avian
Hang Gliders

EVO 3 140

Owner's Manual

BHPA certificate of airworthiness

Numbers

Evo 3 140 Race (Mylar / Matrix):

Serial Number

.....

Before flying your glider please read this manual completely, check all your battens against the batten profile (adjusting them if necessary) and do a thorough pre-flight check.

AVIAN LTD.

Stretfield

Bradwell
Hope Valley
S33 9JT
UK

Tel (01433) 621308
Fax (01433) 621753
E-mail: avian@hanggliding.co.uk
www.hanggliding.co.uk

Table of Contents

TABLE OF FIGURES 4
TABLES 5

SECTION 1: USING YOUR AIRCRAFT 6

INTRODUCTION 6
RIGGING (QUICK GUIDE) 7
RIGGING THE EVO 3 7
PRE-FLIGHT CHECK-LIST 11
FLYING THE EVO 3 13
POST FLIGHT INSPECTION 14
DE-RIGGING 14
VB (VARIABLE BILLOW) 16
VB MAINTENANCE 16
BATTENS AND BATTEN PROFILE 17
TUNING INSTRUCTIONS 18
MAINTENANCE 23
REPAIR 25
COMPONENT LIFE 25
TRANSPORTATION 25
TRANSPORTATION BY AIR 27
STORAGE 27
TROUBLE SHOOTING 28
WHAT SPARES SHOULD I TAKE ON HOLIDAY? 30
LOSING THE KINGPOST- WHAT IT MEANS TO YOU 30
OWNERSHIP 32

SECTION 2: TECHNICAL DETAILS 33

SPECIFICATIONS 33
OPERATING LIMITS 33
RIGGING 35
RECOMMENDED COMPONENT LIFE 36
STANDARD FACTORY SETTINGS 36
STANDARD BATTEN TENSIONS 36
CHECKING VELCRO LENGTHS 37
STANDARD TIP CAP SETTINGS 38
CHECKING WASHOUT 40

SECTION 3: ASSEMBLY DRAWINGS 42

NOSE ASSEMBLY 42
CROSS TUBE CENTRE JUNCTION 45
CROSS TUBE LEADING EDGE JUNCTION 46

TABLE OF FIGURES

FIGURE 1: TENSIONING THE GLIDER 8
FIGURE 2: VB. TRAVEL SET-UP 17
FIGURE 3: MEASURING WASHOUT HEIGHT TO BATTEN 20
FIGURE 4: CHECKING BATTEN TENSION 22
FIGURE 5: HANG POINT STARTING POSITION 34
FIGURE 6: VELCRO TAB LENGTHS 38
FIGURE 7: TIP CAP SETTINGS 39

FIGURE 8: MEASURING WASHOUT HEIGHT TO BATTEN END 40
FIGURE 9: CHECKING WASHOUT HEIGHTS 41
FIGURE 10: NOSE ASSEMBLY 42
FIGURE 11: CROSS TUBE CENTRE JUNCTION 45
FIGURE 12: CROSS TUBE – LEADING EDGE JUNCTION 46

TABLES

TABLE 1: RIGGING COLOUR CODING 35
TABLE 2: STANDARD BATTEN TENSIONS 36
TABLE 3: VELCRO TAB LENGTHS 38

Section 1: Using your Aircraft

INTRODUCTION

Congratulations on your purchase of an Avian Evo 3 140. The Evo 3 140 represents the state of the art in high performance, kingpost-less design. We hope that you will experience many hours of safe and enjoyable flying on your new hang glider.

This manual is designed to help you get the most out of your Evo 3. Please read this manual completely before flying, check all your battens against the batten profile (adjusting them if necessary) and do a thorough pre-flight check including checking the operation of the VB.

Please make sure your first flight on your new glider is in perfect conditions from a site that you are familiar with. If you are uncertain, or have any problems with your glider, **DO NOT FLY**. We have a section on trouble shooting in this manual that features some of the more common problems that pilots have encountered, and our recommended solutions. If you are still not sure contact your local dealer or the Avian factory.

Please pass on this manual to the next owner of your Evo 3 140.

PLEASE NOTE:

Avian Ltd does not have commercial product liability insurance.

Avian hang gliders are built using materials and fittings to the industry standard or better. Avian hang gliders are subject to Avian quality control and testing prior to delivery to the customer.

Once possession of the glider passes to the customer, its maintenance and condition becomes the responsibility of the owner or pilot. Any concerns or queries about the glider's subsequent airworthiness MUST be referred back to the local dealer or the Avian factory.

Hang gliders must be:

- stored correctly
- treated with respect
- checked before take off and after heavy landings
- flown within their flight envelopes
- regularly maintained

Failure to do any of these courts disaster.

Look after your aircraft!!

RIGGING (Quick Guide)

It is recommended that you read this manual in full before flying this aircraft. If you are fortunate you may be shown how it flies and how to rig it in person by the previous owner or your Avian dealer.

For Rigging the main points to remember are:

1. Put the nose batten on its location before opening up the wings.
2. Put the battens in the sail but do not tension them.
3. Pull back the cross tube tension and put in the safety ring before tensioning the battens.
4. Gently push the battens fully home and then tension them.
5. Zip the washout rods in place.
6. Do a very careful and thorough pre flight check. (See this manual.)

RIGGING THE EVO 3

The glider can either be rigged flat on the ground, or with the glider supported on its control frame. The latter should only be attempted in light wind conditions but is useful in confined spaces or where the terrain is likely to cause soiling or damage to the sail.

Flat rigging

1. Lay the glider on the ground with the nose pointing into wind. Unzip the bag and roll the glider so it is the right way up. Take the bag off. (If you tread on the inside of the bag any dirt that you get on it will be transferred to the glider when you put the bag on later.)

2. Take off the glider ties and remove the battens from on top of the sail.

3. Place the nose batten on its location fitting at the front of the keel. (This is difficult to do when the glider is fully rigged.)

4. Making sure that you do not lift the tip high above the ground (to ensure that you do not bend the nose plates), move one wing out a little then the other. It is important to move both wings out slightly (the tip less than 1m) before moving through larger arcs. (The reason for this is that the geometry of the cross tubes does not allow one wing to be pulled out far without the other moving. If you do this when the wings are nearly parallel the leverage you exert is very high. It is possible to put very high loads where you might not at first imagine, bending the nose plates and worse.) Continue until both wings are about three quarters of their maximum travel. If there is any resistance, stop and check to see what is causing it. Free the problem before continuing. Do not attempt to force the wings apart. Lift the wing preferably by the wing tip or by holding under the leading edge. (If you must use the sail hold it by the batten pocket ends on the trailing edge. (To try and minimise trailing edge wear.)

5. Remove the tips socks and unroll the wing tip of the sail.

6. Put the bottom bar on and insert the two stainless pins from the back of the base bar and fit the safety rings. PUT THE RINGS IN IMMEDIATELY. DO NOT LEAVE IT UNTIL LATER. Thread the VB cord through the cleat on the base bar. Tie a 'stop' knot 5 cm from the end of the cord to prevent it being lost up the upright.

7. Lay the battens on the ground and pair them up, red with green, and check that corresponding batten pairs have the same profile. This is a good habit to get into as it will reduce the chances of taking off

on a glider with a turn caused by asymmetric shaped battens. (Periodically the battens should be checked against the batten profile and re-profiled if necessary. Do not forget to check the nose batten.)

8. Insert the battens smoothly starting with the outer (No. 11) curved batten. Insert the batten in the batten pocket second from the tip. (The outer-most pocket is for the compression strut which is inserted later in the rigging sequence.) Insert the other battens working from the tip towards the centre root of the sail. On a new glider a little silicon spray on the batten ends will help them slide in smoothly. Keeping the trailing edge low and slowly easing the battens into their respective pockets will help increase batten pocket and sail life. If the batten will not slide easily into the pocket, move the sail and try again. Do not force the battens in as it may damage the batten pocket Do not tension the battens at this stage.

9. The glider can now be tensioned: First make sure the side wires are not caught around the battens. Then remove the split ring from the special bolt located through the rear of the keel tube. Using the attached cords initially and then holding the webbing, pull the cross tube restraint webbing back. Check that the cords are not twisted. Locate the stainless tang over the stub of the bolt and replace the split ring. PUT THE RING IN IMMEDIATELY. DO NOT LEAVE IT UNTIL LATER. If the tension feels too tight stop and see what is causing the problem. DO NOT JUST FORCE IT. (Consult the trouble shooting area of this manual for possible causes.)

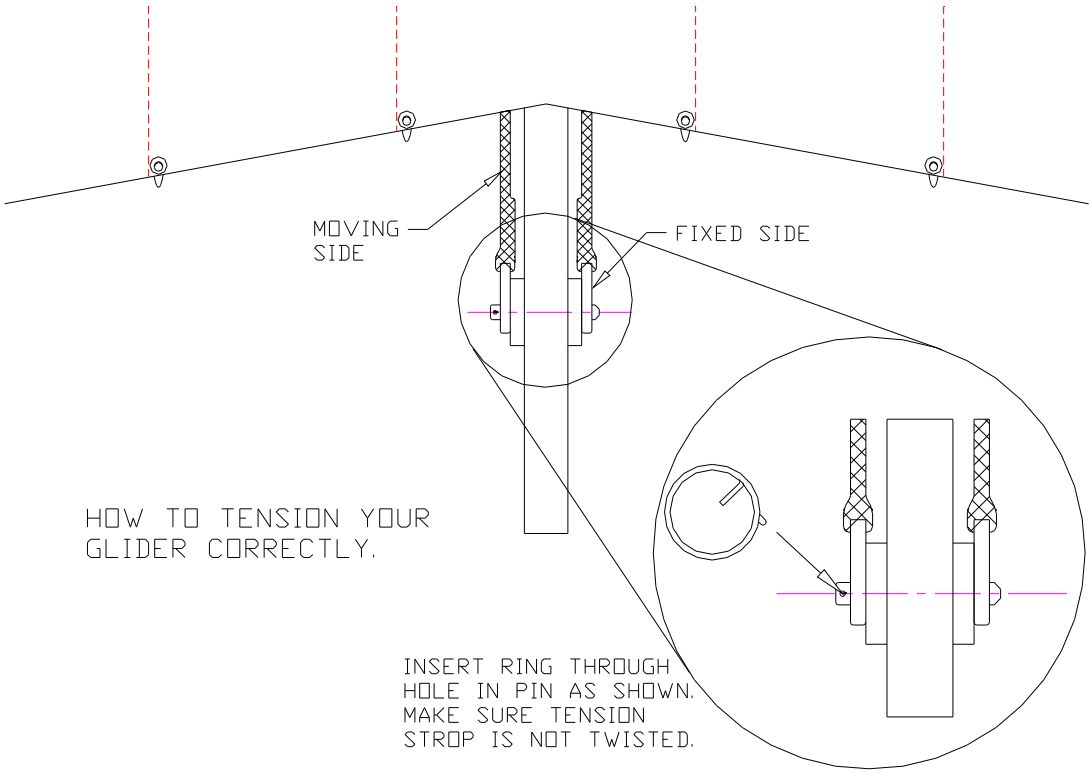


Figure 1: Tensioning the glider

10. Push the battens home the last little bit. With a new sail the battens may need a little push to go fully home. The batten ends can then be snapped closed. The snap battens all snap in the same direction except batten 11 which snaps in the opposite direction. Do not alter the tension of the snap batten ends by turning the fitting. (See tuning.)

11. The compression strut (batten No 12) nearest the wing tip can only be inserted when the glider has been tensioned. It slides into its batten pocket and the front end locates on a plastic cleat on the leading edge. This batten or compression strut is profiled on the Evo 3. Like all the other top surface battens the curve should be up. (The top surface of the wing should be convex, not concave.)

12. The under surface battens should also be inserted when the glider is tensioned. They should be pushed home so that only the rope projects from the batten pocket. Put the most outboard under surface batten in first. The under surface battens can be pushed home with another under surface batten.

13. Lift the trailing edge of the sail near the tip and rotate the washout rods into position. Check that the support wires are not rotated around the washout rods. Zip up the under-surface zips. When the zips are fully done up the washout rods are prevented from folding back alongside the leading edge.

14. Please note the VB must be fully off. It should not be pulled on if the glider is laid flat on the ground. To do so could over tension the side wires, bend the tangs, stretch the speed bar etc. The glider should be stood on its control frame before operation of the VB is checked.

15. Make sure that the wires are not twisted, then stand the glider on its control frame and attach the swan catch, pip pin and safety washer. When lifting the nose of the glider it can be held by the webbing hold on loop while attaching the nose wires. This is useful in windy conditions.

16. Make sure that the nose catch is correctly attached and then put the nose cone on.

17. If flying with wing tip fairing they should now be fitted: Put the tip inside the sail and attach the top Velcro. Lift the trailing edge of the wing tip slightly until the under-surface is as tight as it will be in flight. Velcro the lower surface to the tip fairing. When the trailing edge is released there may be some looseness at the front of the under-surface at the tip. This looseness will disappear in flight. Check for symmetry of fitting of both wing tip fairings.

18. Tuck the padding at the top of the uprights into the double surface of the sail.

19. The glider is now fully rigged. You should now make sure that you do a thorough pre-flight check before you fly.

20. We suggest that if there is significant wind that the glider is left flat on the ground, nose into wind and securely weighted or tied down at the nose until you are ready to fly. In light winds the Evo 3 may be left standing on its 'A' frame tail into wind- but be wary of gusts of wind, thermals and dust devils. Keep a close eye on it.

<u>Rigging on the A-frame</u>

1. This is useful in confined spaces or where the terrain is likely to cause soiling or damage to the sail.

2. Lay the glider on the ground. If there is any wind the nose should be pointing cross or down wind. Unzip the bag and take off enough ties to remove the battens and assemble the A frame.

3. The nose batten should already be in the sail. Move its front end onto its plastic location at the front of the keel.

4. Assemble the A frame. Put the bottom bar on and insert the two stainless pins from the back of the base bar and fit the safety rings. PUT THE RINGS IN IMMEDIATELY. DO NOT LEAVE IT UNTIL LATER. Thread the VB cord through cleat on the base bar. Tie a 'stop' knot 5cm from the end of the VB cord.

5. Stand the glider on its A-frame. Take the bag and remaining ties off and remove the battens from the top of the wing. Check that the glider is positioned correctly relative to any wind and that it can be secured in its current location when fully rigged.

6. Making sure that the wires are not kinked, attach the nose swan catch, pip pin and safety washer.

7. Remove the last of the ties and open the wings slightly. Walk the wings out to about three quarters of their full extension. As before the wings should ideally be walked out together. If you are rigging by yourself move alternate wings gradually apart.

Please note:

Whilst spreading the wings, particularly when the glider is standing on its A frame, it is essential that the leading edges and keel are kept in the same plane. (This is to avoid distortion to the nose plates or any other components.)

8. Take care to place the tips on a piece of ground that is not likely to cause them damage. Leave the tip socks on as this will protect them. The glider should now be standing on its A frame, wing tips and keel.

9. Push the tip socks down the leading edge so some more of the sail is released but leave the sock at the end to protect the sail.

10. Lay the battens on the ground and pair them up, red with green, and check that corresponding batten pairs have the same profile. This is a good habit to get into as it will reduce the chances of taking off on a glider with a turn caused by asymmetric shaped battens. (Periodically all the battens should be checked against the batten profile.)

11. Put the curved battens in their pockets working from the centre cord towards the tip. Keep the trailing edge low and slowly ease the battens into their respective pockets. Do not put in the last four battens Leave the tip socks on.

12. Make sure you have opened the wing as far as possible. Tensioning the glider is made easier with the help of a friend. Get him or her to lift a wing tip, thus opening the wings out further. Tensioning is then easy.

13. The glider can now be tensioned. Remove the split ring from the special bolt located through the rear of the keel tube. Using the attached cords initially and then holding the webbing, pull the cross tube restraint webbing back. Check that the cords are not twisted. Locate the stainless tang over the stub of the bolt and replace the split ring. PUT THE RING IN IMMEDIATELY. DO NOT LEAVE IT UNTIL LATER. If the tension feels too tight stop and see what is causing the problem. DO NOT JUST FORCE IT. (Consult the trouble shooting area of this manual for possible causes. See diagram in flat rigging section.)

14. Take off the tip socks and unroll the sail. The last few battens can then be inserted in their pockets.

15. The compression strut (batten No. 12) nearest the wing tip can only be inserted when the glider has been tensioned. It slides into its batten pocket and the front end locates on a plastic cleat on the leading edge. This batten or compression strut is profiled on the Evo 3. Like all the other top surface battens the curve should be up. (The top surface of the wing should be convex, not concave).

16. Push the battens home the last little bit. With a new sail the battens may need a little push to go fully home. The batten ends can then be snapped closed. The snap battens all snap in the same direction except batten 11 which snaps in the opposite direction. Work from the tip (No. 12 compression strut) towards the centre. Do not alter the tension of the snap batten ends by turning the fitting. (See tuning.)

17. If not already in place, locate the nose batten on its seat just in front of the nose plate. (Some pilots only remove the nose batten occasionally to check its profile.)

18. Lift the trailing edge of the sail near the tip and rotate the washout rods into position. Check that the support wires are not rotated around the washout rods. Zip up the under-surface zips. When the zips are fully done up the washout rods are prevented from folding back alongside the leading edge.

19. The under surface battens are more easily inserted once the glider has been tensioned. They should be pushed home so that only the rope projects from the batten pocket. Put the most outboard under surface batten in first. The under surface battens can be pushed home with another under surface batten.

20. Double check that the nose catch is correctly attached and put the nose cone on.

21. If flying with wing tip fairing they should now be fitted: Put the tip inside the sail and attach the top Velcro. Lift the trailing edge of the tip until the under-surface it tight as it will be in flight. Velcro the lower surface to the tip fairing. When the trailing edge is released there will be some looseness at the front of the under-surface at the tip. This looseness will disappear in flight.

22. The glider is now fully rigged and you should now make sure that you do a thorough pre-flight check before you fly.

PRE-FLIGHT CHECK-LIST

Detailed pre-flight checks must be carried out during rigging. If your glider has travelled on an airline we recommend an even more thorough check including getting inside the sail to check all the main tubing very closely. Always use the same rigging and packing procedure which will help to eliminate mistakes. After rigging, a pre-flight check should always be carried out. The following must be checked:

1. First stand back and have a good look at the glider. Have you missed anything really obvious like forgetting to tension the glider or put the nose cone on. Does the glider look symmetrical? It should.

2. All tubes are straight and not dented. Any damage to carbon spars should be very closely inspected. A small dent is very serious damage. (See: The Nature of Carbon Fibre page 31.)

3. Nose plates and A frame fittings OK. All bolts, nuts and screws secure.

4. Check that all washout rods are deployed and correctly positioned under the span-wise battens.

5. Check that all sail seams are intact with no frayed stitching, particularly in high stress areas. (e.g. wing tips, junction of keel pocket and sail etc.)

6. Check that the wing looks symmetrical with the correct shape. The battens should be correctly shaped and undamaged. The washout should appear even on each wing. If not do not fly, find out why and correct before flight. (See TROUBLE SHOOTING page 28.)

7. All nuts and bolts secure.

8. All quick release fittings secure:

- Cross tube tensioner.
- Nose catch (check the clevis pin and split ring as well).
- Tip compression struts correctly located on the leading edge.

- Quick pins and rings secure on bottom bar.
- Outboard leading edge section fully engaged. (Be especially vigilant if the L/E has been short packed recently.)

9. Cross tube tensioner strop not frayed and twist free.

10. Batten tensions symmetrical on both sides of the glider.

11. Hang loops in good condition, connection to hang point pivot arm secure and pivot arm rotated perpendicular to the keel.

12. Unzip the under surface and check the centre junction. With your fingers check that the cross tube centre bolts are secure. Check that all webbing loops are in good condition. Sight down the cross tubes and check they are undamaged.

13. Check the four nose plate bolts are secure.

14. Walking along the length of the leading edges feel with your fingers to check that they are free from dents. Check that there is a similar leading edge curvature on both leading edges when looking down the inside of the wing from the nose towards each wing tip.

15. Check through the inner washout rod zip to ensure that the wing wire and cross tube leading edge bolts are secure. Looking the other way also check that the washout rod support wires are not twisted around the washout rods. (If this is inadvertently done is will cause a bad turn.)

16. Check that the keel is horizontally straight with a slight downwards bow. Check that the tensioning strop is secure, correctly fitted and that the split ring is in place. As shown in the earlier diagram.

17. Check that the wires are undamaged. Look out for corrosion and fraying. Pay particular attention to inspection of the side wires as, in normal flight, these are the most heavily loaded. **INSPECT BOTH ENDS: THE BASE BAR END AND THE CROSS TUBE JUNCTION END. REMEMBER: IF IN DOUBT DO NOT FLY- RETURN YOUR GLIDER FOR A THOROUGH STRIPDOWN.**

18. Check operation of the VB: Pull the VB rope and check that it pulls on smoothly and releases. If it is jammed check and release if caught. With a topless glider it may be necessary to unzip the centre zip and pull the cross tube centre forwards to get the VB to release while on the ground

19. Check that all zips are done up.

20. Check that all the quick release fasteners are secure. Pay particular attention to the base bar quick pins. As the glider is moved and placed on the ground the safety rings in the base bar quick pins may contact the ground. Long grass seems most likely to cause the problem but it is possible to remove the safety ring from the pin. The problem is minimised if you put the pins in from the back of the base bar. (Thus when the glider is sitting on its keel the head of the pin will contact the ground rather than the safety ring.) Special attention should be given to checking quick release fasteners.

21. Finally have another look at the glider as a whole to check that it all looks good.

FLYING THE EVO 3

Please note the following is not meant to be an exhaustive flying manual but merely a brief note and should be read with that in mind. It is recommended that your first flight on the Evo 3, is from a site you know well, using your normal flying gear, in good weather conditions with good large landing fields. (Don't change more than one thing at a time and be very careful on your first flight.)

Takeoff

Before takeoff make sure you've pre-flighted the glider, that you are clipped in and that you have performed a hang check. Takeoff with the VB off (unless Aerotowing). On takeoff the wings should be held level with the nose slightly raised relative to the takeoff slope. A strong and committed takeoff run is always recommended. Keep the angle of attack low until you are running fast. Once sufficient air speed has been achieved increase the angle of attack gradually to takeoff. Once settled in flight, clear of the ground and obstacles, move your hands, one at a time, to a comfortable position on the speed bar.

In Flight

The control in both pitch and roll is light and precise. Accordingly the glider should be flown with moderate and precise inputs. The glider should not be flown too slow or in a semi-stalled condition as the roll response becomes much slower. The glider should not be flown fast until clear of all obstacles. Coordinated turns require a blend of roll and pitch.

Remember: if you get into a pilot induced osscilation, (PIO) slow down. Hang gliders are generally much more directionally stable when flying slowly. If you want to fly fast pull some VB on first. This stiffens the handling and makes PIO much less likely. It also makes the pitch lighter (the bar easier to pull in.)

The response of the glider at different VB settings and different speeds varies. It will probably take some practise before you are able to fly the glider accurately at all speeds and VB settings. Practising this before aerotowing the Evo 3 140 is recommended.

Stall

The Evo 3 recovers quickly from stalls but will lose height doing so. A wing close to the stall becomes difficult to control. For both these reasons the glider should be flown with sufficient airspeed close to the ground, hill or any other aircraft or obstacles.

Spin

Flex wing hang gliders are generally resistant to spin. It is very unlikely that you will ever experience a spin in normal flight (but see below, Flying with a wet glider). To recover from a spin pull the bar in and increase speed BEFORE applying opposite bank.

Flying with a wet glider

DO NOT TEST YOUR NEW GLIDER IF IT IS WET. Wet gliders do not fly nearly as well as dry gliders. This is because the water droplets on the leading edges disturb the airflow over the wing. The result is that the glider does not perform so well and stalls at a much higher airspeed, so you will not be able to fly the glider as slowly as if it were dry. You may also find that the glider stalls more easily, takes longer to recover from a stall and is more prone to spinning.

If you get caught in the rain as the glider gets wetter you will notice the above effects increase. You will have to fly faster to avoid stalling and should be especially careful when landing. We advise that, with a wet glider, you fly with a lot of extra speed when doing any manoeuvres, near the ground or other aircraft.

Landing the Evo 3

The secret of a good landing is:

- getting prepared for landing while you are still high,
- good field selection,
- followed by a precise approach with plenty of airspeed.

Always plan your landings from high up, check that the VB is in the fully released position and make sure you can get your feet out of your harnesses well before landing. Check the surrounding air for other aircraft preparing to land. Look and check that your approach and over-shoot path have as few obstacles as possible. (Never choose to land immediately behind other gliders or obstacles but land to one side. You'll make a lot more friends!)

POST FLIGHT INSPECTION

After landing, especially if heavily, the glider should be inspected as outlined in the pre-flight inspection.

DE-RIGGING

Remember good de-rigging and packing of your glider will dramatically increase its life.
De-rigging is largely the reverse of the assembly sequence:

De-rigging the glider flat

Lay the glider flat on the ground and into wind. Remove the wing tip fairings.

Unclip all the battens and remove the compression struts and under surface battens.

Unzip the washout rod zips and rotate the washout rods so that they are parallel with the leading edges.

Release the cross tube tension and swing the wings in a few feet. Remove the remaining battens. (Remove all the battens smoothly. Pulling battens out excessively quickly will increase wear of batten ends and batten pockets.)

Pull out the padding that is tucked inside the sail at the top of the uprights. The wings can then be closed further. (This padding is important and correctly positioning it will greatly increase the life of your aircraft.)

Place the padding around the tension bolt. Bring the leading edges in further. Dismantle the 'A' frame. Tie a 'stop' knot in the VB cord to prevent it being lost up the upright in transit. Attach the 'A' frame padding around the bottom of upright castings. When packed the side wires should come out of the top of this packing. All wires should be packed so they are not kinked.

The wing tips can then be brought together. Next the sail should be rolled and tucked inside the leading edge. One side can be rolled and retained with a tie and tip sock while the other is being done.

The battens can be stowed at the front of the glider between the leading edges with the curves over the nose section. The ties can then be placed round the glider holding the leading edges neatly together. Place the glider bag over the glider and then turn the glider on its back.

Put the speed bar in its bag and place it in the sail near the wing tip. Any remaining ties should be put around the glider. Tuck the nose cone under the tie near the nose of the glider.

Zip the bag up and store the glider dry, in a cool, dry and dark place.

De-rigging the glider upright on the keel

This is useful in confined spaces or where the terrain is likely to cause soiling or damage to the sail. It is essentially the reverse of rigging the glider on the keel:

Put the glider keel down and tail into wind. Remove the wing tip fairings and under-surface battens. Unclip all the battens and remove the compression struts.

Unzip the washout rod zips and rotate the washout rods so that they are parallel with the leading edges.

Remove the outer 5 or 6 battens from each tip of the glider. Roll the tip of the sail and put on the tip socks. (This is so that when the cross tube tension is released the tips are covered and protected on the ground.)

Release the cross tube tension and move the wings in slightly. It might be necessary to undo the centre zip and pull the cross tubes forward a little first.

Attach the tension bolt packing. The keel remains on the ground.

Remove the rest of the battens except the nose batten.

Remove nose cone.

Bring the wings closer together. Pull the sail between the leading edge and keel so that it is all above the leading edge. Roll it carefully and tuck it inside the leading edge. One side can be rolled and retained with a tie and tip sock while the other is being done. The tip socks are long enough to contain both washout rods.

Remove the nose batten if you intend to. Put all the battens into the batten bag. Release the nose wires.

The battens can be stowed at the front of the glider between the leading edges with the curves over the nose section. The ties can then be placed round the glider holding the leading edges neatly together. Take off the ties holding the sail in place and put them around the whole glider in the normal way.

Place the glider bag over the glider and then turn the glider on its back.

Dismantle the 'A' frame. Tie a 'stop' knot in the VB cord to prevent it being lost up the upright in transit. Attach the 'A' frame padding which is located around the bottom of upright castings. When packed the side wires should come smoothly out of the top of the packing and all wires should be arranged with no kinks.

Put the speed bar into its bag and store in the sail near the wing tip. Any remaining ties should be put around the glider. Tuck the nose cone under the tie near the nose of the glider.

Zip the bag up and store the glider dry, in a cool, dry and dark place.

VB (VARIABLE BILLOW)

The variable billow (VB sometimes called variable geometry VG) is used to change the flying characteristics of the glider while in flight.

As mentioned else where in this hand book, when the glider is rigged the VB cord should be threaded through the cleat on the speed bar and knotted 5cm from the rope end. (This is a good habit to get into. The knot will prevent the end of the VB cord being lost up the upright.)

If anything is attached to the right hand rubber backed upright (the one down which the VB cord runs) it could adversely effect the operation of the VB (See 'trouble shooting'.)

For take off it is recommended that the VB is in the fully released position. (This is with very little cord sticking from the upright.) In this position the glider is easiest to turn. (You may find with experience, and especially if aero-towing, that you prefer to take off with a some VB pulled on.)

In normal flight, it is easiest to fly with the VB fully released (OFF). VB (Say 10-70cm of cord) might be pulled on in smooth conditions. This will give a better sink rate with little loss of handling.

For flying fast or for best glide performance (for example, flying between thermals) use more VB With full VB be aware that the roll rate of the glider is significantly reduced especially if flying slowly. **Do not use full VB near the ground, near other aircraft or near any other obstacle**.

For flying slowly, near the ground, near other aircraft or other obstacles, in rough air or landing it is recommended that the VB is close to the fully released position. VB off position will give the most effective roll control.

When releasing the VB, do so in a smooth manner. Do not just pull the rope out of the cleat and let go. This will give a needless shock loading to the airframe.

VB MAINTENANCE

Due to the design of the Evo 3 VB, it should be smooth and easy to operate.

To keep it this way, make sure that the ropes are clean and not twisted. Remove grit or dirt from the upright casting and replace the ropes if they show signs of wear. It is also important to keep the tension strop of the glider untwisted.

Silicon spray is a useful lubricant which will help maintain easy operation of the VB Spray it both on the keel in the area of movement of the leveller and its webbing loops and on the VB pulley in the lower upright casting.

Pay special attention to VB cord routing when changing uprights. It is possible to miss route the cord resulting in a difficult to use.

VB Set-up

The VB on your glider should be factory set. However the ropes do stretch a little and it may be necessary to adjust the ropes to retain full VB Travel.

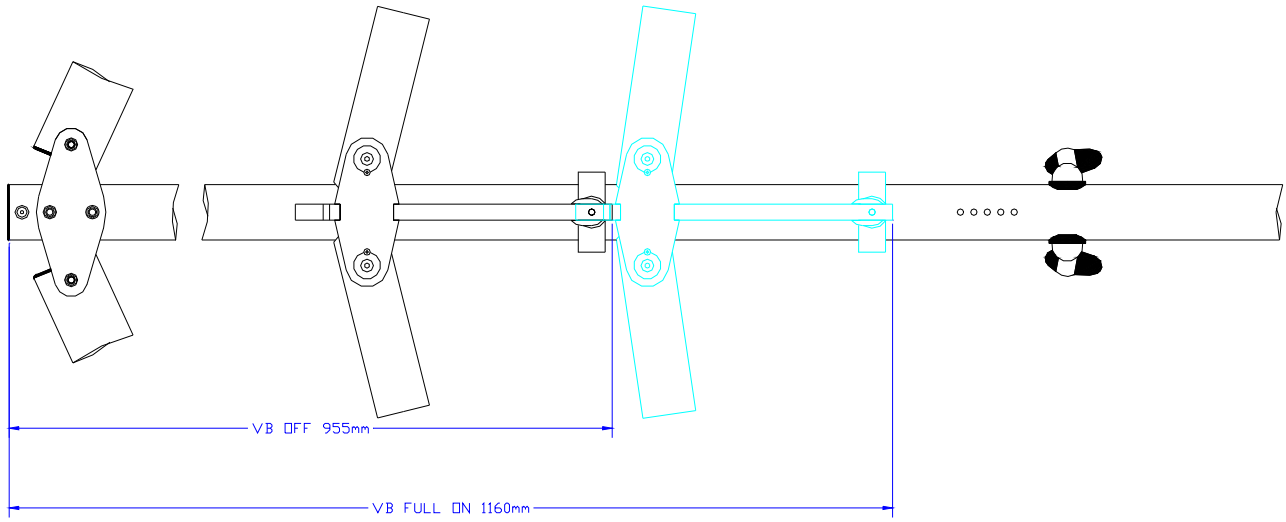


Figure 2: VB. Travel set-up

NEVER ALTER YOUR GLIDER OR VB IN SUCH A WAY AS TO INCREASE THE MAXIMUM TENSION OR REDUCE THE MINIMUM TENSION.

BATTENS AND BATTEN PROFILE

The Evo 3 battens should be maintained in the correct profile. Failure to do this could result in adverse flying characteristics. Batten profiles for all Avian gliders can be obtained from Avian Ltd. The correct profile must be used on the appropriate glider.

Batten Material

The nose batten are made from 1/2" OD 6082 aluminium alloy tubing.

All other battens are made from 10.6mm OD 7075 aluminium alloy tubing.

6082 Alloy tubing is softer and easier to bend. 7075 alloy is harder, more difficult to bend and more brittle but it holds its shape much better.

How often should your battens be checked?

At first check your battens regularly. This will give you some idea of how fast they are changing profile. The Evo 3 has 7075 battens which tend to hold their shape well. The nose is made from a softer 6082 alloy. 6082 battens tend to get harder, and hold their shape better, once they have been re-profiled a few times. On the Evo 3 the batten most likely to require re-profiling is the nose batten.

Don't forget: If you don't know how the glider has been treated while it is out of your care (for instance if it has been sent by carrier or on an aeroplane) check the battens against the profile and do a very thorough pre-flight check **BEFORE** flying.

Checking the profile

The best place to check the profile of your battens is at home on a flat surface. (It is very difficult to do on the hill with no flat surfaces and the wind blowing the paper profile away.)

The printed profile should be rolled out flat and a book placed at either end to hold it down.
The battens can then be compared to the profile.

Place green (right) number 1 batten against number 1 profile. Place the front end of the batten against the profile and check that it matches the profile along its whole length.

If it does not match the profile see where it deviates and adjust the batten accordingly in that area. (See below.) Continue this process until the batten matches the profile. Then do the same for red number 1 batten. Check that both number 1 battens are exactly the same shape. It is more important that the battens are symmetrical than that they are a perfect copy of the profile. Asymmetrical battens could cause a turn in your glider.

Move onto batten number 2 and so on until you have checked all the battens. Do not forget to check the compression strut. Also check that the under surface battens are straight.

Nose batten

The nose batten profile should not be under-cambered but can be a little over-cambered. This is because the cut of the sail will tend to flatten the batten if it is over-cambered. The objective with the nose batten is to get the sail to fit tightly around the nose area.

Batten Profile

The batten profile is printed with the profile or shape that the battens should match. The profile is printed and there may be a slight error in the length of the battens. (1-2%) Thus battens with shape at each end should be aligned with the nearest end when checking the shape.

How to alter the shape of the batten

The objective is to get a smoothly curved batten but it is not quite as easy as it looks. It is very difficult to bend the batten very close to its front end. Do not attempt to alter the profile over the first 3cm of the batten. If your battens need profiling do the 6082 battens first as they are much softer.

To increase the curve in the batten hold the batten either side of where you want to increase the curve and run the batten over your knee or leg exerting a gentle pressure. (It helps if you are wearing something slippery.) Compare with the profile and repeat if necessary. Try to avoid point bends and make sure that the bends are all in the same plane. (7075 is a hard aluminium alloy and extra care must be taken while profiling to avoid broken battens.) To reduce the curve, do the opposite of the above either over your knee or preferably by pressing on a flat surface. If you have a point bend try and remove it. Warm battens seem to be less likely to snap while bending. Putting them on the radiator briefly at home before bending should help. (However don't get them too hot as this will destroy the hardness of the batten.)

Batten Tensions

See tuning below.

TUNING INSTRUCTIONS

It is important to remember that tuning a glider is in no way meant as a remedy for a damaged glider. If your glider has been flying well and suddenly changes (e.g. after a heavy landing.) you

should thoroughly check your glider to find out what has been damaged. If you can't find a problem take it back to Avian and get the glider stripped down for a thorough inspection and all damage repaired.

Trim speed

The trim speed is adjustable by moving the hang loop forwards or backwards along the keel. Forward movement will speed trim the glider faster, whilst rearward movement will slow it down. Only move the hang loops in small increments (one hole maximum). The factory starting setting for the position of the hang loops is shown on page 5. It is important to adjust your glider to a trim speed that is safely above stall speed and comfortable for you. (Trim speed is usually in the region of 24 mph on the Evo 3 140 but remember your ASI may be calibrated differently to ours and how the glider flies is the important thing not exactly what your ASI reads.)

Tuning out turns

If your glider will not fly straight in still air without constant pilot input then it is said to have a 'turn'. If the glider will fly straight but is easier to turn one way than the other then it has a 'slight turn'.

Both are annoying and it is worth tuning your glider to fly without any preference to turn in one direction. It is useful to note when the turn is most noticeable. For example does it get worse with the VB on full?

If your glider previously flew straight then the most likely explanation for the turn is that you have miss-rigged or damaged your glider. Check the glider carefully when de-rigging to see if you can see any problems. A compression strut not tensioned on one side would give a bad turn.

If a turn is detected on a correctly rigged glider, first check the battens. Check them against each other (making sure that they are the same on both sides) and then against the profile. Next check that the batten tension is the same on both sides of the glider. (See Battens) If there is still a turn check that the leading edges are straight and undamaged.

If the glider has a turn with the VB on full but flies straight with the VB off. Then the turn is likely to be due to washout rod set up. A slight turn that gets much worse with the VB on full is also likely to be due to washout rod set up.

A slight turn that only gets slightly worse with VB on may be tuned out using the adjustable tip caps. You will require one 5mm Allen key.

The black plastic tip caps are infinitely adjustable. They have a line marked on them and there is another line marked on the leading edge. These references are used for initial assembly (See STANDARD TIP CAP SETTINGS page 38). The line on the leading edge is the datum.

To loosen the cap so that it can be turned insert the Allen key and turn anti-clockwise a couple of turns. If the cap of the Allen key starts to protrude give the key a sharp knock which will push the cap screw in. (Do not loosen too much.) It should now be possible to turn the tip with a little effort. (The tension of the sail is still pulling the cap tight into the leading edge.) When the tip is in the desired position re-tighten the Allen screw. Do not over tighten it.

The washout should only be adjusted in small increments. (MAXIMUM 1MM at a time.) The total movement should **NOT** exceed 10mm each side of the datum.

Which way to adjust the tip caps?

The wing that is lifting should have the washout increased (i.e. trailing edge lifted) while the wing dropping should have the washout reduced (i.e. trailing edge lowered). Mark the leading edge with a pencil before loosening the 5mm Allen screw so you know where you started. Make the adjustment and fly to check the result. If large adjustments are required it is very likely that the glider is damaged in some other way and a thorough examination or better still full strip-down inspection is recommended before further flight.

Washout at the tips

The washout at the tips can also be altered symmetrically, that is increase or reduce the washout on both wings. Only small changes are needed and large changes are counterproductive. A small reduction in the washout (2mm) will make the glider feel slightly lighter in pitch and show perhaps a slight increase in glide performance. In smooth air the glider handling will probably appear much the same but if a wing is lifted it will be more difficult to get down.

Movement in the opposite direction will have the opposite effect. However it should be emphasised that large movements are not beneficial.

To check the ideal tip cap setting. The glider should be flown clear of the ground and all other aircraft with the **VB** on. The under surface at the extreme tip of the sail should be just tight. (See Initial factory set up STANDARD TIP CAP SETTINGS page 38.)

Washout rod adjustment

The washout in the wing of the Evo 3 140 provides pitch stability and should NEVER be reduced beyond the C of A lower limit. (See CHECKING WASHOUT page 40.)

However sometimes the rod heights are not quite symmetrical and the glider has a turn. (If your glider had a bad turn when you last flew it, but in previous flights flew straight it was probably miss rigged prior to your last flight. See: pre-flight checks.)

A turn caused by washout rods tends to be much worse with the VB on full. It may be possible to see asymmetry but it is best to check the batten profile, batten tension and the washout heights before changing the washout rods. The glider will turn towards a high washout rod. (I.e. if a left washout rod is high the glider will turn left.)

Checking washout is outlined in the Technical Details section of this manual. (See page 40.) The easiest way is to rig the glider flat on a very flat surface *without* the speed bar. Check that the washout rods are correctly positioned. With the glider tensioned, but the VB fully OFF, the heights of the batten ends can be checked. (The nose of the glider should be flat on the ground. Make sure that nothing is lifting the keel front or rear as this will effect the readings. (e.g. The glider may be balance on a zip slider.))

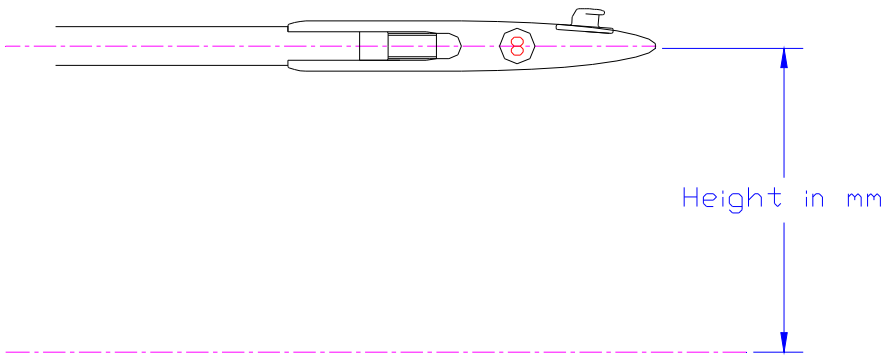


Figure 3: Measuring washout height to batten

The heights of appropriate battens can be measured with a tape measure and recorded. Check the heights for symmetry and with those in the technical details. Is the No 8 left batten the same as the No 8 right batten?

Due to the flexibility of the glider if you push the battens and washout rods down on one wing then the rods will rise on the other side of the glider. Thus it is difficult to get precise symmetry and that is why an average washout height of both sides is more relevant.

If the washout rod heights are within specification and appear roughly symmetrical but the glider still has a turn, when flown, it is possible to alter the rods: Lower the rods on one side of the glider while increasing the height on the other side of the glider by the same amount. In this way the average washout rod height remains within limits.

To alter the washout height the split ring should be removed from the eyebolt adjuster in the inner end of the washout rod. The eyebolt can then be removed from the universal joint and turned by ½ turns then replaced in the universal joint. If the eyebolt is screwed out, making the washout rod longer, then the rod is raised and visa versa. The opposite adjustment should then be carried out to the corresponding rod on the opposite side of the glider.

Small adjustments like this are permitted provided that the rod height between left and right wing does not differ by more than 20mm. After adjustment the sail should be pushed down on both sides to take up any slack and the heights checked again. Make sure all the pins and split rings are replaced before packing the glider. It is vital that the average height of both the inner washout rods and outer washout rods remain above the lower limits given in the technical details section. (Lowering the rods below this limit is likely to make the glider dangerous in pitch stability. DO NOT BE TEMPTED!)

Batten Tension

The tension pulled into the glider by the battens makes a noticeable difference to the handling of the glider. (See STANDARD BATTEN TENSIONS page 36 for the factory set-up of batten tensions.) Asymmetry of the tension particularly at the tip battens will result in a turn in the glider. (e.g. If the No 12 compression strut is tighter on the right wing the glider will turn to the left.)

The Avian clip batten system was designed to give easy rigging and easy adjustment with maximum sail life. However it should be noted that due to the easy over-centre nature of the clip it is possible to get extremely high tensions in the battens. This should be avoided as it gives not advantage and is likely to cause sail damage. Also note that a 'tension' of 2mm on a short batten is greater than one of 2mm on a long batten.

To check the batten tension the glider should be fully rigged with the VG on full.

Each batten is unclipped in turn to check the tension. The batten end should be re-clipped below the sail and then viewed from above the check the tension. It is best to work symmetrically. I.e. get the tension the same in both left and right batten number 1 then move to batten number 2 etc. To adjust the tension unclip the batten and rotate one full turn. One turn alters the tension by 1mm.

When you have the glider flying perfectly mark the battens at the end of the clip ends with an indelible pen. Thus the batten tensions can easily be returned to standard should the tension on one become inadvertently adjusted.

Other tuning should NOT be carried out without reference to Avian Ltd., or an approved dealer.

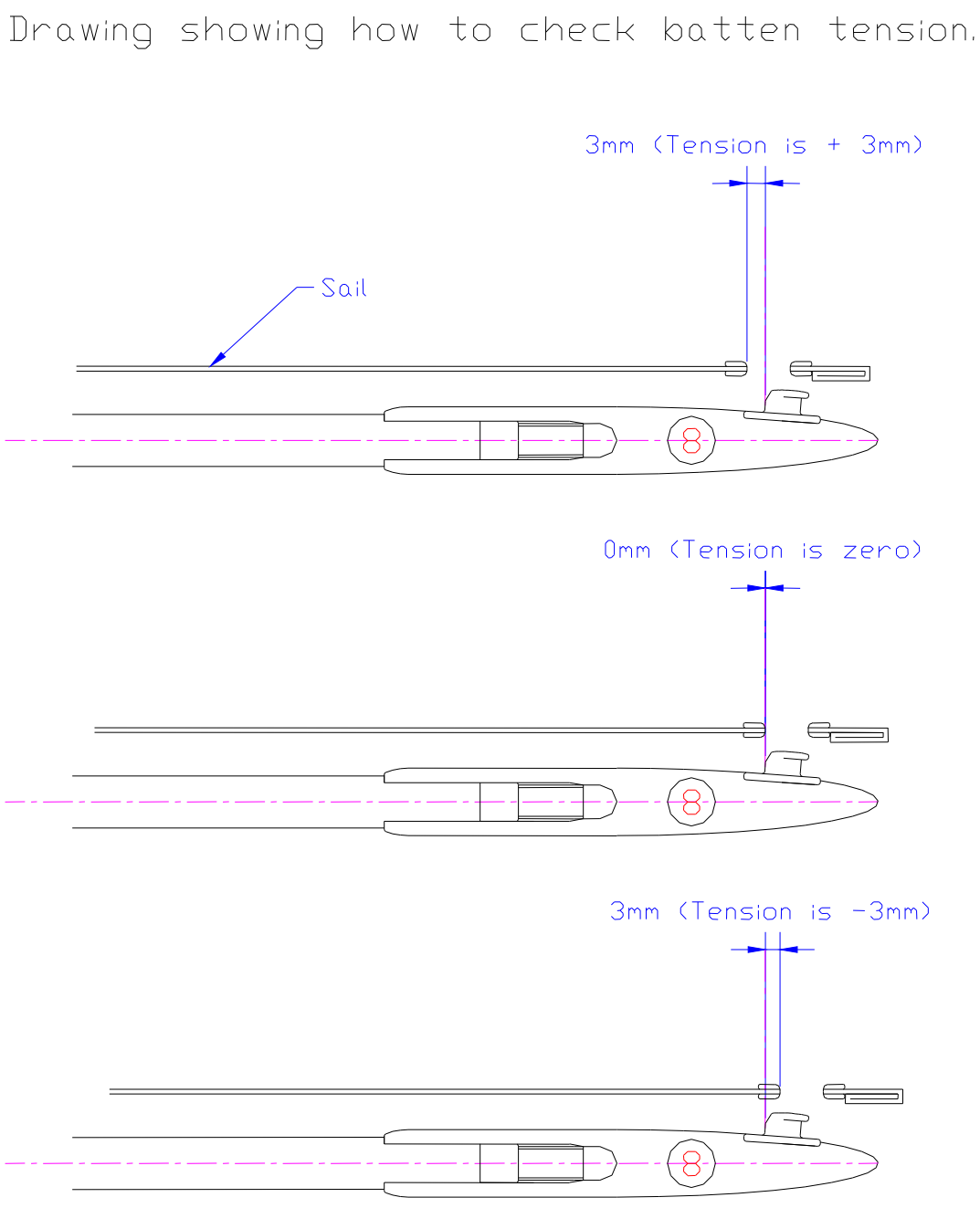


Figure 4: Checking batten tension

MAINTENANCE

Hang gliders need to be kept in good condition and a good state of tune to perform well and safely. The Technical Details section of this handbook shows the original factory settings. You can check and record the tuning of your glider or return it to its original settings. Hang gliders are NOT zero maintenance machines.

Annual strip down and factory inspection

Avian recommend that the Evo 3 has a factory inspection every year or 100 flying hours which ever is the sooner. This is a sensible precaution to take and is offered by Avian at special prices in the months of December and January. An additional benefit of the strip down is that the latest upgrades can be fitted sometimes for free.

General

Careful attention to the rigging and de-rigging sequences will reduce the risk of accidental damage. Repairs should be undertaken by the Avian factory or an approved dealer using genuine Avian spares.

The correct storage of your glider will also greatly influence its life. The glider should always be stored:

- **Well packed.**
- **Completely dry.**
- **Well supported.**
- **In a dark, cool and dry place.**

Washout Checking

It is very important that the washout rods are not lowered below the minimum settings. The washout of the Evo 3 140 is essential to maintaining good pitch stability. Thus checking the washout and adjusting if necessary is important.

Airframe Maintenance

Apart from damage caused by over stressing the glider i.e. crashing etc. the major wear and tear on the glider happens in transit.

Aluminium Tubing

Care and consideration in de-rigging and transportation will pay dividends in airframe life. Damage to any one of the structural members is serious and the only remedy is replacement. Insufficient care during ground handling or transportation can lead to tube abrasion or indentation. The former accelerates fatigue fracture and the latter reduces the strength of a component. Keep a regular watch for tell-tale hair-line cracks. Although rare, cracks are most likely to occur at dents or in high stress areas such as around bolt holes. If you bend, dent or damage the tubular members in any way, seek immediate professional advice before flying again and have replacement parts fitted.

Carbon Spars

Carbon fibre spars must be looked after carefully. Damage to them is likely to be much less obvious than to a metal tube. Any visible damage could signify serious structural damage and should be inspected by Avian Ltd. before flight.

Fasteners

Any fastener (i.e. nuts bolts etc.) which is bent or shows signs of wear or corrosion should be replaced immediately. Nyloc nuts should only be used ONCE. One clear thread of the bolt should stick out beyond the end of the Nyloc. Nuts should be tightened only so that they are snug. In most applications on a hang glider the nut is only there to stop the bolt from falling out. DO NOT OVER-TIGHTEN NUTS AND BOLTS. Over-tightening them can crush the tubes and damage the hang glider.

Rigging Cables

The main danger with the rigging lies in kinking the cable. This is usually caused by careless rigging and de-rigging or by over tightening the bolts that attach the tangs to the airframe. (It should be possible to swivel the tangs with light thumb pressure.) Once a cable has a kink the strands are damaged and replacement is the only cure. The side cables are particularly important and should receive a frequent detailed inspection. Check for cable damage along the length but the main failure area lies immediately adjacent to the swaged fitting. Look carefully for signs of strand fracture at this position. Corrosion shows itself as a white powdery deposit. Corrosion cannot be cured and the only answer, again, is replacement. Even apparently undamaged rigging wires should be replaced every 200 hours* or 2 years which ever is sooner. (See Section 2 Wires for checking age of wires.)

* For none standard wires see Technical Details. (These require more regular changing.)

Cross tube tensioner

The stitching on the cross tube tensioner is easy to see and should be inspected frequently. The rest of the tensioner strop is hidden in the sail and keel pocket so that any damage is more difficult to see. Thus do take time to inspect this thoroughly, particularly around the **VB** Pulleys and the cross tube centre junction leveller. If any damage to the strop is found (fraying, abrasions, cuts or wear to the stitching) the strop should be changed before flying.

Wing fabric maintenance

Any cuts or tears at critical areas such as the trailing edge, sail fixing points or similar high load areas, must be repaired at either the Avian factory or an Avian approved workshop. Small damage to panels, leading edge covers etc., can be repaired with proprietary self adhesive tape. We define small damage as abraded holes no more than 10mm diameter and small cuts no longer than 15mm. Anything larger should be inspected by Avian approved personnel.

Stitching Damage

Thread damage never gets better and eventually runs. If you abrade a seam or damage the stitching in any way, have the damage repaired before it gets worse. Small, non load-bearing areas can often be repaired in situ by the tedious but effective method of hand sewing back through the original stitch holes. Use a needle and only the correct polyester thread: available from Avian or most good sail makers.

Wing fabric cleaning

It is, without doubt, better to keep the wing clean than to try and clean it. Some dirt never comes off completely. With a new glider avoid getting it dirty in the first place by careful rigging and de-rigging. If you decide you do need to wash your wing, then select a dry day and have access to a good hose and clean water supply. Never use bleaches, strong soaps or detergents. The soap residue can react with ultra violet light and degrade the fabric. We recommend a very mild liquid soap (washing-up liquid) and a soft sponge. Gently wash the fully rigged wing, frequently hosing clean. Copious amounts of clean water will not harm

the wing and can be very beneficial in removing sand and grit which may get trapped inside the sail. (Usually in the nose or wing tip areas.) Removing stains from stitching is difficult. Resist the temptation of scrubbing with a stiff brush as it might do more harm than good. Ensure that the wing is completely dry before de-rigging and storing.

Battens

Battens form the wing shape and substantially influence the performance of the wing. They need treating with care and, since they are subject to constant stress both during flight and rigging, they may lose their shape. It is essential that they are checked against the template at frequent intervals and re-profiled if necessary. (See Section: Battens and Batten profile.)

REPAIR

The Evo 3 airframe is deceptively simple, but like all aircraft requires skilled and qualified attention. We do not recommend self repair or re-assembly by other than Avian or Avian nominated repair agents. No replacement parts should be fitted unless they are factory supplied and identified as such. When ordering spares always quote your glider serial number (make a note of it if you have to replace your keel. It should be recorded on the front of this manual). Bent aluminium tubes must never be straightened, always replaced. Frayed cables and cables with damaged or twisted thimbles must always be replaced.
To help you identify components some of the main assemblies are shown in Section 3: Assembly Drawings page 42.

COMPONENT LIFE

(See RECOMMENDED COMPONENT LIFE page 36) The safe working life of the structural components of the Evo 3 is dictated by the environment in which the aircraft is used and the care taken during day to day operations. Inspection, therefore, is an essential tool in deciding the continued use of most components, particularly the sail. UV exposure shortens the life of the sail, which is why it should not be left needlessly exposed to sunlight or any other source of UV radiation. A factory inspection is recommended every 100 hours or 1 year. (See MAINTENANCE page 23.)

TRANSPORTATION

The wing must always be transported inside its bag, well packed and with all the protective padding in place. The zip on the bag can be placed down to prevent entry of rainwater. During transportation, or when stored on slings, the wing must be supported at its centre and at two points not more than one metre from each end. Supports should be padded and relative movement between glider and supports must be avoided at all times. (If travelling abroad pay attention to the legal requirements for both glider overhang and coloured flags etc.)
SHORT PACKING

It is sometimes useful to short pack your glider especially for transportation by air. It is unusual to be able to take the glider full length on an aeroplane and is always best to short pack it.

Tools.

You will need a large Philips (posi-drive) screw driver and a 4mm Allen key.

The Evo 3 leading edge has been specially designed in two main sections, the inner (nose to out board of the cross tube - leading edge junction) and the outer (tip section of the leading edge). These sections can be separated for short packing - useful for transport overseas or storage.

Removal of the outer leading edge

The outer leading edge section slides inside the inner leading edge. It locates on a clevis pin which stops it rotating. The outer section can be removed without removing the clevis pin. (THE CLEVIS PIN SHOULD NOT BE REMOVED ON ANY ACCOUNT.) To take the outer section off:

Unzip the glider bag and remove the sail ties. Release the leading edge tension at the nose by unscrewing the Philips self tapping screws at the nose. The sail can then be disconnected from the end plugs using the 4mm Allen key.

Make sure the position of the Velcro ties is marked on the ties. Undo the ties closest to the leading edge. (This will allow the Mylar leading edge to be folded with less damage.)

The leading edge outer can now be pulled out. No other component should be unfastened or removed to withdraw the outer leading edge. Before removing them mark them 'left' and 'right'.

Remove the leading edges. Place a padded bag over the end of the inner leading edge. (To prevent damage to the sail cause by the end of the inner leading edge.)

Place a cylindrical object (Cardboard roll 4" diameter, roll of bubble wrap or plastic bottle etc.) along side the sail and bend the tips round. (Take care not to crease the Mylar or damage the sail on the end of the inner leading edge or by bending it round too sharply.)

Wrap and pack the leading edge outers so that they will not damage your sail.

Wrap the whole glider well to protect it against people who may not take much care of it.

Re-assembly of the glider

This is basically the reverse of removal of the leading edges:

Open the sail out and remove padding from the end of the inner leading edge.

Check the 5" lines on the inner ends of the outer leading edges. (These are marked with felt tip and give visual confirmation that the leading edge is fully engaged.)

IMPORTANT: Check that you have your outer leading edges in the correct sides. (CHECK THE MARKS THAT YOU PUT ON THEM) When the glider is rigged the location for the tip batten (compression strut) should be on the top front of the leading edge. The datum on the tip cap should be facing backwards towards the trailing edge.

Slide the outer into the inner leading edge. When almost home the leading edge should be twisted slightly until the slot engages with the clevis pin. They should then be pushed fully home. Light tapping with a mallet or something soft might be needed to slide the outer home completely. THIS IS VERY IMPORTANT AND VISUAL CONFIRMATION THAT THE LEADING EDGE OUTER IS FULLY HOME UP TO THE 5" LINE IS ESSENTIAL

Remove the self tapping screws at the nose and replace the Allen screws at the tips only finger tight.

Rig the glider. TAKE GREAT CARE TO PULL THE SAIL TOWARDS THE NOSE WHEN OPENING THE WINGS OUT. THIS IS ESSENTIAL FAILURE TO DO SO COULD RESULT IN VERY SERIOUS SAIL DAMAGE.

When the glider is fully rigged the tapping screws at the nose can be replaced. The eyelets should line up with the screw holes, though it may be necessary to rotate the sail slightly first.

Tighten the Allen bolts at the wing tips. These should only be tightened slightly so that they are not loose. Do not over tighten as it might crush the leading edge.

With a fully rigged glider working through the washout rod zip hole re-fasten the Velcro ties. Align them with their marks so they are the correct length. Check all the Velcro ties. If in doubt their lengths can be checked see CHECKING VELCRO LENGTHS page 37.

Check all fasteners especially those that have been replaced in your pre-flight check.

TRANSPORTATION BY AIR

Remember, your glider has to be loaded on and off the plane and get past the baggage handlers at both airports. (Don't forget, it also has to make the return journey.)

The object is to:

- Make the glider as short as possible.
- Protect the glider so that it will not get damaged in transit.
- Make the package as light as possible with handles so it is easy for the baggage handlers to move. (If they can't lift it they'll probably use a fork lift.)
- Minimise the damage to the sail caused by packing the glider.
- Make the whole operation simple, so that you can easily repeat the procedure for your trip home.

The type of damage you are trying to protect against

Damage through dragging the glider with one end across the floor. Protect the ends with thick cardboard or something that will not wear through too quickly.

Damage due to the glider being dropped on to an edge like a railing or the edge of a container truck. (If the whole package has some padding this helps. Bubble wrap seems to be pretty good but difficult to unpack and re-pack. You will need lots of sticky tape. Pack some for the return journey as well.

Dirt: Airports and aeroplane holds seem to be dirty places. If you've got a nice clean glider bag it won't be after a trip on the plane. Hence the use an old glider bag etc. if possible over your glider bag and packing.

Finally a cover that shows damage is quite useful. i.e. if you use a cardboard box and somebody drives a 747 over it you will be able to see the tyre marks on the box.

If you are lucky you may have a purpose made box or bag. (Avian make an armoured short pack glider bag. It speeds up the process of short packing and provides good protection. If you are making more than one trip it is a small price to pay for peace of mind. see www.hanggliding.co.uk or contact Avian.)

The vital point is that when your glider has been on a plane you must check it very carefully. Your life depends upon it!

STORAGE

The correct storage of your glider will also greatly increase its life. The glider should always be stored:

- **Well packed.**

- **Completely dry.**
- **Well supported.**
- **In a dark, cool and dry place.**

The glider should always be stored dry. The sail is made from anti-mould treated cloth but extended storage wet might never-the-less encourage mildew. Wet storage will greatly increase corrosion of the airframe wires and fasteners. Salt water will of course be many times more damaging. After flying on the coast the glider should be washed with fresh water. Always try and store your glider inside. If it is wet leave the bag open and try and open the glider out to dry properly as soon as possible. It is important to keep the glider out of the sun when not in use as exposure to UV radiation damages the sail. Use the thick bag supplied and if at all possible store in the dark.

TROUBLE SHOOTING

The tension strop gets caught

When rigging the glider and spreading the wings the tension strop should appear through the keel-pocket. If it does not, stop and check to see where it is caught rather than force it. Check for any damage to the tension strop before flying.

The tension strop is difficult to pull on

1. The tension strop might be twisted around the cross tube centre junction. When freed, inspect the strop for damage and replace if necessary. Try and keep the strop twist free.

2. The side wire is caught:

a) The side wire is caught behind a batten end or wrapped around the control frame: Release the wire, check for damage and replace if necessary.
b) The side wire is twisted at the junction with the leading edge. (The wire kinked over the tang): Release the wire, check for damage and replace if necessary check the side wire nut and bolt. (The kinking of this wire is more likely if the tang is very loose. The tang should offer some resistance to movement with light thumb pressure.)

The VB is difficult to pull on or fails to release

The VB may not release fully on the ground because of the weight of the cross tubes on the keel.

Other problems with the VB

The VB may also be difficult to pull if mud or stones get into the lower casting. Remove the obstruction.

Other problems are unusual but are most easily cured by following the VB cord until you find an obstruction. If you have recently replaced the 'VB' upright check the routing of the cord.

The wings are difficult to close when de-rigging the glider

If de-rigging on the keel the weight of the wings is transferred to the keel. This stops the cross tube junction from sliding so easily on the keel when the tension is released. (See above.) The easy remedy is to unzip the under surface and pull the cross tube junction forwards. The wings can then easily be moved inwards.

When the tension strop is released it should be pushed towards the keel pocket to feed some slack into it. This allows the wings to move together more easily. It is possible for the tension strop to get caught. Find the obstruction and release the tension strop and continue to move the wings inboard.

The glider has a turn

Check for crash damage then see tuning instructions.
Check that the washout rods are not twisted around their support wires. See Pre- Flight Checks.

The glider has become more difficult to turn

1. This can be caused by an incorrect but symmetrical batten profile. (Asymmetrical battens tend to cause turns.) The glider handling does deteriorate significantly if battens are out of profile. Check the battens (don't forget the nose batten) against the profile more regularly.

2. This may also be caused by an incorrect trim position. (The position of the hang loop.) The glider might be trimmed too slow "hands off" and be flying in a semi-stalled condition. See tuning instructions.

3. This can also be caused by 'foreign bodies' in the cross tube junction area. Remove them and check for damage.

The glider is heavy or "strange" in pitch

The glider is heavy or handling badly despite the hang point apparently being in the correct position. The backup hang loop might be caught in such a way that it interferes with the main loop when moving the bar (in or out depending on the position of the backup loop relative to the main loop.) Also check the routing of the hang loops from the rocker past the tension strop and VB through the sail. Free the backup loop so that it is loose at any flying speed. Always fly with a backup loop.

The glider appears to be trimmed too fast despite having the hang loop at its furthest rearward position

1. If you are new to the glider and have previously flown a glider which has a heavier pitch response you may actually be pulling the bar in without realising. On a smooth day, when you have a safe ground clearance and are clear of all other aircraft, slowly release your grip on the base bar and check the bar position and trim speed without putting any load on the speed bar.

2. As above this might be caused by a backup loop that is caught and interfering with the main loop when flying. Free the backup loop so that you are sure it is loose in flight.

The short under surface batten has been put in the long under surface batten pocket

You can sometimes do this accidentally if rigging quickly. If you have pushed the batten in a long way, you may have to totally de-rig to remove it.

In future always work in from the tip with the under surface battens i.e. put the shorter battens in first. In this way if you get the wrong batten it will be too long and easy to remove from the pocket.

The nose cone is lost

YOU SHOULD NEVER FLY WITHOUT A NOSE CONE. Check that the nose cone is not down the leading edge pocket of the glider. Hold the leading edge up to the light and look for the silhouette of the nose cone. For this reason do not store the nose cone down the leading edge of the glider.

The leading edge pocket appears to have black marks or other dirt on the inside

This is usually grass or other debris which has got down the leading edge pocket. Try and get is out as best you can. The problem is usually caused by the storage of the battens in the leading edge pocket which tends to fill the pockets with debris and encourages mildew. DO NOT STORE YOUR BATTENS IN THE LEADING EDGE POCKET.

The under surface appears to have black marks around the keel and centre junction

This could be caused by some leakage of lubricant from the cross tube centre junction. Clean around the area with a dry rag. Wipe marks off the inside of the sail.

WHAT SPARES SHOULD I TAKE ON HOLIDAY?

Clearly you can't know what spares unless you know what sort of damage might occur to your glider.

However based on the volume of spares sold and the price of the spares the following list is rough guide or check list in order of importance:

Spare uprights / downtubes
Spare safety split rings various sizes.
Spare top of upright bolt (Often bent at the same time as uprights.)
Spare clippy batten ends. (One for each side.)
Sticky back Dacron. (To repair minor cuts or blemishes to the sail.)

Other possibles though less frequently ordered:

Speed bar
Tip battens / batten repair kit.
Washout batten.
Spare speed bar attachment pin.

LOSING THE KINGPOST- WHAT IT MEANS TO YOU

The 'topless glider' has been developed to reduce parasitic drag and thus increase performance by removing the top rigging. This resulted in one of the largest changes in hang glider design and performance for some time.

The old style top rigging provided two things:

- The top rigging braced the airframe when on the ground or when the glider was subjected to negative 'g'.
- The kingpost provided an attachment point for the anti-luff lines which contributed to the glider's pitch stability.

These two jobs are now done by the new structure without the aid of a kingpost. This has resulted in the use of new materials such as carbon fibre reinforced plastic (CFRP), more usually seen in racing cars. CFRP is used because it provides better stiffness and strength to weight ratios than aluminium. This results in a 'kingpost less' airframe that is only slightly heavier than a standard airframe.

Strength

The most obvious requirement is the need for strong cross tubes. These carry the weight of the wings when on the ground. This load is transferred to the keel via the leveller (or cross tube centre junction).

The keel has also lost its top wire bracing so it needs to be stronger to support the loads from the cross tubes and resist downwards bending of the keel. e.g. When pulling the nose to lift the keel off the ground prior to flight.

When rigging or de-rigging on the keel the wings are held up by the cross tubes. The load exerted by the cross tubes on the keel and resultant extra friction mean that the tension is more difficult to pull on or let off. Hence the preference for help lifting a wing when rigging or the need to pull the cross tube centre junction forwards when de rigging prior to folding the wings in. Of course neither of these are necessary when rigging or de-rigging flat.

Pitch Stability

The glider's pitch stability is now provided by washout alone thus the rods for maintaining washout are very important. On the Evo 3 there are two washout rods each side. The inner rod swings out automatically when rigging. The outer must be positioned when the glider is rigged. Thus do not be tempted to alter the angles or heights of the rods. Also do not disconnect the inner rod from the sail in an attempt to make the sail easier to pack. (It will result in incorrect rigging next time.)

The Nature of Carbon Fibre

Carbon Fibre Reinforced Plastic (CFRP) or carbon fibre as it is sometimes shortened to is a composite material. It is made up of a matrix and filaments of fibre. The matrix (epoxy resin) is the material used to bind the filaments used in the composite material. The filaments used are carbon fibre. In 'hybrid' composites a mixture of fibres or filaments are used.

The idea of composites has been around for some time. Combing the properties of two or more materials can result in a composite material exhibiting 'superior' properties than either of its constituent parts.

Filaments or fibres are used as they exhibit superior mechanical properties than large expanses of the material. The two main reasons are that fine filaments can be bent around a much smaller radius than larger pieces. (Consider a fine filament of fibre glass and a sheet of glass.) The other reason is that carefully extruded filaments contain many fewer imperfections per unit length than a larger object. In materials such a glass the imperfections seriously reduce the strength.

Another property of composite materials is their *Anisotropy.* That is they exhibit different mechanical properties such as strength and stiffness along different axes. In CFRP the majority of the strength is in the direction of the fibres. This is different to metal alloys which are generally described as *Orthotropic* which means they exhibit the same mechanical properties in all directions. CFRP can be made *Quasi-orthotropic* (similar to orthotropic) by running fibres in all directions. There is often little reason to replace a metal with a quasi-orthotropic composite.

The salient point is that carbon fibre is not like metal and must be treated differently. It is much less resistant to high temperatures than metals but more corrosion resistant. However the main area of concern is the ability to detect damage in carbon fibre: a sharp blow to a metal tube is likely to result in an easily detectable dent. The same blow to a carbon fibre tube may leave a barely visible mark while significantly reducing its strength.

As a result of this commercial composite aircraft parts are designed to have sufficient strength with Barely Visible Impact Damage (BVID) and thus 'perfect' parts have enormous safety margins. Of course Avian cross tube spars are designed to the same criteria. However a small dent in a carbon fibre cross tube should be considered as much more serious damage than a similar sized dent in an aluminium cross tube. Damage such as this should be examined professionally, by Avian, before flying.

OWNERSHIP

Please pass on this manual and batten profile when selling your glider. Please notify Avian Ltd. of change of ownership and change of address. This is important so we can let the know about upgrades or in the unlikely event, recall components or gliders. (Avian Ltd's contact details are on the front of this manual.)

- Please keep a record of all work done on your hang glider.
- Please let us know of any ideas for changes that you think would improve our hand book, hang gliders or service. We are interested and would also like to hear if you have any complaints about the gliders or our service.
- We would be most grateful to receive any interesting photographs of our gliders.
- Finally we hope that you have many hours of safe and very enjoyable flying.

Section 2: Technical Details

SPECIFICATIONS

Wing span	32'	9.75 m
Wing span + wing tip fairings	32' 9"	10m
Wing area	146sq.ft	13.6 m^2
Aspect ratio	7.4	
Min sink rate	170ft/min	0.86m/s
(wing loading =	1.75 lbs./ft^2	8.5kg/m^2)
Max. L/D ratio	15.5:1 (Dependent on Harness etc.)	
Speed range*	18 - 70 mph.	29 - 113 km/h
Max. speed (VNE turbulent air)	45mph	72km/h
Max speed (VNE smooth air)	70mph	113km/h
Normal packed length	17' 8"	5.4m
Breakdown length	13' 11"	4.25m
Glider weight rigged	73 lbs.	33 Kg
Glider weight in bag	77 lbs.	35 Kg

*Speeds measured using *Brauniger Comp – GPS* vario-ASI system. (VNE: Velocity Never Exceed.)

OPERATING LIMITS

1. Minimum pilot rating

Advanced Pilot (It is also suggested that you are 'current' before flying a new model of hang glider.)

2. Manoeuvres

1. Aerobatic manoeuvres are not permitted.
2. Pitching the nose up or down more than 30 degrees from the horizontal is not allowed.
3. Do not exceed more than 60 degrees of bank
4. Do not fly the glider inverted or backwards.
5. Do not fly with auxiliary power without factory approval.
6. Do not fly with more than one pilot

3. Hang Glider Payloads

Pilot 'Clip in'	Min.	Max.
weight range	12 Stone 8 lbs.	17stone 4 lbs.
(i.e. Including kit)	176 lbs.	242 lbs.
	75 Kg	105 Kg

Pilot 'Naked'*	Min.	Max.
weight range	10 Stone 3 lbs.	15stone
	143 lbs.	209 lbs.
	60 Kg	90 Kg

*Pilot naked weight range assumes a 'normal' 15kg of kit. (If in doubt weigh all your flying kit.)
For this example: Pilot 'Naked' weight + 15kg = Pilot 'clip in weight'

4. Hang Point Position Range (Pitch trim)

(See diagram below.)

The hang loop is attached to the keel via a 'rocker'. It is important that if the hang loop is re-fitted (for example a new length hangloop is fitted) a note of the original position should be made first. The backup loop must be attached as well as the main loop. A new Nyloc nut should be used. The position of the rocker can be changed by moving the base of the rocker clevis pin (without removing the main hang loop bolt) forwards or backwards one hole at a time. (See Tuning; pitch trim.)

Max. forward position 1325 mm
Maximum rearwards position 1375 mm
Measure this distance, do not count the holes or guess.
(Distances are measured from the front of the keel *without* plastic bung to centre of hole in keel.)

Please note:

The recommended starting position is **1350 mm** from the nose. (See also wing tip fairings section.) The first flight should be in perfect conditions. If the hang point position needs to be changed move by only one hole (12.5mm) at a time.

5. Hang Point Recommended Starting Position

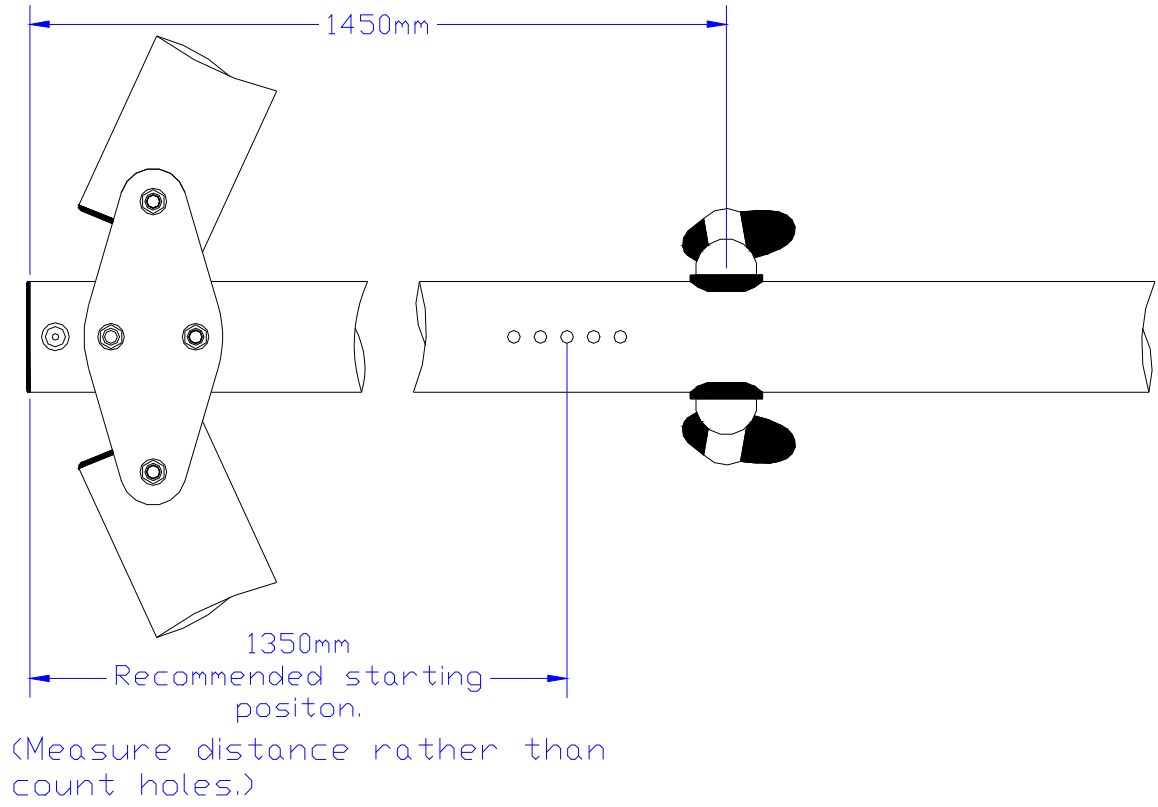


Figure 5: Hang point starting position

Measure this distance, do not count holes or guess.

RIGGING

Colour Coding.

Avian rigging wires are colour coded so that you can check the approximate that age of the wire. The wires have a small coloured patch on one of the ferrules sealed in with heat shrink protection. If they heat shrink is missing the wire should be replaced immediately. (The heat shrink provides support to the wire where it emerges from the ferrule to reduce flexibility and thus reduce wear in this most vulnerable area.)

Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Grey	White
0	1	2	3	4	5	6	7	8	9
	2011	2012	2013	2014	2015	2016	2017	2018	2019

Table 1: Rigging colour coding

Replacement interval

Normal rigging wires (2.5mm OD 7 * 7 galvanised wire rope covered to 3.3mm clear PVC.) should be replaced every 200 hours or 2 years. (See also COMPONENT LIFE page 25)

Competition thin lower rigging (2mm OD 1 * 19 and 2mm OD 7 * 7 galvanised wire rope.) should be replaced every 50 hours or more frequently.

Thin Lower Rigging

Only For Competitions!

These wires are slightly thinner than standard wires and they have no protective plastic covering. Their use is recommended only for competition flying. The main 'problem' with these rigging wire lies in the fact that they are less flexible than 2.5mm OD 7*7 wires and need replacing much more frequently. In addition, without a protective plastic coating, it is highly recommended that a pilot using these wires flies with suitable face protection (i.e. full face helmet and visor) and gloves. Gloves may also be required for your ground while ground handling.

Strength and Reduced Life of 1 * 19 galvanised wire rope

This galvanised steel wire rope is theoretically the same strength as the normal rigging used. However Avian's testing suggests that, when made into rigging, the resulting cables are not as strong, even when brand new. Thus it is even more important that kinked cables should be replaced immediately. Once a cable has a kink the strands are damaged and replacement is the only cure. Before every flight check for cable damage along the entire wire length. The most likely failure area lies immediately adjacent to the swaged fitting. Look carefully for signs of strand fracture at this position at both wire ends. These wires are much less flexible and extra care should be taken not to kink the wires when packing or rigging the glider. Due to the shorter 'life' of these wires it is especially important to replace, even apparently undamaged rigging wires, every 50 hours of flying or more frequently.

If in doubt specify normal rigging. Avian test pilots use normal 2.5mm OD 7 * 7 plastic coated rigging for all flying except competitions.

RECOMMENDED COMPONENT LIFE

Due to the nature of their material, construction and position within the structure, certain components have a critical fatigue life and it is mandatory that these components are replaced within the time stated in.

Cross Tubes	2000 hours
Leading Edges	1000 hours
Control frame / fittings	1000 hours
Keel	1000 hours
Rigging wires / Tension strop	200 hours or 2 years.

A factory inspection is recommended every 100 hours or 1 year (See MAINTENANCE page 23.)

STANDARD FACTORY SETTINGS

Standard factory settings are included for information purposes. When repairing, carrying out maintenance or checking washout the factory settings are a useful reference. **It is vital to get the washout settings correct**. However if you have slightly different batten tension settings, pitch trim setting or wing tip cap settings and you like the way your glider flies then we recommend that rather than change the settings back to standard you record them for your future reference.

STANDARD BATTEN TENSIONS

The batten tensions for the Evo 3 are measured with the glider fully rigged with the VB on full.

With all the battens tight undo one clip end at a time.

The clip end should then be clipped to the closed position beneath the sail without the batten end in the eyelet. (See drawing below.)

When viewed from the top of the sail through the eyelet the distance between the edge of the eyelet and the should be noted:

Compare the batten tensions with the set up table below.

Standard Factory Set up for new Evo 3 140

Batten Number	Tension (mm)	My Alternative 1	My Alternative 2
1	3		
2	2		
3	0		
4	0		
5	0		
6	0		
7	0		
8	0		
9	2		
10	2		
11	2		
12	3		

Table 2: Standard batten tensions

Set the battens in a symmetrical manner working from the root to the tip. E.g. 1 left then 1 right, 2 left then 2 right etc. When each batten is checked clip it back into the sail and move to the next batten.
The symmetry of batten tension is important. E.g. if you tension No 12 batten more on one side than the other it will give the glider a turn.

Batten 12 (compression strut)

On some early gliders batten 11 is tensioned with a 5mm bungee. This is double tensioned. To set up pull just one loop of the elastic. The other loop should pull tight on the sail. With no stretch in the elastic it should run to the bottom of the groove in the batten. (i.e. the first loop of the elastic imparts virtually no compression on the batten.)

CHECKING VELCRO LENGTHS

Setting Velcro Lengths in wing of Evo 3 140

Vertical cloth 'baffles' join the top and bottom surface of the wing. These baffles (or rib cloths) help to control the under-surface of the glider in flight by providing a limit to how far the bottom surface can move away from the top surface. Unrestricted this movement is often associated with yaw in flight. The baffles are located at many battens especially towards the wing tips. Velcro tabs help in a similar way and are used between top and bottom surface battens and also where part of a baffle is missing.

It is **strongly** advised not to alter the set up of the Velcro ties. However if you have disconnected the ties (e.g. for short packing) the set up lengths could be useful.

The set-up of the Velcro tie lengths is important:

1. If they are not done up then when the glider is packed they can catch each other and become set at random lengths. (DO NOT DO THIS)

2. If they are too tight it makes the handling stiffer.

3. Too long gives better handling but the glider is likely to yaw more easily in flight.

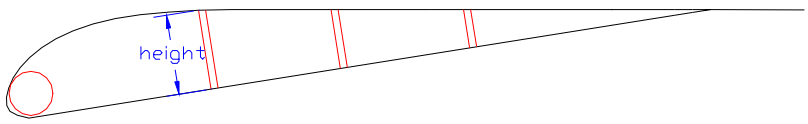


Figure 6: Velcro tab lengths

Below is a chart of the recommended heights measured in mm. (Note span position is top surface batten number. No 1 is batten closest to keel.)

Nose	Span Position	2	4	6	7	8	9	10	11	Tip
	Front				Baffle	Baffle	Baffle	140	Baffle	
	Middle	150	150	150	Baffle	Baffle	Baffle	Baffle	Baffle	
	Rear				Baffle	Baffle	Baffle	Baffle	Baffle	

Table 3: Velcro Tab lengths

Note: It may appear that pulling the VB. fully tight on the ground and then setting the Velcro so that they are just tight would be a good method. However this can result in Velcro tabs that are too tight. DO NOT make large adjustments.

STANDARD TIP CAP SETTINGS

The tip caps can easily be adjusted with a 5mm Allen key. (See Tuning out turns on page 19.) (Note there are two sizes of allen key on this glider. A 4mm allen key is required to remove the sail but a 5mm to adjust the tip caps.)
The view below is shown from the back of the glider. If your glider has a different setting then you should mark the tip cap position before returning them to factory standard. If their setting is asymmetrical and the glider flies straight then returning them to the symmetrical standard setting is likely to introduce a slight turn in the glider.

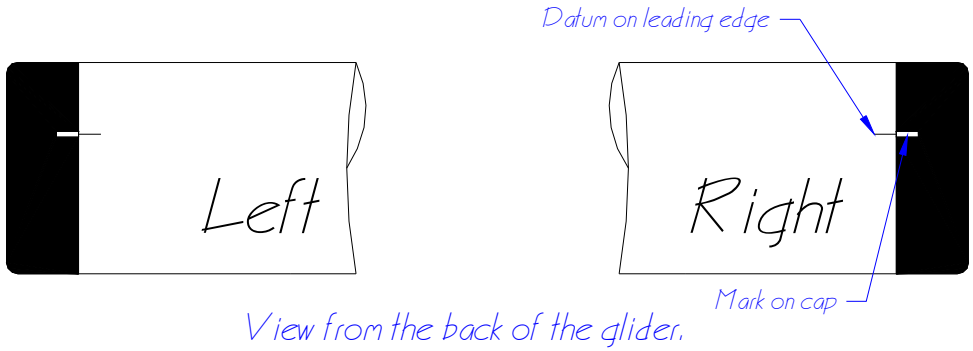


Figure 7: Tip cap settings

CHECKING WASHOUT

Washout rods

The washout rods are factory set and should not be altered by the pilot except in the way outlined in the tuning section of this manual. (See Tuning out turns on page 19.) During initial assembly the angle of the washout rod is set on the airframe without its sail. The angle is expressed as a height from the end of the washout rod perpendicular to the flat surface the airframe is lying on. Note the *average* height of the left and right washout rod is important though the two heights should not differ by more than 20mm.

The washout angle can also be checked with a fully rigged glider by measuring heights to the trailing edge of the glider as follows:

The batten profile should be checked and altered if necessary. The span-wise battens should be checked for straightness. The glider should be rigged flat on a very flat surface without the speed bar. Check that the washout rods are correctly positioned. With the glider tensioned, but the VB fully OFF, the heights of the batten ends can be checked. The heights should be measured from the centre of the batten ends perpendicular to the flat surface. These heights correspond to the washout rod angles. Minimum heights are given on the next page.

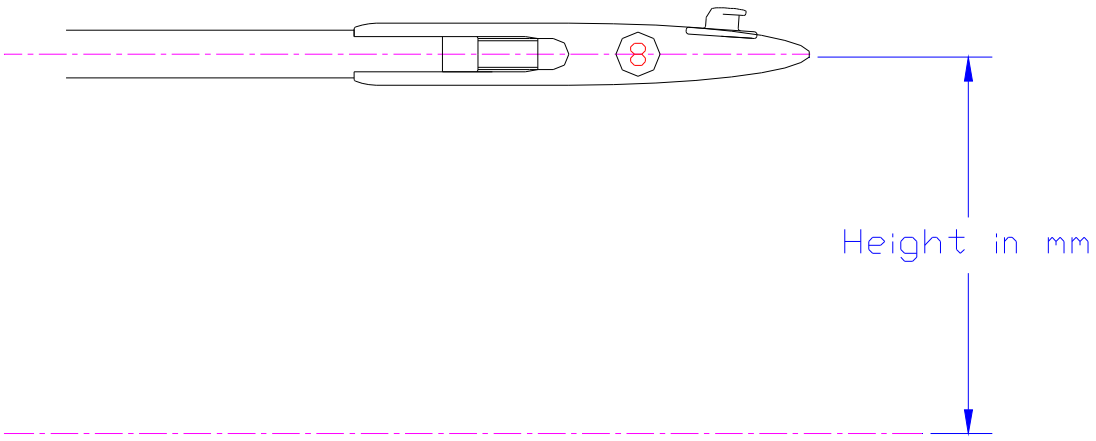


Figure 8: Measuring washout height to batten end

Damage to the leading edges or washout rods can alter washout heights.

The washout rod heights should be checked periodically or after a heavy landing or crash. It is especially important to check the washout heights if a new leading edge component has been fitted. If the washout heights are below those specified they should be adjusted up to the correct heights. If it is not possible to adjust to the minimum heights DO NOT FLY. Please refer to Avian Ltd.

Checking Washout Glider **Minimum** Requirements

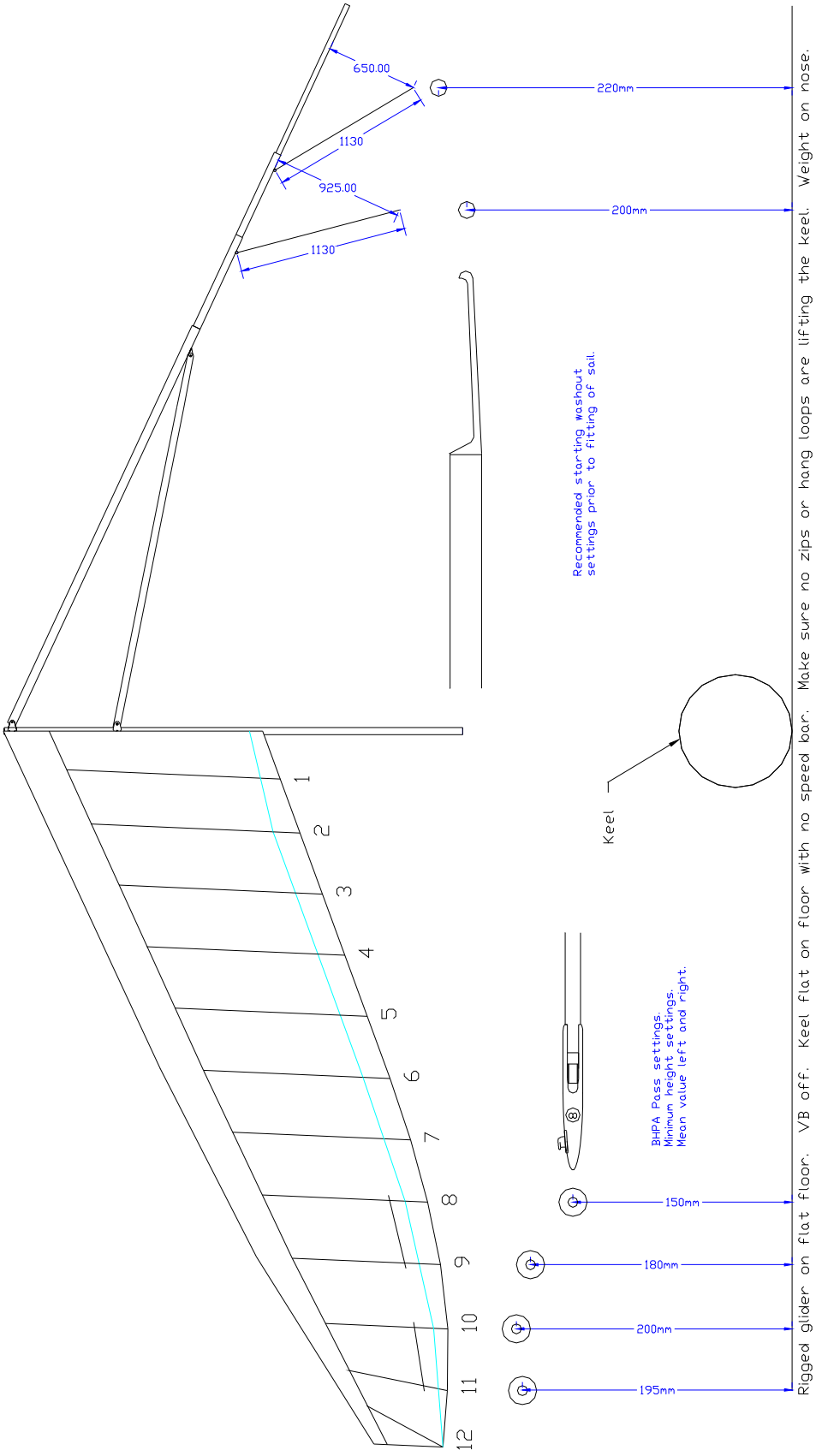


Figure 9: Checking washout heights

Section 3: Assembly Drawings

NOSE ASSEMBLY

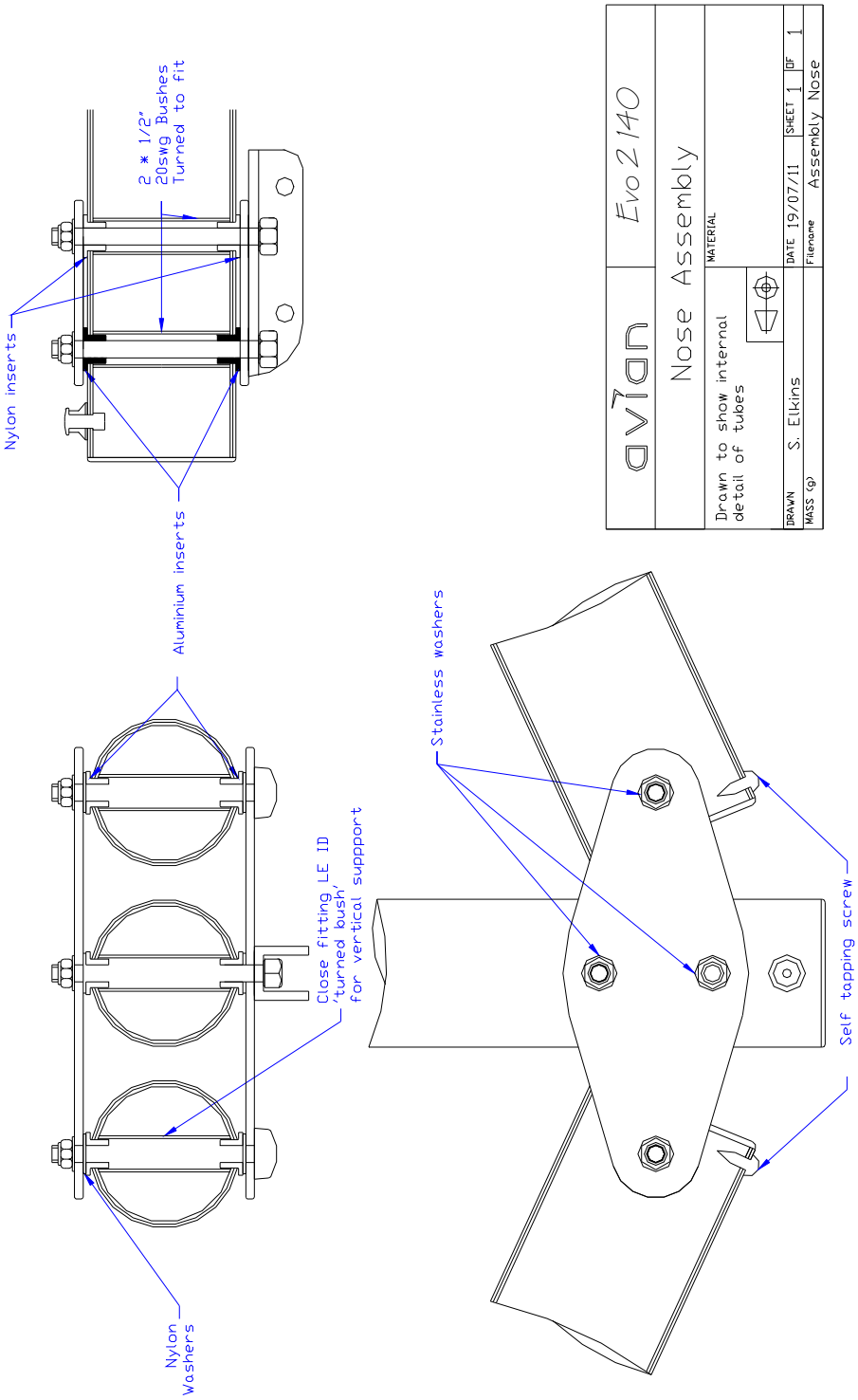
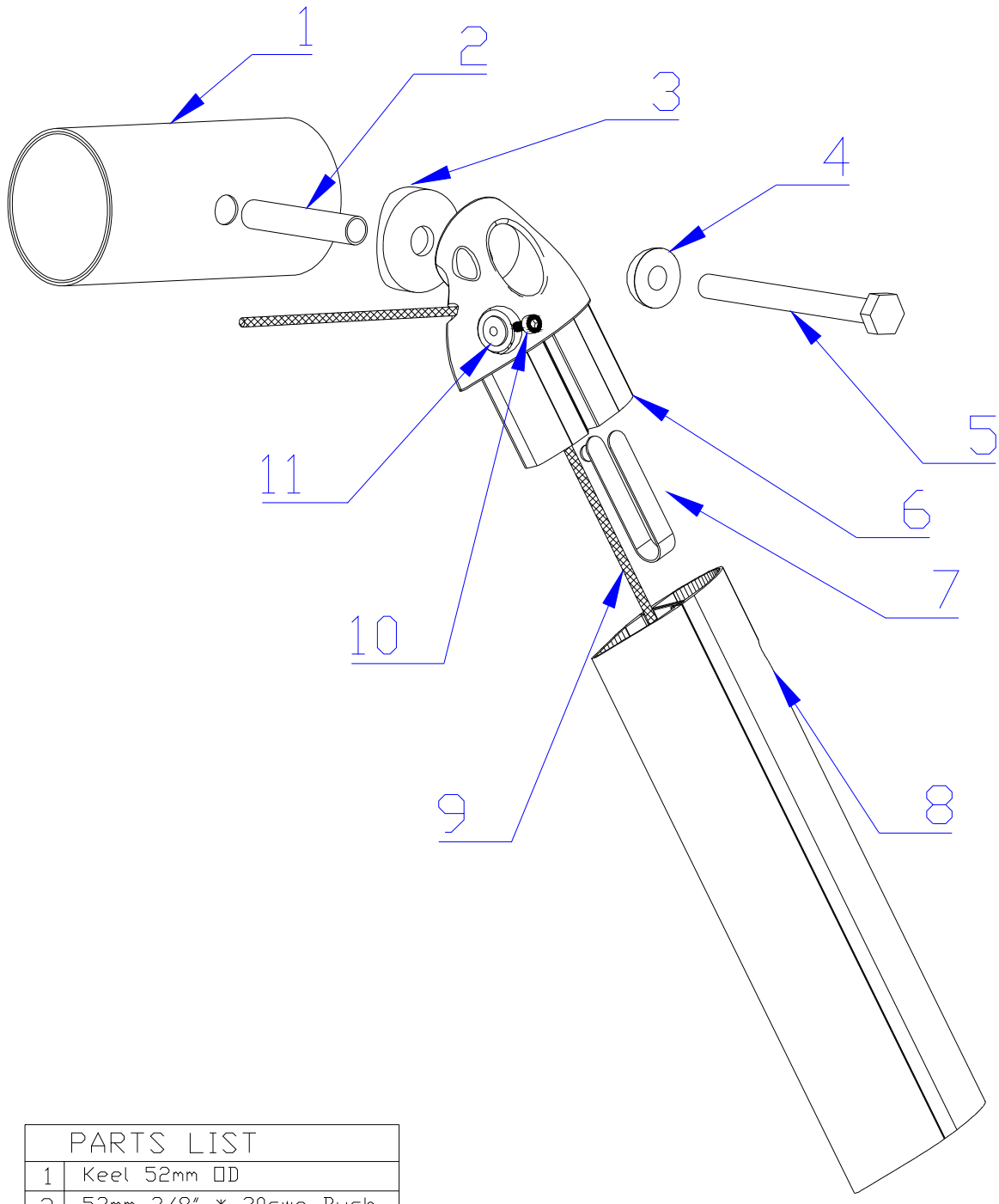


Figure 10: Nose assembly

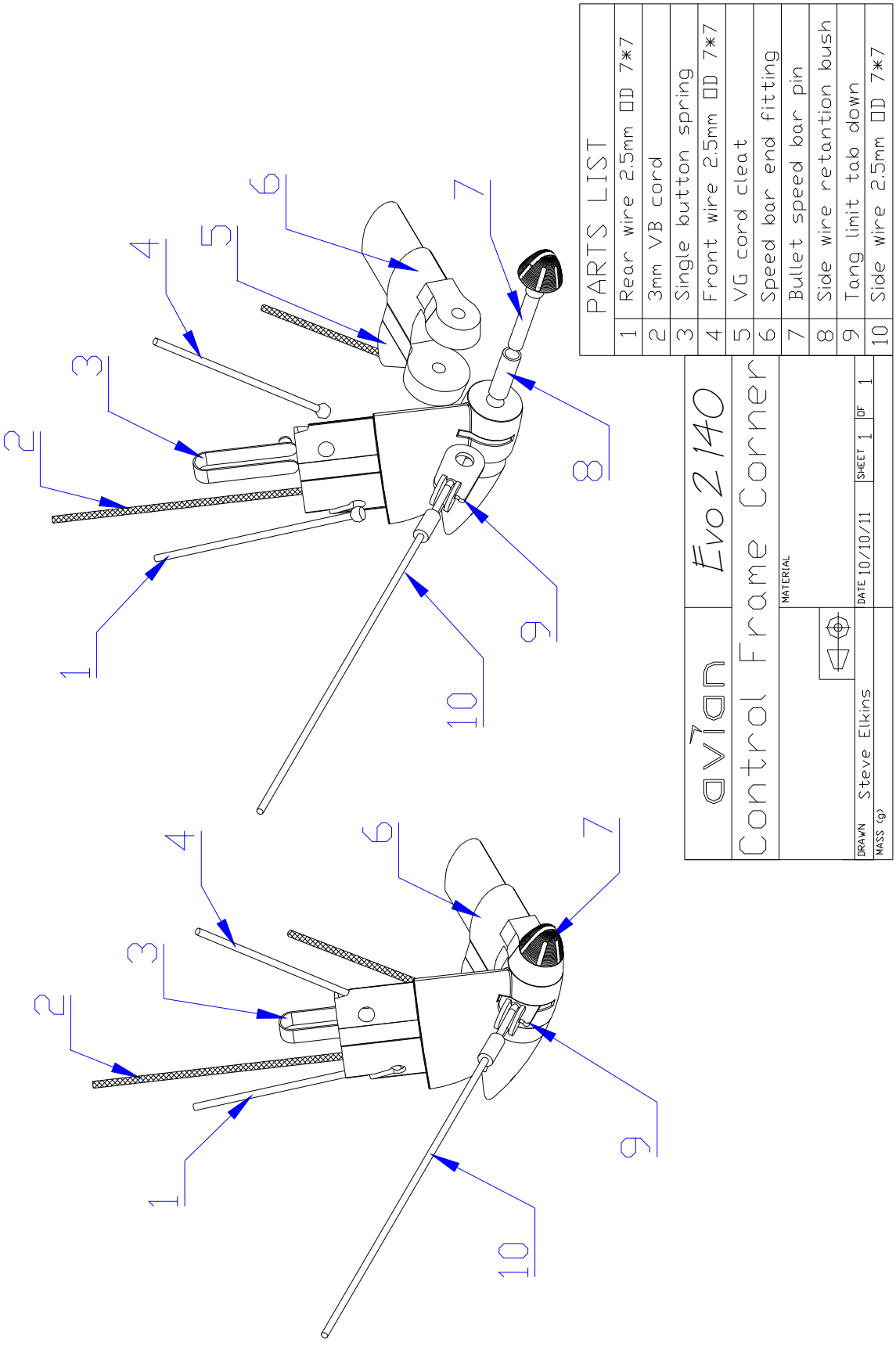
UPRIGHT TOP FITTINGS



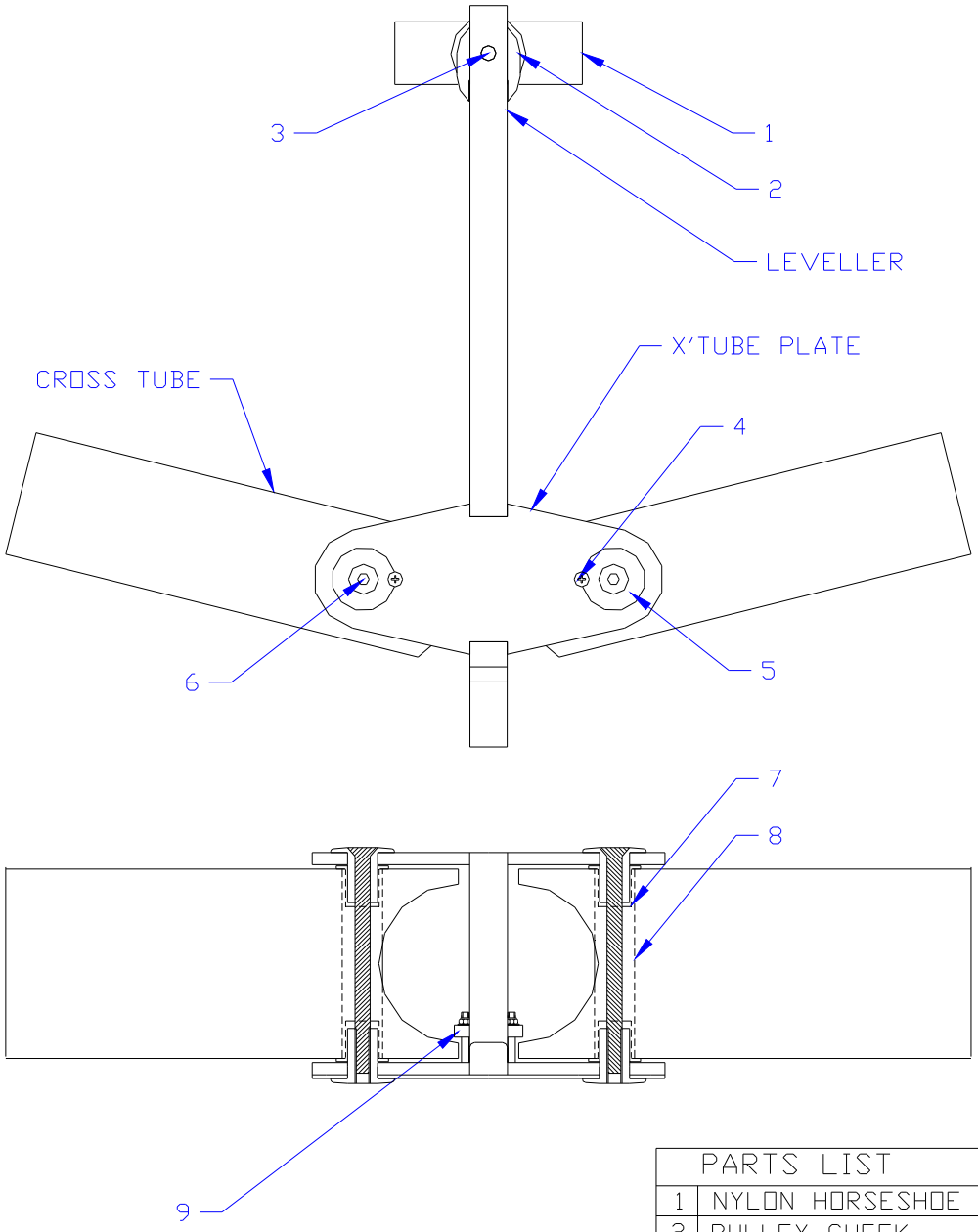
PARTS LIST	
1	Keel 52mm OD
2	52mm 3/8" * 20swg Bush
3	Nylon saddle
4	Nylon hemisphere
5	M8 * 95m bolt
6	Top right casting
7	Single button spring pin
8	Speed upright
9	3mm VB cord
10	M3 Cap Screw
11	VG Pulley and bearing

avian	Evo 2 140
Control Frame Top	
	MATERIAL
DRAWN Steve Elkins	DATE 11/10/11 SHEET 1 OF 1
MASS (g)	

LOWER UPRIGHT FITTINGS



CROSS TUBE CENTRE JUNCTION



PARTS LIST	
1	NYLON HORSESHOE
2	PULLEY CHEEK
3	M6 BOLT
4	M3 LOCK SCREW
5	MAIN BOLT
6	M6 C/S SCREW
7	BUSH FITTING
8	ALU. BUSH
9	LOWER PLATE CLIP

Figure 11: Cross tube centre junction

CROSS TUBE LEADING EDGE JUNCTION AND SIDW WIRE ATTACHMENT

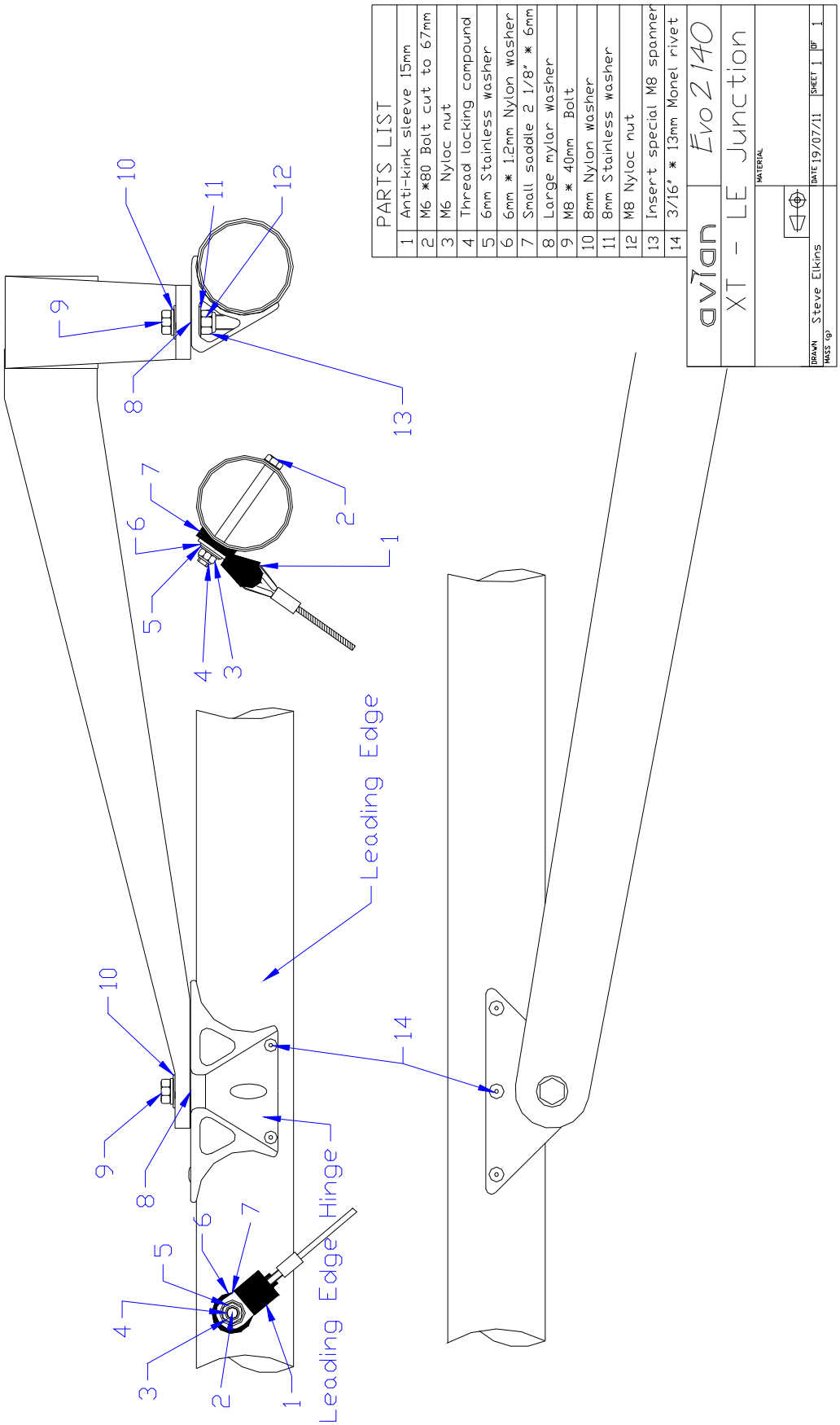


Figure 12: Cross tube – leading edge junction

WASHOUT RODS (SPROGS)

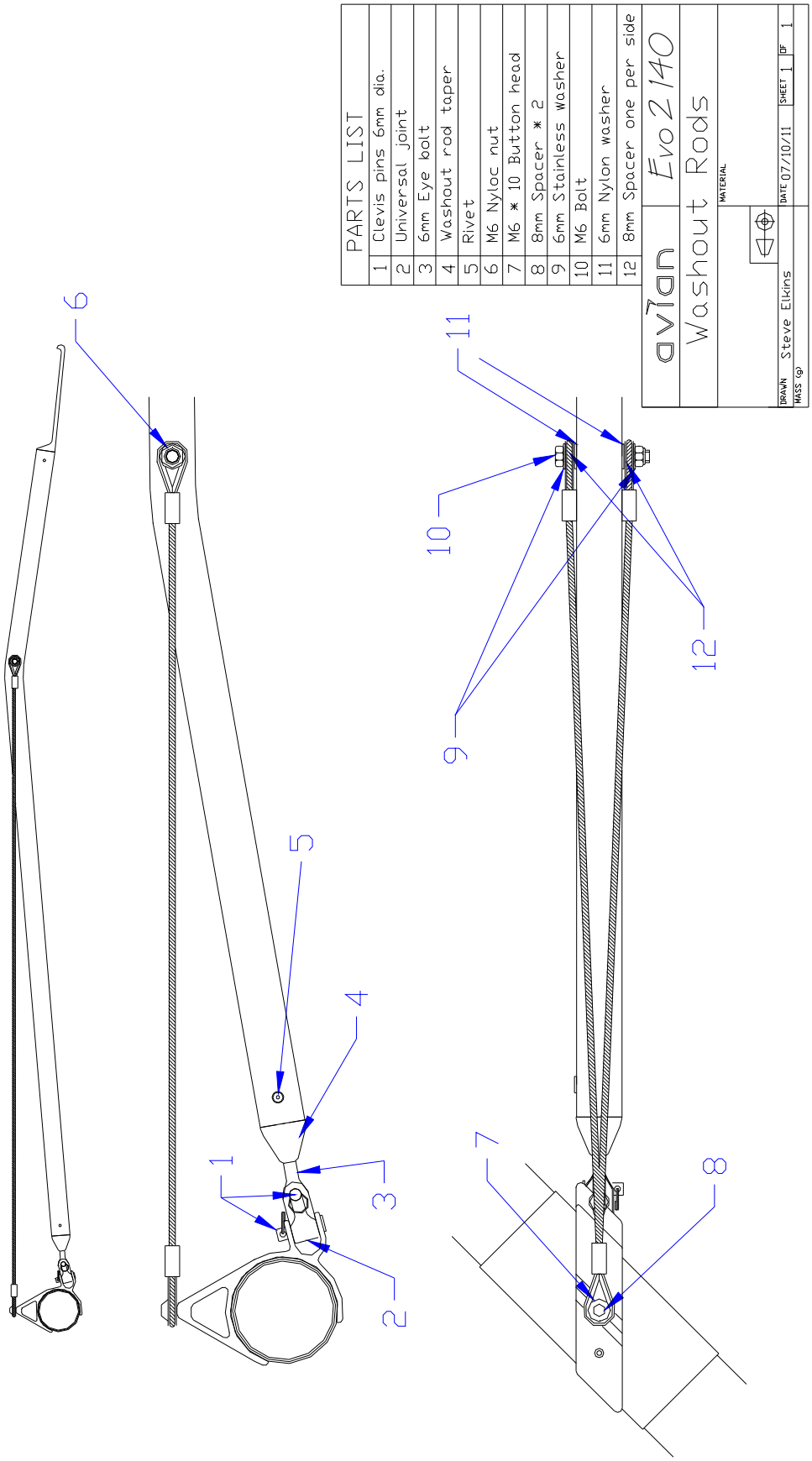


Figure 13: Washout rods and wires.