

Assembly Manual

Sukhoi SU 31

2.60M
2.75M

Sukhoi SU 31—2.75m/2.6m



Introduction to the Sukhoi SU-31



For over a decade the SU-31 has earned the reputation of being one of the best and most successful aerobatic aircraft of all times. Besides the naked facts, some just love it because of its looks, some just because of the huge cowl housing a round engine. Our 3m SU-31 represents all these qualities and the new, smaller version is building right on this legacy.

With 2.75m wingspan this aircraft is just that little bit bigger than a typical „100cc“ aerobatic plane, and just that little bit smaller than giant the 3m machines which not everybody can transport and store so easily. The 2.75m wingspan has proven to be the golden compromise for many.

However, CARF-Models can offer this airplane also with a typical 2.6m wing, which makes it even more a pattern machine, perfectly suited for F3A-X. Almost „square“ dimensions will give any pilot the competitive edge over most of the pack. And if 3D flying is preferred, the 2.75m wing with its thick trailing edges is putting the model into action in any airshow or freestyle contest.

As usual, with our SU-31 2.75m you get an extremely well prefabricated airplane. It is super-strong, yet light weight and well-engineered for the flying stresses in competition. Made for 100-120 cc engines, it will also house the 3W 114 four cylinder engine, which many favour in this class.



Wings:

The 2.75 m wing has not only extended wing tips, it also has a slightly thicker airfoil, resulting in a thick trailing edge of 5-10 mm from tip to root. It is designed for 2 aileron servos, where the outer servo has been moved inwards. A single servo setup doesn't seem to be working safely anymore, since the torque of the extremely powerful servos needs to be brought into the aileron somehow, and the light weight structure of a control surface can only take so much load on one specific point. So the two servos are highly recommended, even though they do not need to be symmetrically distributed over the wing span.

A 40 mm aluminium tube as a standard wing joiner has proven to be sufficient for this size of airplane and can be upgraded by the many aftermarket carbon tubes available today. Why did we make the two wings? Mainly to allow this plane to become a leading figure in the German F3A-X contest rounds, where the wing span is limited.

Liability Exclusions

You have acquired a kit, which can be assembled into a fully working R/C model when fitted out with suitable accessories, as described in the instruction manual with the kit. However, as manufacturers, we at Composite-ARF are not in a position to influence the way you build and operate your model, and we have no control over the methods you use to install, operate and maintain the radio control system components. For this reason we are obliged to deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect application and operation of our products, or which are connected with such operation in any way. Unless otherwise prescribed by binding law, the obligation of the Composite-ARF company to pay compensation is excluded, regardless of the legal argument employed. This applies to personal injury, death, damage to buildings, loss of turnover and business, interruption of business or other direct and indirect consequent damages. In all circumstances our total liability is limited to the amount which you actually paid for this model.

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

It is important to understand that Composite-ARF Co., Ltd, is unable to monitor whether you follow the instructions contained in this instruction manual regarding the construction, operation and maintenance of the aircraft, nor whether you install and use the radio control system correctly. For this reason we at Composite-ARF are unable to guarantee or provide a contractual agreement with any individual or company that the model you have made will function correctly and safely. You, as operator of the model, must rely upon your own expertise and judgement in acquiring and operating this model.

Things that are handy to know

Personal safety:

There are a couple of things that are good to keep in mind when you are assembling your Sukhoi SU-31. Some of them are common sense, but it doesn't hurt to be reminded. While you are working with tools and sharp implements, be aware of others around you and the environment you are working in. Always wear eye protection, and when working with solvents and glues, keep your area ventilated. When cutting or sanding materials, always wear a face mask to avoid inhaling particles. Keep your work environment clean and tidy at all times. A clean workshop will enhance the experience. Protect all parts from scratches and dents. Use rubber matting on your bench, and be careful of components like screws getting between the part you are working on and the bench.

Assembly process:

This assembly manual is set out in an order that simplifies the process. Each step is in an order that leads into the next. You may wish to change and do some things in a different order, which is fine provided you keep in mind that some things need to be done before some others. When planning out the installation of your components, always keep the centre of gravity location in mind. If you plan ahead you can avoid having to add weight to your model. It is far easier to remedy a nose heavy model than a tail heavy model. A few grams of lead at the rear is preferable to hundreds of grams in the nose! You will find that it is easiest to fit items that cannot be relocated, like aileron and elevator servos, before you do a preliminary C of G check. Rudder servo(s), RX and ignition batteries etc can generally be relocated to suit your requirements.

Most of all, enjoy the process of creating your new Composite Arf Sukhoi SU-31, a job well done is always satisfying!

Servo arms:

Your new Extra 330SC has provision for 2 servo's per aileron, we recommend the use of two high quality high torque servo's. We used JR NX8921 (30+kgs) on all surfaces. We also used 1.5" Alloy servo arms on the ailerons and elevators. For the rudder there is a Phenolic arm supplied, this arm needs to be attached to an alloy servo disc, DO NOT USE THE STANDARD NYLON SERVO DISCS! The nylon servo arm/disc supplied with your servos are unsuitable, and should not be used, they may strip under heavy loads resulting in surface flutter. If you wish to use an alloy servo arm on the rudder, a 4" to 4.5" offset arm is suitable.

Please consider the use of a good quality throttle servo, precision is required to maintain good throttle trim and consistent idle control. A poor quality servo will result in an inconsistent idle, and poor throttle transition. A 1" throttle servo arm is all that is required, try and keep the servo end points as close to 100% as possible. Setting up a good mechanical linkage is critical for obtaining a good throttle transition and consistent idle.



Engine Choices:

There is a multitude of engines available for you to use in your Sukhoi SU-31. The airframe is suited to today's current crop of 120cc engines. We used a DA120 in the process of producing this manual, the performance is excellent with an abundance of power, as well as being very light.



Build Requirements

Additional Components:

- Engine
120cc twin cylinder. (DA120 used in this manual)
- Exhaust
We strongly suggest the use of canister mufflers, obviously a lot is dependent on your engine selection, the following types will fit easily to the SU-31
MTW TD75
KS86
Both MTW and KS make adjustable headers to suit their canisters.
- Fuel
40oz (1200cc) DuBro fuel tank #690
Tygon fuel line
Fuel dot or filler
Fuel filter
- Wheels
4.5" – 5". DuBro, Kavan, White Rose, or similar
Tailwheel assembly, Medium Size Carbon Leaf, J&J or White Rose (or similar)
- Servo's
High quality high torque for all flying surfaces (8 required), we recommend;
JR NX8921 or DS6311HV
Futaba S9075SB or BLS172SV
Throttle – any good quality servo, but make it a good one. A good constant idle requires a precise servo, such as a JR DS8231, or a Futaba S3071HV
- Alloy Servo Arms
SWB, Secraft, Hanger 9 or similar. 1.5" for Elevators and aileron. (Phenolic rudder arm supplied)
- Spinner
4.5" P51style TruTurn, or 4.5" Mejzlik Carbon
- Receiver and Ignition Batteries
Owner's choice
Battery straps

Adhesives:

- Epoxy
Loctite Hysol 9462, recommended. Or 30min epoxy. (If using 30min epoxy you will need micro balloons and (or) milled glass fibre. Hysol 9462 does not require these items)
- CA Glue
Thick and thin types, as well as plastic applicable CA
- Silicone Adhesive (Silastic, optional for canopy)

We used Hysol 9642 in all areas where epoxy was required during the build for this manual.

For surface cleaning we recommend old fashioned liquid lighter fluid such as "Ronseal". Do not use acetone for cleaning the external painted surfaces, damage to the paint could occur. (If in doubt, test on a small area that will not be seen).

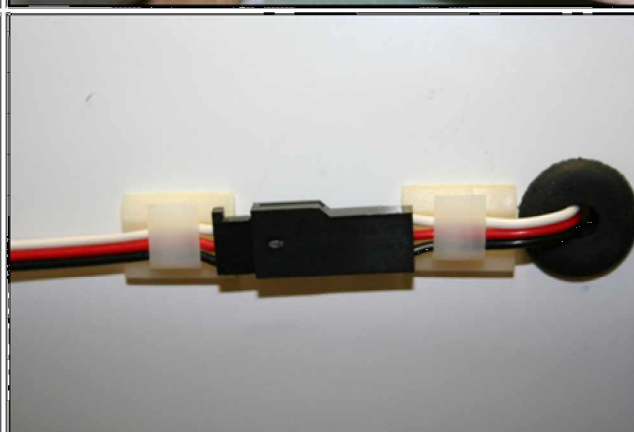
Tools Required

You will not require any specialized tools to build your Sukhoi SU-31. However some items make the job a little easier, such as a tapered reamer (RC car body reamer), a step drill bit and a centre drill bit. These items make drilling holes in the composite materials less problematic, and very simple. Normal drills, can at times, tear at the material, particularly when making larger holes. The centre drill bit ensures an accurate drill path during the drilling process. These items should be easily obtained from your local hobby store, and or hardware store like “Home Depot” etc. If you can't obtain these style items, don't stress, the job can still be done with a little due care.

- Electric or Battery Drill
Pedestal type preferred, hand held
- Drill Bits
Various sizes, metric
- Sharp Knife
X-Acto or similar
- Measuring
Steel rule(s), tape measure, square (ruler), small level
- Dremel Tool
With cutting discs, sanding drums, and various burrs
- Hand Tools
Screw drivers, pliers, ball drivers, hex drivers etc
- Additional Materials
Masking tape, sand paper, marking pen, soft cloth (towels)



Securing fuel line and servo extension leads is made a little easier when you use self adhesive clips and rubber grommets. Most of these items should be readily available from your local hardware store. You may have other methods that you prefer to use to protect your leads and fuel lines, and that is fine, as long as they are secured in position and protected from chaffing where they pass through, or over structural components.



Landing Gear

You find it much easier to work on your SU-31 once it is standing on it's wheels. Assembly of the undercarriage is pretty straight forward, most of the work has been already done for you. The undercarriage legs have been pre drilled and pretty much only require you to fit your wheel of choice.

Parts Required:

Undercarriage Legs

Landing Gear Parts Bag

Wheels 4.5 -5" (not supplied) (We used DuBro 5" TL)

Tailwheel Assembly (not supplied)

Tools Required:

Electric Drill (pedestal type preferred)

Drill Bit – 4.5mm,

6mm Hex driver

10mm spanner

The legs bolt to the fuselage using the 20mm x 6mm bolts provided in the hardware pack, T nuts have been pre fitted to the undercarriage plate. The axle bolt is 50mm x 6mm, you will also find a 6mm nut, and a 6mm Nyloc nut to secure the wheel to the leg. Please note some wheels need to be drilled out to accept the 6mm axle bolt. Use the washers provided to space the wheel correctly on the axle bolt, ensure the wheel is not binding when the axle bolt is tensioned.



Tailwheel Assembly:

You will need a flat carbon leaf tailwheel assembly for your SU-31, there are many available from vendors like J&J Tailwheels, or White Rose Engineering. We chose to use a J&J medium size carbon leaf tailwheel. The mounting plate for the tailwheel is pre fitted, and has 4mm T nuts already installed. All that is required is for you to drill the hole for the mounting bolts in your tailwheel of choice. The bolt spacing is 40mm, but please measure before you drill your tailwheel assembly, some variations may occur during production. Use the 15mm x 4mm cap head bolts and washers provided in the hardware pack to mount the tailwheel assembly.



Engine Installation

Parts Required:

- Cowl Assembly
- Fuselage Parts Bag
- Engine

Tools Required:

- Electric Drill
- Drill Bit – various
- Square
- Steel rule(s)
- Level
- Masking tape
- Marking pen

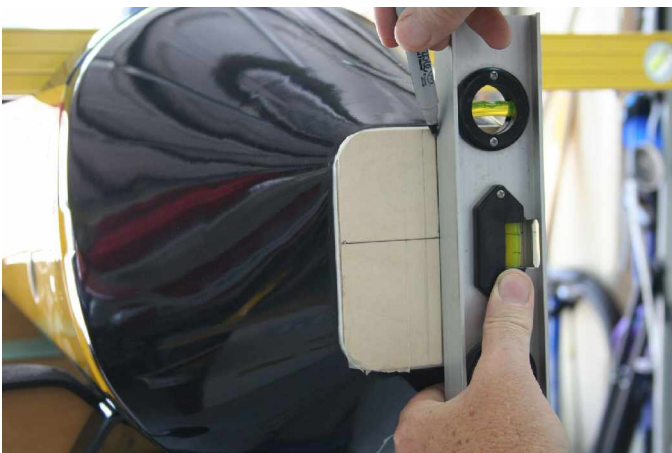


The engine installation requires that the cowl assembly be fitted first. In order to obtain correct engine to cowl alignment, you will need to get some reference marks that can only be obtained when the cowl is complete and fitted. The engine dome has right thrust already built into it, so all you need to do is find the centre of the spinner and transpose the information to the firewall, you will not need to calculate the engine offset. First up you need to attach the cowl assembly, and transpose the spinners centre from the cowl to the fuselage firewall. It's not really that difficult, but you may want another set of hands available to assist you.

It's much easier to just use the bottom portion of the cowl, while this makes the process look a little simpler, the cowl can change it's over all shape when both halves are joined, resulting in an incorrect spinner to cowl alignment. So, if you can manage, try and get the required marks with the cowl full assembled, but if you find it too difficult, just use the bottom half, but double check your marks with the cowl fully assembled.

First up you need to mask off the ply firewall on the fuselage, then fit the cowl securely. Next, we are aiming to image the spinner centre from the cowl onto the firewall. To do this we will need a square and a rule. Place the rule across the front of the cowl (use double sided tape to hold in place). The front of the cowl is 270mm, 135mm is centre. Using your square set flat against the firewall, bring it to 135mm as indicated by the rule, and make a mark. You have now found the horizontal line for the engine.

To find the vertical line place the square horizontally flat against the fire wall, and move into the spinner centre position, mark this position on the firewall. Now that you have a vertical and horizontal mark, you can now use these marks to draw out the position of the engine. Remove the cowl and get ready to mark out the engine placement. Use the seam line of the fuselage as reference, but you can also place a small level on the wing tube socket in the fuselage make sure everything is level.



A DA100/120 has a bolt separation pattern of 70mm across and 80mm from top to bottom. Make your marks as shown in the picture, or to suit your chosen engine.

When you are satisfied with your engine position markings, drill your mounting holes. Drill a 3mm pilot hole first, then use a 7mm drill bit to enlarge the hole to suit the 6mm T-nut. Using a 6mm bolt and a washer pull the T-nuts into position.

Mount your engine using the alloy standoff's supplied in your hardware pack.



Ignition and battery mounting

At this point in the assembly process it pays to think about where you wish to place your ignition, ignition battery, kill switch and receiver batteries. If you are using one of the current crop of light weight engines such as the DA120 (2.25kg), you may need to place as much of the on board weight as far forward as possible to obtain the required C of G. Obviously if you are using an engine in the region of 3kg this is less critical.

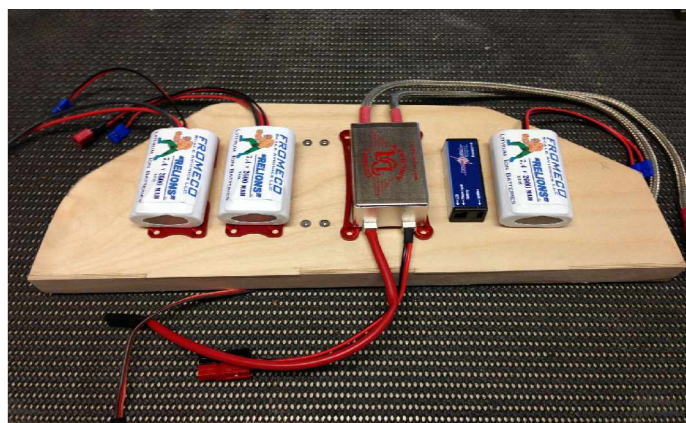
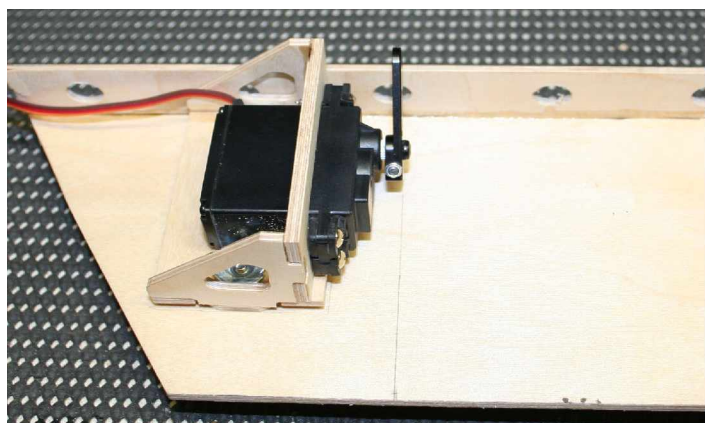
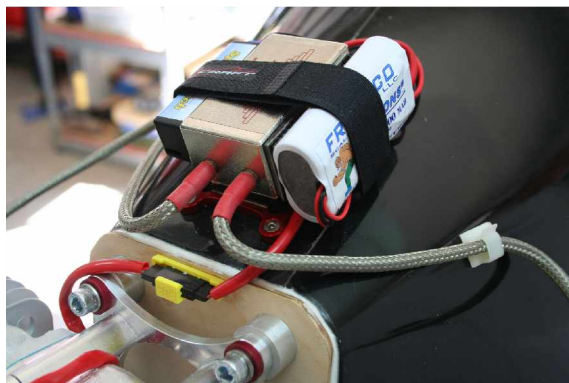
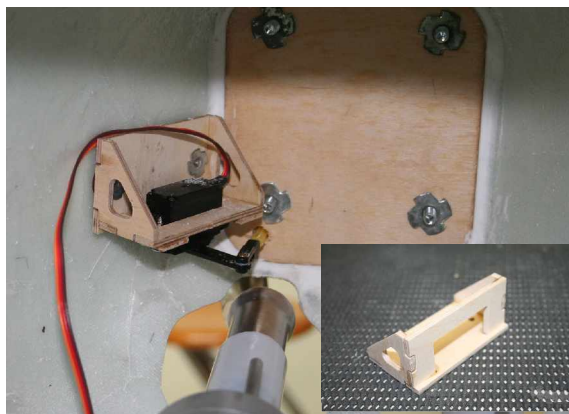
The ignition and ignition battery can always be attached to the engine dome using zip ties, Velcro straps, or some of the after market mounts that are currently available. There is a milled plywood throttle servo mount in the hardware pack, this can be attached to the side of the engine dome. The exact position of the servo mount can vary dependant on your engine selection. All you need is for the throttle servo arm to be at the same level as the carburetor arm. With the DA120, the throttle linkage will be just below the LH lower engine bolt.

If you are passing the ignition high tension leads through the dome, ensure they are protected and not resting against the cut fiberglass. Rubber blanking plugs are ideal for this, simply punch a hole in them and cut one side. Tygon fuel tube can also be used.

Option

One option is to place all of the batteries on a tray mounted behind the firewall. This is a pretty simple process which will require some 3mm ply to make the tray. The ply tray needs to be shaped to fit behind the firewall inside the engine dome. The shape of the dome may vary slightly from model to model, so make a cardboard template first, then, you can make any adjustments necessary before you start cutting ply.

How you place the items on the tray is dependent on the equipment you choose. As you can see from the pictures, we had no trouble fitting everything we needed on the tray. One other advantage of the tray is, you can mount the throttle servo underneath it. When mounting the tray inside the engine dome, keep in mind the throttle servo position. If positioned correctly you will have a nice straight path for your throttle push rod. We have provided a plywood throttle servo mount in the hardware pack for you.



Exhaust Installation

Parts Required:

- Exhaust System. (KS86V, MTW TD75 etc)
- Headers. (KS Comfort Headers, MTW Knuckle headers etc)

Tools Required:

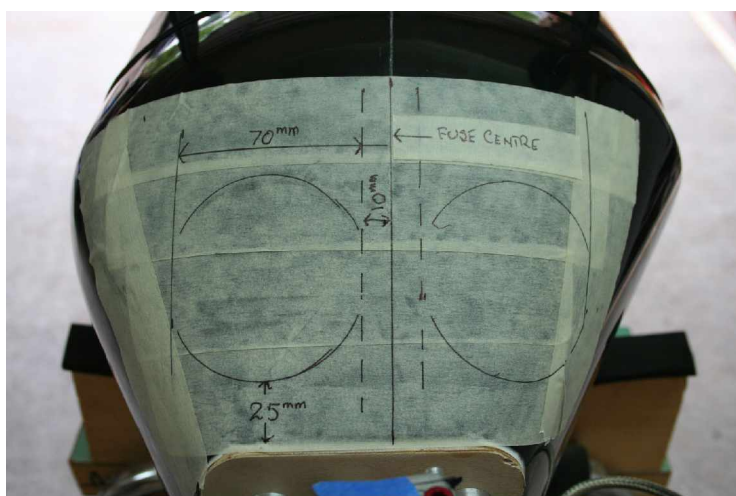
- Electric Drill
- Drill Bit – various
- Dremel tool
- Square (rule)
- Steel rule(s)
- Masking tape
- Marking pen

Mounting a canister exhaust system in the SU-31 is pretty straight forward. Obviously there is a large selection of canisters on the market to purchase. During assembly we used KS3086 rear exit canisters. However there is enough room in the fuselage to accommodate most brands and styles of exhausts. Adjustable headers were also used to fine tune the positioning of our canister. Adjustable headers such as those produced by MTW and KS really make the canister installation process much easier, and will allow you to better position your exhaust system.

Mask off the bottom of the engine dome in preparation for marking out the desired cut out area. Again the area that needs to be cut out will vary dependant on your exhaust selection. It's important with a dual canister installation that you keep the centre seam area intact, try and leave at least 20mm on either side of the seam uncut.

Use the engine dome centre seam line as a reference for marking out the area that requires cutting out. As you can see from the pictures, we removed an area 70mm x 70mm. This gave us plenty of room to pass the canister through, and allows air to flow in and around the canister. Use your Dremel tool with a suitable cutting burr to cut out the area you have marked out. Don't forget to use safety glasses and a face mask!

The canisters we used passed underneath the wing tube. To accommodate this we made a plywood canister mount to suit. This didn't take long, all that was needed is a fret saw and some 2.5mm or 3mm ply. Its easier to make a cardboard template first, to ensure a good fit and less hassles.



Horizontal Stabilisers and Rudder

Parts Required:

- Stabs, elevators and rudder
- Stab parts bag
- Elevator servo (JR NX8921 or similar)
- Alloy Servo Arm (SWB, Secraft, Hanger 9 etc) 1.5"

Tools Required:

- Dremel tool
- X-Acto hobby knife
- Philips head screw driver
- Pliers

The horizontal stabilisers are pretty much completed for you at the factory. The dual elevator control horns are pre fitted, and the stab tube is already set up and ready to go! You will need to trim the 4mm alloy hinge tube to the correct length, and install your choice of servo.

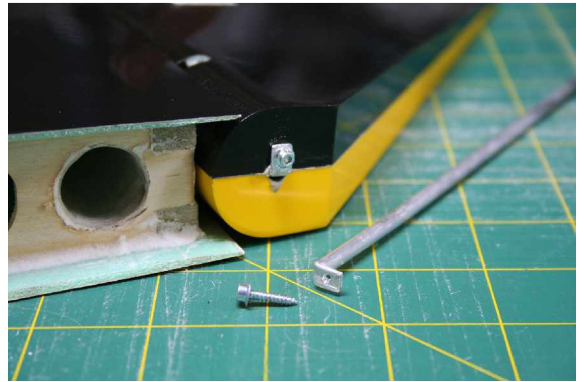
Fitting the hinge tube is quite simple, and shouldn't take too long. The SU-31 elevator differs from some CARF models, the hinge pin can not slide right through, the outside of the elevator does not have an exit hole. The alloy hinge pin is supplied over length and will need to be trimmed to suit the SU-31, this also allows you a bit of latitude, incase you make an error. Using a pair of pliers flatten about 10mm at the end of the alloy hinge pin, then bend this section over 90°. Drill a small hole in the flat section for the retaining screw to pass through. Trial fit the hinge pin and trim to suit, using a small screw locate the hinge pin into the elevator halve as per the picture. Please keep in mind these alloy pins are a consumable item, they will wear and will occasionally need to be replaced, check them as part of your routine maintenance program, replace when necessary.

In the parts bag supplied you will find 2.9mm x 13mm pan head sheet metal screw to mount your servos. It's important that you do not use the mounting screws supplied with your servo. The mounting rib that is pre installed in the stabiliser has the mounting holes pre drilled for you and the standard servo mount screws are unsuitable. Some brands of servos use mounting eyelets that are too small for the 2.9mm screws. You will need to change these if necessary. Use JR standard servo eyelets.

A servo arm exit slot has been pre milled at the factory. This is only a preliminary slot, you may need to enlarge the area required to suit your servo and servo arm. This process is quite straight forward, but make sure you measure twice and cut once! Mount your servo using the 2.9mm sheet metal screws provided. The output shaft of the servo goes toward the stab tube. Pass the servo lead through the pre drilled hole in the rib before dropping the servo in place. You will need to assemble the components that make up the push rod. It may be necessary to trim the 3mm threaded rod and brass tube. The brass tube slides over the threaded rod to add strength. The brass tube should not be loose, a snug fit is required.

Alternatively you may want to use an aftermarket turnbuckle, such as those provided by SWB, Secraft or Hanger 9. A turnbuckle length of 60mm is required. A suitable ball link may also be used in place of the alloy clevis.

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The stab tube is already complete and ready for you to use, no more needs to be done other than fit the tube to the stabs. The retention bolts have been pre fitted for you, and only requires you to fit the stabs to the fuselage. The stab tube may already be marked with L and R, to help you distinguish the correct orientation. If not, don't stress, it can only go one of two ways!

Before you attach the stabs to the fuselage you will need to make the exit for the elevator servo leads. Essentially the elevator servo lead can exit pretty much anywhere between the stab tube and anti rotation dowel. But it does need to be in line with both of these holes. However be aware there is a former just aft of the rotation dowel hole. A good location is 25mm forward of the stab tube.



The servo lead needs to be protected in some way from the harshness of the fibreglass fuselage. The edges of the fibreglass will quickly wear through the protective coating of the unprotected extension lead. Rubber grommets are readily available from most good hardware stores. Select a grommet that is large enough to allow the lead ends to squeeze through. About 15-20mm will do fine. You don't want it too big, so as the lead falls back through.

Making a hole large enough for a grommet to fit is a simple job with a RC car body reamer! Simply push into your marked position and start turning. The reamer will remove the material quite efficiently without tearing. If you choose to use a drill bit, please be very careful, often the drill bit can bite and tear at the fibreglass. Pass your lead through the grommet and insert the grommet into the fuselage. You may want to use a clip to secure the extension lead to the side of the fuselage as shown.



Ailerons

The aileron servos need to be attached to the hatch covers on the bottom of the wing. Plywood mounts are provided for this purpose. Once assembled these mounts will need to be epoxied onto the servo hatch. Assemble the mounts and for now, just CA them.

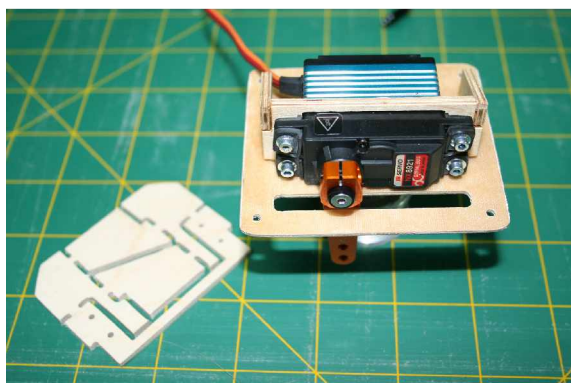
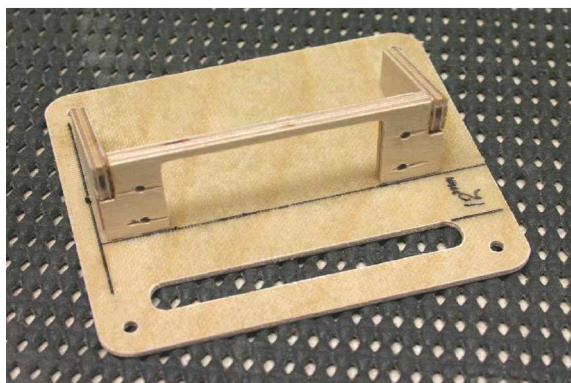
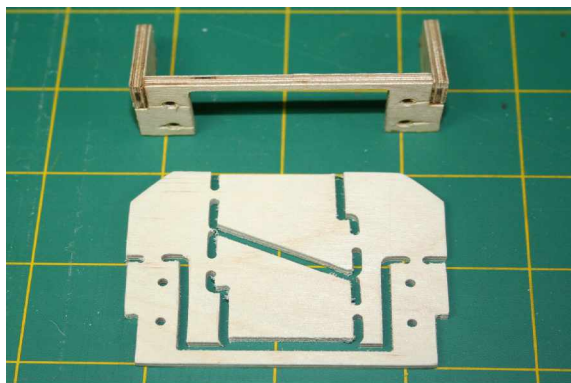
You will need to mark out the placement for the servo mounts on the hatch covers. Be careful that you have the hatch cover in the correct orientation. The servo hatch sits on a plywood retainer built into the wing. This small ledge is about 5mm wide. You will need to mark this area on the servo hatch as shown. The servo mount is mounted slightly off centre in an effort to get the servo output shaft as close to the centre of the servo arm slot as possible. The servo needs to be installed with the output shaft toward the leading edge of the wing. Place the servo mount so as your servo arm fits nicely between the edges of the cut out. When satisfied with its position epoxy in place, making sure you epoxy the inside corners of the servo mount. Don't forget to give the surface of the hatch a light sand before applying the epoxy. Set aside and allow epoxy to set.

Now your servo hatches are complete, and you can now fit them to the wing. Sit the hatch in place and hold them there with some masking tape while you pre drill the holes for the hatch retaining screws. Use a small drill bit (1.5-2mm) to drill the holes for the hatch cover retention screws. Use the 2.9mmx15mm sheet metal screws provided.

A couple of servo extension leads will be required to have the servo leads exit the wing root. As these leads will be permanent, it would be wise to use a safety clip or some heat shrink to prevent the leads from separating. This is good practice for all extension leads that will remain permanently attached.

Assemble the push rods from the components in the parts bag. If necessary trim to length. The servo arm should exit the hatch at 90° to the hatch. Ensure that both the aileron servos are aligned like this. The push rods for both sides should be the same length. If you wish to use after market turnbuckles a 60mm or 2.5" item is required. Alternatively a ball link can be used in place of the alloy clevis.

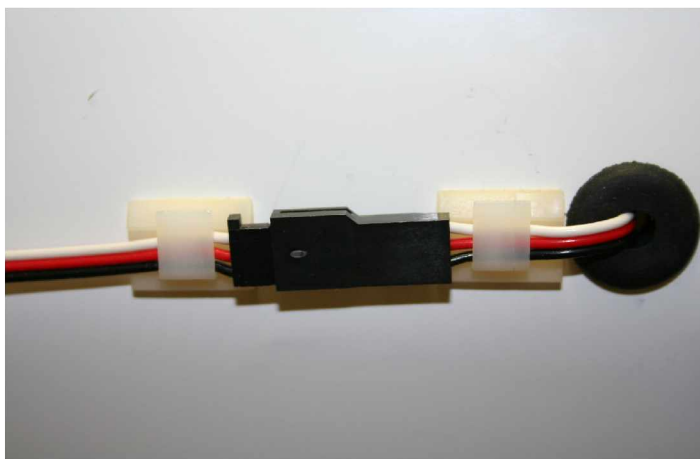
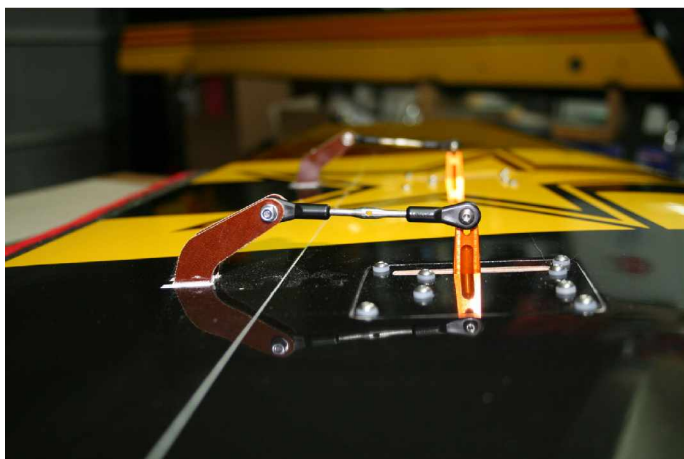
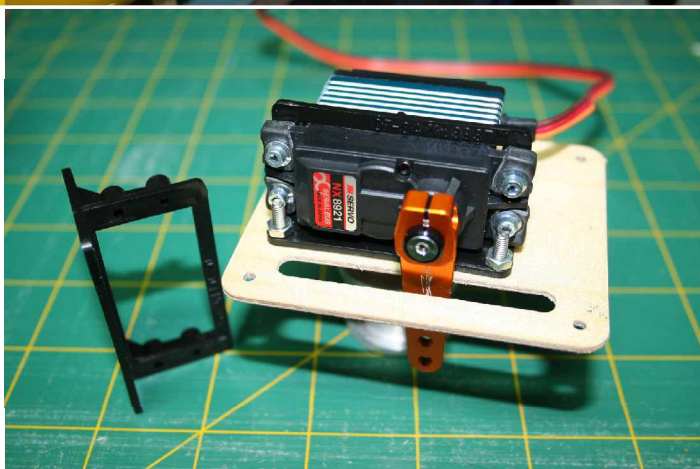
Attach the servo hatch's to the wing using the 15mm screws provided. The aileron control horns are pre fitted at the factory and ready to use. These double horns provide excellent strength and the 3mm ball link provided will fit nicely between the horns. When you have adjusted the push rod to the correct length, fit the push rods between the servo and control horn. Carefully move the aileron through its full travel to ensure there is no binding.



The wing fillets fit perfectly on the wing. Attaching the fillets is pretty easy and only require a little effort. Silicone makes a good medium for attaching the fillets, this allows plenty of time to get the alignment to your liking before the silicone sets. Hold in place with masking tape while everything goes off!



(As an alternative to the plywood servo mount, you could also use a JR single servo side mount (#07-04). These items are pretty cheap and can be attached with some 3mm screws and nylock nuts. Most hobby stores will keep these items. The same measuring process as with the ply mounts applies. Work toward keeping the servo output shaft as close as possible to the centre of the hatch slot.)



Canopy

Parts Required:

- Canopy

Tools Required:

- Masking Tape
- Marking pen
- Scissors
- Canopy Adhesive
- Clear Silicon (Silastic)
- Syringe 30ml

Fitting the canopy is one of the areas that people seem to dislike! Really it's not that difficult, and the SU-31 canopy fits in place beautifully. Fixing the canopy to the canopy frame can be accomplished with a good quality silicone sealant. That's right the same stuff plumbers use!

You may opt to use an epoxy, a plastic CA, or specialized canopy adhesive. But be careful, CA can run, as well as fog the canopy. Be really careful with any kind of CA kicker, discolouration and fogging can occur. Epoxy can also be used, but it can be pretty messy, however it is pretty affective. Canopy adhesive needs a long time to cure, and is particularly runny.

Silicon works particularly well in this area, and provides a clear strong bond. It is also easy to clean up and if you ever need to replace the canopy, removing the old one is pretty straight forward.

The clear canopy needs to be trimmed first. Start by removing the excess material, so you can fit it over the canopy frame for marking. The canopy can be cut with sharp scissors (If you are in a cold climate you may need to warm the canopy before you cut. Test a waste area first). Attach the canopy frame to the fuselage and place the canopy over it. Move the canopy into a settled position and mark the cut lines. Leave about 10mm over lap. Take your time here, and make sure you are happy with the positioning and marking.

After you have trimmed the canopy you will need to prepare the canopy frame before you start the final fit. You need to make sure that you sand off any high spots on the canopy frame where the canopy will sit. Occasionally during the moulding process some excess resin can form high spots. Also there is a fibreglass band that runs along the middle of the canopy frame. The edges of this band need to be smoothed. This can mostly be done by hand with some sandpaper, but if you use a Dremel be careful not to remove too much material. Lightly sand all the area where the canopy will sit, then wipe clean.



It's important that you fit the canopy while the canopy frame is attached to the fuselage, this will keep the frame properly aligned and not twisted. Masking tape is used to hold the canopy in position prior to gluing. It may pay to have another pair of hands available to assist you here. Perhaps you can bribe your best buddy with a beer, or two (after their assistance)!

When you have trimmed the canopy and prepared the canopy frame, attach the frame to the fuselage and secure in position with the mounting bolts. Make up some grip handles from masking tape and attach to the canopy. Use as many as you see fit, but usually 4 will do the job. Carefully place the canopy inside the fuselage through the opening in the canopy frame.

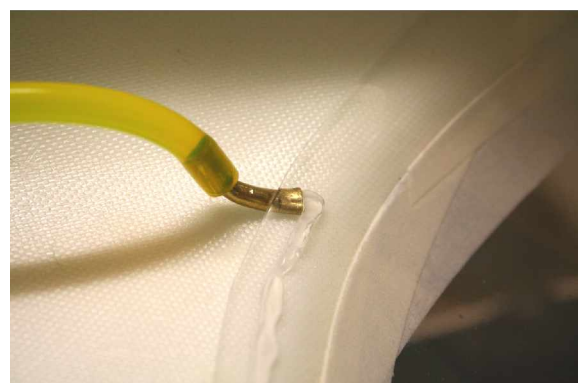
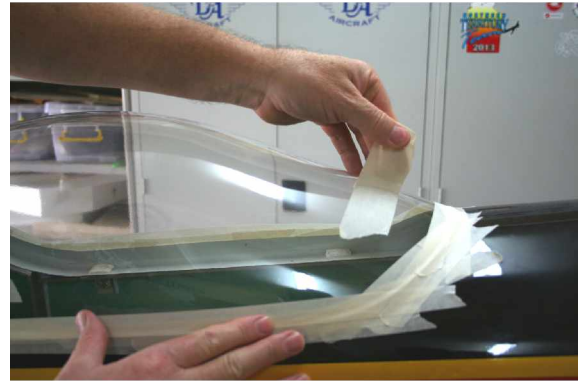
Lift the canopy into position with the masking tape handles you pre-fitted. Once you have the canopy settled in position start to tape it onto the canopy frame. It's easier to start with the top of the canopy first, then the front and sides. Tape all the way around the canopy edges. Use your finger nail to push the tape snugly against the edge of the canopy frame. It doesn't hurt to run a few overlapping layers of tape to secure the canopy.

Remove the canopy frame from the fuselage. As you undo the mounting bolts take note to see if the frame is distorted. Now is the time to fix this if it is distorted. Place a towel or something similar on the work bench so you can work on the canopy without marking it.

A syringe is one of the easiest ways of applying the silicon between the canopy and frame. A 30ml syringe has more volume than required, but its physical size makes it easier to handle, it's great for guys with big hands! Attach about 100-150mm of fuel tube to the syringe, with a small piece of brass or alloy tube. You should have some off cuts left from the elevator hinge pins. Bend a gentle radius in the brass tube and carefully flatten the end a little, so it can slide between the canopy and frame. You will only need to half fill the syringe with silicon, and it is a little easier to manipulate the plunger if the syringe is not completely full.

Insert the brass tube between the canopy and frame, and start to squeeze the silicone between the two. As you squeeze the silicone into position carefully keep moving the brass tube along the canopy until you have gone all the way around. Gently run your fingers around the inside of the canopy to settle the silicone. If any of the masking tape has lifted away from position, gently press it back into place. If a little of the silicone has oozed between the tape and the canopy, don't worry, it will easily clean off, either with a gentle rub, or with a little mineral turpentine.

Reattach the canopy to the fuselage and bolt into position. Leave it in position until the silicone cures. After several hours (4-5) the silicone should be touch dry and you can start to remove the masking tape. Leaving the canopy overnight is also a good option if you are unsure. When you remove the tape, simply rub away any silicone that has come above the tape. Mineral Turpentine with a soft cloth can make it easier. Jobs done!



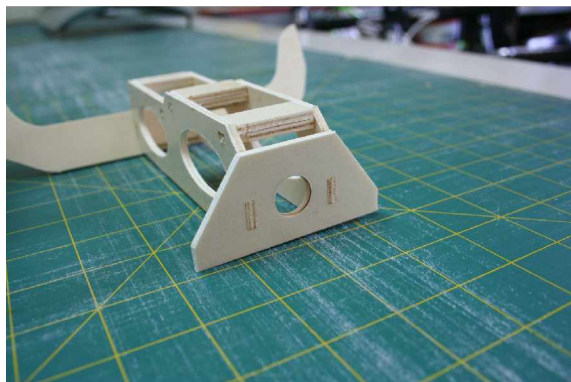
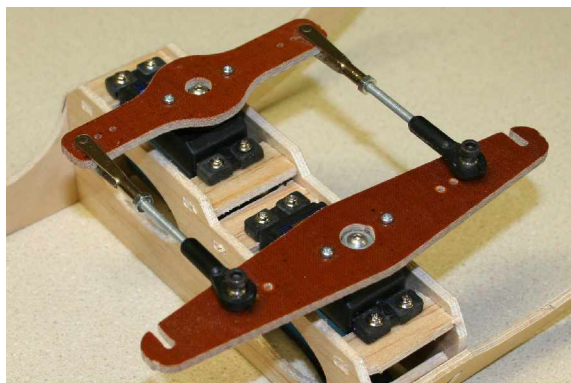
Rudder Servo(s)

Parts Required:

- Rudder tray components
- Rudder parts bag
- Phenolic servo arms
- Rudder Servo(s)
JR NX8921 or DS6311HV
Futaba S9157 or BLS172HV
- Alloy servo discs
- Alloy Servo Arms (optional)
- SWB 4.5" Full arm, plus 3" Full arm (front servo)
- SWB or Secraft turnbuckles 50mm (2")

Tools Required:

- Steel rule(s)
- Marking pen
- Philips head screw driver

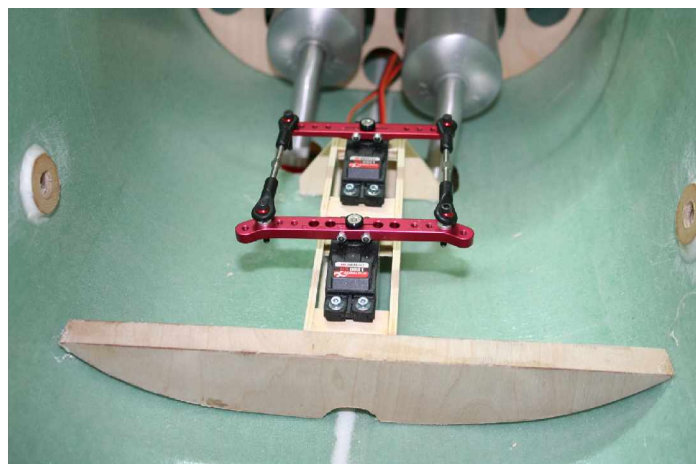
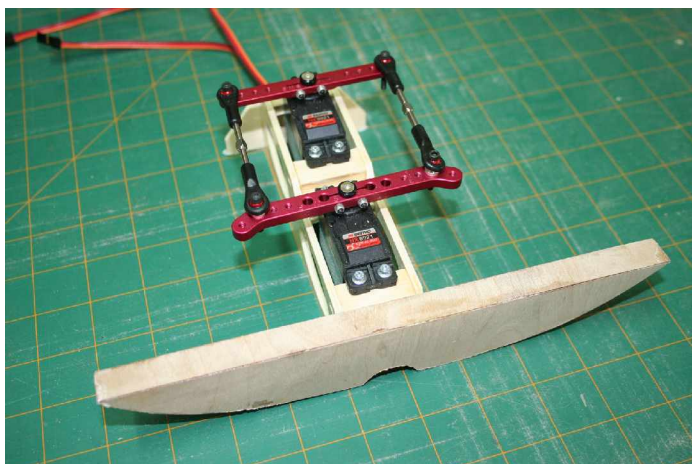


The rudder tray provided is suitable for 2 servos. You may elect to use 1 x 30kg plus servo. The servo tray is designed to fit into the fuselage former at the beginning of the turtle deck. Before you proceed, you should assemble the model, and do a preliminary C of G check to make sure that you will meet the C of G requirements. If the model is tail heavy now is the opportunity to move the rudder tray further forward in the fuselage. If you do need to move the rudder tray forward, you will need to make 2 new ply formers to attach to the existing rudder tray.

The supplied phenolic arms are required to be mounted onto alloy servo discs. **DO NOT USE THE STD NYLON SERVO DISCS!** The standard discs provided with the servos may strip under heavy loads resulting in control surface flutter. Screws are provided in the hardware pack to attach the phenolic arms to the alloy discs.

As an option you can elect to use alloy arms. The alloy arms need to be 4.5" for the rear servo and 3" for the front servo. (You may also wish to use turnbuckles and ball links to connect the 2 servos). An offset arm is preferable, as the pull/pull cables are to be installed crossed.

Assemble the rudder tray from the wooden components. Don't forget to fit the mounting doublers where the servo sit. You may wish to drill a hole for the servo leads to pass through in the rear former. If you have elected to mount the servos in the standard (rear) location you can fit the former to the tray at this time. Lightly sand the area in the fuselage where the tray will be attached. Before you epoxy the tray in place make sure that it is centred in the fuselage. You can use CA and kicker in a couple of spots to hold in position while the epoxy cures.



Pull/Pull Cables:

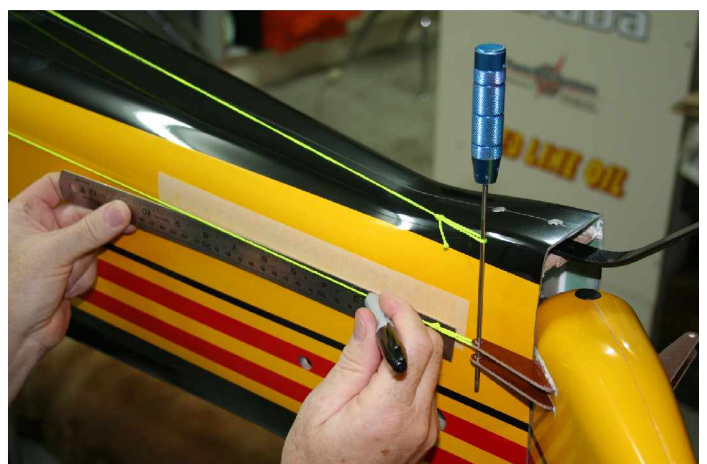
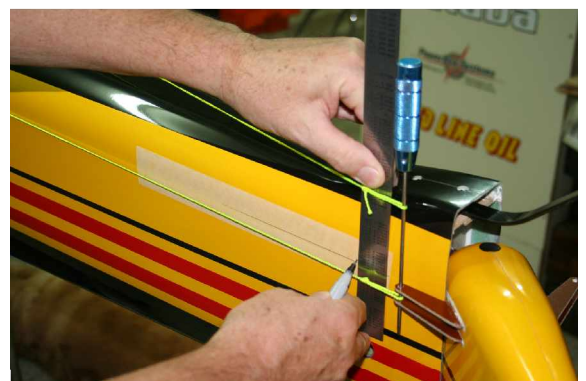
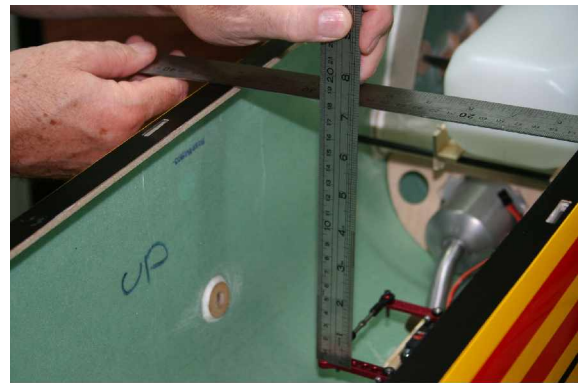
This is one area where the term “Measure twice, cut once” really comes into play. While the job of fitting the pull/pull cables is not difficult, being sure of your measurements is important. While we have supplied measurements for the cable slots, you should still make your own measurements to verify that the positioning is correct. Small changes to the assembly process and changes of equipment can alter the outcome, so “Measure twice, cut once”!!

The first line we need to establish is the horizontal line, essentially the plane the pull/pull cable will lay on. This process is quite simple and will only require a few measurements.

You need to establish where the pull/pull cable meets the servo arm. Use a straight edge on the canopy seat, measure to the top of the servo arm. If you are using alloy arms, measure to the centre of the ball link, this will be a few millimetres higher. Now that you have a measurement, you need to transfer that to the outside of the fuselage. Place some masking tape on the fuselage roughly where your mark will be. With the straightedge on the canopy seat mark a line using the measurement you just established. Now that you have the servo arm position marked on the outside of the fuselage, you can use a string line to mark the horizontal cable line.

You will need a couple of meters of string with a loop at one end. Attach the loop to the rudder horn using the 3mm bolts provided. Centre the string loop between the control horns, then position the other end of the string over the servo mark. Tension the string so there is no sag, then hold in place with some masking tape. You have just established your horizontal cable line. Place some masking tape on the fuselage about 50mm from the rudder control horn. Using the string line as a reference, use a rule to mark a horizontal line. You need to cut a slot about 30mm long.

Flip the model upside down, and directly underneath the servo draw the servo arm measurements onto some masking tape. Remember this measurement is dependent on which servo arms you use.



When you are satisfied that the cable exit slot is positioned correctly, make a cut with your Dremel and cut off wheel. The cut off wheel will cut the fuselage material with ease, so keep the tool steady. You should now make up your pull/pull cables. Start by doing one end only. Divide the cable supplied into two equal lengths. Fit the threaded cable eyelets into a ball link, and feed through the cable. The crimps supplied are spacious enough to pass the cable through three times. By looping the cable around for a third pass through the crimp, you minimize the chances of the cable slipping and pulling through the crimp. Once you have completed the crimp you may like to cover it with some heat shrink. You can now pass the cable through the exit slot and fit the ball link to the rudder control horn.

If you are using the phenolic servo arm provided in the hardware pack, you can simply loop the cable through the slot in the arm and crimp. If you elect to use an alloy arm, you can repeat the same process as you have already completed at the rudder end. Another item worth using is a SWB wire tensioner, these items make keeping the cables in tension very simple.

Whichever type of arm you use the process to tension up the cables is pretty similar. It's important that you temporarily plug in your rudder servo(s) to your receiver and centre them up using your sub trim. The final fitting of the cables is a little easier if the servo(s) are powered up and centred. Using some masking tape, hold the rudder in place by taping the boost tab at the fin. At this point you want to take care that you don't move the transmitter rudder stick. Now that everything is in place and held in position, pull the cables taught and crimp.

Don't forget to leave room for tensioning adjustment at the ball link. You do not want everything wound right up and no thread left to fine tune the cable tension.



Fuel Tank Tray

Parts Required:

- Carbon Tank Tray Mounting Rods
- Plywood Tank Tray Discs
- Fuel Tank – DuBro 40oz
- Tygon Fuel Line

Tools Required:

- Steel Rule
- Marking pen
- CA and some Kicker
- Hysol (or Epoxy with micro balloons)

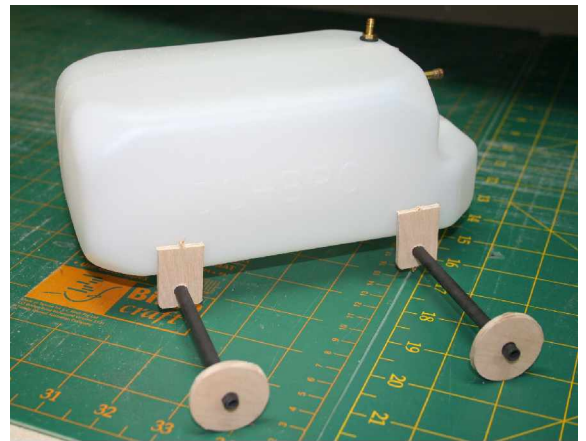
The fuel tank tray is a pretty basic structure, comprising of two carbon rods and 4 mounting plates. The round mounting plates are essential for spreading the load over a wider area and keeping the tank tray secured and in place. You may elect to use some of the ply pieces to aid in keeping the tank in position. This is not completely necessary as the tank can be held in place with some zip ties. However the option is yours. We used a Dubro 40oz (1200cc) fuel tank, however there is plenty of room for most size tanks, or even a smoke tank.

You need to position the tank centrally over the top of the wing tube, this is where the C of G is located. The carbon rods will need to be cut down to suit, ours came in at 282mm and 276mm. However this measurement may vary from model to model, so please take a correct measurement to meet your requirements.

As you can see from the pictures, when the carbon rods are held in place with 4 ply discs, simply tack these discs in place with CA and kicker, then when you are satisfied with the positioning, epoxy in place. You may also want to add some ply strips to support the tank if you wish (see picture), although this is not necessary.

You can also epoxy ply across the tank tray rails to mount your radio equipment, please keep in mind that you need to be able to get your hand through this area when attaching the forward wing retention nuts.

Please note: if you are using one of the current lightweight engines on the market such as the DA120, you will need to mount the majority of your radio equipment as far forward as possible to aid in obtaining the correct C of G. It may not be possible to mount the batteries over the wing tube.



Engine cooling and vents

It is important to keep your engine cool, regardless of the engine manufacturer. Keeping your engine cool is good practice, your engine will love you for it! Another area you must also consider is the fuselage. If you are running canisters or tuned pipes this is a must!

We will show you how we ducted the air to the DA120 that we used. Clearly with so many engine choices, it would be impossible to cover all variations. But the principle is the same, and the following is a good guideline for you to follow.

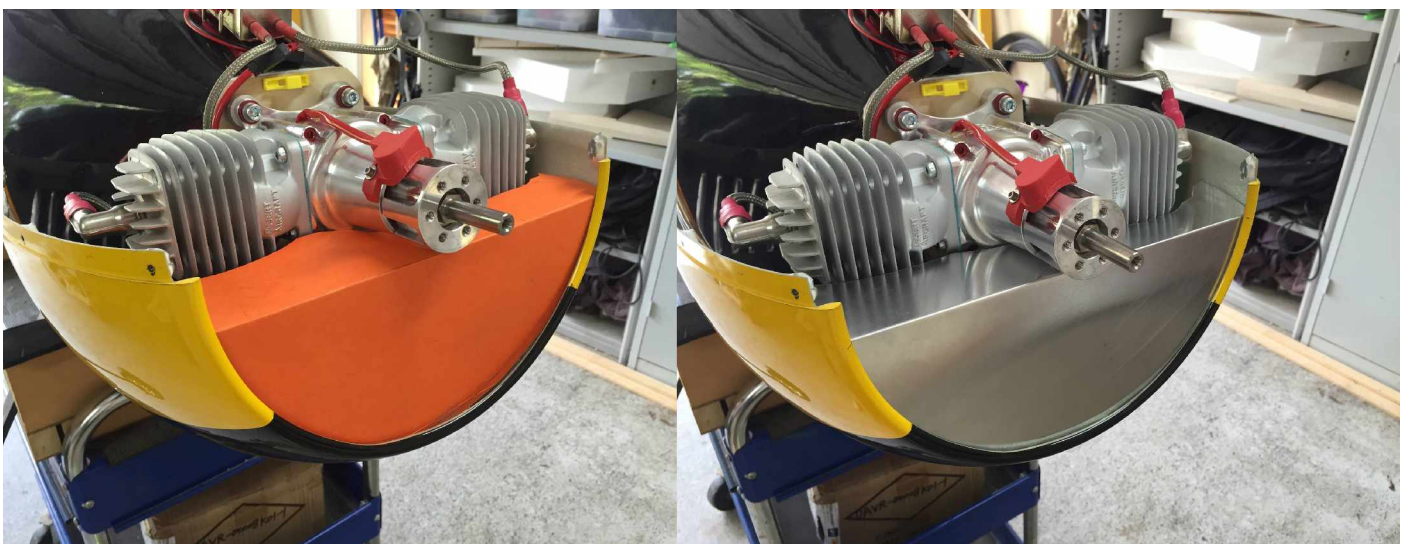
Remember, what we are trying to achieve, is to channel all the incoming air from the opening at the front of the cowl directly onto the cylinder fins, before it can disburse or be forced to other areas of the cowl. It's important that your ducting components are close to, but not touching your engine. About 2mm is sufficient.

We manufactured our ducting components from 0.5mm Alloy, but 4mm balsa and 0.5mm ply will also do the job. The balsa is easily shaped to your requirements and is also very light. The ply is added as the top layer when most of the shaping is done to add strength and a tough surface. Use some card to get the basic shape you require, and then trace the shape onto the balsa. The thin ply can be easily cut with scissors and the final shape trimmed with a sanding block. We used medium CA to glue the ply to the balsa.

Tack your components in place with some CA and kicker. Make sure you trial fit as you go. It is also a good idea to bolt the upper part of the cowl in place from time to time just in case the lower cowl is getting slightly pulled out of shape. When you are satisfied with the fit, epoxy the components in place. While the epoxy is curing, reassemble the cowl and fit to the fuselage, so as everything stays in shape.

To ventilate the fuselage you will need to cut some cooling slots. The fuselage material is easy to cut out, using your Dremel. Finishing with a sanding drum will keep the process simple and tidy. Where you place the slots is again dependent on the final fit out and components used.

Keep in mind that you should not cut through the seam line or the fibreglass reinforcement band. Keep your vent slots about 25mm from the seam line. Use the seam line as a reference to keep your vent slots nice and straight. The shape of the slots is not that important, but making them oval, and just large enough to accommodate the Dremel sanding drum makes the process easy.



C of G and Control Throws

The centre of gravity position of the SU-31 is 195mm from the trailing edge of the wing at the tip. Picking the completed model up at the tips will not harm the airframe, but due care should be taken in the method you use. Do not use any pointed implements to hold the model up, you may penetrate or damage the fuselage or wing structure. It's quite simple to have someone give you a hand, and using your fingers carefully lift the model at the C of G points you have measured.

Control throws:

This is another area, where your personal preferences are going to determine what you actually need. We have listed below what we believe is a good starting point. From there on you can fine tune your SU-31 to suit your requirements.

The SU-31 has a top skin hinge system, and as such it needs reverse differential, that is you will need more down travel than up! The reason for this is, as the aileron goes down, it actual looses area volume, part of the aileron disappears into the wing, decreasing the amount of surface area exposed to airflow. A good principle to work with is to give your aileron 10mm more down at full rates. Although at full rates the roll rate will be blistering, as you move into low or mid rates the preset differential will become more evident. Obviously you can use your transmitters differential settings if it is capable of doing so, just remember this type of differential is reverse to what is considered normal.



Surface	Low Rate	Low Rate Expo	High Rate	High Rate Expo
Aileron (Up)	50mm	30%	70mm	40%
Aileron (Down)	55mm	30%	80mm	40%
Elevator	50mm	30%	90mm	40%
Rudder	60mm	30%	100mm	40%

We hope you have enjoyed assembling your Composite Arf SU-31 and you have many years of happy flying with it. We have strived to cover as many area's as possible to ensure the assembly process flowed as smoothly as possible. If you have found yourself in difficulty and need some assistance, your sales rep is only an email away. Please contact your rep and they will endeavour to assist you, and get you back on track. Alternatively you can contact us via the emails below. We also welcome your feedback, please contact us if you would like to see something added or altered. We are always looking to improve our products and the information we supply.

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www.carf-models.com

SU-31 2.6m/2.75m manual V1 (March 2015)