallel to each other using a steel ruler on the servo case sides.



(below) Back view of the inner ganged servos, showing the lock-nuts that secure the servos , and the grommets and brass ferrules fitted around the perimeter of the mounting plate. Note that the 1.5" SWB arm has been sanded a little for a good fit of the clevise.

The inner servos should be installed with the output shafts towards the *leading* edge of the wing, and the outer servo is installed with the output shaft closest to the *trailing* edge.

The phenolic plates are isolated from the ribs using the grommets and brass ferrules originally supplied for fitting into the servos, as shown here. Fit them into the milled semi-circular cutouts around the edges of the phenolic mounts. You will need a couple of extra grommets and ferrules for this.



Servo Arms

It is ***mandatory*** to use full metal servo arms for the aileron controls, and we always use the SWB double-loc arms (shown here).These arms clamp onto the servo output shaft with no lost movement (play) at all. We used 1.5" arms on the rear two servos, and a single 1" arm on the front inner 'ganged' servo.

Whichever make of metal arms you use, chose the lengths carefully to provide full deflection throws without having to electronically reduce the end-points, to ensure the highest torque and mechanical advantage.

If using the SWB arms you will need to reduce the thickness of the 1.5" arms a little at the end so that the supplied aluminium clevises fit without binding, and this is easily done on a belt sander (see photo on page 16). The 1" SWB arms used for the front (ganged) inner servo are

already the correct thickness for the M3 aluminum clevises provided. Drill out the threaded holes in the SWB arms to 3.0mm diameter for the clevise pins, and apply a little grease to the hole to make sure there can be no binding of the Ø 3mm pin in the servo arm.

Secure your chosen metal servo arms to the servos, centering them all with your R/C so that the arms will be at 90 degrees to the bottom wing surface (not to the servo case). Connect the outer hole on the front inner servo arm (if used) to the 2nd hole from the centre on the rear 1.5" arm as shown, and adjust the linkages between the 2 inner servos carefully to eliminate any buzzing, or fighting between them.

Install the completed outer servo mounts into the wing first, screwing them to the plywood rib using 6 of the Ø 2.9 x 13mm sheetmetal screws provided in the hardware pack, as shown. The rib has small ply doublers factory-installed on the outer face of it. It does make the outer servo fixing easier if you make up a very long x-head screwdriver so that you can access the screws from the wing root. Install the inner mount in the same manner, using 10 screws.

If using dual 'ganged' servos in the inner phenolic mount you will need to lengthen the small servo arm slots that we have already made in the bottom wing skin.

(above) Inner servo linkage shown using a single servo, installed in the rear of the phenolic mount. If using dual 'ganged' servos you will need to extend the servo arm slot forwards for clearance on the front servo arm.
(below) Aileron linkages are assembled using the provided hardware. Outer servo hatch is secured with Ø 2.9 x 10mm screws. Mill the slots in the hatches to suit your metal servo arms.

Check that the servo output arms are aligned with the dual phenolic aileron horns, and correct any misalignment by adding thin plywood shims under the phenolic mounts if necessary.

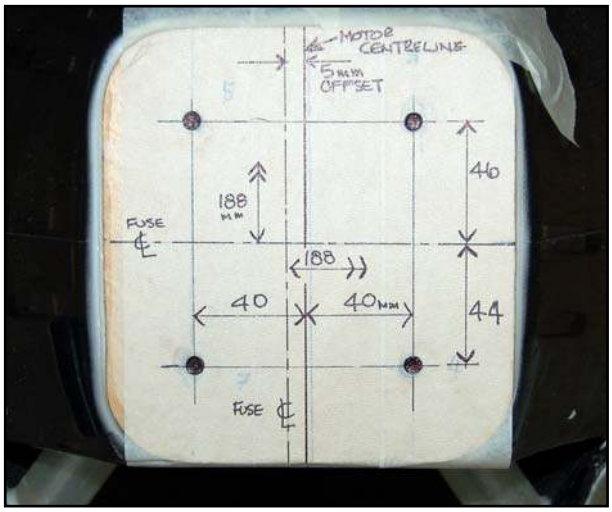
Mill a slot in the servo hatch covers for the outer servos, to suit your servo arm, and secure in position using the Ø 2.9 x 10mm screws provided. The small slots in the wing underside for the inner servos will need to be made larger - to suit the exact location of your servo arm.

Make up the linkages as shown, using the M3 x 90mm threaded rod supplied, with the aluminum clevise and a plain nut at the servo end, and the M3 ball-link at the aileron end. Ensure that the threaded rod is screwed fully into the shank of the plastic ball-link. The ball-link is secured between the dual phenolic aileron horns using the M3 x 20mm allen bolts and lock-nuts provided in the hardware pack. Add a drop of Loctite for extra safety.

Engine Installation

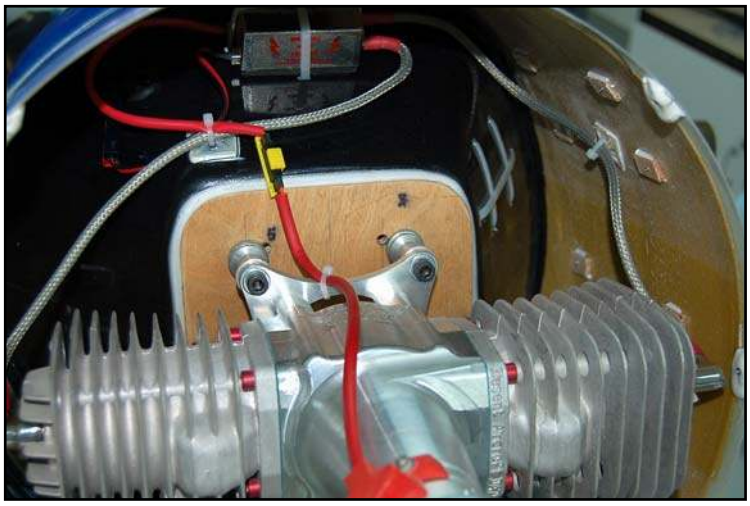
We strongly advise you to complete the motor and exhaust installation before the fuel tank base and the vertical former at the back of the landing gear mount plate are installed, as it provides much easier access.

Here we show a DA-150 motor installed, with a pair of MTW TD110 canisters, and this is an excellent combination. Another suitable motor would be the 3W 157cc X1 B2 twin, which is powerful and very compact - and easily fits inside the 376mm diameter (14.8") cowling.



(above) Centrelines and offsets marked on the firewall to suit DA-150 mounting.
(below) The DA-150 is fitted on 25mm long stand-offs, and the final side & down thrust set using washers between them and the firewall. You can also seen the ignition unit, secured by cable ties onto the top of the motor dome.

The front surface of the motor-dome and firewall already has approx. 1.5 degrees of sidethrust built into it, and the downthrust is nominally set at 0 degrees. However, due to manufacturing and assembly tolerances these may vary slightly, and you can check the precise angles of the firewall in your plane with an incidence meter.



(below) Another DA-150 view showing the headers and the location of the hole thru' the firewall for the Tygon fuel tube.

Accurately mark the exact vertical and horizontal centrelines on the plywood firewall. Cover it with masking tape and measure from the inside surface of the circular fuselage, vertically and horizontally. You should find that the centre will be 188mm from the inner surfaces.

The Composite-ARF Yak only needs 1 - 1.5 degrees right thrust, so the motor only needs to be offset to the (pilots) left by 5mm to have the correct thrustline and the spinner centrally positioned. Mark another vertical line 5mm to the (pilots) left of the fuselage centerline as shown.

The downthrust required is also very small at approx. 0.5 degrees, so you should offset the centre of the motor about 1 - 2mm above the horizontal centreline. Both the DA-150 and 3W 157 Xi require standoffs of 25mm (1"), and the remaining small adjustments for final thrustline settings are made by adding the included large diameter washers between the firewall and the standoffs.

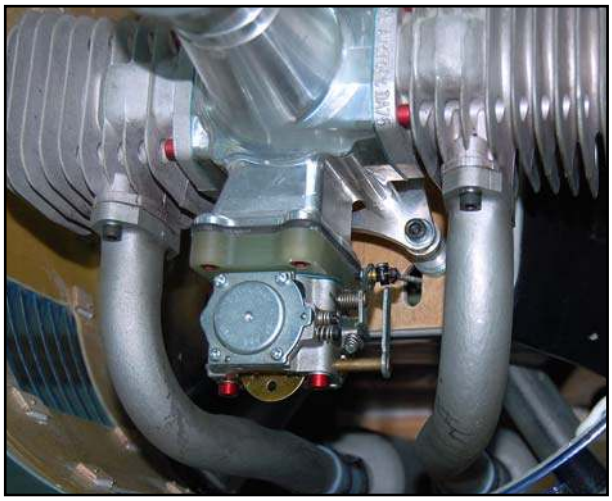
The mounting plate for the DA-150 has horizon-

tal hole centres of 80mm and vertical centres of 90mm, so mark these offsets either side of the motor centreline as shown. Drill the 4 fixing holes Ø 6mm, and secure the motor to the firewall using the M6 x 55mm bolts, and the T-nuts against the inside face of the firewall. Add washers as needed behind the standoffs to set the correct thrustline, and then fit your spinner backplate to check that it will be centrally positioned in front of the cowling.

Don't forget to add a drop of Loctite to all the engine mounting bolts during final assembly.

Fuel-proofing

We *highly* recommend that you fuel-proof the plywood firewall, and all bare wood inside the motordome/tank base area with a thin coat of laminating resin, to protect your investment in the case of a fuel leak. It's wise to do this now, before the motor is finally installed.



(above) Throttle linkage goes directly backwards through a slot in the firewall, to the servo which is mounted on the milled plywood assembly included in the kit.
(below) 2 views of the compact 3W 157cc Xi installed. The venturi for the carburettor clears the fuselage by about 6mm (1/4")

Canister and Header Installation

Included in the wood pack is a milled plywood bulkhead designed to suit the excellent MTW TD110 mufflers (or similar Ø70 cans), and this must be glued into the muffler compartment approx. 440mm (17.5") back from the front of the fuselage. No other support is needed.

Cut eight 20mm lengths of the hard silicone tube provided, and insert into the milled slots in the corners to make the isolation mounts (see photos on next page).

Sand the outside edges of the plywood support a little to fit (if necessary) so that it does not deform the fuselage of muffler compartment, sand the gluing areas very well, clean off the dust and tack-glue in glue in position with a few drops of thick CA. Now trial fit your headers and the 70mm canisters to your motor and carefully push them into the muffler support to check that the position is correct.

Check that there is at least 8mm (3/8") between the canisters and the fuselage/muffler compartment/landing gear support tubes in all positions so that there can be no heat damage, and if necessary bend the headers a little to set the cans exactly in the required position.

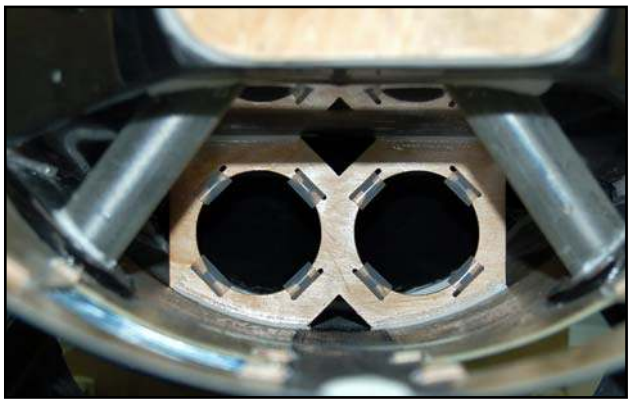
Exhaust Cooling

Remove the canisters and turn the fuselage over so that you can cut out the air exit holes underneath. These should be minimum 150mm long and 45 wide, with radiused corners to prevent the composite sandwich tearing. Leave at 50mm space in between the 2 holes, where the carbon joining tape is, for strength. If you fly in very warm ambient temperatures, extend the length of the slots to 170mm (forwards to wards the pipe support bulkhead) to ensure sufficient air exit flow.

(above) MTW headers & canisters are available as optional items from C-ARF. Shown here are the TD110 cans and headers for the DA-150.
(below) Support bulkhead securely glued into position in the muffler compartment with epoxy and micro-balloon mixture.

Now you can glue the pipe support bulkhead into the fuselage properly, using a slow epoxy and micro-balloons mixture, reaching thru' the air exit holes to glue the rear face.

You will need to make 2 slots of about 25mm wide and 40mm long for the muffler exits, between the landing gear legs as shown.



For security, during final muffler installation, install 2 of the small sheetmetal screws though each the teflon joiners into the canister entries and header ends to make sure that the cans cannot slide forwards or backwards during flight.

Tuned Pipes.

There is more than enough space to fit a pair of tuned pipes in the muffler compartment, but it is too short for full-length pipes. If you wish to fit pipes then you will need to extend the back of the compartment by about 150mm (6"), and reposition the Rudder servo tray on top of it. However, we have included a pair of milled plywood tuned pipe supports in the wood pack, to suit Ø 50mm pipes, such as the Greve units.

(above) Make two small 40 x 25mm wide slots for the muffler exits.
(below) 2 small screws thru' the Teflon joiners prevent the cans moving in flight.

In the near future we hope to manufacture a molded muffler compartment extension for customers who want to fit full-length tuned pipes.

Motor Cooling

It is imperative that your chosen motor not only receives sufficient air to cool it through the opening in the front of the cowl, but that the air is forced to go through the cooling fins of the cylinders - otherwise the air will just take the easiest route and exit the bottom of the cowl without doing any cooling. In this case

you will overheat, and damage, your valuable motor.

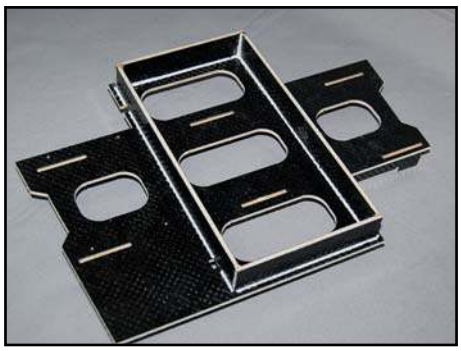
Depending on your motor you will definitely need to make some sort of baffle to force the air through the cooling fins, and this can be made from scrap 1.5mm plywood or 3mm balsa. Cut a half-circle of 330mm diameter and glue it into the cowling, as shown, and then a horizontal shelf of the same material which is glued to the back of it and trimmed to clear the cylinder fins by 6mm (1/4"). It looks neater if you paint it matt black first, using heat-proof spray paint (as used for car manifolds/exhausts).

(below) Simple 1.5mm plywood baffle to improve motor cooling.

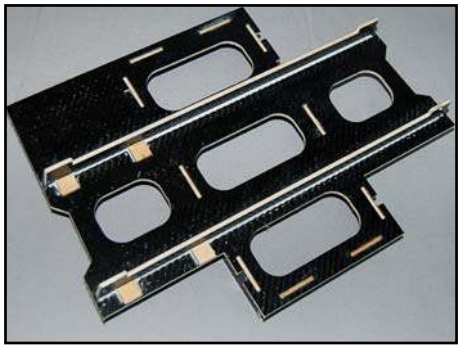
Fuel Tank Base

The Fuel tank base supplied is a cnc milled balsa/composite assembly, that also provides space for mounting the receiver and Powerbus system. It is reversible - so you can assemble it either way around, and fit the Rx and Powerbus on either side of the fuselage.

It is sized to fit a Dubro 1500 cc (50oz) tank (part #692), but can be adjusted to suit your choice. 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. Secure the fuel tank to the tank base with cable-ties through the milled slots, as shown in the R/C installation section.



(above & below) Top and bottom views of assembled fuel tank base.



Lightly sand all the parts, assemble with thin CA as shown, and then reinforce all joints with a fillet of 30 minute epoxy and micro-balloons. Don't forget to seal the bare edges of the balsa sheet with a brushed-on coat of thin epoxy.

Prepare the areas well for good glue adhesion, and then permanently glue the completed tank base in place on top of the fibreglass sleeve for the wing tube, and to the top of the composite side-rails at the edges of the cockpit opening using a slow epoxy and micro-balloon mixture.

The fuel tank is secured to the base using 3 cable-ties as shown. The small plywood doublers glued underneath the tank base are for the screws that secure the Powerbox.

(above) Fuel tank base with 1500cc Dubro #692 fuel tank, Power box and Receiver.

Landing Gear support bulkhead

After you have completed the fuel tank base, and glued it into position you must glue in the plywood upper landing gear support bulkhead - which transfers some of the landing loads throughout the fuselage.

This milled part is supplied in the wood pack, and it is not installed in the factory to give you better access when installing the motor and R/C gear, batteries etc.

Sand the inside of the fuselage and the top of the LG platform carefully and glue this bulkhead in vertically with slow epoxy and microballoons mixture. Do ***not*** forget to glue this bulkhead in before flying your Yak !

(above) Glue the landing gear upper support bulkhead in position with epoxy & micro-balloons after finally fixing the tank base into position.

R/C & Equipment Installation

Everyone has their own favourite methods, equipment and layouts when fitting the R/C and gear, and the installation shown here is just a guide.

We highly recommend a high-quality servo powerbus system and dual Rx batteries for the ultimate in safety and security, for example the Powerbox 40/24 shown. 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 PowerBox power control unit is designed especially for large models and provides dual battery inputs with hi-amp connectors, multiple outputs for 7channels/24 outputs (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 full 'PowerBox' range is available from C-ARF as an option. Please visit our website for more details.

(above) A general view of the R/C installation, showing fuel tank base, Rx, Powerbox, and dual RX batteries. Ignition battery is located inside the motordome.

Ignition Batteries

We always use 2400 (sub-C sized cells) for

the ignition system. The 4-cell pack for the DA-150 is secured inside the fuselage against the front left side of the motor dome with cable-ties on a foam isolation pad.

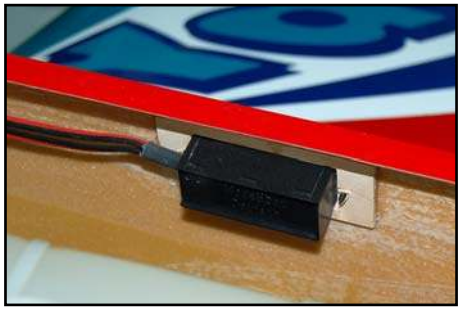
Receiver Batteries
The prototype Yak is fitted with two 5 cell NiMH Rx packs of 2400mAH each, and a 4 cell 2400mAH ignition pack, and the ready-to-fly weight is just under 18.5 kg (40.5Lbs). If you chose to use LiPo or Duralite packs the flying weight would reduce to about 18 kg.

There is absolutely no problem setting the correct CG on the Yak 3m, and you will see from the photos that we fitted 1 Rx pack on the tank base, and the other to the back face of the muffler compartment - both on foam pads and secured with cable-ties. These positions set the 'pattern' CG without any other weight adjustment.

Make sure that all batteries, and other heavy items, are very securely fixed in the plane - remember how much they will effectively weigh when subjected to 4 or 5 G's!

Receiver
C-ARF strongly advise that you position the receiver as far away from the high-voltage ignition unit as possible - at least 200mm (8") for the minimum interference risk. We positioned the Powerbox Competition and the RX on the balsa-composite plate on the left side of the tank base.

Please mount the sensitive Receiver on a rubber or foam sheet, at least 3mm thick, to isolate it from vibrations. You can easily secure the Rx either using 2 small cable-ties, or by gluing a plywood stick across 2 large holes in the mounting plate - using 2 rubber bands around the Rx case. (see photo above)



(above) PowerBox Switch mounted in fuselage side, with ply reinforcement. Antenna wire and stab extension cables are routed thru' silicone protection sleeves and fixed securely.
(below) Protect all wires and tubes where they pass thru' bulkheads, or near sharp composite parts, with a short length of silicone tube, and cable-tie firmly in position.

RX Antenna
The Rx antenna was routed to the side of the fuselage, then backwards along the fuselage side and out of the top of the fuselage immediately behind the canopy - inserted into a removable plastic tube. Keep it as far away as possible from the cables for the elevator servos and the closed-loop rudder wires.

Switches
Often regarded as the 'weakest-link' in an R/C system, it is very important to use quality switches for both Receiver/Powerbox and motor ignition, and we only use high quality switches from Power box. The electronic 'Sensor' switch included with the Powerbox Competition is a 'Fail-ON' type, for additional safety. We use an analog 20 Amp power-switch, also from Powerbox, for the ignition system.

If fitting the switches into the outside surface of the fuselage, as shown, you should reinforce the area inside with a small patch of 3mm thick plywood to reduce vibrations transmitted to the switches. It only adds a few grams. The Powerbox switches come with paper templates, making it easy to cut the slots in the fuselage accurately.

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. If you are using a 'Powerbox' this unit is already fitted with all the ceramic chokes. Also no 'Y' leads are needed, as the powerbox provides multiple 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 photo right). 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.

Make sure that any plug/socket servo cable connections that cannot be easily seen and regularly checked, for example the servo connections in the wings, are secured together with tape - or a short length of heatshrink tubing as shown here. Also tape down any loose cables that could get trapped or caught in linkages.

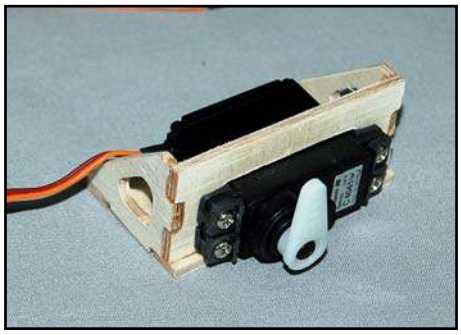
Throttle servo
You can install the throttle servo anywhere you chose, using the milled plywood mount that we supply (photo right). We mounted it inverted, on the underside of the landing gear support plate, immediately in front of the left carbon leg, and this gives a short and straight direct linkage to the DA-150 carb.

We advise you *not* to mount it directly on the back of the firewall, due to higher vibration levels which can quickly 'kill' the servo. 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.

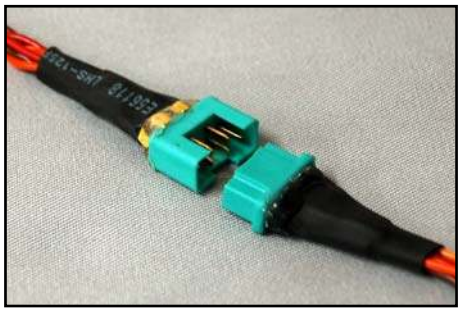
M3 all-thread, steel clevises and locknuts are included in the hardware pack to make up your throttle pushrod.

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

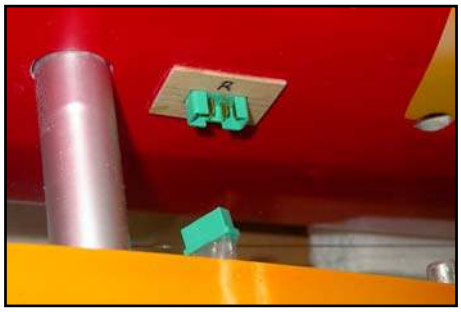
Motor Ignition System
The ignition unit is normally fixed to the motordome, as



(above) Milled plywood throttle servo mount can be installed anywhere you chose. Linkage is included in the hardware pack. Assemble with thin CA and then reinforce the joints with 30 minute epoxy.
(below) Secure the connection between the motor pick-up and the ignition plug with heatshrink tube of a very small cable-tie.



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



close to the engine as possible - because of the length of the HT leads that connect to the spark plug(s). Mount it on a foam pad and secure with cable-ties, to the top surface of the motor dome immediately behind the engine as shown on page 22. Don't forget that the ignition unit also gets warm during use, so it is wise to put it in a location where there is some cooling airflow. Keep the ignition unit as far away from the receiver as possible.

Use a very small cable tie, 'safety clip', or a length of heat-shrink tubing to securely connect the plug and socket from the motor pick-up to the ignition unit.

Fuel Tank

The fuel tank is held to the tank base with 2 large and 1 small able-ties. Drill a hole in the motor firewall as 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.

(below) Fit barbs to all brass tubes and fuel connections for safety. Easily made from a paper-clip, soldered onto the brass tubes.

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 aerobatic 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, or short lengths of brass tube) 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).

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 maneouvers. Check engine, cowling, wing and stab mounts carefully again.

- Are all extension leads, cables & 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 clevises?
- Did you tighten the M3 locknuts against all the clevises 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.

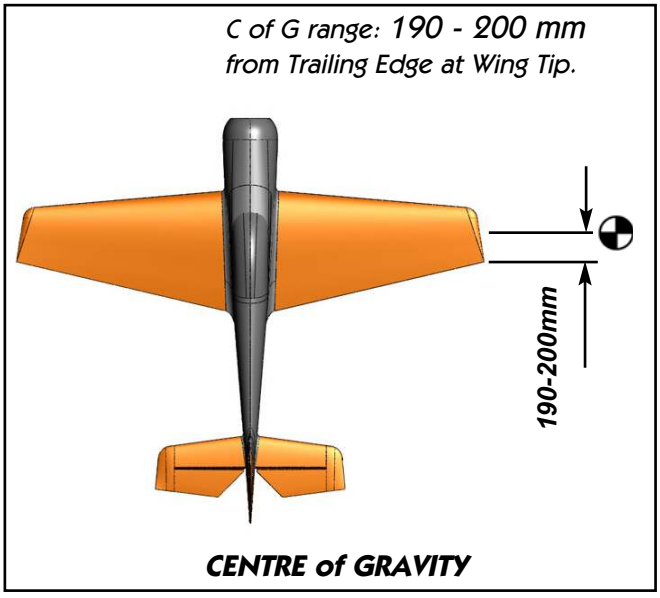
Then you can go on set up all the linkages, control throws and R/C system as described below.

Setting Up Your Aircraft

Centre of Gravity:

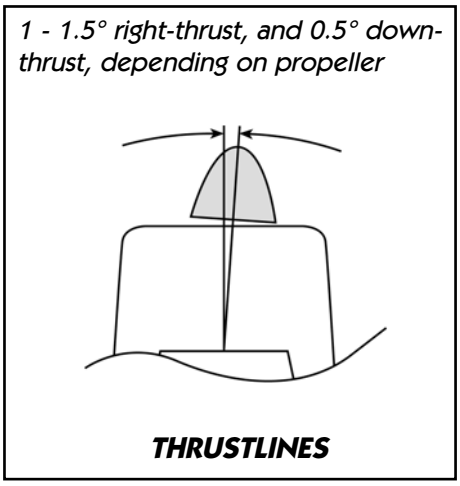
Set the Centre of Gravity to 190 - 200mm (7.5 - 7.9"") forwards from the TRAILING edge at the wingtip for the 1st flights. Hold it with a helper at both wing tips in this position and make sure the plane balances horizontally. This is the 'pattern' CG position.

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



Engine Thrustline:

Initially downthrust should initially be set at 0.5° degrees and right thrust 1.5 degrees, depending on the prop used. We recommend a carbon 2-blade 30 x12 or a 32 x 10 on a 150cc motor. 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.

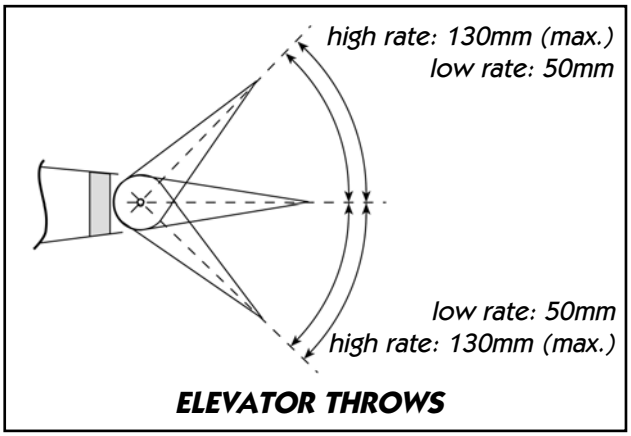


Control Throws:

All measurements are at the root/trailing edge position. All controls should be set with a dual rate switch.

Elevator

On high rate the elevator should really be at maximum, up to 50 degrees both sides (approx. 130mm), but in this case with 50% exponential. Low rate should be no more than 50mm (2") both sides. This is the perfect throw for nice and crisp snaps. If you like you can add about 20% exponential to the low rate setting as well.

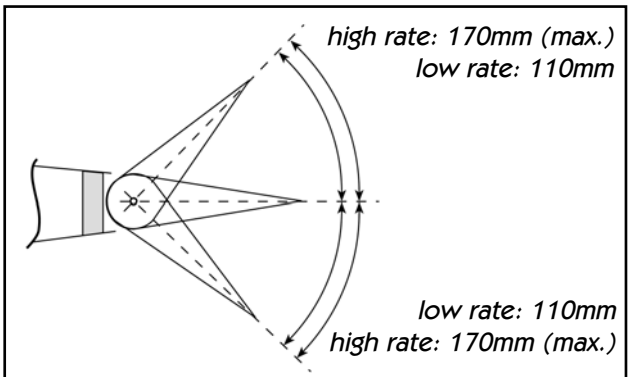


ELEVATOR THROWS

Rudder

Set the high rate to maximum throw (about 170mm) both sides, and at low rate reduced to about 110mm. These throws are measured at the widest chord of the rudder.

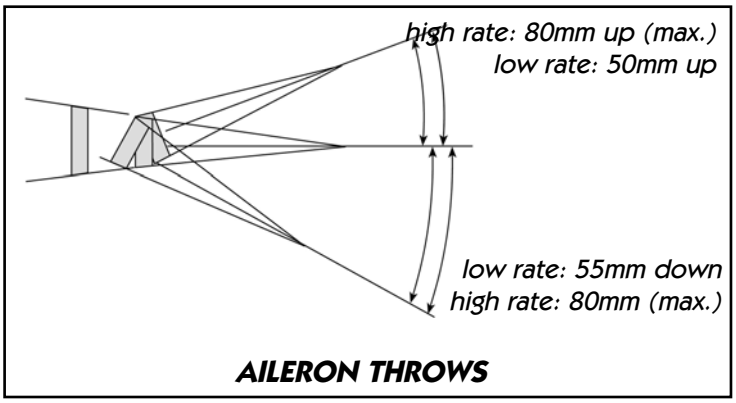
Check your linkages and closed-loop cables again and make sure that there is NO slop at all in the rudder set-up!



RUDDER THROWS

Ailerons

Aileron throw for high rate is 75 - 80mm up and down (measured at root). Use at least 30% exponential at high rate. For low rate you should decrease the throw to the TOP to 50mm, to the BOTTOM to 55mm. 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 maneouvers, this doesn't effect the rolling too much, so you can maximize the throws to whatever is mechanically possible, even more up than down if you wish.



AILERON THROWS

General

Your Yak 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, and if a servo gear or output disc/arm strips the flutter will not stop until the plane 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 shorter servo arms, *not* by using electronic settings). Using 2 servos per aileron as described in this manual will never overload or damage high quality servos, even if the maximum travel of each servo is slight-

ly off. The aileron control surfaces have enough torsion flexibility so that damage to the servos should not occur.

Flying the Yak 55SP

The Yak has proven to be a very neutral flying airplane. It also maintains a very constant speed in ‘up’ and ‘down’ lines. These two characteristics alone make it a perfect pattern plane, well suited for IMAC up to unlimited class.

It makes a pilot look good. It covers up mistakes. It makes complicated maneouvers easier because it flies slowly. Still it's like on rails, even in windy conditions. It does not even know what a knife edge mix means ... it does not need any mixing at all. It’s just "straight"!

Snaps are crisp, and stop immediately. Rolling maneouvers are perfectly on the line, due to the mid-wing design. Up and down lines are slow and constant, giving you time to concentrate on the next move.

Not only for IMAC and high class Pattern, but also for 3D the Yak has its qualities. Large control surfaces and low wing loading make it float slowly, yet tumble like crazy at the same time. The wide wing chord allows a very wide CG range, which means that it can be flown very tail heavy, doing even more exciting manouvers than other planes.

Now, since the engine manufacturers have been much slower than their promises in developing a large giant scale aerobatic engine, we have decided to scale our ultimate Yak 55SP 3.3m down to a span of 3m, making a bold statement in the popular 40% class of aerobatic planes, perfectly suited for the reliable and economical 150cc engines on the market today.

We know that many have waited for this move, and we've tried hard to make sure that nobody will be disappointed. The 3m Yak, just like its bigger and smaller brothers, is one of the best flying planes ever designed. It's a "must have" if you want to be successful in advanced or unlimited IMAC.

We hope that you enjoyed building your Yak 55SP. Please 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

Have Fun!
Your Composite-ARF Team

Appendix:

Yak 55SP 3m Kit (Version 1.0)

Kit Contents

Quantity	*Description*
1	Fuselage
1	Wing, right (with servo hatch taped in place)
1	Wing, left (with servo hatch taped in place)
1	Stab, right
1	Stab, left
1	Elevator, right
1	Elevator, left
1	Rudder
1	Cowling
1	Protection bag set (fuselage, wings, and stabs)
1	Canopy frame
1	Wheel pant, right
1	Wheel pant, left
1	Landing gear, carbon, right
1	Landing gear, carbon, left
1	Wing tube, 6061 T6 alloy, Ø 50mm x 1035mm.
1	Stab tube aluminium Ø 20mm x 435mm.
1	Clear canopy
2	Elevator hinge, aluminum tube, Ø 4mm x 500mm. (packed in elevators)
1	Rudder hinge, brass tube, Ø 4mm x 600mm (packed in rudder)
1	Milled wood/phenolic parts bag
1	Hardware bag
1	Instruction Manual (English)

Hardware List

Fuselage Pack

Quantity	*Description*
4	Allen Bolt M6 x 55mm (engine mounting)
12	Washer, M6 , large (engine mounting)
4	T-nut, M6 (engine mounting)
8	Air vent/Louvre, aluminium (painted to match cowl)
8	Allen Bolt, M3 x 12mm (for cowl fixing)
8	T-nut, M3 (for cowl fixing)
8	Washer, M3 (for cowl fixing)
32	Sheetmetal screws, Ø 2.2 x 10mm (for securing air vents)
2	Allen bolt, M6 x 20 (to secure top of LG legs)
2	Washer M6 (to secure top of LG legs)
1	Threaded rod, M3 x 125mm (throttle linkage)
1	Clevise, steel, M3 (throttle linkage)
1	Nut, M3 (throttle linkage)
4	Sheetmetal screws, Ø 2.9 x 13mm (throttle servo)
4	Plastic Nut, M6 (wing mounting)
2	Silicone tube, 10mm Ø x 150mm long (for mini-pipe bulkheads)
4	Allen bolt, M4 x 16mm (canopy frame fixing)
2	Allen bolt, M6 x 70mm (wheel axles)
2	Nut, M6 (wheel axles)
2	Washer, M6 (wheel axles)
4	Sheetmetal screws, Ø 2.2 x 10mm (wheelpant fixing)

Wing Pack (2 sets)

Quantity	*Description*
2	Allen bolt, M3 x 20 (to secure ball-links to aileron horns)
2	Stop nut M3 (to secure ball-links to aileron horns)
2	Clevise, aluminum M3, with Pins and E-clips (linkages to servo arms)
2	Nut, M3 (linkages)
2	All-thread, M3 x 90mm (linkages)
2	Ball-link, M3 (linkages)
4	Sheetmetal screws, Ø 2.9 x 160mm (to secure servo hatches)
12	Allen bolt, M3 x 12mm (to fix servos to phenolic plates)
12	Washer, M3 (to fix servos to phenolic plates)
12	Stop Nut, M3 (to fix servos to phenolic plates)
16	Sheetmetal screws, Ø 2.9 x13mm (to fix phenolic plates to ribs)
1	All-thread, M3 x 65mm (to connect inner two servos)
2	Clevise, Aluminum, with pins & E-clips (to connect inner two servos)
2	Nut, M3 (linkage between inner two servos)

Stab Pack (2 sets)

Quantity	*Description*
1	Allen bolt, M3 x 16mm (to secure stabs to spar tube)
1	Washer M3 (to secure stabs to spar tube)
4	Sheet metal screw Ø 2.9 x 16 mm (to secure servos)
1	Clevise, aluminum M3 (with pin and E-clip)
1	Ball-Link, M3 (linkage)
1	Nut, M3 (linkage)
1	All Thread M3 x 75mm (linkage)
1	Allen bolt, M3 x 20mm (to secure ball-link to elevator horns)
1	Stop nut M3 (to secure ball-link to elevator horns)

Rudder Pack

Quantity	*Description*
4	Allen bolt M3 x 16 mm (ball-links to servo arms)
4	Stop Nut, M3 (ball-links to servo arms)
4	Ball link M3 (servo linkages)
4	Clevise, steel, M3 (servo linkages)
4	Nut, M3 (servo linkages)
4	All thread M3 x 45 mm (servo linkages)
7	Bolt, M2 x 12mm (to secure rudder phenolic arms to metal discs)
7	Nut, M2 (to secure rudder phenolic arms to metal discs)
12	Sheetmetal screws, Ø 2.9 x 13mm (to secure rudder servos)
2	Allen Bolt M3 x 20mm (ball-links to rudder horns)
2	Stop Nut, M3 (ball-links to rudder horns)
2	Ball-link, M3 (cables to rudder horns)
2	Nut, M3 (to secure threaded ends)
2	Threaded ends for Pull-Pull Cables, M3
2	Pull-Pull Cables 0.9mm Ø, 1.6 metres each
4	Crimp tube 2.6 mm. I.D

'Spare' hardware pack

***** *This bag contains a few extra items that might be useful in the event of maintenance or repair.*

2	Plastic Nut, M6 (wing mounting)
2	Ball-links, M3
2	Phenolic control surface horns
2	All-thread, M3 x 150mm
2	Allen-bolt M3 x 20mm
2	Stop Nut, M3
1	Allen Bolt M6 x 70mm

Available Accessories:

Tail gear setup with 35mm Ø wheel, size 'XL'. (product #801001)
Desert Aircraft DA-150 motor (product #951000)
Canister set for DA-150 (product #910150)
PowerBox 40/24, dual NiCad crossover unit. (product #960200)
PowerSwitch, pair, 20A, for dual NiCads (product #960300)

* Please check our website : www.composite-arf.com, for current availability of options and accessories.

(above) Complete kit contents of the Butterfly scheme (orange/yellow) #732000

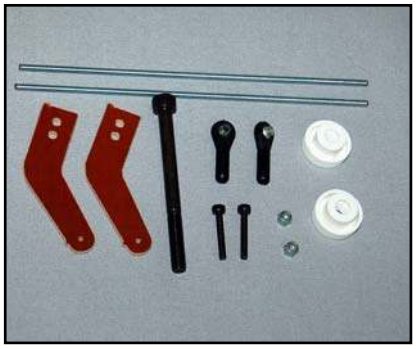
(above) Underside view of the Butterfly Blue/Turquoise scheme.

(above) Contents of Fuselage hardware pack

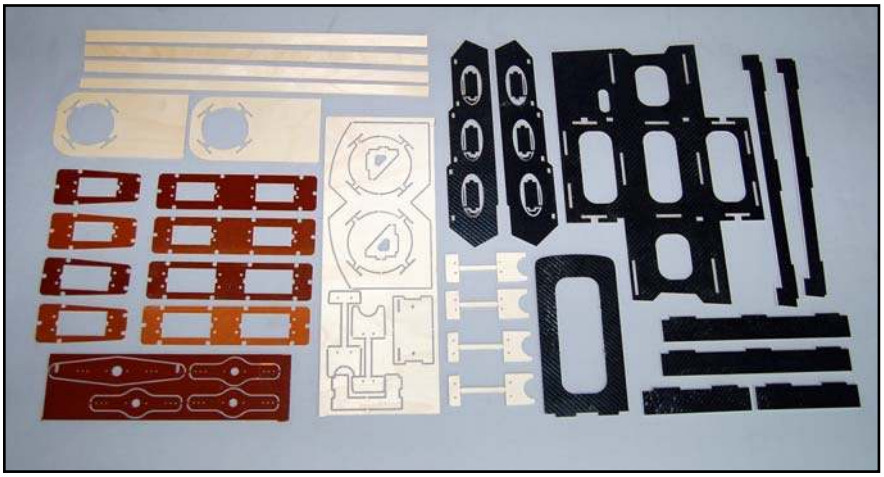
Contents of Wing Hardware pack (2 sets)

Contents of Stab Hardware pack (2 sets)

(above) Contents of Rudder Hardware pack



(above) Contents of Spare Hardware pack



(above) Contents of Milled wood and Phenolic pack