7 Engine Installation

Note that the engine is LIVE until the magneto wires are grounded.

7.1 Rotax 912

7.1.1 Preparation

a) Find a clean area to work on the engine, and then give it an even better clean: you do not want any dust or swarf etc. to get into your engine.

b) Read the instructions which came with the engine for details of installation requirements, and for maintenance and operating procedures.

c) Remove the carburettors and air filters by loosening the screw clamping the carburettors into the rubber mounts and sliding them out. Cover the exposed holes with tape or similar.

> *When reinstalling the carburettors the rubbers should be degreased to remove any oil, and the clamps tightened as specified in the engine instructions.*

d) In order to clear the engine mounts, undo the bolt holding the cable clamp and the rear CDI bracket where it attaches to the engine.

> *Be careful not to let the screw or washers fall into the magnets around the magneto area.*

e) Discard the cable clamp and the spacer tube below the rubber part of the CDI mounting.

> *If the cable clamp is used the cables will be crushed by the engine mount.*

f) Shorten the thread on the rubber bobbin by the length of the spacer tube.

g) Replace the L-bracket above the rubber part of the rear CDI mounting with the supplied longer version, Figure 132.

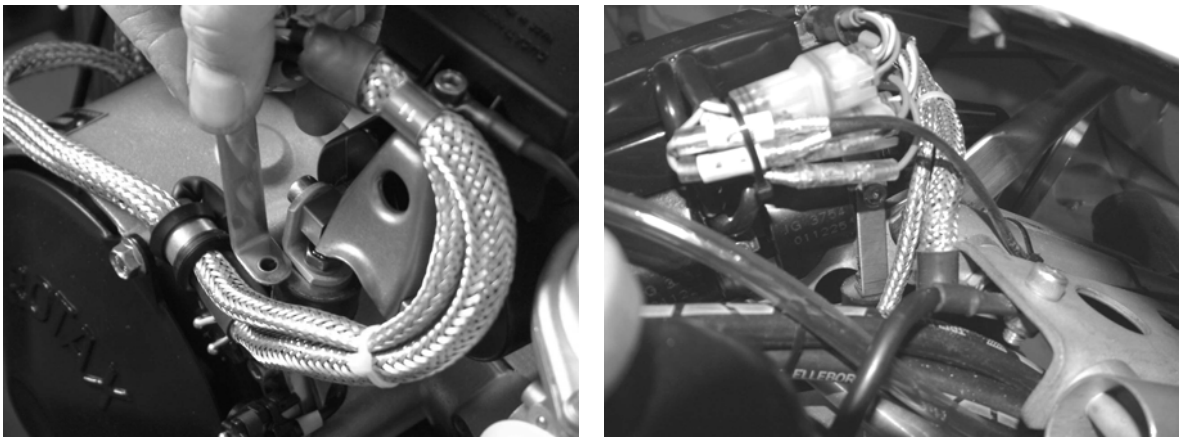


Figure 132; replacement CDI mounting bracket.

h) The mount for the CDI should be put back in place, omitting the cable clamp and the spacer tube as already instructed, and the screw carefully tightened up.

Leave the bolt securing the top of the mount loose, as it will need to be removed later when mounting the engine.

i) The water pump inlet on the bottom rear of the engine must be turned so that it points to the lower starboard side of the engine, see the engine instructions for the procedure.

Take care not to lose the O-ring seal and note the torque value of 10Nm (1kgm, 7ftlb) for the fixing screws.

j) Remove the upper rear case bolt located above the starter.

This bolt will be replaced with a 10mm x 140mm Allen head machine bolt when the engine is fitted.

k) The upper port mounting bolt will not clear the cylinder head fins. The fins must be trimmed with a file, a small Dremmel grinding tool, or similar method.

l) Trial fit the bolt to make sure you have trimmed enough off, including the rubber mount and washers. Ensure an easy fit, to eliminate any risk of cross-threading the bolt.

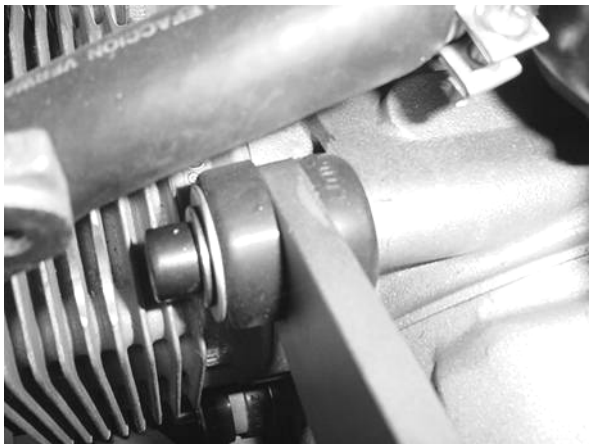


Figure 133; upper port mounting bolt.

m) Drill a small hole for lock-wire in the heads of all four 10mm diameter engine mounting bolts.

Use a new, good quality bit, drill slowly, and lubricate with 3-in-1 oil.

n) Push the rubber mounts firmly into their holes in the engine mounts, and secure with adhesive such as epoxy or silicone.

o) The stainless-steel diagonal brace ***tu310*** will be fixed to the starboard engine mount after the engine is in place. However, as it is difficult to drill in situ it may be drilled now if desired.

To do this the spacing between the inner edges of the engine mounting plates must be held at 175mm at the position of the rubber mounts. Check that the mount is symmetrical, then position ***tu310*** *and drill a fixing hole through the starboard mounting plate. Do not secure it yet. Some fiddling may still be required later.*

Check that ***tu310*** *clears the rubber engine mounts, file the end of* ***tu310*** *if necessary.*

p) Swing the stainless-steel diagonal brace ***tu310*** up out of the way.

7.1.2 Mounting

a) Position the engine on the Skyranger making sure you do not bump the CDI pickups located on top of the flywheel.

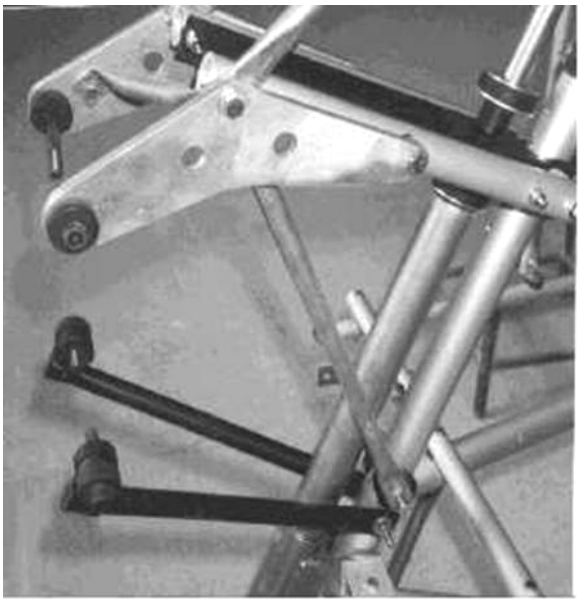


Figure 134; engine mounts.

Support the engine on a bench, such as a workmate, chock it up to the correct height, and offer the fuselage up to it. An engine hoist (which can be hired from your local hire shop), or some other method of lifting the engine may be used as an alternative.

Be careful how you support the engine, do not let its weight bear on any of its many ancillary parts such as the spark plugs, filters etc.

Warning: do not let the engine tip forwards whilst connecting the upper engine mounts to the mounting plates as damage will occur to the rear of the engine.

b) Fix the upper starboard rubber engine mount between the two penny washers with the long 140mm bolt.

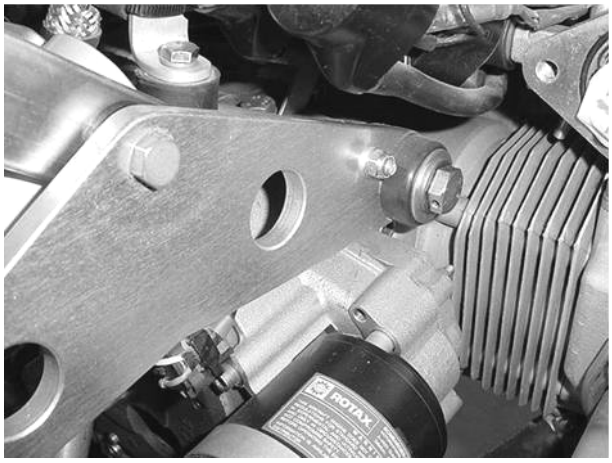


Figure 135; upper starboard mounting bolt.

c) Fix the upper port rubber engine mount between the two washers with a short 60mm bolt.

d) Fix the lower starboard rubber engine mount between the two washers with a short 60mm bolt.

e) Fix the lower port rubber engine mount between the two washers with a short 60mm bolt.

Figure 136; lower port mounting bolt.

f) Tighten the bolts to a torque of 38Nm (3.8kgm, 27ftlb).

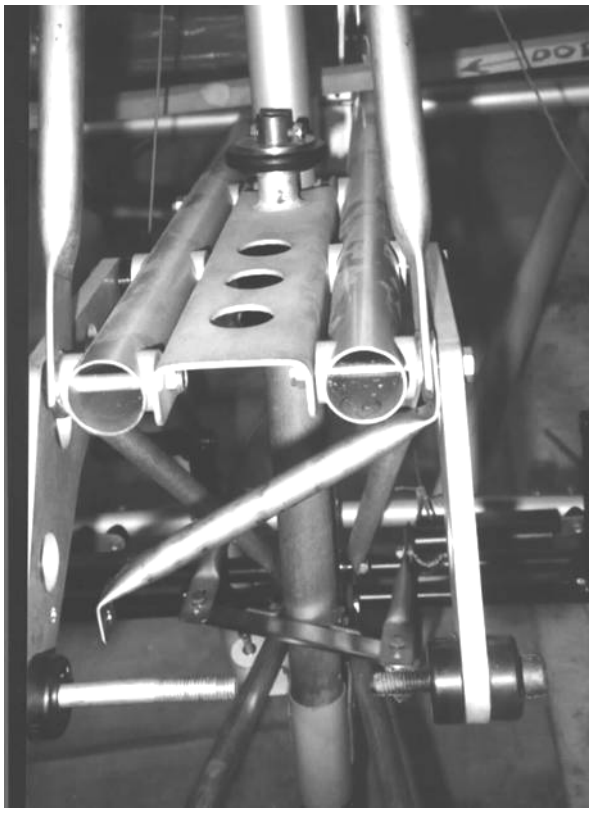


Figure 137; diagonal piece.

g) Check that the engine mount is square, then fit the front end of the stainless-steel diagonal brace ***tu310*** to the starboard engine mounting plate by drilling a hole for a 6mm diameter bolt.

   It will be necessary to undo the two rear mounts on the ignition unit to allow the brace to pivot past it.

   It may also be necessary to remove the starboard intake manifold to drill the hole. Check the engine instructions, and remember to cover the all holes before drilling and scattering swarf around. When refitting the manifold, use a torque setting of 10Nm (1kgm, 7ftlb) on the 6mm diameter bolts.

   The hole position will require careful marking, as you will probably have to drill from the opposite side from the brace.

   *If necessary file the end of **tu310** to clear the rubber engine mount.*

h) Wire-lock the engine mounting bolts.

7.2 Rotax 582

The Rotax 582 engine is mounted in the inverted position, suspended from the engine mount by 4 rubber mounts and a pair of intermediate plates which also support the exhaust.

7.2.1 Preparation

a) The gearbox should be rotated so that the propeller axis is above the crankcase of the inverted engine.

First remove the cover from the gearbox, complete with the propeller flange, taking care not to damage the gasket.

Then undo and remove all of the gearbox mounting bolts, some of which are on the outside of the gearbox, some on the inside.

Rotate the gearbox through 180°.

Reassemble the gearbox, taking care that the lower gear in the gearbox is correctly meshed before refitting the cover.

The torque setting for the gearbox bolts is 24Nm and for the cover bolts is 10Nm. No threadlock is required.

Remember to fill the gearbox with the oil specified in the engine manual before operation.

b) Reposition the breather cap to the top of the gearbox.

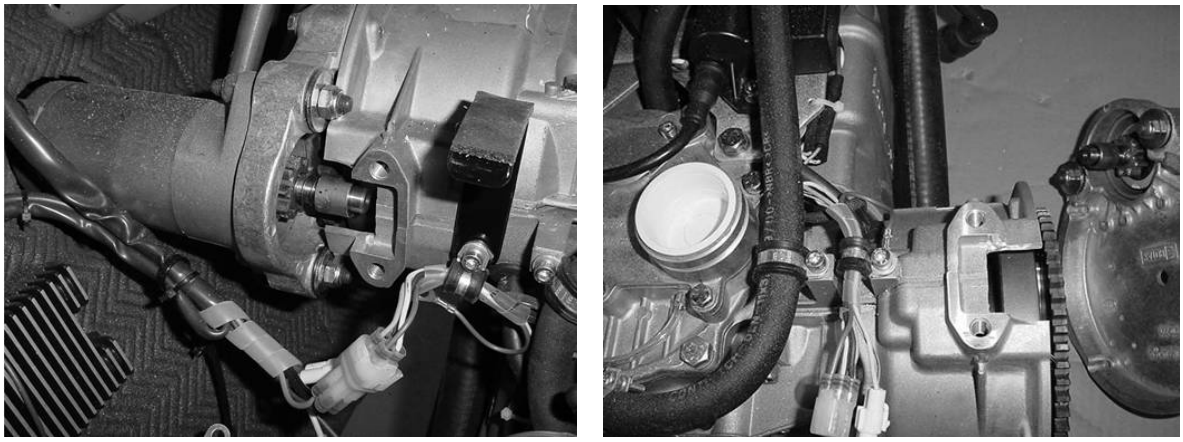


Figure 138; 582 mag-end starter.

c) The electric starter must be mounted at the magneto end of the engine, on the starboard side.

The crankcase will need to be cut away as per Figure 138, as the starter needs to be mounted in the 3 O'clock position rather than any of the standard positions.

Take care to contain any swarf. Do not cut through any of the internal components!

Remember the engine is going to be inverted, so cut away the correct side, see Figure 197.

d) Remove the rotary intake valve reservoir from the engine.

e) Undo the pipes from the rotary valve reservoir and swap them over.

Reposition the reservoir above the inverted engine, Figure.

f) Undo the pipes from the engine and swap them over.

The reservoir will be mounted properly later, but for now temporarily tie it up out of the way.

g) Drill out the 5mm exhaust mounting hole in the intermediate engine mounting plate to 6mm.

h) Drill the heads of the M10x55 hex-head engine mounting bolts for lockwiring.

Cap-heads are too deep to fit between the mounting plates and the mount itself.

i) Fit the intermediate plates to the engine using the M10x55mm bolts, large steel washers above the plates, and the 28mm long spacer tubes between the plates and the engine, Figure 41 and Figure 144.

Ensure that the exhaust mounting holes in the intermediate plates are on the exhaust side of the engine.

Tighten the bolts to a torque of 38Nm (3.8kgm, 27ftlb).

j) Lockwire the bolt heads together.

Figure 139; 582 engine mounting.

7.2.2 Mounting

a) Position the engine on the Skyranger.

Support the engine on a bench, such as a workmate, chock it up to the correct height, and offer the fuselage up to it. An engine hoist (which can be hired from your local hire shop), or some other method of lifting the engine may be used as an alternative.

b) Insert the rubber vibration mounts into their large holes in the intermediate plates, and Figure 139.

c) Fit the M10x55 mounting bolts from the top down.

Use a small washer beneath the bolt head.

Use large penny washers on both sides of the rubber mounts.

Secure with a Nyloc nut and Loctite.

7.3 Jabiru 2200

a) Remove the engine from its shipping box.

To get the lid off undo the 4 screws on the sides, not the large number of screws on the top.

The engine sits upside down on a framework. Remove the screws holding this framework into the box.

Tape a piece of wood to the sump ready for the engine to rest on, otherwise the exhaust stubs may touch the ground.

Get a friend to help to lift the engine out of the box and place it upright on the bench.

b) Fit the ring shaped pieces of the standard Jabiru rubber mounts to the upper mounts on the aircraft, and fit the other, larger part of the standard Jabiru rubber mounts to the lower engine mounts on the aircraft.

The drawings in the Jabiru manuals vary on this arrangement, but the text describes this arrangement. If the top mounts are the other way around the front half of the mount tends to get squeezed out by the engine thrust, whereas with this arrangement the central part passing through the engine mount hole prevents this happening.

c) Fit the engine to the mount, Figure 140.

Support the engine on a bench, such as a workmate, chock it up to the correct height, and offer the fuselage up to it. An engine hoist (which can be hired from your local hire shop), or some other method of lifting the engine may be used as an alternative.

Be careful how you support the engine, do not let its weight bear on any of its many ancillary parts such as the spark plugs, filters, exhausts etc.

d) Fit the other rubber mount parts followed by large steel penny washers between the rubber parts and the securing nuts.

Discard the internal spacers supplied by Jabiru, they are not required with this design of mount.

e) Check that the flattened parts of the lower engine mounts lie flat against the saddle washers on the front vertical ***tu14***.

If they do not then support the engine and remove them, and carefully tweak them to get them to lie flat.

f) Remove the support from beneath the engine.

g) Tighten the castellated nuts until they reach the end of their thread, then back off if necessary to secure with large split pins.

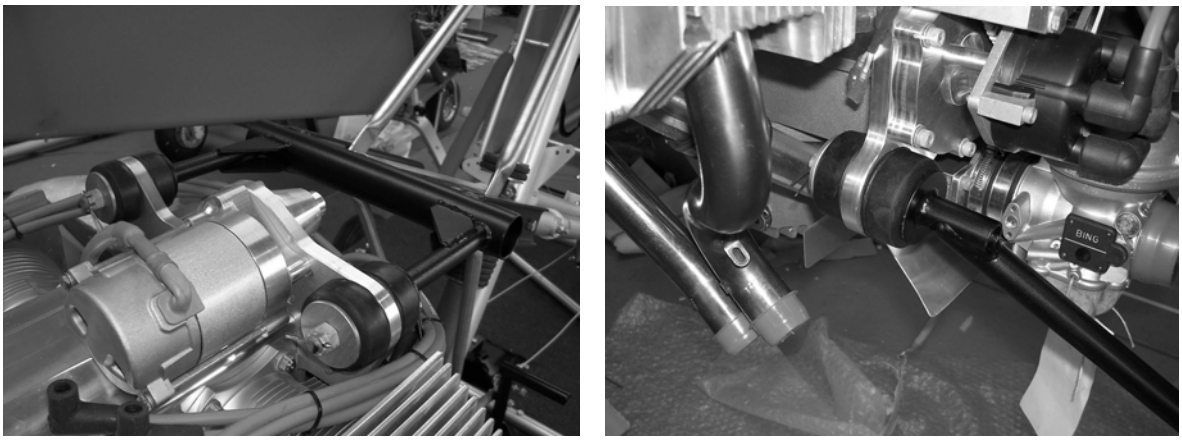


Figure 140; Jabiru engine mountings.

8 Wings

The wings are built at this stage to allow them to be fitted to the fuselage to permit accurate positioning of the parts supporting the windscreen. Use these instructions for both long and short (Swift) wing versions. Remember to make a handed pair of wings!

8.1 Wing Frame

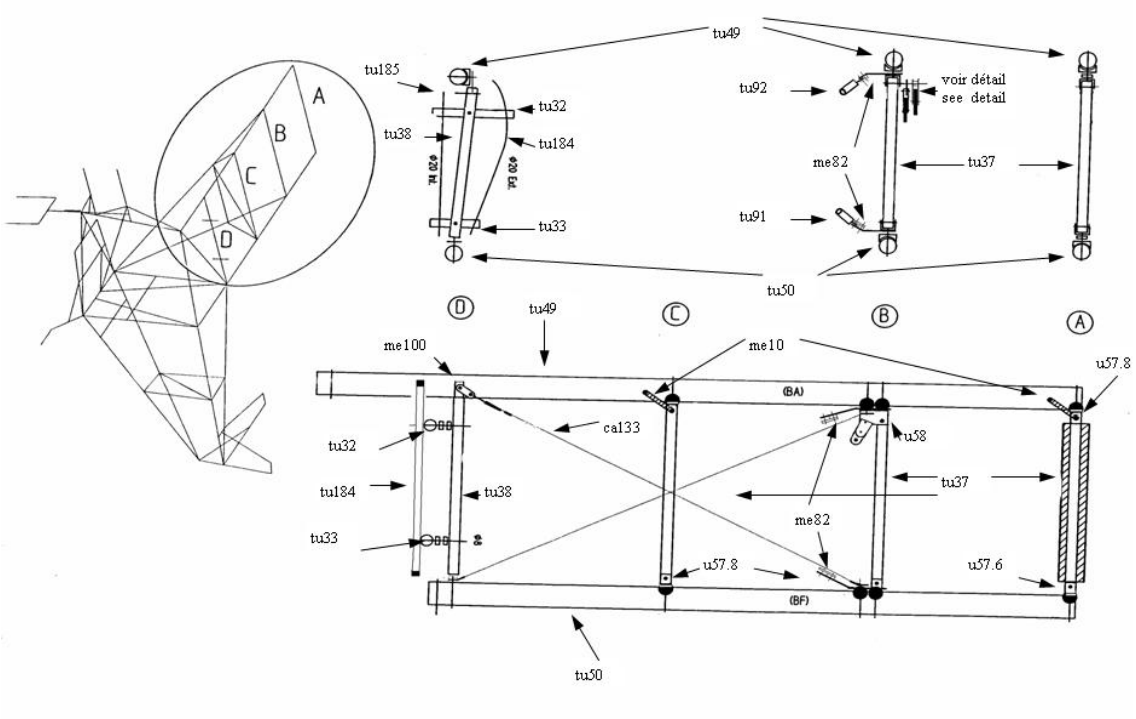


Figure 141; overview of wing structure. Ignore the cable numbers.

a) Set the leading edge tube ***tu49*** and the trailing edge tube ***tu50*** across two supports at a comfortable working height, or lay a piece of carpet or similar on the floor to work on.

b) Tighten the fittings already attached to the tubes except for the aileron eyebolts (the outer 3 eyebolts) as per the rest of this section.

   Remember to include the leading-edge tip extension tubes. These may need to be fitted first, if they are not already in place (N/A for Swift version).

   Important: Do not over-tighten the bolts, and remember the Loctite! *You should not be able to see any deformation of the tubes when you have finished tightening the bolts. If you can see any oval-ing of the tubes, you have tightened them too much.*

   The saddle washers shown in Figure 155 over which the tensioning tube fits often foul the edge of the rear spar attachment bracket on the fuselage. It is worth filing 2-3mm off the side closest to the wing root before the saddle washer is fitted to the spar.

c) Join the leading and trailing edge tubes with the oval tube ***tu37*** at the tip, Figs 142,143,144.

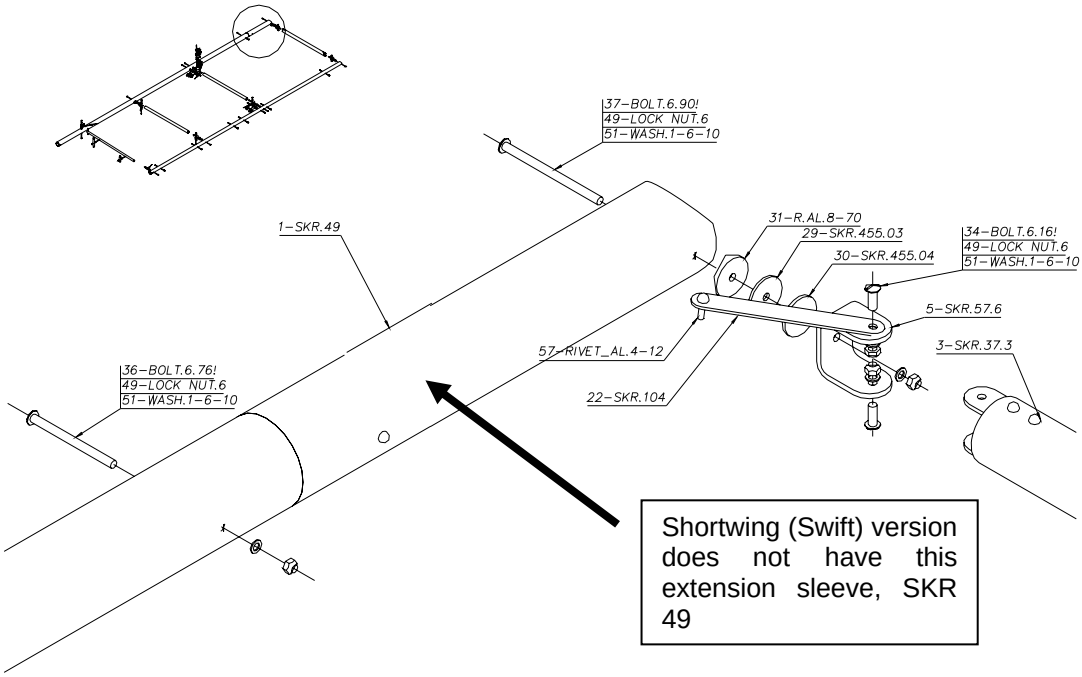


Figure 142: Front of tip

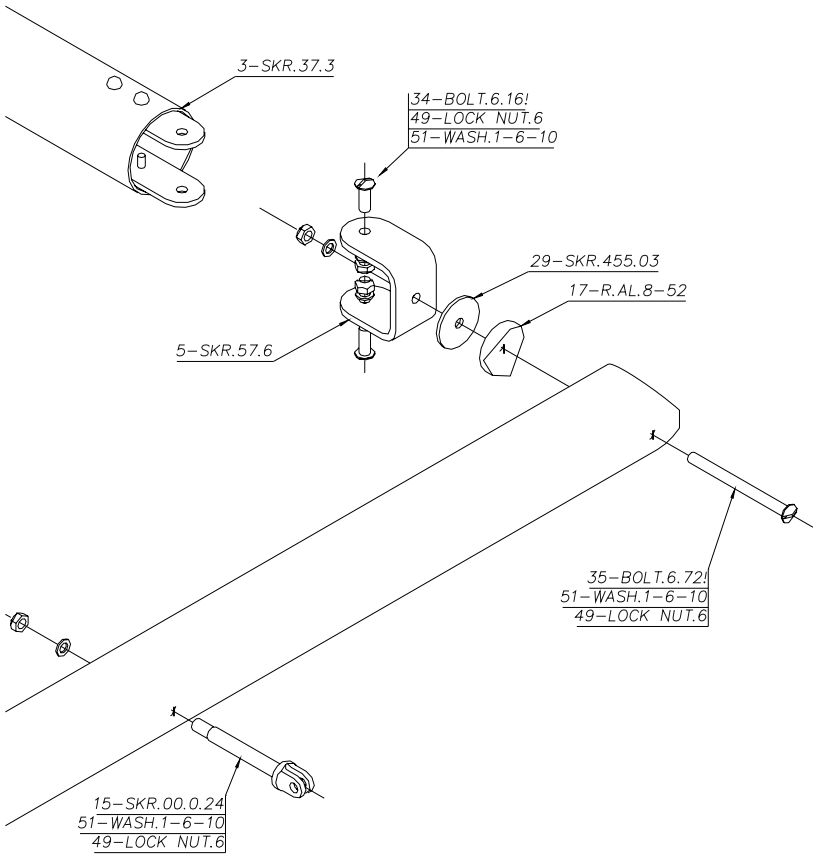


Figure 142; rear of tip.

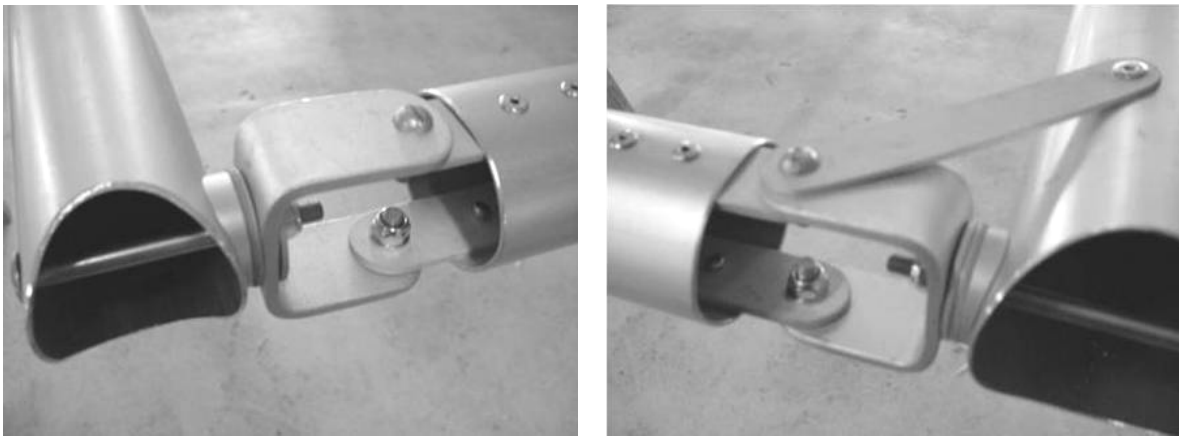


Figure 143; wing tip.

d) Use a round ***tu37*** tube to join the leading and trailing edges at the jury strut location, Figure 146, Figure 147, Figure 144 and Figure 145.

The orientation of the bracket that holds the jury struts should be long side downwards and towards the tip, Figure 145.

The orientation of the bolts should be head downwards, to maximise clearance from the jury struts when they are fitted at the very end of this manual. They must not be fitted sooner, as their length depends upon the exact alignment and tension of the airframe.

Note: The Aerofoil section jury strut option (Skyranger Swift) uses a different upper mounting, replacing the bolt and L bracket with an eyebolt.

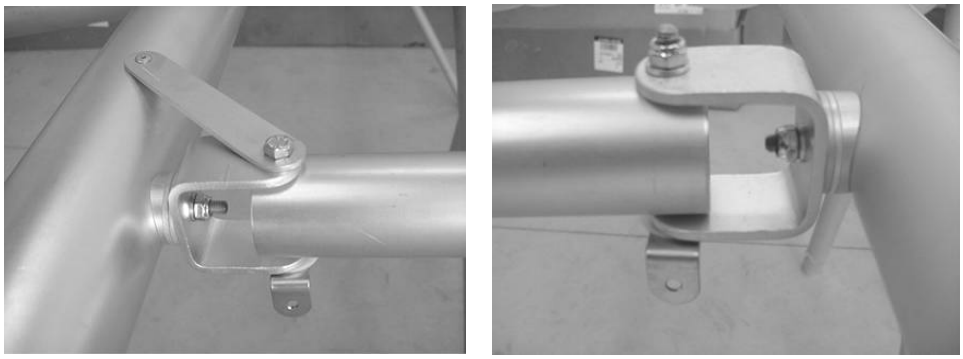


Figure 144; jury strut attachments.

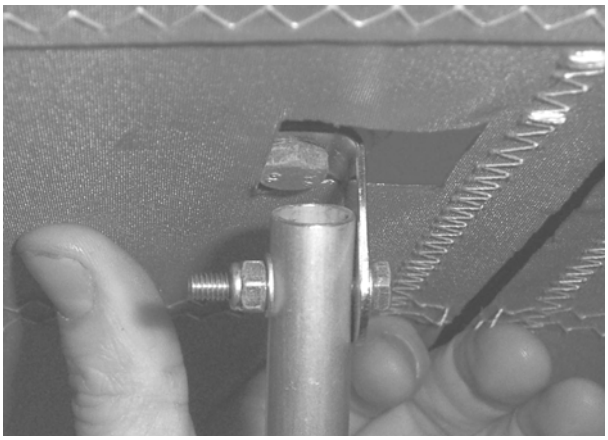


Figure 145; jury strut bracket orientation, note the adjacent seam.

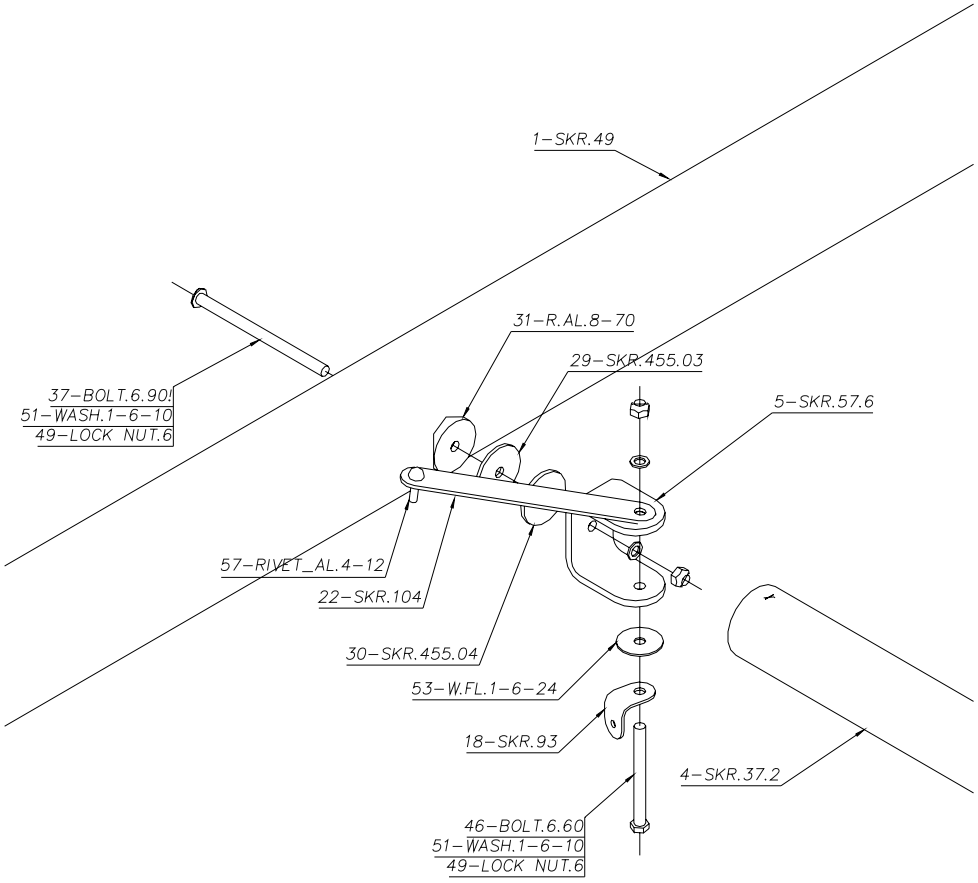


Figure 146; front jury strut attachment.

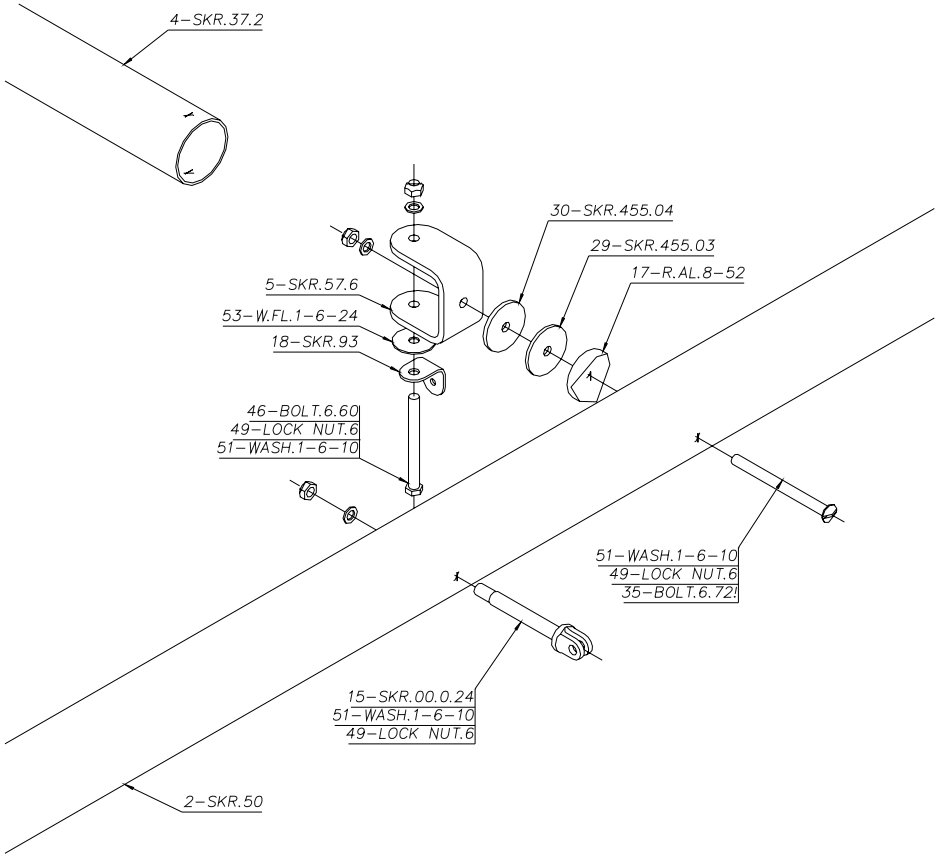


Figure 147; rear jury strut attachment.

e) Rivet the small aluminium strips, located on the top of the ***tu37*** tube attachments at the tip and the jury strut locations, onto the top of the leading edge tube, pointing towards the wing root.

Use 4mm aluminium rivets. These plates hold the tubes from turning.

Check that the jury strut attachments are vertically downwards, and that the flattened part of the tip tube is approximately horizontal, as per the drawings.

f) Use another round ***tu37*** tube to join the leading and trailing edges at the lift strut location, , Figure 149, Figure 151 and Figure 148.

Don't forget to attach the bracing cables at the lift strut ends: the one with the turnbuckle to the trailing edge, using the end without the turnbuckle; and the one without the turnbuckle to the leading edge.

Note the altered arrangement of the aileron pulleys, Figure 149. A spacer tube has been incorporated between the top and bottom parts of the U-bracket, with the lower pulley bracket held between the spacer and the upper part of the U-bracket. The upper pulley sits on top of the U-bracket, with a thin plastic washer between it and the bracket.

Leave the bolt securing the pulleys loose at this stage, to allow the aileron cables to be passed through later.

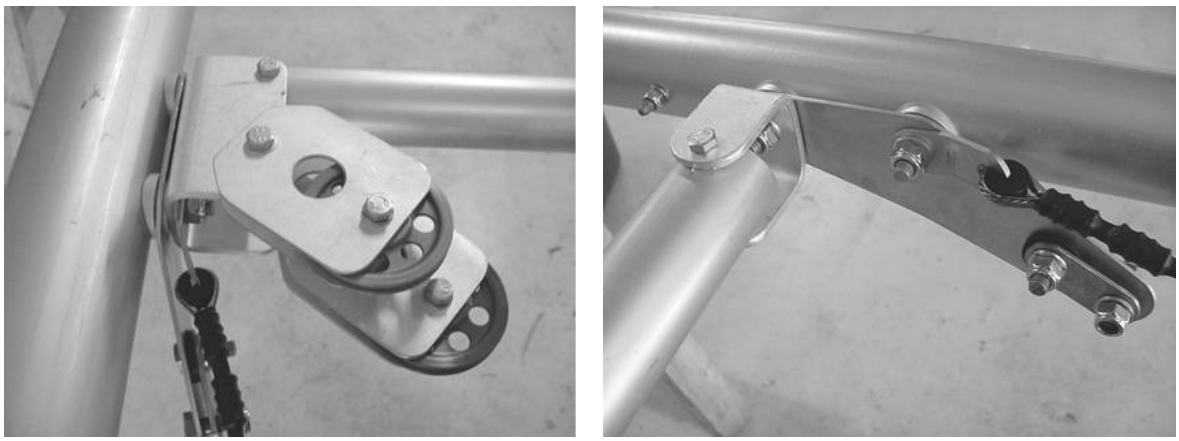


Figure 148; lift strut attachments.

Figure 149; UKMOD aileron pulleys.

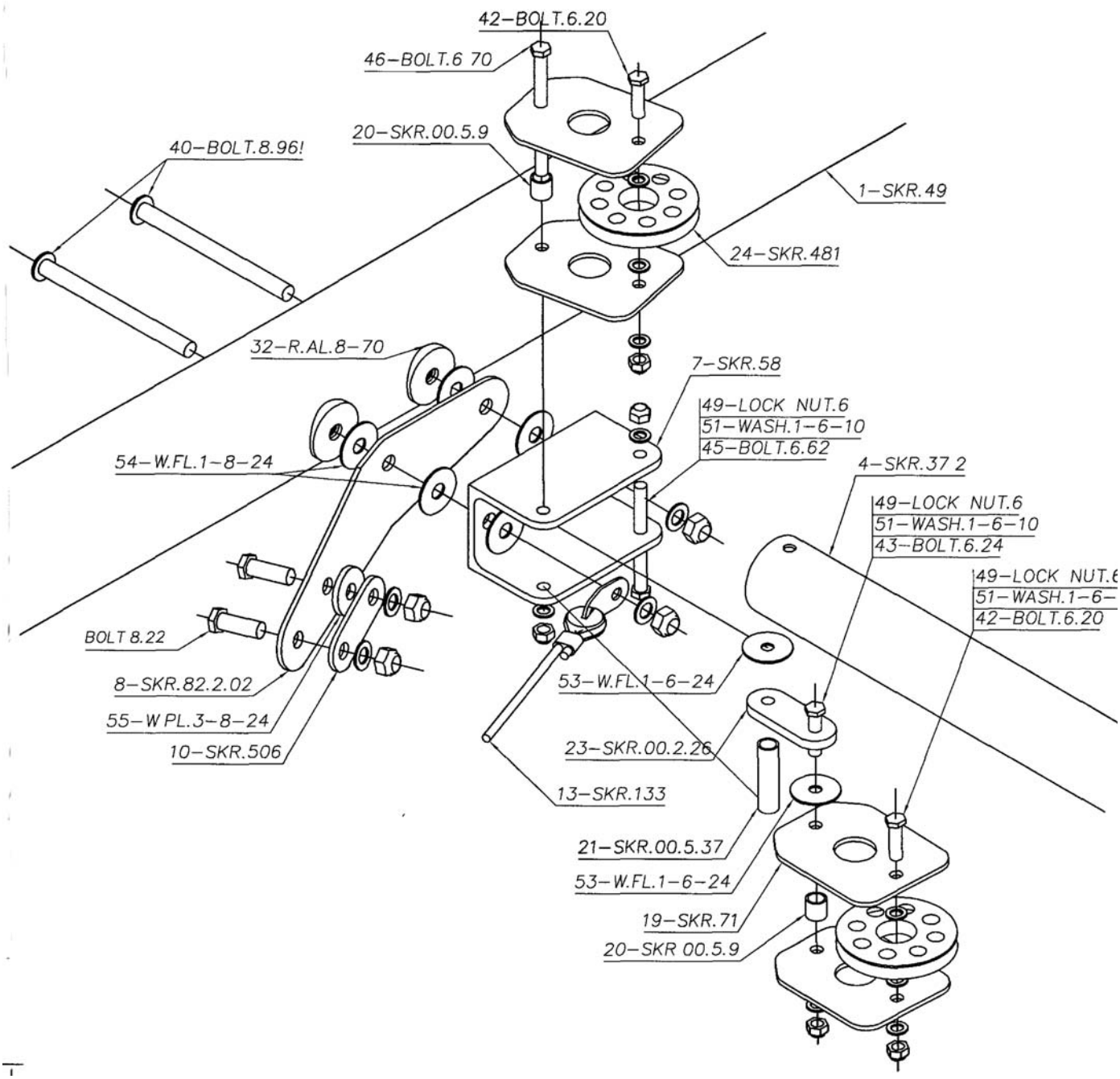


Figure 150; front lift strut attachment. And UK MOD pulleys

(The bolts holding the pulleys and the tu37 should point upwards to avoid pressing against the coverings. Alternatively they may point downwards, but then nutcaps must be used to protect the coverings from the protruding bolt ends.)

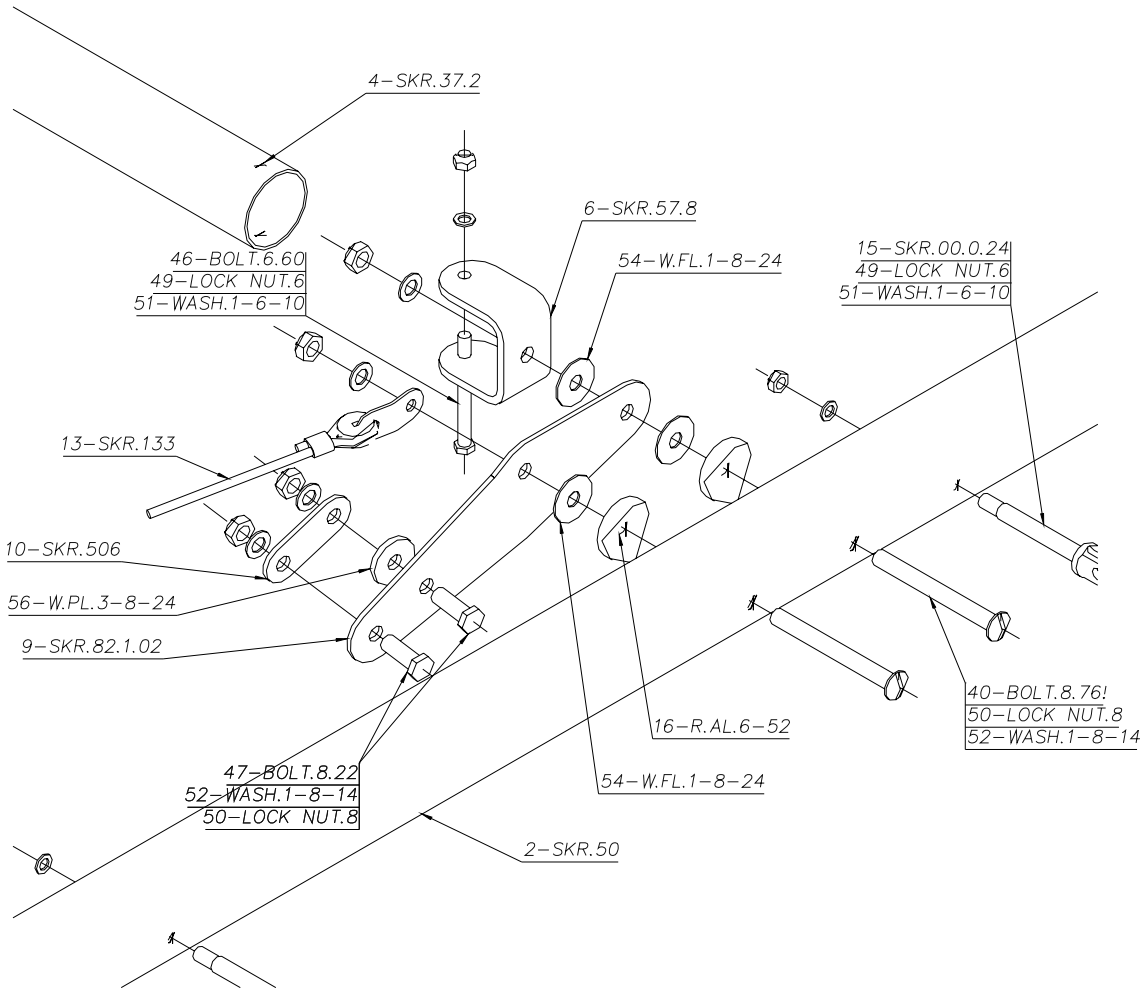


Figure 151; rear lift strut attachment.

Attach the bracing cable without a turnbuckle to the fuselage end of the trailing edge tube,

Refer to figure 153 and Figure 154.

g) Attach the bracing cable with the turnbuckle to the fuselage end of the leading edge tube, with the turnbuckle at the fuselage end.

*Make sure that the cables cross and run over tube **tu37**. The cable with the turnbuckle must be over the other cable. If the sleeving on the cables is not in the correct location it may be slid along the cable by heating it first with a heatgun. If this does not work, protect the tube where the cables cross with some prop tape.*

Do not tighten the turnbuckle yet, as the compression tubes are not yet fitted.

The split pins can be secured now, but do not wirelock the turnbuckle until the covering has been fitted.

To protect the coverings the bolt securing the turnbuckle should be cut off leaving only a couple of threads showing above the Nyloc. File to remove any sharp edges.

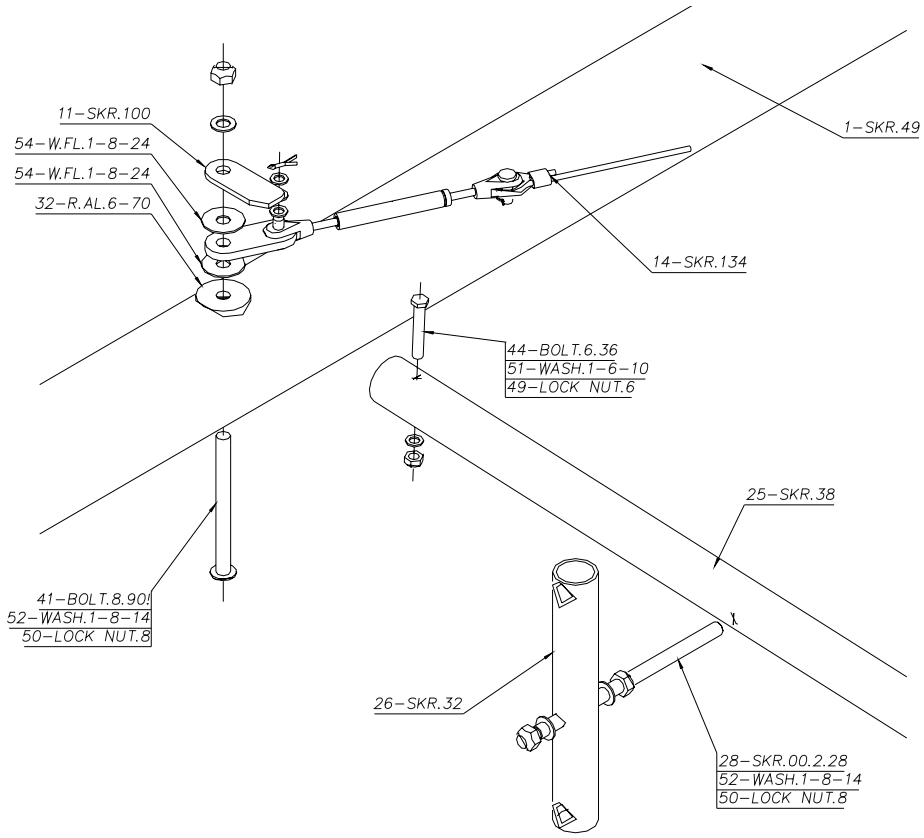


Figure 152; front of tensioning tube.

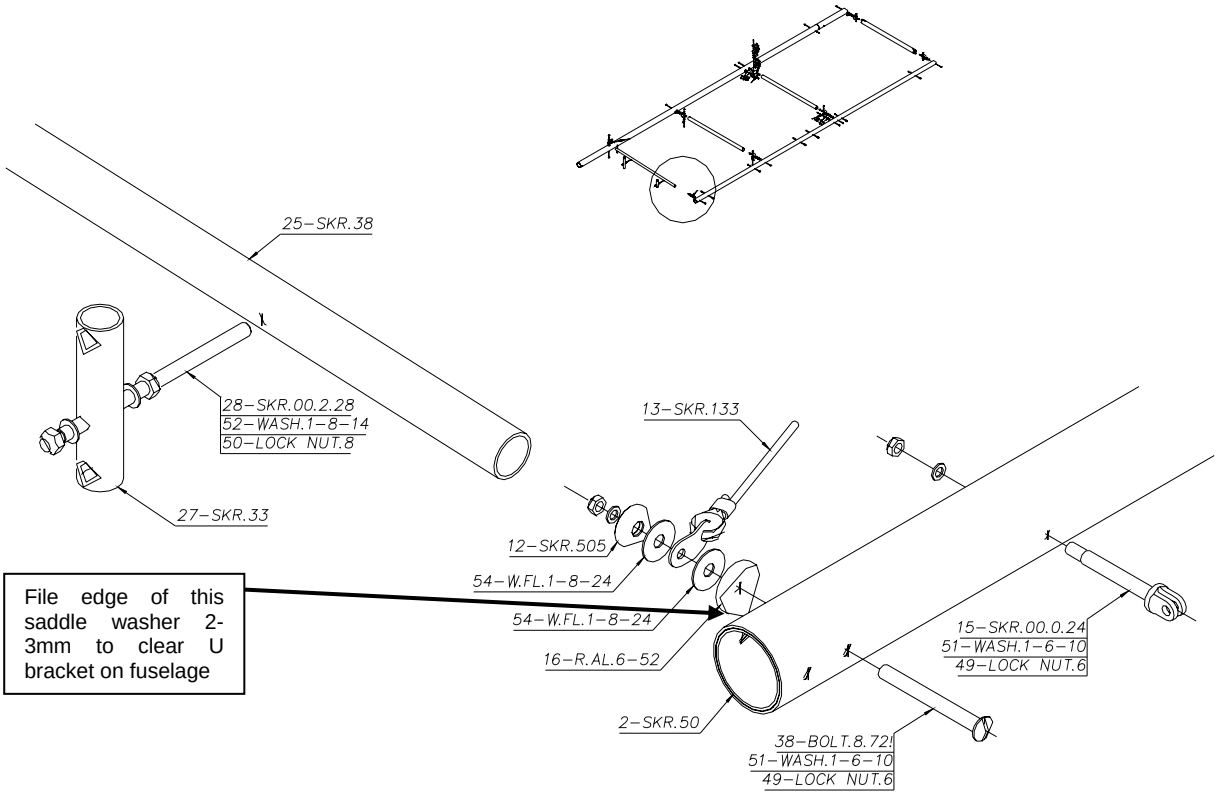


Figure 153; rear of tensioning tube.

Figure 154; tensioning tube fittings, front in left photo (note bolt through compression tube), rear in right photo.

8.2 Aileron Horn Assembly

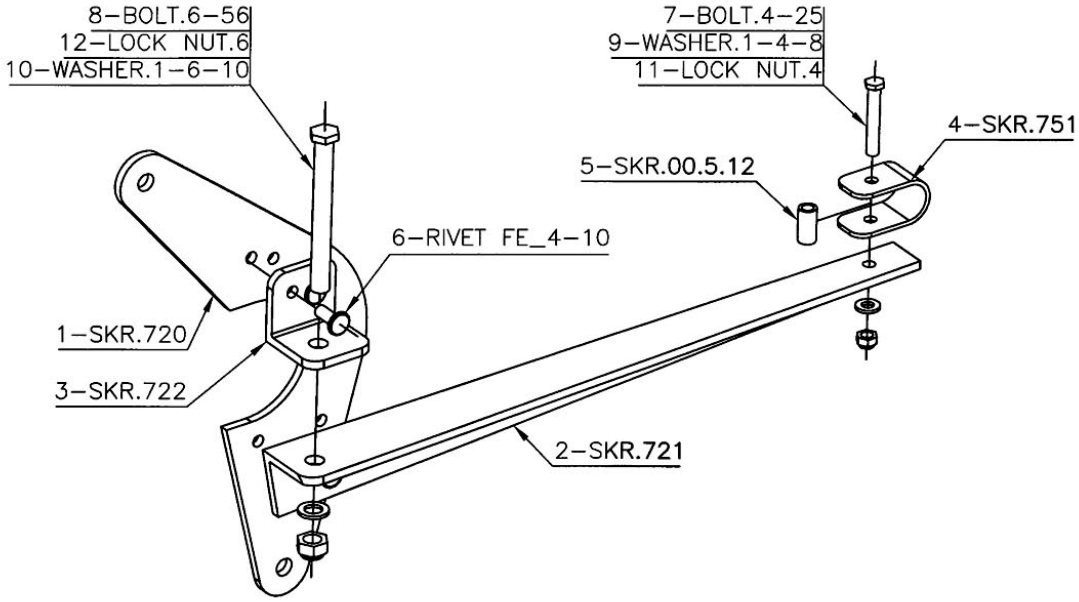


Figure 155; aileron horn parts.

a) Find the hole in the aileron leading edge spar.

   This is located 480mm from the inboard end of the spar.

b) Burn through the fabric with a soldering iron at this point to uncover the hole.

c) Lightly bolt into position the upper and lower angles.

   Use the 6mm bolt with 45mm shank length.

   The long brace goes underneath with horizontal edge facing the inboard end of the aileron, placing the horn towards the wing tip.

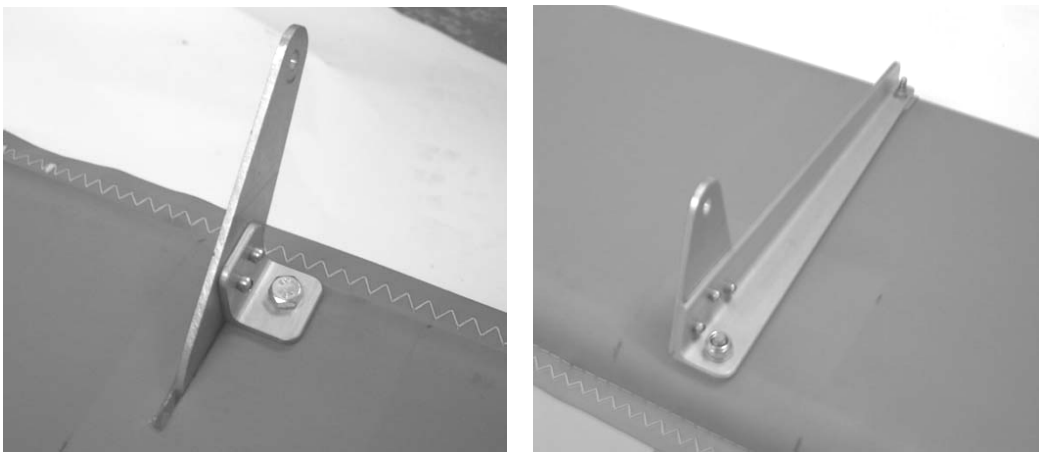


Figure 156; aileron horn, top and bottom.

d) Temporarily mount the aileron onto the wing, and line up the long brace to point at the aileron pulleys.

   This will put the brace at around 90° to the trailing edge of the aileron.

e) If the aileron movement feels at all stiff, the holes for the eyebolts on the trailing edge may need to be eased slightly to achieve good alignment and thus easy movement. Once satisfied tighten the eyebolts, remembering the Loctite, and do not over-tighten (as a guide they should still be able to turn with only moderate finger pressure).

f) Burn a small hole in the fabric at the trailing edge through the 4mm hole at the rear of the brace.

g) Burn a hole in the same position on the upper surface fabric.

h) Remove the aileron from the wing.

i) Insert a 4mm bolt to hold the angle in position and using the angle as a guide burn a slot 70mm long on the under surface measured from the centre of the leading edge spar, Figure 157.

j) Use the long brace from the opposite aileron against the upper surface as a guide to melt the upper slot.

This slot should be 60mm long measured from the centre of the leading edge spar.

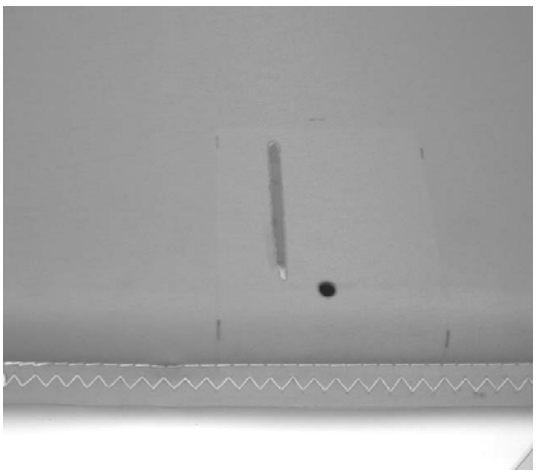


Figure 157; slot for the aileron horn in the undersurface of the aileron,

k) Put the braces back in their correct positions and secure the trailing edge with a 4mm bolt passing through the thin sheet aluminium U-piece, the spacer tube and the lower brace, the sequence shown in Figure 155.

Note that the U-piece edges should be bent up slightly so that the edge does not cut the fabric over time.

l) Tighten this assembly, and also tighten the 6mm bolt holding the front of the top and bottom braces.

m) Insert the aileron horn.

If it is a tight fit through the fabric you may have to lengthen the slots a little.

n) Check the alignment of the rivet holes.

These may have to be gently eased with a 4mm drill or reamer.

o) Insert all rivets, from the horn side, to ensure they all fit, then pull up the rivets.

8.3 Attaching the Wings to the Fuselage

Note this is a temporary fitting, before removal for covering and transportation. However, it should be performed in order to allow easy setting up of the controls.

a) Select the front and rear lift struts ***tu92*** and ***tu91***.

b) Lay them on the ground next to the fuselage in the position that they would attach.

The inboard ends are those fitted with the angled stainless-steel brackets.

The strut with the angle cut out of its trailing edge is the front strut.

c) Attach the struts to the main undercarriage cross-beam, ***tu9***.

The plastic washers between the strut ends and the main beam shown in Figure 158 are not required.

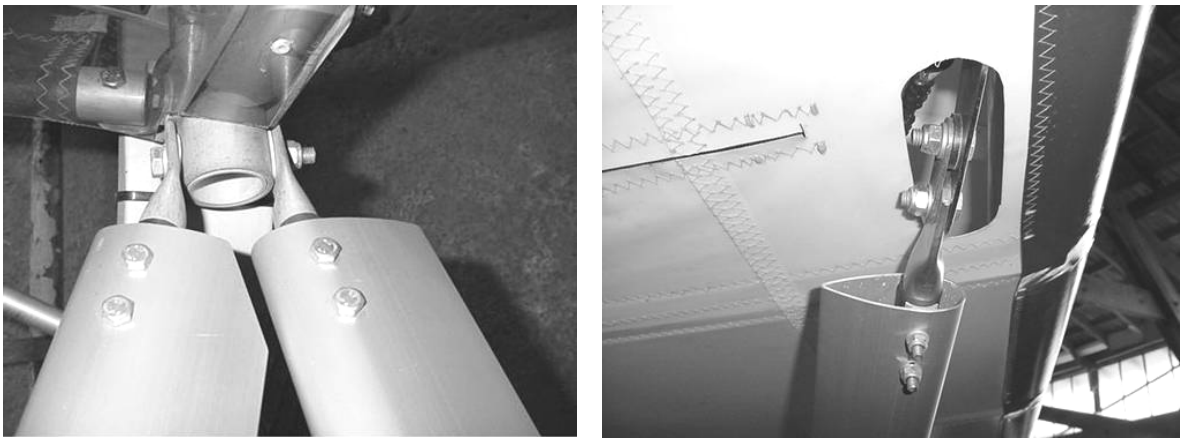


Figure 158; lift strut attachments.

d) With two people, attach the wing to the fuselage.

One person should hold the tip up while the other person puts the pins through the U-brackets to secure the leading and trailing edges on the fuselage.

Put the leading edge pin in first, from the rear, then the trailing edge pin, from the front.

e) Lift the struts up to the wing and attach them to the leading and trailing edges, Figure 152 and Figure 159

Do not install the jury struts at this stage, wait until the wing has been covered and the geometry checked. This will happen at a later stage.

Do not overtighten the upper bolts holding the lift struts to the wings, there is no need to distort the connecting brackets.

8.4 Aileron Control Cables

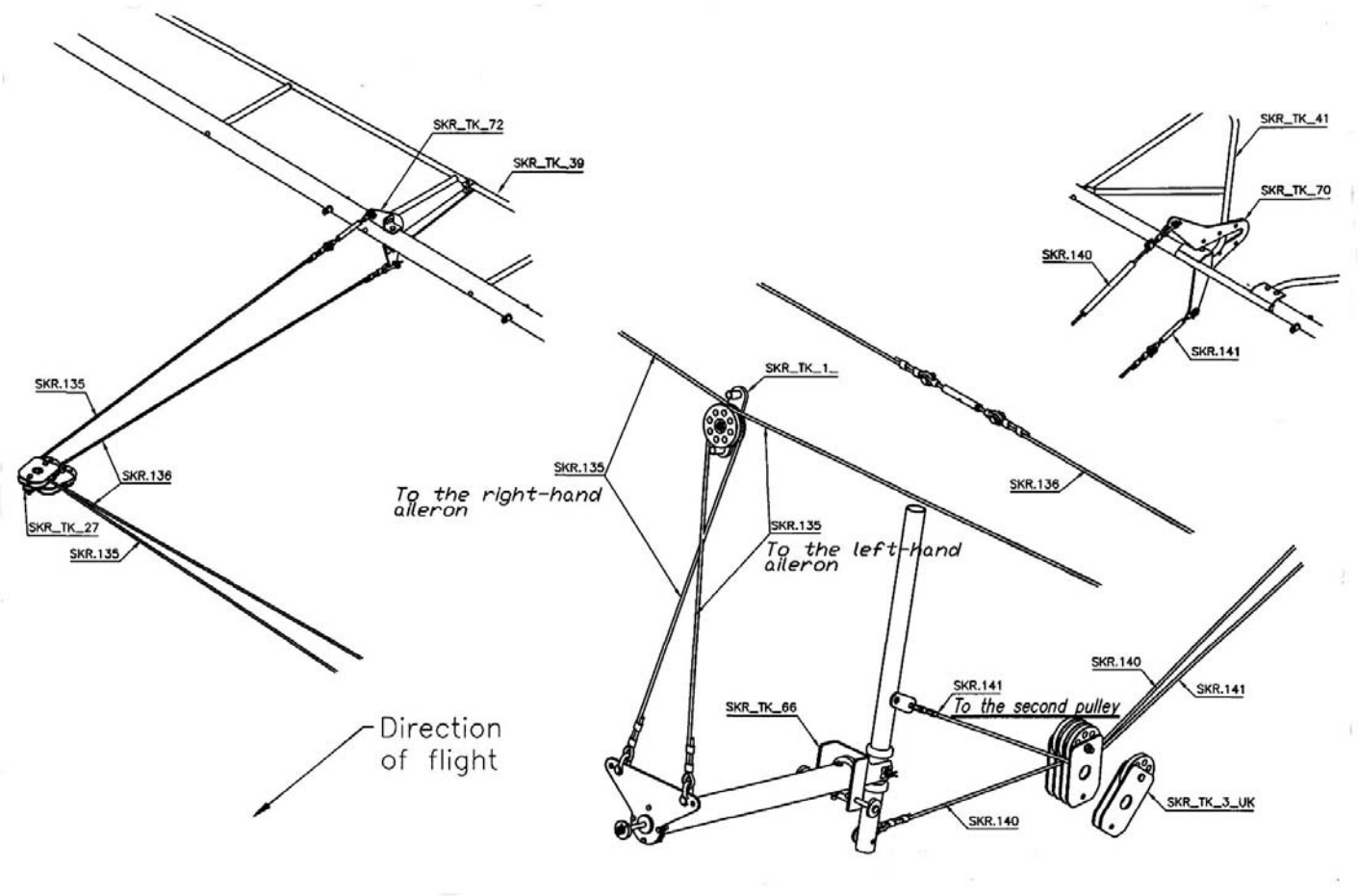


Figure 159; aileron cable runs.

a) Temporarily fit the ailerons onto the wings.

b) Check the ailerons for unrestricted movement.

   If any friction is felt the holes in the trailing edge where the eyebolt hinges attach should be elongated slightly along the tube. This is worth doing on all the hinges, even if no friction is present at this stage, as when the coverings are fitted they tend to build some stress into the wing and cause the ailerons to bind slightly which spoils the feel of the controls.

c) Select the pair of upper aileron cables, those with the turnbuckles on one end.

d) Thread the ends without the turnbuckles around the upper pulleys inside the wings and through the U-brackets at the jury strut attachment locations.

   Work from the ailerons inwards towards the fuselage.

Figure 160; cable routed through U-bracket.

e) Pass the cables around the pulleys at the top of the front vertical tube ***tu14*** where the leading edges attach, Figure 162.

f) Prepare the fittings for attaching the aileron cables to the driving horn connected to the control stick.

Attach a pair of the stainless steel plates to the port aileron cable using a shackle pin and two plastic washers on the outside of the plates to take up some of the slack, and permanently secure with a split pin, Figure 161.

Attach the other pair of stainless steel plates to the starboard side of the aileron driving horn, again using a shackle pin with a pair of plastic washers outside the plates, permanently secured with a split pin.

Figure 161; aileron cable connections viewed from beneath.

g) Attach the starboard aileron cable end to the stainless steel plates on the starboard side of the aileron horn using a shackle pin and a nappy pin or split ring.

h) Attach the stainless steel plates on the port aileron cable to the port side of the aileron horn using a shackle pin and nappy pin or split ring.

i) Attach the turnbuckles to the upper control horns.

Figure 162; aileron cable fuselage pulleys.

j) Select the other aileron cables ***ca6*** which are connected in the middle by a single turnbuckle.

k) Pass the ends of the cables ***ca6*** over all the tubes in the wing and the fuselage (except the windscreen supports) and around the lower pulleys inside the wing.

> *Loosen the turnbuckle and feed the other ends from the fuselage outwards towards the ailerons.*

l) Attach the ends to the lower control horns on the ailerons.

m) Tighten the bolts securing the aileron pulleys in the wings.

> *Ensure the pulleys can still move to take up the correct angle to the cables.*

n) Check the gap between the pulley and the plates to make sure that it is not more than 1mm or so.

> *If it is, there is a chance that the cable could jump the pulley and slip between the plate and the pulley. If there is an excessive gap, check the plate for bends and check for the proper washers between the pulley and the plate.*

o) Tension the cables by hand to check that all the cable lengths are accurate.

p) Check the angle of the lower pulley bracket inside the wing.

> *This is the bracket for the cable **ca6** that connects to the lower control horn on the aileron. You will need to bend the bracket with a twisting*

motion so that the pulley is in the same plane as the cable, and moves smoothly.

q) A short plastic sleeve should fitted over each of the central cabin tubes ***tu19***, immediately behind the front vertical ***tu14***, to form aileron horn stops, Figure 163.

These will require cutting to slip over the tubes if not installed earlier, and to allow packing out later to set the aileron deflections.

Figure 163; aileron stops.

r) Set the levelness of the ailerons with the turnbuckles at the ailerons, whilst the centre turnbuckle simply takes up the slack.

Final adjustments to neutral position and control surface movement will be done when the aircraft is complete.

s) Check the right and left joy stick movements for the proper aileron deflection: stick left, left aileron up, right aileron down and vice-versa.

t) Check for any stiffness and binding.

u) Small pieces of prop-tape can be applied to tubes where the cables may occasionally touch them, but the cables should not be rubbing continuously on any tubes.

v) If the cables are found to “slap” against the leading edge tubes within the cabin area, either apply tape, or position a couple of cable ties or similar around the leading edge tubes to act as buffers for the cables.

8.5 Flaps

a) Temporarily mount the flaps on the wings.

If the pin securing the wing trailing edge to the fuselage touches the leading edge tube of the flap, the pin should be shortened to fit.

The control rod mounting plates at the flap roots face downwards.

b) Attach the push rods for the flaps to the flap handle,.

The slightly longer flap pushrod and the longer spacer tube goes on the starboard side of the rear end of the flap handle.

c) Attach the push rods from the flap handle to the plates on the flap roots.

The plates may require a tweak to line them up with the pushrods.

d) If the flap lever rubs the cables, check the fitment of the flap lever and adjustment of the cables against the respective instructions.

If the starboard flap pushrod still rubs the control cables (due to the UKMOD controls) cut a few mm length off the port side spacer tube and add it to the starboard side spacer tube.

e) Adjust the flaps to set the centre of their trailing edges 5cm below the level of the rear fuselage covering, Figure.

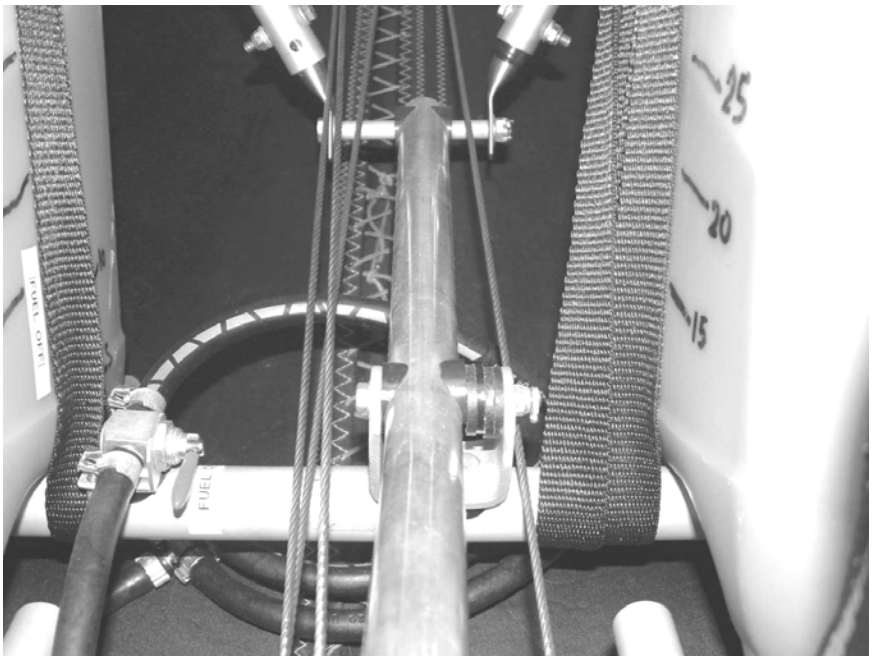
Final adjustments will be done when the aircraft is complete.

If the starboard flap push rod runs out of adjustment (too long), turn it 90° and drill another hole 10mm above the original hole at the bottom of the push rod. Use this to secure the push rod end fitting.

f) Check the smooth operation of the flaps, including moving the ailerons to check for any contact between them.

g) If the attachment plates at the bottom ends of the flap pushrods are found to press hard against the coverings they may be rounded off to a radius of 8mm from the hole edge, and a patch stuck onto the covering to further protect it.

The fuel tanks push the covering downwards out of the way of the flap pushrods, so wait until they are fitted before getting too concerned.



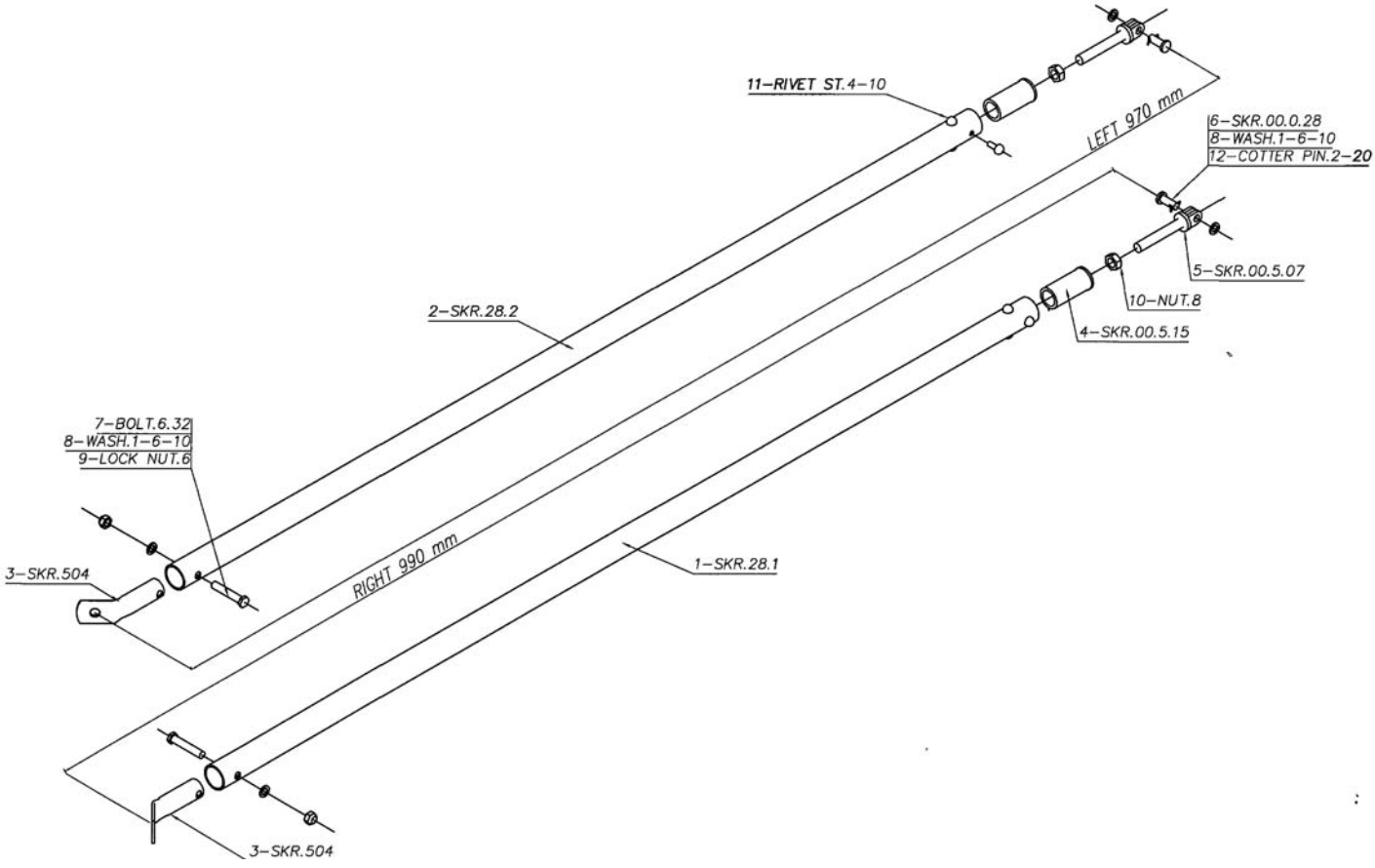


Figure 164; flap handle, looking rearwards and flap rods.

8.6 Covering the Wings

a) **Do not cover the wings until they have been inspected!**

See the inspection schedule and tick sheet.

b) Select the odd-one-out from the battens: the trailing edge fitting is flat rather than forked, lay this one aside for the cabin roof.

c) Select a typical batten and draw around it onto a large sheet of paper, to make a template for checking the batten profiles later should this be required after repairs etc. .

d) Check the battens and their fittings for any sharp edges which might damage the coverings.

Smooth the ends with glass paper or similar if necessary.

Polishing the battens with car wax makes them slide in more easily, but on no account do this for aircraft with Dacron coverings if you intend to paint or lacquer the aircraft, the reaction will not be a pretty sight!

e) With two people remove the wings from the fuselage.

Remove the lift struts from the wings followed by the fuselage, then remove the wings from the fuselage and lay them down flat in a very clean place.

Do not place the wings on concrete as it will scuff the cloth when you cover the frame.

f) Apply a layer of clear, thin, lightweight self-adhesive plastic film, such as Fablon, to the leading and trailing edge tubes and wing tip tubes where they touch the covering.

Do not skip this step! *This prevents vibration from abrading the anodising, which can then cause unsightly stains visible through the covering.*

To save weight just apply the film where the cloth can touch the tubes. If desired to increase resistance to corrosion it may be applied to the whole circumference of every tube, which will protect these difficult to clean areas.

Do not use thick, heavy tape, such as prop tape or gaffer tape, as this adds too much weight, is too grippy, and can look horrible!

g) Thicker tape should be applied only to the U-brackets at the wing tips to prevent chafing of the coverings.

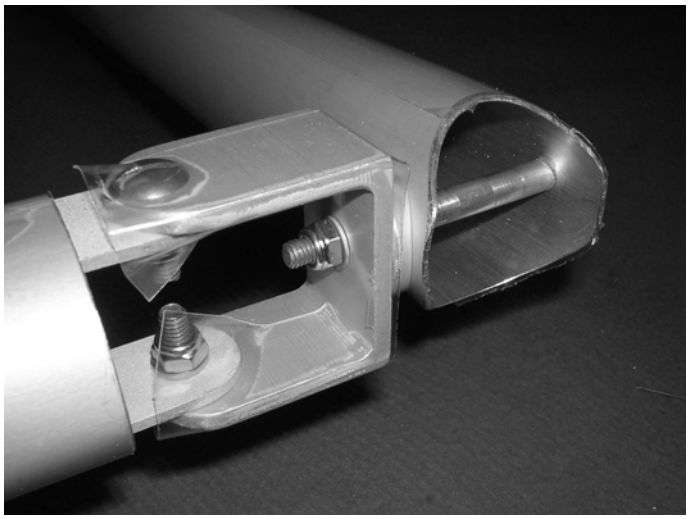


Figure 165; prop tape over wing tip U-brackets to prevent chafe.

h) Lay the wing cloth on the clean surface, next to the frame, with the lower surface of the wing upwards.

The lower surface is the one with the zips.

Take care when handling the coverings to keep your hands (and any tools etc. you may handle) clean at all times.

i) Remove the turnbuckle from the drag cable.

Make sure that the cable with the turnbuckle is over the top of the fixed cable.

j) Remove the compression tubes ***tu38***, the innermost cross-tube in the wings.

k) Insert only the upper surface (curved) outermost (tip) batten, but leave an inch or two still poking out of the rear of the batten pocket.

It will be found to be very tight if inserted later, with a risk of ripping the batten pocket.

Figure 166; slide the wing frame into the covering.

l) Collapse the wing frame using a scissor type motion so that it will slip easily into the fabric envelope of the wing, Figure 166.

The trailing edge has the most fittings on it, so scissor the wing to insert the trailing edge first.

m) Slide the frame of the wing into the cloth taking care not to damage the fabric with any of the fittings attached to the frame.

Keep track of the turnbuckle, tie a bit of string to it if necessary.

n) Use the same type of scissor motion to expand the frame back to its original shape.

Make sure that the fittings for ailerons, and flaps, as well as the strut attachments, exit through their respective holes in the fabric.

o) Stand the wing up with the trailing edge on the clean surface, and the leading edge up.

p) Attach a small rope through the grommet on the leading edge so that you can use a bar to press against the leading edge of the frame to stretch the fabric into place, Figure 167.

You may need to use a bar and pry against the leading edge tube, being careful not to damage it. Note the piece of wood to protect the tube end in the photograph.

Check that the fabric is properly seated at the tips of the leading and trailing edges. It should be nice and snug, with no wrinkles near the tip. If prop tape or similar has been incorrectly used it is possible that it will grip the fabric and prevent it sliding down the leading edge, causing difficulties later.

Figure 167; pulling the fabric into place.

q) Tighten the bolts on the compression tubes ***tu38***.

r) Install the compression tube ***tu38*** by placing the end without the bolt over the round spacer on the trailing edge of the wing frame. Put the other end over the aluminium cam, and push the strut into place.

The cam should pop straight when the tube is pushed into place. It may be necessary to apply a sharp tap, or to use a blunt screwdriver to push the cam straight. There is no need to bolt the cam in place.

Ensure that the two large holes on the compression tube are facing the fuselage end of the wing.

The technique shown in Figure 168 may be of use. Or maybe not…! Wear a glove to clout the screwdriver, and note the broom handle inserted into the trailing edge being held down by a strategically located foot, whilst the leading edge is lifted upwards by the arm holding the screwdriver.

Figure 168; fitting the compression tube.

s) Lay the wing flat on its lower surface.

t) Replace the turnbuckle on the drag cable and tighten by hand until the other cable comes taught, which may require some effort.

The cable with the turnbuckle goes over the other cable.

If the cable without the turnbuckle will not tighten up, check that the covering is properly seated along the leading edge.

u) Install the two large diameter battens (***tu186*** curved, ***tu87*** straight) at the wing root end of the wing covering, Figure 169.

They are inserted through the holes at the trailing edge of their pockets (look closely, they are there), not through the holes further forwards.

Push the battens in as far as they will go and slip them into the wing root side of the pocket so that they are held securely in place.

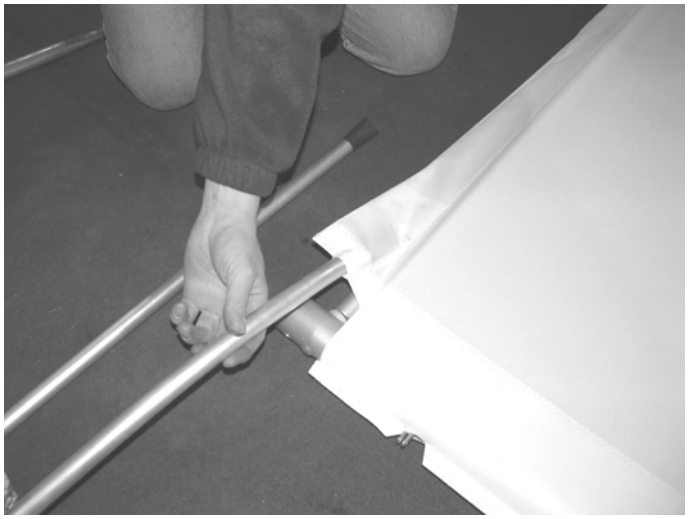


Figure 169; large diameter wing root battens.

v) Install the two wing tensioning tubes (***tu32*** and ***tu33***) against the outboard side of the large diameter battens.

Cut the ends of the tensioning tubes at an angle, on the sides opposite the holes, and finish them nicely. This prevents them cutting into the fabric.

They will fit into the holes cut in the fabric for this purpose. The longer end of the tensioning tubes goes uppermost. The holes cut into these tubes must clip over the battens, and the threaded rod must enter the holes in the compression tube, Figure 170.

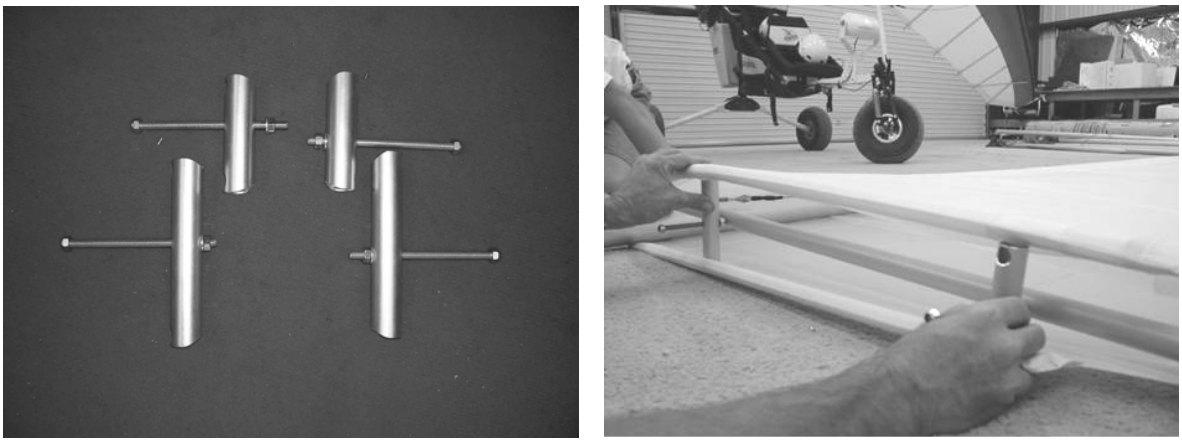


Figure 170; tensioning tubes.

w) Tighten the wing tensioning tubes against the compression tube by turning the threaded rod.

To turn a threaded rod, put two nuts on the end and tighten against each other. Turn the rod with a spanner on the outermost nut, whilst holding the nut behind the tensioning tube with another spanner.

The threaded rod will push against the compression tube and tension the fabric.

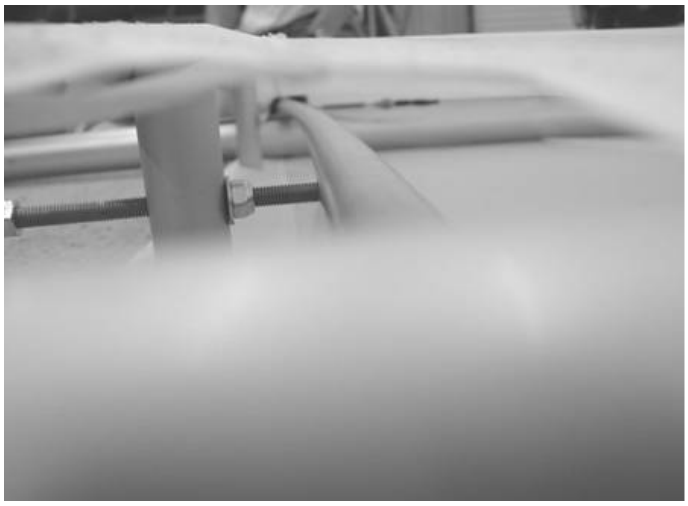


Figure 171; compression tube bowing.

x) Tension the fabric to the point that you see the compression tube bowing, Figure 171.

There should be around a 4cm gap between the compression tube and the vertical wing tensioning tubes.

This should result in the bow in the compression tube being no more than the diameter of the compression tube. You can check by placing a straight edge along the compression tube and measuring the space in between.

y) Check that the cables in the wing are still taught, tighten if necessary, then secure the turnbuckle with safety wire.

z) Use the rope that you have attached to the leading edge of the fabric to pull the fabric tight in the same manner as before.

Look for the wrinkles just near the leading edge-root section of the wing. Tension the fabric with the rope until you see these wrinkles pull out. This will require a good firm pull.

aa) Whilst holding the tension on drill a hole through the centre of the grommet and secure the fabric in place with a 4mm or larger steel rivet and a washer.

Alternatively a stainless steel countersunk screw can be used.

Remove the string before the final rivet pull or screw turn.

bb) Leave a nut on the end of the threaded tensioning rods and cut off the remaining thread, then finish nicely with a file.

cc) Measure the distance from the fabric to the end of the leading edge and make both wings the same, otherwise it will look odd when aligned with the cabin doors.

A typical measurement is around 44cm.

8.7 Inserting the Battens

a) Make sure the wing battens are clean, and insert them into the fabric to the point where their rear ends still sit on the trailing edge tube.

Get someone to steady the wing.

Start with the upper surface battens first. Begin at the tip and work your way toward the root.

Do not let the battens twist, use two hands.

Use one smooth motion to insert the batten all the way into the wing. Stopping in the middle can cause the batten pocket to rip when you try to continue.

Wear a glove on your pushing hand.

Figure 172; inserting a batten. Use your other hand to prevent the batten twisting.

b) Once each wing batten is in place, use a screwdriver to slip the fabric flap over the end of the batten, then slide the batten sideways into the pocket in order to secure it in position.

Figure 173; secure the battens in position.

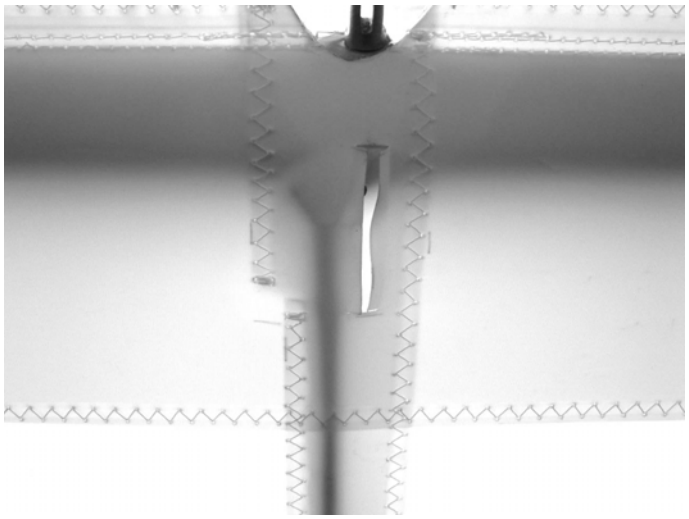


Figure 174; batten end.

c) Next do the same with the lower surface battens.

d) After the fabric has settled for a few weeks, any remaining minor wrinkles can be taken out using a heat gun to shrink the fabric. Great care must be taken not to burn the fabric!