



# **MAX** 157

## **User's Manual**

Moyes Delta Gliders

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# HIGH PERFORMANCE MADE EASY

## THE MAX OWNERS MANUAL

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## INTRODUCTION

Congratulations! You are now the owner of one of the finest flex wing hang gliders available.

The MAX is a new and innovative concept in hang glider design and is instantly recognizable by its quality, handling, performance and appearance.

MOYES is confident that you will enjoy pleasant recreational flying combined with high performance.

Your MAX is also fully certified to international standards so that you may enjoy worry free airtime.

Please do not hesitate to call and let us know how your MAX is performing. We welcome your feedback.

Safe and happy flying.

Best regards,

The Moyes Team.

## DESIGN CONCEPTS AND TECHNICAL INFORMATION

The MAX is designed for high performance without sacrificing the easiest and most predictable handling characteristics possible.

It also has a simple set-up/breakdown procedure and is manufactured from materials that will last for many years.

A new sail design developed from our winning competition gliders has resulted in a glider which shows outstanding climbing ability, a superb glide angle and most importantly, superior handling and low speed control. This gives the MAX a distinct advantage while thermalling and soaring.

Weight near the wing tips has been reduced by replacing the washout strut with an outboard luff line. Swivelling ball tips and neoprene inserts make both roll and pitch pressures light and positive. Co-ordination in turns is perfect, with no tendency to 'wind in'. You will discover that the MAX is a joy to fly on cross-country flights and very easy to land.

A single stage set up with internal luff line compensation for the variable geometry greatly simplifies the set up procedure, eliminating the need to open the double surface to connect the compensator, further speeding rigging/de-rigging.

Finally, use of European designed fittings and 7075 battens have reduced the weight of the MAX.

## **SPECIFICATIONS**

### **MAX 157**

SAIL AREA	157 sq ft (14.8 sqm)
WING SPAN	32' 3" (9.92 m)
ASPECT RATIO	6.6
NOSE ANGLE	125 degrees
DOUBLE SURFACE	70%
WEIGHT	66 lbs. (30 kg)
PACK UP LENGTH	18' 10" (5.7 m)
BREAKDOWN LENGTH	12' 7" (3.8 m)
HOOK-IN LIMITS	154-220 lbs (70-100 kg)

### **OPERATING LIMITS**

The MAX is to be HGMA certified as a utility class hang glider and therefore has the following limitations.

This glider must not:

1. Be towed, except by factory approved method.
2. Be flown by more than one person at a time.
3. Exceed 30 degrees nose up or down to the horizon.
4. Exceed 60 degrees bank angle.
5. Be flown inverted or backwards.
6. Be flown with auxiliary power.
7. Be flown at speeds in excess of Vne.

Pilot rating: This glider requires at minimum a USHGA 'Intermediate' rating or equivalent.

Maximum bank angle: 60 degrees

Maximum pitch angle: 30 degrees nose up or nose down.

Maximum pilot weight: The maximum pilot hook-in weight (Including harness etc.) for the MAX 157 is 220 lb.

Minimum pilot weight: The minimum pilot hook-in weight (Including harness etc.) for the MAX 157 is 154 lb.

Stall speed: at Maximum pilot weight is 25 mph.

Maneuvering Speed: at Maximum pilot weight is 45 mph.

Maximum Speed: at Minimum pilot weight is 50 mph.

Vne: The velocity never to exceed is 54 mph.

Aerobatics: None allowed.

Spins: Prohibited.



**Important:** We advise when flying your MAX for the first time that you use a calibrated airspeed indicator. This will enable you to become familiar with the control bar positions relative to your body at the maximum maneuvering speed of 45 mph and the velocity never to exceed of 54 mph.

Please contact the factory for any further information regarding this advice.

**Towing advice:** The MAX has been designed for foot launched soaring flight. It has not been designed to be motorised, tethered or towed. However it has been towed by the Moyes successfully using the HEWITT SKYTING system and is approved for towing in this manner provided that all of the HEWITT SKYTING criteria are strictly followed. Please contact the factory beforehand for advice on towing.

## DISCLAIMER

**WARNING:** The owner and operator must understand that due to the inherent risk involved in flying such a vehicle, no warranty is made or implied of any kind against accidents, bodily injury or death. Operations such as aerobatics or erratic pilot technique may ultimately produce equipment failure and are specifically excluded from any warranty.

## ASSEMBLY PROCEDURE

It is possible to rig the MAX in two positions, either lying flat on the ground or standing on the control frame. The lying flat method is useful in higher winds as the chances of the glider being blown away are reduced.

The second method is acceptable in lower wind conditions and helps keep the sail from getting dirty or suffering tears and scrapes from the terrain in the rigging area.

The 'lying flat' rigging sequence is as follows:

1. Lay the glider on the ground with the nose into the wind with the zip facing upwards. Unzip.
2. Spread the uprights and insert base bar ends onto the alloy forgings at the base of each upright. Secure with the pip pins. Pivot the control frame up briefly to check that all of the rigging wires are outside the control frame.
3. Holding the control frame with one hand, flip the glider over so that the control frame is flat on the ground.
4. Remove the glider bag and unclip all the sail ties.
5. Pivot the kingpost up and attach the luff lines with the spring clip to the thimble on the short wire at the top rear of the king post. It may be necessary to pull back on the king post to attach the clip.
6. Open out one wing until you feel resistance then spread the other wing likewise. Alternate until you have both wings open fully. This sequence avoids catching the crossbar on the keel as it spreads apart. When opening the leading edges avoid lifting them too high as this may distort the nose plates.
7. Remove the battens from their bags and lay behind the sail from smallest to largest. Black is for left, white for right.
8. Insert the tip strut into the double surface and place on the hook mounted on the leading edge. Secure the strut with double bungees on both the top and bottom surfaces.
9. Insert the remaining top surface battens from tip to root using gentle pressure until the batten meets resistance. Lift the sail at the trailing edge and shake in order to float the batten over the crossbar or leading edge. DO NOT FORCE:- care taken during insertion and removal of the battens will minimise wear of the batten pockets. Secure all the battens with double looped bungees. Finally insert the nose batten from the front using the cord to lift the batten onto the nose bolt.



10. Tension the crossbars by pulling back on the cord attached to the keel. When the webbing pullback loop appears take hold and continue pulling back until the 'D' shackle can be inserted into the quickclip by pressing down the steel button. If difficulty is encountered lift the keel a little, if this does not help, ensure that rigging wires top and bottom are not snagged or kinked. DO NOT FORCE. CHECK ALL WIRES.

11. Attach the rear kingpost wire ring to the pullback quickclip underneath the luff lines. This must be attached before the nose wires are hooked up.

12. Insert the lower surface battens carefully as there is a chance of missing the batten pocket where the battens enter the sail. Secure these battens with a single bungee.

13. Lift the glider onto the control frame and ensure that all the lower rigging is untangled.

14. Press the bottom nose wire ring into the nose plate quickclip. The easiest technique is with the keel on the ground, pull down on the nose plate and push the ring up into the quickclip. Velcro up the nose cone, pulling it tight.

15. Pre-flight the glider thoroughly by following the checklist in the next section.

If you prefer to rig the glider standing on the control frame follow this initial sequence (refer to previous method for details regarding each step).

1. Lay glider on the ground, unzip the bag and assemble the control frame.

2. Stand the glider on the control frame.

3. Remove the bag and undo all the sail ties.

4. Spread the wings out. IT IS ESSENTIAL THAT THE KEEL AND THE LEADING EDGES ARE KEPT IN THE SAME PLANE DURING THIS STEP. Damage to the crossbar and nose plates may otherwise result.

5. Attach the luff lines to the king post top.

Follow steps 7-15 as per the first method. When rigging on the A-frame always be aware of wind conditions and position the glider accordingly to avoid ground loops.



## PRE-FLIGHT INSPECTION

A thorough pre-flight inspection should be followed before each flight. DO NOT neglect this procedure or allow others to distract your attention while running through the checklist. Where airframe junctions are obscured by the sail, access zips have been provided to allow inspection.

Start at one point, the nose plates for example, and work around the glider checking components carefully.

1. Sight along both leading edges checking for similar curves. Check the nose plates and that the nose batten is properly located.
2. Walk towards the wing tip feeling for dents in the leading edge.
3. Unzip the inspection panel at the crossbar/leading edge junction and check the wire mounting points.
4. Check the sail tension at the tip and twist the ball up to check for free movement.
5. Check the tip struts for proper location.
6. Walk to the keel checking all batten cords, including the bottom surface battens.
7. Check the luff-line attachment points at both the trailing edge and king post top. Ensure that the luff-lines are not caught around the batten ends.
8. Check that the pullback 'D' shackle and top rear wire ring are secured in the quickclip fitting.
9. Repeat steps 2-7 in reverse order for the other wing.
10. Check the nose ring is secured in the quickclip fitting correctly.
11. Check that the lower rigging is not kinked or caught round the control bar.
12. Check that the uprights are straight and that the base bar pip pins are correctly assembled
13. Check the bolts and housing at the top of the A-frame.
14. Pull the V.B. on full, then release, checking that the compensator pulls the luff lines up as the V.B. is released and that the pulleys move freely.



15. Check that the hang loop and safety loop are in the correct trim position and are not worn.
16. Check the nose ring, base bar pip pins, pullback D- shackle and rear top wire again. These four items are critical to the safe operation of the glider.
17. Attach your harness to the hang loop, checking carabiners carefully. Check the height of the harness above the base bar.
18. Set up instrumentation.
19. DO A HANG CHECK.
20. SPECK OUT!

### **DERIGGING PROCEDURE**

This is basically achieved by reversing the assembly procedure. Fold the wings into the keel at the same time, otherwise the crossbar may jam between the keel and the leading edge and prevent the glider from being folded properly. To fold the wings at the same time, stand astride the keel facing forward and hold the trailing edge of each wing. Swing the wings inwards, lifting the leading edges slightly off the ground to avoid scraping the sail.

Keep the leading edges and keel in the same plane at all times to avoid damaging the crossbar and nose plates, especially when packing the glider on the control frame.

Roll the sail carefully to avoid unnecessary creases and always use the padding provided to prevent sail wear.

Try to make the packed glider as compact as possible as this will reduce wear and tear during travel.

## OPTIONAL BREAKDOWN PROCEDURE

The MAX breaks down easily for long distance or overseas travel. The procedure is as follows:-

1. If the glider is packed, undo all the sail ties.
2. Spread the leading edges until they are about three feet apart at the ends.
3. Undo the ball tips by reaching into the sail at the tips and grasping the leading edge firmly. Hold the ball with your other hand and 'pop it' out of the socket.
4. Slide the outboard leading edge tube away from the inboard section then pad the ends of the sleeves with rags etc.
5. Fold the outer sail sections back towards the front and secure with a tie.
6. Lie the outer leading edge sections alongside the glider and secure with sail ties.
7. Fold the excess bag length over the glider, then zip up the bag.

Simply reverse these steps for reassembly, ensuring that the outboard leading edge sections are locked securely in place on the clevis locating pins and that the sail is fixed securely with the ball tips.



## FLYING TECHNIQUES

### Take off

The MAX has a neutral static balance and is very easy to launch in both calm and windy conditions. Have the nose slightly lower than you would normally and the wings level. Run hard till the glider lifts you off the ground.

### Turns

The MAX has a light roll rate even at low flying speeds. Turns are most easily accomplished by pulling on a little extra speed, weight shifting and pushing out slightly. Adjust the bank angle with a combination of pitch input and lateral weight shift.

The MAX is very well coordinated and will remain at the input bank until the turn is removed. Give yourself a margin of safety and DO NOT fly at minimum sink speed close to terrain.

In our experience it is best not to use the Variable Geometry on full when thermalling. In theory climb should be faster with the V.G. on but in practise the quicker roll rate with V.G. off permits the pilot to core thermals more effectively and so compensate for any slight increase in sink rate.

### Stalls

The stall characteristics of the MAX are gentle and predictable but will vary, depending on the wing loading and whether the V.G. is applied.

With the V.G. OFF; Stall characteristics are mild. If you push out slowly the nose will rise and the glider will begin to 'mush'. The sink rate is more than doubled in this mode and control will be difficult. Further increase in the angle of attack will result in a minor stall. Unless you are in very smooth air, a wing may drop. Allowing the control bar to come back will lower the angle of attack and the glider will regain airspeed.

When the V.G. ON; The glider will not mush since washout in the sail is reduced. The stall is more severe as a larger area of sail reaches the stall at once. However, by allowing the control bar to come back and reducing the angle of attack the glider will quickly regain flying speed.

Pushing out more quickly will increase the severity of the stall. NEVER stall the glider completely with the nose pitched up very high. This is one of the most dangerous and uncontrollable maneuvers for a hang glider and can result in a tailslide and severe tumble.

Tip stalling in a turn is a possibility when flying too slowly in marginal conditions. DO NOT push out too much when flying close to terrain. In the event of a tip stall allow the bar to return to trim and the glider will quickly regain airspeed for full control.



## Spins

The MAX will strongly resist spinning unless the V.G. is fully applied, the glider is stalled and weight is held to the high side of a turn. However, if a wing is stalled and an incipient spin is entered move your weight forward and in the direction of the turn. The wing will regain airspeed and begin flying again.

## Landing

.....is easy in the MAX. Your final approach should be straight into wind at just faster than best L/D speed. Bleed your speed off slowly, wings level, as you enter ground effect. In light or no-wind conditions a full, hard flare is required with the control frame held out. In stronger winds, a gentler flare will suffice.

If the flare is initiated too early and the glider climbs, hold the flare right out and the glider will parachute down.

## The VARIABLE GEOMETRY (V.G.) System

This adjusts the amount of tension in the sail. To use simply pull the rope through the cleat at the right hand end of the base bar. To release flick the rope out of the V in the cleat and let it slide through.

The lightest handling is experienced when the V.G. is OFF, and this setting should be used for take off and landing where roll authority is critical.

Maximum glide performance and sink rate are obtained by pulling the V.G. full ON. In this position the amount of billow in the sail is reduced and so roll authority is diminished. Intermediate settings will provide a trade off between glide and handling. Experience in varying conditions will determine how much V.G. to use for the differing situations encountered.



## TUNING INSTRUCTIONS

Your MAX has been test flown by factory authorised pilots to check that the trim and handling characteristics are normal.

### Trim speed

The trim speed is the speed at which the glider flies 'hands off', i.e. when the centre of pressure is directly over the centre of gravity. The trim speed is determined by the position of hang loops on the keel. Ensure the hangloop is correctly fixed to the keel and the backup is also securely fixed.

### Luff lines

The luff lines play an important role in maintaining positive pitch stability on the MAX. At very low angles of attack the sail drops relative to the frame, but the luff lines hold the trailing edge of the sail up. This introduces reflex into the airfoil and thereby gives the airfoil a positive (i.e. nose up) pitching force.

The important point to note is that until the sail drops the luff lines do not come into action. Hence lowering the luff lines will not improve glide performance. It will merely lower the pitch stability of the glider when you most need it, in rough air or when ejected from a rowdy thermal.

Do not alter the luff lines from the original specifications under any circumstances. The loss of stability can be dramatic and life threatening. The glider will be more likely to tumble.

Tightening the luff lines may increase the nose up pitching moment but it will also increase pitch pressures. Handling characteristics will deteriorate because overly tight luff lines will not allow the sail to billow shift. See the section on Luff line maintenance for factory settings.

An internal compensator is used on the MAX to allow the luff lines to be at the optimum length throughout the entire V.G. range. In the full-off V.G. position, the compensator raises the luff line height and in the full-on V.G. position, lowers the luff line height. If the compensator is moved from the factory setting the pitch stability of the glider will be severely compromised. Do not adjust the compensator.



## Luff line maintenance

It is critical to the stability of your glider that the luff lines are adjusted to the correct factory settings. In flight, they should be just a little slack. But this may be difficult to view yourself. So the best method to check for correct adjustment is on the ground. Assemble the glider in the normal fashion on level ground and in no wind.

Make sure the crossbar is in the correct position as if flying with V.G. fully off (as far towards the nose as possible and in the centerline of the keel). Have the rear of the keel resting on the ground.

Fix a thin string to the luff line eyelet on one wing and to the equivalent eyelet on the other wing. The string should be attached to the luff line eyelet in the sail. Pull the string tight until it is straight. Now measure from the string to the top of the keel tube, perpendicular to the keel. Your measurements should be approximately as follows, starting from the inner luff line and working outboard.

GLIDER	1	2	3	4	luff line
MAX 157	5 1/4"	7 1/4"	8 1/4"	6"	
		133 mm	185 mm	210 mm	150 mm

All measurements should be within + or - 0.2" of these figures, as measured to the top of the keel tube. If the luff lines are not at the above factory settings, contact your dealer or the factory for advice.

## Turns

If your glider develops a turn, check the following:-

1. Check the leading edge spars for straightness. To do this properly, the leading edges should be removed and rolled on trestles or with one end on the ground while looking along their length. If you cannot find a bent leading edge it is still possible that one of the leading edges has been stressed in a hard landing - this results in slightly different bending characteristics in each leading edge. This is not always critical and the turn can be tuned out by batten bending.
2. Ensure all the battens are correctly profiled and symmetrical on each side.
3. Check the ball tips - sometimes grit may enter the socket and restrict movement. Clean if dirty.
4. Check the leading edge tension is the same on both sides - pull on the sail at the tip when the glider is de-rigged to test the 'give' in the sail.



If none of the above checks has cured the turn, it can be tuned out by changing the batten cambers slightly. The only two battens that should be changed in either wing are the last two curved battens near the tip (nos. 7 and 8; not the tip strut). For example, if your glider has a right hand turn, the two battens on the right hand tip need to have their camber increased by about 1/2" (12 mm). If the right turn still persists, reduce the camber in the two left tip battens by about 1/2". Batten recambering is a delicate adjustment and should be carried out by an experienced pilot.

Tightening the batten bungees has the same effect as a increasing the camber. Generally speaking, slackening the cords improves handling at the expense of glide angle.

### **Leading edge tension**

This should be left at the factory setting. Increasing the tension with shims will flatten the tips and marginally improve the performance but the glider will be harder to roll.

### **The variable geometry system**

The V.G. system works by pulling the crossbar back (via the pulley blocks giving a mechanical advantage of 8:1). If the V.G. sticks in any position it is usually because of friction between the rope and the pulleys. Avoid getting grit into the pulley blocks at sandy sites and test for free movement during your pre flight checks.

If the V.G. does stick in flight, pull about two feet of loose rope through the cleat and gently jiggle the control bar back and forth (conditions permitting). This will free the V.G.

## TRANSPORTATION AND STORAGE

Much of the wear and damage that affects hang gliders occurs during the transportation of the wing to the launch site, especially if rough access roads are involved. With this in mind use thick padding on the racks, avoid hard spots pressing on the glider and keep the overhang at each end as short as possible.

Use flat webbing straps rather than elastic cords or rope to secure the glider to the racks as this distributes the tie-down loads over a larger area. Support the glider in at least three places to prevent too much flexing of the leading edges. Ensure the glider is dry prior to storage and air the glider every few months, otherwise the sail may become mildewed or mouldy.

## MAINTENANCE SCHEDULE

Your new MAX will require very little in the way of maintenance if you care for it properly in your day to day use. The schedule that follows and the general information below it provide a guide to the proper care of your glider.

Every 50 hours:-

1. Check all tubing for wear and/or damage.
2. Check all wires for wear or damage, particularly the lower side wires.
3. Inspect all sail mounting points.
4. Inspect luff lines, attachment points, compensator line, pulleys and carabiner.
5. Inspect all crossbar tensioning strap components for wear/distortion. This includes the rope, brackets, bolts, nuts, crossbar plates and limiting wire.
6. Check batten profiles, Inspect all batten bungees for wear and check the tension is the same on each side.

Every 100 hours:-

A complete inspection and strip-down of your glider is recommended (see next section for strip down guidelines). Contact your local Moyes dealer or the factory for the glider's annual inspection if you are not confident of completing the work without mistakes.



## Spars

Examine all frame spars (tubes) for dents, wear spots, bolt-hole elongation, corrosion and straightness. Replace if at all suspect.

## Hardware and Bolts

Normal in flight forces place very little load on the hardware. Heavy landings and crashes however can easily load the structure far more severely. Aircraft bolts can bend and should be checked periodically or after any incident that may cause damage - e.g. the glider blowing over while resting on the control frame. Check especially where pivoting movement occurs, e.g. at the crossbar plates and at the crossbar/leading edge junctions. Replace any suspect bolts and lock nuts. It is very important not to overtighten your airframe bolts. All airframe bolts should be tightened just enough to take up the slack. All bolts should show 1 1/2 threads exposed above the nyloc nuts.

## Cables

1. Any frays or kinks in cables should be examined with great care and any frayed cables replaced immediately.
2. Inspect all thimbles for elongation.
3. Sidewires should be replaced every 100 hours regardless of wear.
4. Each cable has a breaking stress in excess of 800 lbs (363 kg). Non-aerobatic flight loads seldom exceed 300 lbs.(136 kg), even in rough thermal conditions.
5. If you regularly set up and pack up your glider in rough rocky areas you will need to replace your cables more frequently than someone who flies at grassy sites. Use your best judgement - those cables hold the frame together.

## Sail

1. If you must wash the sail, use a light detergent only. Soaps made for washing wool generally produce the best results and are the least likely to damage the resin in the sailcloth. Always rinse thoroughly.
2. Acetone or methylated spirits can be used to remove stubborn stains without harming the sail. Avoid using solvents on the mylar sail sections. Rinse well.
3. Check the sail for tears and abrasion. Apply sail repair cloth ('stickyback') to minor tears and holes in the sail that are not in critical areas. Have any major sail damage repaired by a professional sailmaker espe-



cially if it is in a critical area such as the root, trailing edge or tip sections.

4. Inspect all the eyelets and attachment points in the sail.
5. The best protection for the sail is to always use the bag. Do not carry the glider on top of a car even for short distances without the bag. U.V. radiation in sunlight causes most of the damage to the sail. Avoid leaving the glider in the sun any longer than is necessary.

## **Mylar**

If the mylar inserts have become creased it is possible to iron them flat. Provided the damage is not extreme this procedure works well. Mylar is a polyester so use a cool or 'polyester' setting on the iron or the inserts will melt.

With proper care and maintenance your MAX should last for many years of flying. There is, however, much that is still not known regarding the effective lifetime of a hang glider before material fatigue and degradation compromise the airworthiness of the aircraft. That's why it is important to carry out maintenance as outlined above.

## **Stripdown Guidelines**

1. With the glider upside-down but folded, remove the control frame from the keel. Remove V.G. cord from the cleat and pull through the upright.
2. Turn the glider over and pull the ball tips from the sockets. Undo the nose plate bolts and remove the sail tabs, (replace the nose bolts to hold the leading edges in place).
3. Undo the top and bottom wires from the crossbar/leading edge junction, gaining access via the zipper in the undersurface.
4. Undo the king post base bolt. Remove the compensator by undoing the shackle from the pulley.
5. Undo the bolt holding the top front rigging to the nose plates. Remove the king post and top rigging together.
6. Remove the bungee at the nose end of the undersurface zip and undo the zipper.
7. Pull the glider frame forwards out of the sail through the double surface opening, making sure that nothing catches and that the wires pull through their holes in the sail.
8. Take the mylar inserts out of the leading edge pocket.



## A FEW LAST WORDS

Your MAX is a sophisticated high performance hang glider that will provide you years of safe and enjoyable soaring provided that you look after it properly and always maintain a healthy respect for the demands and potential dangers of flying.

The MAX has been tested to internationally accepted airworthiness standards. There are, however, forces in nature which can severely compromise your safety regardless of the quality of design or condition of the aircraft you are flying. You are reminded that you are flying a hang glider at your own risk and that your safety is ultimately your responsibility. We strongly recommend that you fly conservatively, allowing safety margins in both the conditions in which you choose to fly and in the maneuvers you attempt.

Have fun, fly safe and see you in the sky !

