The Paramania Revolution 2 Wing - Owner's Manual

Contents

1.1 Introduction

Since introducing the original Reflex wing in 1994, Paramania feels privileged to have progressively improved levels of safety, speed, performance, and ease of handling in the sport of paramotoring. Our succession of products, the Reflex MK1 & 2, the Action, the Action GT, the Revolution 1, the Go-Fly, the Fusion and Taxi, reflect Mike Campbell-Jones, our designer's, ongoing evolution of Reflex technology for soft wings.
Mike's experience gives the Paramania team the leading edge - the ability and insight to design wings that consistently bring new technology to the foreground.
The Revo2 Wing is no exception. It is the first of a new species of wing, a truly innovative hybrid that we call a 'Powerglider'. A powerglider being a wing designed to optimise powered flight while having such free flight performance that it is also making inroads into the free flight world.

The Revo2 Wing is a pure beginner/intermediate powerglider, combining all the proven elements of the Paramania range – safety, performance, technology, stability and usability.

We love it and know you will too. Congratulations for choosing the Revolution 2 Wing.

1.2 About this manual

This manual is to help you understand you're Wing, please read it carefully and regularly!
It offers you, the pilot, guidelines in the use of your wing. It is in no way intended to be used as a training manual for this or any other Paramotor wing or Paraglider. You may only fly an aircraft of any description when qualified to do so or when undergoing training from an accredited School or Instructor.

"It must be understood that flying can be a dangerous activity unless undertaken by properly trained people flying in a responsible and disciplined manner. As the owner of a Paramania wing, you have chosen to fly one of the safest aircraft of its type available.
*Nevertheless, in the final analysis, any aircraft is only as safe as the pilot flying it, and it is your, the pilot's, responsibility to make sure that you have the required training * and experience to be able to make your own informed judgements about how, where, and when, you fly"*

Paramotoring (powered paragliding) is a relatively new activity that is still evolving. Should you have any doubts about the suitability of the wing for the type of flying you wish to practice, or should you wish to extend your flying in other ways, we recommend that you seek further guidance from your own instructors or direct from Paramania. Under no circumstances should you attempt to copy the type of flying that may have been demonstrated to you or that appears on any video demonstration of the wing without first receiving proper aerobatics training from instructors experienced in the use of this wing.

In order to achieve satisfactory performance it is essential that proper consideration is given to matching this wing with the appropriate harness, motor and propeller. **While we can make recommendations, the choice and suitability of any particular harness or motor remains outside our control and responsibility.

Paramania, its directors, employees and agents can accept no liability for any consequences arising from the use of their products howsoever caused.

Note –
**The Paramania website makes a link to a worldwide network of professionals that offers step by step training and support for you to become as safe a pilot as possible.*
*** All such advice is available from our dealer network and other professional training centres.*

1.3 Pilot skill level requirements

The Revolution2 is super easy to launch and fun to fly! Its forgiving nature makes it perfect for schools and training. Like its predecessor (the Revolution classic) it has a surprising level of safe performance. It enables its pilots to explore the sky and gain experience for those vital first years. It is the perfect entry level wing that you won't get bored of.

2.1 About the Revo2

Within our sport there are limits: those related to material technology and pilot ability can be gradually extended; while other 'natural' limits cannot.
Thus while the Paramania team are renowned for expanding the flight envelope of paramotoring, the limit to, for example, how fast you can fly while still being able to foot launch remains. Or to the amount of turbulence one can fly in, or to the weight that can be safely supported by the wing.
Recently we have focused on making wings easier to launch and handle, as well as on their safe performance. The Revo2 is a direct result of this research.

2.2 Design concept

The Revo2 has been designed by Mike Campbell-Jones. His history in the development of powergliders that exclusively use Reflex wing sections, coupled with his experience in Microlight aircraft and glider design, mean that your Fusion wing benefits from a wealth of knowledge that spans over 30 years, back to the early days of hang-gliding.
Microlights were initially developed as powered hang-gliders that over time favoured more powerful engines and smaller more stable wings. It soon became clear that the faster your wing, the more often you could use it!
Similar interests have pushed forward the evolution of a utility paramotor flying machine like the Revo2. Towards a machine on which the pilot needs to spend less time and effort flying actively, responding to every lump and bump, and is instead freer to focus on navigating, getting comfortably from A to B, or performing other tasks, such as photography, observation or general flying.

Although your wing has been designed to fly like a conventional Paraglider, the Reflex wing section means that it has an elevator built into its shape. The wing is no longer dependent solely on payload as its only source of stability. It maintains its own attitude in pitch, rising and falling through thermals and turbulence, whilst remaining stable above the pilot's head, requiring minimal control input.
The trimmer system allows you to raise the rear of the aerofoil, effectively reducing the chord and surface area by some 30%, giving the wing a higher wing loading and increased speed without changing the angle of attack. The centre of pressure also moves forward adding further to the pitch stability. This redistribution of loading gives the wing exceptional tuck-resistance and increases the working aspect ratio. The result is a faster, more efficient wing under power and at speed, much like a traditional powered aircraft.

When requiring more lift at lower speeds, the rear section can be trimmed down to restore a fully flapped Reflex aerofoil thence the Revo2 changes its characteristics, becoming closer to a conventional paraglider with smooth sporty handling, short slow take-offs and steep climb outs. It's like having two wings in one.

About the Revo2's new aerofoil section

The Revo2 has the very latest in MCJ pitch positive 'deep Reflex' wing sections. The extra performance characteristics are waiting for you to discover.

(2.2 continued)

As with most of our wings, when flown above the neutral trim position, the pilot can fly inactively, fast and with hands off the toggles, most of the time. However, the Revo2's unique aerofoil is carefully 'shape-controlled' by an innovative fabric gathering system.

So when trimmed below the neutral position (slower) the Revo2 behaves much more like a normal Paraglider with a sink rate and glide ratio similar to any intermediate model, additionally the handling becomes light and responsive, and some built in Reflex pitch stability is still maintained. Depending on the conditions, it can now be flown more actively with the pilot's hands spending more time on the control toggles. Its roll rate and tight but flat turning circle are most impressive.

About the CLE (Composite leading edge) system

The Revo2 (and the Revo 2 and Taxi), share our new Composite Leading Edge technology. The word "composite" describes 2 or more elements brought together to create a new material with desirable engineered properties. Our latest light weight leading edges mix Dacron™ with Nylon66, which is strategically placed to work in compression. The result is a unidirectional stiffness, which holds inlets open and smoothes the leading edge, whilst maintaining the flexibility designed to reduce the risk of cravats. Launching is a totally new experience with this system.

Why the larger centre sections (fuselage)?

There are 3 principal reasons.
1. Structurally – In general, when paragliders are constructed with increased aspect ratio, the centre chord of the wing becomes narrower, so less ridged. Increasing the volume and depth at the centre of the wing, allows us to produce a wing with a higher aspect ratio whilst keeping the same levels of stiffness as a wing with less aspect ratio.
2. Aerodynamically - The larger centre cells behave as a "wing strake" or barrier. This helps to control the 'span-wise' airflow. This re-aligns the airflow, reducing induced drag and giving better directional stability. Note:- All birds and most aircraft have a central fuselage!
3. A large centre rib also provides a method of linking the lines from both sides, giving faster inflation and improved launching characteristics because the pilot weight is transferred to both sides at once. This is the same as cross bracing on a paragliding harness, only installed as an integral part of the wing.

Why the "Centre Keel Lines"™ ?
The Revo2 has both sides of the wing linked through "Centre Keel Lines"™, which allow a more controlled weight shift movement from side to side. The pilot is thus able to transfer weight without much deformation at the centre of the wing. Further, both sides improves tuck recovery dramatically, as the pilot's weight is always loaded on more than just one half of the wing.

Seen here the wing has minimum distortion at the centre during a heavily weight shifted turn

About Reflex technology

Paramania's design history and pioneering developments in Reflex technology (since 1994), have given us the experience to devise wing sections and trimmer systems that allow a pilot to trim safely from Paraglider to Powerglider, changing the shape of wings to match the requirements of paramotor flight.

Many wing manufacturers entering the paramotoring market claim different variations of the Reflex theme.
However for Paramania the vital characteristic of the Reflex wing is that it is pitch positive:- A Reflex wing will pitch forward on entering, and rearward on exiting, a thermal. A normal Paraglider wing will pitch rearward on entering and forward on exiting. It is most noticeable when flying through turbulent air or thermal activity i.e. when rising or descending air masses are encountered.

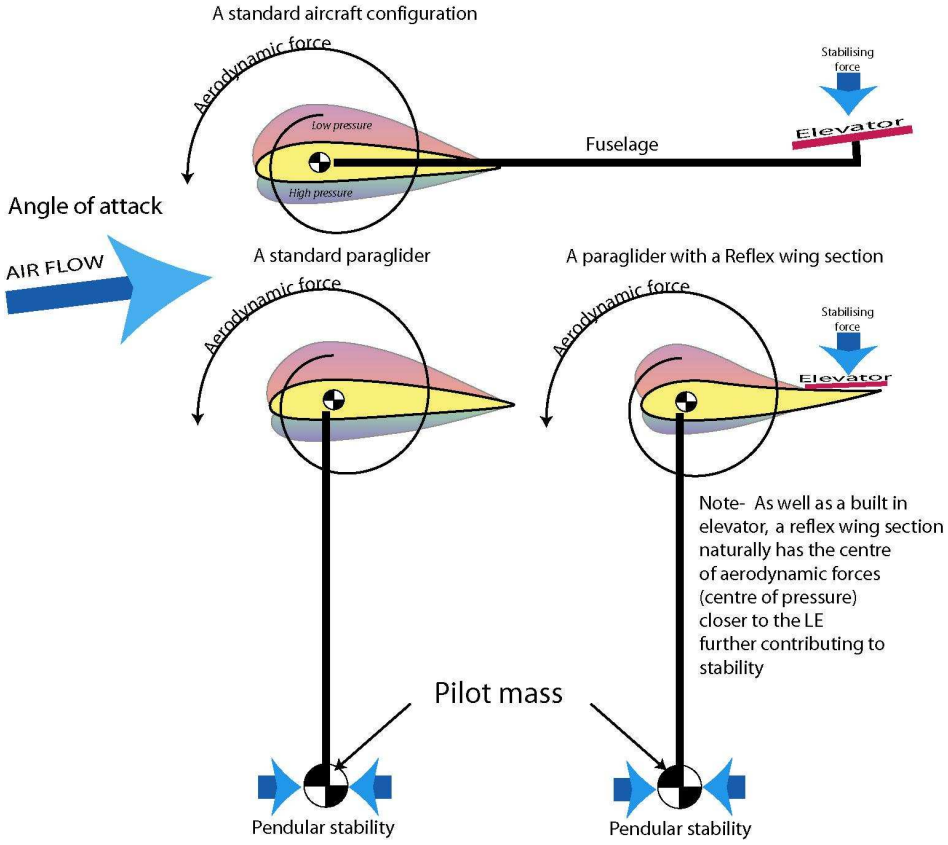
These opposing reactions are very clear and apply to any aircraft trimmed positively rather than negatively. Generally all aircraft are trimmed positively as otherwise the aircraft's pitch stability would be much more dependent on pilot input.
Most paragliders are trimmed negatively and despite some pendulum stability, the pilot needs to learn to fly actively otherwise the wing may easily collapse in rough air.

It has now become clear that without the introduction of Reflex technology or pitch positive wing sections we would have seen many more accidents, as the necessary pilot skills required to fly normal paragliders with engines at low level in turbulent conditions are extremely high. In fact Reflex is possibly the single most important reason why our sport has been able to evolve - it has made it safe for paramotoring flight to develop!

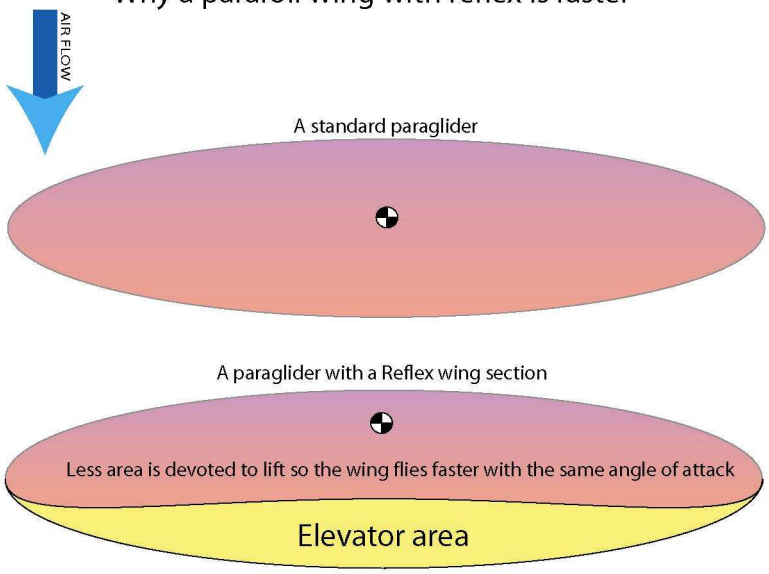
So… what exactly does Reflex mean..?

Reflex technology refers to a specific type of wing section that has an elevator built into its shaping making it auto-stable and pitch positive. i.e. It is a wing with built-in pitch stability. It was originally developed for tail-less aircraft (where **no** fuselages or elevators were fitted). When introduced into a Paraglider type wing it gives desirable pitching characteristics. As a result more than 50% of wings used for paramotoring are now Reflex wings. The reason is simply that a reflex wing is pitch positive, whereas most standard Paraglider designs are not!

Why a parafoil wing with reflex is more stable in pitch



Why a parafoil wing with reflex is faster



Whilst sink rate is reduced (not a problem with power), the glide and efficiency at speed is improved because the area flown on, has an effective higher aspect ratio, which gives a flatter polar curve
Eg Reflex wing sections = more stability and efficiency at higher speeds

Note:- Some of the latest developments in reflex technology are in the control of the elevator area using intricate systems that improve slow speed flight characteristics, so giving the best of both worlds with a wider range of speed and performance

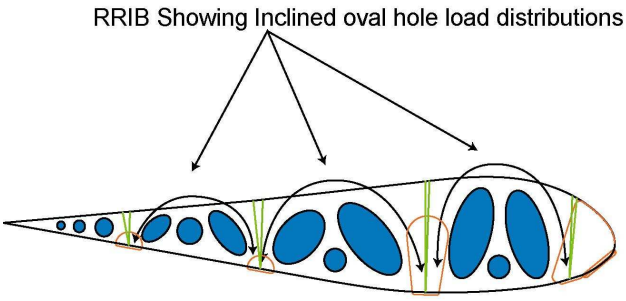
2.3 Construction

We produce our wings with Gin Gliders based in Korea, Gin's renowned precision and quality is clearly visible in all of our wings and like all Gin's products our wings carry a lifetime guarantee. Your wing's strength and durability has been achieved through innovative design and the careful choice of the best modern materials. All materials from which it is constructed are batched and every stage in its manufacture can be traced to a named operator and checker.

The top and bottom surfaces are made from the hard-wearing **Porsha-Marine NCV, 44gm, and 37gm** respectively. The wing tips, leading, and trailing edges are reinforced using a mix of load tape and Mylar. The semi-closed leading edge improves the aerodynamics whilst stabilizing lateral movement between surfaces, giving it a more solid or rigid feel once in the air

The structural ribs

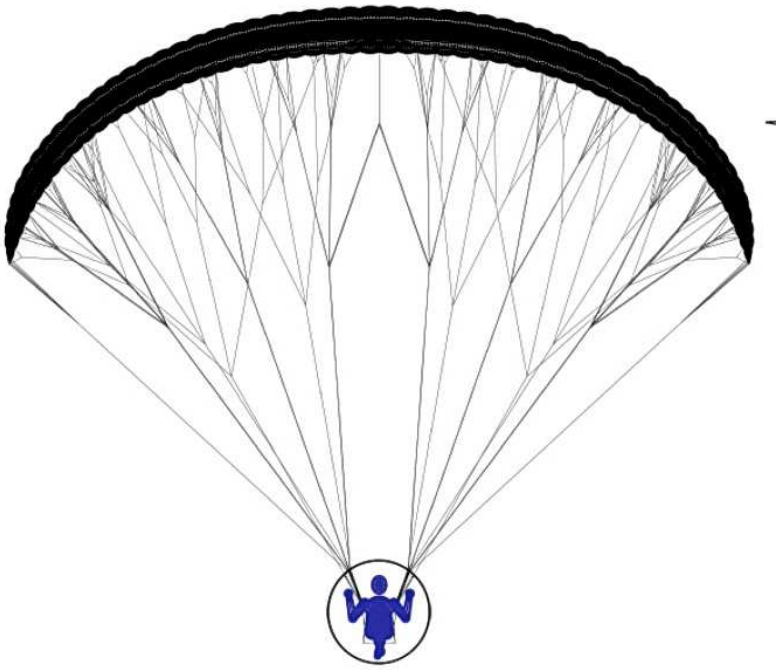
These have been designed with inclined oval ports that allow air to flow to the areas within the wing where internal pressure is needed most. They open like valves to increase their area during inflations when the ribs are off-load and when loaded, distribute the forces efficiently from the line attachment points into the top surface, so minimizing distortions normally created by conventional holes. Suspension line attachments are reinforced in 3 dimensions: vertically with the main rib, at an angle with the diagonal ribs, and at 90 degrees with bottom surface lateral tape. The ribs are heavily reinforced with Mylar wherever the loads are substantial i.e. around the "A" and "B" line attachments.



& general Revolution rib reinforcements

The Revo2's special line configuration

The Revo2 has a lot of extra lines towards the tips, these lines act as a net, dramatically reducing the possibility of cravats (for an explanation of cravats see section 3.4). All the angles of the lines are individually calculated to act as a fabric gathering system for the complex changes of our latest Reflex aerofoil. Thus the whole wing can actually change its shape, much as a bird trims its feathers!



The line configuration and diagonal rib structure share the same angles throughout the wing. This further enhances the load distribution; we have found this gives much quicker inflations.

All lines are made from **Gin Arimid Technora**, the latest in line technology, and incorporate the best qualities of its predecessors, **Kevlar and Dynema**. It is both strong and flexible, whilst remaining temperature stable, and are less prone to shrinkage when lightly loaded.

The lines are split into 4 levels: Primaries, Secondary's, Tertiary's and Quadry's. Line diameters are **2.3, 1.6, 1.3, & 1.1mm** respectively.

The **Malions**, which attach the lines to the risers, are made of polished stainless steel. This avoids corrosion and gives excellent strength and durability. The riser material is 1.2K / 25mm polyester webbing. The main attachment points are reinforced with **Cordura™,** to protect against wear from the karabiners.

The Revo2 has been built with paramotoring in mind - when new it has a safety factor of approx 50% over and above its tested loading. It has been engineered to perform to its specifications for about 400 hours.

WARNING: Humidity and/or UV exposure will drastically reduce the lifespan of your wing. Always store your wing in dry and dark conditions. (See section 4.1 Basic Care)

2.4 What your Wing comes with

1. The Wing
2. User manual (CD, USB or paper)
3. Paramania Ruck-sack (reversible, normal or field)
4. Stuff sack & compression strap
5. Speed bar
6. Basic repair kit, including spare primary "A" lines
7. Paramania accessories (t-shirt, 2 mini wind socks or others)

Your Revo2 is a high-end quality product –

As such it has been fully inspected, firstly by the factory, and secondly by your local Paramania dealer. Should you not be entirely satisfied with your Paramania powerglider please contact your dealer directly. *(And if you're happy contact them anyway :)*

2.5 Setting up the controls

Hang check

The following is best carried out by an instructor or at the very least by an experienced motor pilot. Before flying your Revo2 with a motor unit, we recommend that you do a static hang test. This is done by hanging your motor unit from an appropriate structure from the wing attachment points by using a strong rope or strap, then by sitting in the harness, and getting an assistant to measure up the risers from the hang points up. The aim is to make sure that you, the pilot, are able to reach the brakes whilst in flight. Allowance should also be made for the wind blowing the toggles out of reach.

Brake line lengths

The Revo2 risers come with a single pulley system which slides up or down, brake lines are clearly marked in two places - specially for high hang point power units.

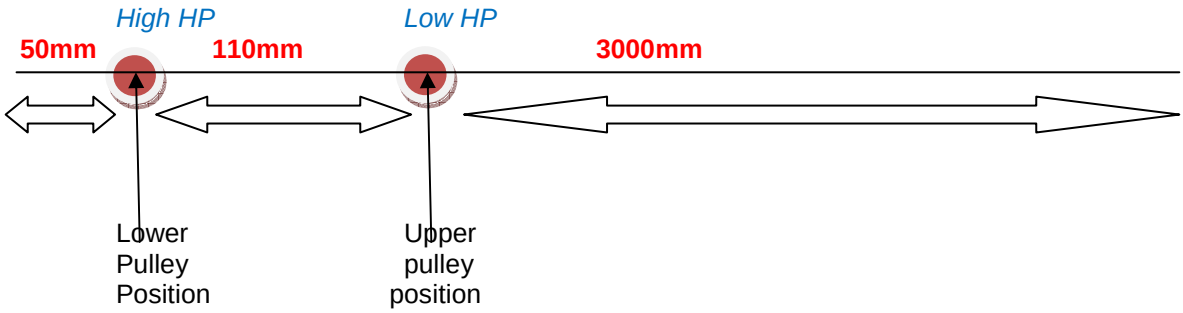
These line marking positions are fixed and need no adjustment.

WARNING :- Stay within the marks, shorter or longer lines can impair safety!
*Note:It is **always safer** to have this adjustment too long rather than too short. Short lines can dramatically change the flight characteristics by removing stability both in pitch and roll*

Higher hang points require longer brake lines, lower hang points, need shorter settings.

All new wings leave the factory rigged for low hang points

Total primary brake line length = 3160mm for all current sizes



Double checking brake line lengths!

Below is a useful method for double-checking brake line lengths, which may be necessary if the marks are warn, not clear or are simply not there because the brake lines have been replaced.

Remember, it is always best to seek the advice and assistance of a local instructor or experienced pilot for any setting up requirements.

Choose a steady breeze of about 10kph. Ground-handle the wing above your head, with an ordinary harness or your motor unit on your back. When the wing is nicely level, check that when the brake toggles are up against the brake pulleys the trailing edge of the wing is not being pulled down. Then as you gently pull the brakes you should have only a few centimetres of movement before they start to pull down on the trailing edge of the wing. Make sure it is the same length on both sides.

Note:- When free flying, the wing should always be set up though the top pulley or with newer versions the sliding pulley in the upper position.

3 Flight Operations

3.1 Flying with and without a motor

The design philosophy of the Revo2 is that of a paramotor wing, which also performs well as a free flying glider and may be flown as such with no adjustment. Slower trim settings reduce internal air pressure and consequently give a lighter feel to the brakes and a better sink rate. The main difference between a reflex wing and other paragliders is the increased resistance to tucking, both during launch and in flight. Its greater speed range and stability mean that it can be flown with safety in stronger conditions. The wing even becomes more stable the faster you fly.

First flights

We recommend that you get used to your new wing through a period of ground handling. Normally you will be taken through this step by step, by your school or Paramania professional. Your first flights should be made using the recommended take off position.

i.e. the Take off position 3-4 between the 'fully slow' 5-6 and the 'neutral' position 0.

If you are used to conventional paraglider wings, the Revo2 will feel familiar. Try flying with a small amount of brake pressure - you will encounter this point at about the one-quarter-brake position where the pressure just begins to feel a little heavier.

When you have become fully confident with your wing, try experimenting with faster trim-settings, weight-shift and speed bar and enjoy the extra speed and security the Revo2 gives you.

3.1a Launching

The hardest thing for any pilot and especially with a Paramotor, is forward launching in zero wind! For this Paramania have paid special attention, the Revo2 has been designed to be exceptionally easy, it virtually comes up on its own, rarely over-shoots, and has excellent directional stability during takeoffs

Forward launch

We recommend that when the wing is laid out, all the lines are at full length with little or no slack between wing and pilot. Next pull the brake lines in, to ensure that the middle inflates first. The Revo2 is easily inflated by using “A” risers only. When launching simply move forward from this position pulling on the “A” risers, whilst keeping the pressure balanced between each side (meaning the tension on the “A” risers). The wing shows little or no tendency to dive overhead, so frontal collapses which so often lead to failed launches, are rare. Instead the wing almost waits for you to catch up with it.

***Note**:-In certain trim positions i.e. ‘take off’ to ‘neutral’ positions, the Revo2 requires almost no pull on the “A”s at all, accelerating forward movement alone may be sufficient.*

Reverse launch

Once again, the wing is very easy to launch because it does not over-shoot, so the pilot has little or no need to hold the wing back before making the turn. Reverse launches on this wing can be carried out in as little as 5 kph.

3.1b In Flight

The best trim position for pure fun handling is around the take off position. The Revo2 makes precise efficient turns. Its handling is light to the touch with a forgiving range of movement; it allows pilots to make mistakes but has the ability to correct them automatically, its sink rate on full slow is comparable with most other conventional intermediate gliders.
With the trim fully released, the wing takes on more solid characteristic, carving through the air with increased pitch and roll stability, its speed is impressive and it cushions turbulence
With more speed, brake pressures increase as does the range of movement prior to the stall point. Turns and rate of roll are linked in a linear fashion. However at full speed WTS system or simply weight shift become more effective than the brakes. As a conventional paragliding pilot it may take time to gain sufficient confidence in the wing to “let go” of the brakes, but once you do it’s a whole other world!

3.1c Use of the speed bar

On the Revo2 - The speed bar increases the speed by approximately 15% (this is a little less than other Paramania models). When applied the wing cuts through turbulence even better with the bar applied. However, if any instability is encountered due to excessive turbulence it is recommended to release the bar for recovery and to return to normal flying mode. The speed bar is primarily for use during straight and level flight. As you become more experienced, careful release of the bar whilst entering turns, has an effect similar to pulling the stick back on a conventional aircraft.

You can use it to “surf the thermals” i.e. progressively apply the speed bar in lift and turn it into forward speed, then, ease off on the bar as you exit the thermal whilst entering sinking air and convert that speed into lift.
Although the speed bar can be used with confidence across the whole range of trim settings, it is obviously most effective and recommended to use it with the trims off. i.e. on the faster settings.
Use of the speed bar with full trim on (slow) is not recommended and serves NO purpose anyway!

Get to know your speed bar! It can enhance your stability and safety.

3.1d Landing

Paramania have worked hard in this area The **Revo2** is very easy to land. The wing manoeuvres well and its angle of approach is very controllable using the brakes alone. The interesting thing with the Revo 2 is that it is capable of a slow deep brake student type approaches as well as a faster more commonly used with reflex, high energy approach and flare. To recap, during the landing 'flare', the brakes, light at first, become progressively heavier over a healthy amount of travel, and forgive the pilot even on a slow approach. This is a vital point and makes the Revo2 landing extremely forgiving.

On landing in high winds the wing may be deflated with confidence using a strong pull on the rear or “D” risers, or, off to one side with a brake, in which case it is a good habit to watch the wing tip go down - it will save on propellers etc!

3.2 Flying under power

For powered flight many of the characteristics are the same as in the previous section (3.1). However there is a certain amount of additional information, particularly where the addition of the thrust of the power unit and correct matching of the wing to the motor unit is concerned. Paramania cannot be held responsible for the multitude of combinations possible, however if you wish to contact us we can offer some advice.

NOTE: *Thorough pre-flight checks of wing, harness and engine are essential prior to any launch.*

3.2.a Forward launching the Revo 2 in zero wind

While there may appear to be no wind this is rarely the case and it is essential for aircraft of this type to take off and make the initial climb out to a safe height (relative to the surrounding terrain) into wind. This makes maximum use of the wind and avoids the danger of losing airspeed when climbing out steeply through wind gradient. Particular attention must be paid to trees, power lines and other large obstacles, and to any rotor (vortices) that they may generate. Remember:- when rotor doubles, turbulence increases by a factor of x4!

Preparing the wing

Lay the wing out, downwind of the motor, so that the lines are fully extended and as if attached to the motor or central focal point, then lay the risers down ready to clip in.
Set the trimmers to the take off position (faster settings may be desirable in stronger conditions, see diagram Revo2R02). Make sure that when warming up the engine you do so upwind of the wing, in case a gust blows the wing towards the motor, and then cut the engine whilst clipping in.

Next carry out the following checks:

1. Pilot prepared – clothing safe?
2. Helmet on and fastened?
3. Malions securely connected to risers (no twists)? Trim set?
4. Nothing likely to foul the propeller?
5. Speed bar system running freely and out of harm's way?
6. Steering toggles secure, brake lines free and not twisted?
7. Wing Tip Steering (WTS), if fitted, secure and adjusted correctly?
8. Engine delivering full power?
9. Airspace is clear for takeoff?

Attach the wing and proceed with the launch (as in section **3.1a Launching**).
From now on you should try to control the wing whilst facing forwards. If the wing is low behind you and you turn around, the lines will trail over the propeller. However, falling backwards onto the motor is both dangerous and expensive and must be avoided at all costs, even that of a few damaged lines!
During the launch, if the pressure on each of your hands feels even, open the throttle to full take off power, leaning backwards against the thrust so that the engine is pushing you along the ground rather than into it.
It is best to try and leave the brakes alone and just let the wing come up. If it starts to go off to one side, move sideways and centre the wing. If possible try to maintain the direction of your launch. If the wing starts to drop backwards, increase pressure on both "A" risers to help it up. As you increase power, try to maintain a constant angle with the motor and smooth power control. Any sudden changes will alter your course because of the powerful gyroscopic and torque effects.
As the wing comes up the resistance reduces. Until this happens it is best to keep moving and looking in the launch direction, whilst simply feeling the wing, normally it will stabilize over your head without over-shooting. Only when you feel the resistance reduce is it a good time to check your wing, making sure it is nicely inflated and that there are no tangles or lines fouled, however this must be done whilst on the move and without turning. Allow your run to accelerate. Feel for pressure on the brakes, gently come down on them as required to steer or to increase lift for taking off.
If the wing is so far off to the side or behind that it cannot be recovered, kill the engine, abort the take-off and reassess the launch conditions.

Note:- So many pilots try to look at the wing as it is coming up, in doing so they usually upset the launch. This is because when looking they turn their body at the same time, both changing the thrust line and asymmetrically twisting the risers.

Points to note:-

- If your propeller protection cage is flimsy, the pressure of the lines on it during launch may distort it to the point where it fouls the prop. If this is the case make sure the lines have cleared the cage before you open the throttle.
- All control inputs should be smooth and progressive.
- Don't attempt to take off if the wing isn't roughly level overhead. Dangerous oscillations may result if you apply full power with it too far off to one side.
- Keep your undercarriage down until you are definitely flying!
- The faster the trim setting, the more brake the wing will need to get off the ground.

3.2.b Reverse launching in stronger winds

Because the Revo2 launches so easily it is possible to perform a reverse launch with both front risers and one brake in one hand and the throttle and opposite brake in the other. If the wind is appreciable then this is the easiest method of launching, but if the wind is light and variable, the difficulty of running backwards safely with a motor on, makes a forward launch preferable.

It is wise not to open your wing out to the point where it is liable to be caught by the wind until you are ready to launch, especially if it is already connected to your motor.
Lay the folded wing on its back with the trailing edge pointing into the wind.

Unfold it just enough to locate and untwist the risers and check that no lines have gone over the leading edge.

Extend the risers upwind as usual, separating left from right.
We suggest that you pre-twist the risers over each other half-a-turn in the direction in which you wish to turn during launch and lay them out in this position with the rear risers uppermost. This is because, once clipped in, the propeller cage on your back makes it virtually impossible to turn without assistance when the wing is on the ground.

Carry out your standard pre-flight checks now.

Having started and warmed up your motor upwind of the wing, attach yourself to the power unit, face the wing, approach the risers and clip them on to the appropriate malions.
By pulling on "A" and "D" risers simultaneously the wing rises up like a wall, facing the wind and ready to launch. The "A"s encourage the air intakes to present themselves to the wind, the "D"s keep it on the ground. On uneven ground the leading edge of the wing should be level with the horizon. We recommend that you momentarily raise the wing off the ground to check for tangles and line snags.
Holding risers, brakes and throttle control as outlined above, gently pull the front risers up to lift the wing over your head. It is unlikely to over-fly you, especially if it is trimmed to fly fast. This may be contrary to what your paragliding intuition tells you, but on the faster settings (trim neutral) the Revo 2's Reflex wing section stabilizes the wing and prevents it from pitching forward. It may even sit back a little but applying a small amount of brake makes it pop forward.
When the wing is steady above you, turn around, apply power, and take off. As with forward launching, the trim/power/brake relationship must be established for the best rate of climb and forward speed.

Points to Note:

- This is a cross-hands reverse launch. You must master this technique before attempting it under power.
- No amount of ground handling practice is enough! Your local paramotoring/paragliding school may also assist you here.
- All control inputs should be smooth and progressive.
- Don't attempt to take off if the wing isn't roughly level overhead. Dangerous oscillations may result if you apply full power when it is off to one side.
- Keep your undercarriage down until you are definitely flying!
- The faster the trim setting, the more brake the wing will need to get off the ground. Speed systems may cause problems when clipping in. Don't get your lines crossed!

Hot Pilot tips
Turning around will be much easier if you tilt the wing slightly over into the direction you are about to rotate into.
If at any time you are not happy with your launch, you can simply abort by lowering the wing to the ground by using the rear or "D" risers.

Warning:- *Many pilots, particularly if they have trained previously in paragliding, get into the habit of using the brakes to abort or control their wing in windy conditions - experience has shown us that sooner or later they* ***WILL*** *put a hand back into a spinning propeller.* ***Always use the rear or "D" risers instead.***

3.2.c The climb out

Once off the ground and flying safely, continue into wind using the brakes to achieve the desired climb rate.
Provided there are no obstacles in your path, it is often safer to fly level with the ground after take-off, gaining more speed before converting it into considerable height using the brakes and then easing off into the climb out.

The Revo2 is very forgiving, but even so It is best not to climb out too steeply there is some risk involved if the engine fails i.e. a stall and diving recovery. Take care to set up a reasonable approach.

Don't make things hard for yourself - fly with sufficient airspeed at all times, and keep your airspeed under control at low altitudes.
Because all paragliders have a large distance between the thrust of the engine unit and wing, applying power suddenly has a big effect. Therefore care should be taken especially during climb out or close to the ground.
Depending how the hang points are set up on your power unit you will feel to a greater or larger extent the propeller torque. It may be necessary for you to steer against it to maintain direction. However if you are countering the torque effect during a steep climb on slower trim settings under a lot of power, take care as once again there can be a risk of stalling.

3.2.d In Flight handling

The Revo2 is a wing which has been designed to be pure fun. it is remarkably forgiving in all areas of its flight envelope - it encourages pilots to have fun whilst providing a relatively safe playground.
As with anything new, we recommend that you get into it gently and don't rush, give it time, be smooth and concise with the controls, and above all, make sure when you start a turn to finish it properly!

Power induced oscillations

Certain combinations of weight, power, and propeller size can cause oscillation where the torque and gyro effects lift the pilot to one side. This usually occurs when climbing rather than in level flight.

To counter this you can:

• Make sure you complete your turns by being smooth on the controls.
And/or
• Change the throttle setting and reduce the level of power.
And /or
• Adjust the torque strap if fitted.
And/or
• Shift your weight in the harness.
And/or
• Set up the wing tip steering (WTS) kit or other wing tip device to adjust out the torque effects.

Weight shift is the best counter. Oscillation usually occurs on high power settings - more power and a larger propeller cause more oscillation. It could be that your control inputs are amplifying the oscillation. In this case, throttling back a little and flying hands-off should take care of the problem.
*Note: It is quite common even for experienced pilots to be too busy on the controls, this is referred to as **pilot induced oscillation**, and the simple answer is to stop moving your hands.*

Level Flight

Once at a safe height after takeoff, if you wish to go cruising reach up and let off the trimmers to a faster setting, and let go of the brakes completely. If conditions are very rough you may wish to keep hold of them, however the Revo2 is even more stable at higher speeds, so we do suggest you let go of the brakes and enjoy the flight. If wing tip steering (WTS) is fitted, use it to maintain level flight. WTS really helps hold your course particularly when thermals get under one side of the wing.

Note:- All paramotors should have adequate netting to prevent toggles entering propellers whilst in flight – check yours!

Hot pilot tips
If you have an alti/vario, keep an eye on it. Whilst in level flight it is easy to creep into a climb without noticing. Use the information from your instruments to optimize your forward speed and reduce drag and fuel consumption. This will all be specific to your own set up. With its hands-off flight capability, the Revo2 is good at letting you do this.

With a sound understanding of the current wind conditions at different altitudes, and intelligent use of any thermal activity, wave, convergence, ridge or frontal lift, it is possible to conserve your fuel and greatly extend your operating range. The engine of course makes it easy for you to get yourself into the right place at the right moment to best exploit the conditions.

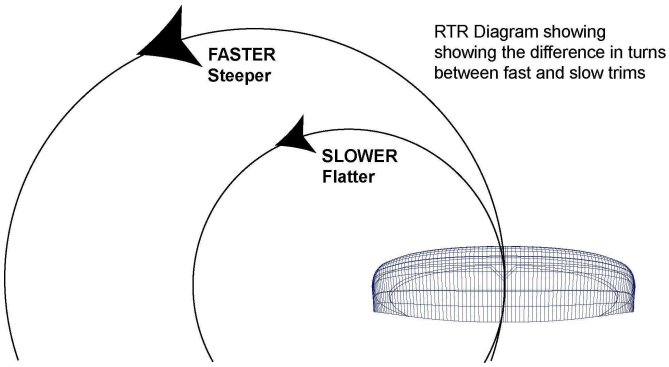
3.2.e Using the Trimmers and Speed Bar

The Revo2's Reflex wing section is unique - it has a remarkably wide and relatively safe speed range – of over 3 times greater than its stall speed as compared with most aircraft that only have 1-2.5 times.
With the trimmers fully off the wing's speed and stability increase and hence its ability to cut through turbulence and cover distance improves. On faster trim or speed bar settings, brake pressures generally increase and then weight-shift or wing tip steering (WTS) become more effective and safer.
Note:- Brakes can remove the Reflex character of the wing by distorting the wing's shape the wing may become less stable.

The wide range of trims and the speed bar are there for you to explore the full flight envelope. We only ask that you do this at a safe height and with adequate training and experience.

For correct trimmer usage, first study the Revo2 R diagrams 01 & 02, showing trim and speed bar movement as well as speed bar hook-ups. The diagrams also show you the effect on the wing's aerofoil shape relative to the different trimmer settings, as well as the Centre of Pressure (CP)changes indicating differing levels of pitch stability.
See Revo2 R 2 for details (It is the same for all current sizes).

On the slower settings, sink rate improves dramatically and handling on the brakes becomes much lighter enabling you to make the best use of thermal cores. You will also have improved climb rate and shorter slower take-offs and landings. See diagram RTR below describing differences in turning radii.



RTR Diagram showing showing the difference in turns between fast and slow trims

Points to Note:

• Remember, trims and speed bar are controls, so are extra items for your pre-flight checks!
• If the trim settings inadvertently become asymmetric, the wing just crabs. Likewise, if lift is dumped, by releasing the trimmers accidentally, the Revo2's Reflex wing section keeps the wing above your head and you will just lose some height while accelerating.
• In general, when flown with the higher hang-point motor units, the wing has more of a tendency to dive when entering turns; this may also result in higher 'G' loadings in tight turns and a bigger swing effect when exiting manoeuvres. Weight shift is usually less effective with high hang-points. However; usually there is extra pendulum and lateral stability is gained.

Hot pilot tips
As your skill improves at all speed settings the differential application of both brakes while banking will allow you to make very effective turns by increasing the lift to assist the turn when the lift axis is angled towards the bank. Likewise engine thrust and speed bar can be applied at certain times to increase turn rate etc. These techniques come with pilot experience and allow you to get the most from your wing and achieve fully coordinated, smooth turns, much like those possible on a three axis aircraft.

3.3 Landing

There are two options - either with an engine running or not.

3.3.a Power-off landings

Cutting all power at about 50m and gliding in like a paraglider will minimises the risk of propeller damage but you only get one go at it - you have to get it right!
Generally the Revo2 rides out turbulence better when landing with a faster trim setting, so if it is rough come in fast (on neutral trim), allowing yourself room to bleed off speed just above the ground before touching down. If you aim at a restricted or tight landing area, in zero-wind conditions, it is advisable to use take off or even full trim (maximum lift configuration). This will hardly alter your glide angle but will decrease your sink rate and forward speed and make you turn radii smaller. These types of decisions become more critical at higher wing loadings.
Practice makes perfect!

3.3.b Power-on landings

At a steady-tick over, lose height at a shallow angle, then as you near the ground, level out and bleed off speed before flaring to touch down. Kill the motor as your feet touch the ground. The advantage of this method of course being that, if at any time you feel your approach is wrong, you can power up and go round again. The disadvantages are the increased risk of (expensive) prop damage, the dangers involved in falling over with the engine running, and in getting your lines in the propeller if you are late to switch off before the wing deflates.

Points to note:

• If possible, find out all about your landing area before you take off.
• Check the wind direction before you set up your approach.
• Power-off landings probably need less space.
• If in doubt, practise your approach until you are sure you can land safely.
• Never rely on your engine - always be ready for an emergency landing by practising spot landings regularly.

3.4 Advanced manoeuvres

The Revo 2 has achieved an EN rating for the range of manoeuvres carried out by the test authorities. However it is essential that pilots undertake proper training before attempting certain aerobatics.
We suggest that you seek advice from instructors or experienced pilots before conducting **ANY** of these manoeuvres or before flying in extreme conditions, and you should definitely carry a reserve parachute if this type of flying is for you.

'Big Ears'

This method is a good and safe way to descend; however, care should be taken when pulling down the outer "A" lines not to pull them too far. Also the Revo2 has a lot of load on the "A"s especially on the faster trim settings. A spiral may be a more efficient way to get down.
Note:- We do not recommend using Big Ears with a lot of power as there is a risk of stable stall and anyway it defeats the point of the manoeuvre.

B-Lining

The Revo 2 B-Lines well, however we recommend that you undertake proper training as recovery characteristics change throughout the trim range. A spiral is a much safer and more efficient way to get down, or, simply using the speed bar.

S.A.Ts and Helicopters

The Revo 2 has proved very forgiving in these types of extreme manoeuvres - however they **definitely** require approved and proper pilot training.

Adverse flight reactions

Cravats

Despite the intensive research and development that have taken place cravats remain a possibility. The Revo 2 is a modern wing having an efficient line configuration for optimum performance. This means more gaps in-between the lines, hence the possibility of a cravat.
A cravat occurs when part of the wing fabric makes its way in-between lines and gets caught there. This usually happens after recovery from a major deflation caused either by severe turbulence like helicopters passing near or foolishly induced by the pilot. Normally pumping the brakes will unravel the wing, if not, then a sharp pull on the “B”s or “D”s usually does the job.

Stable stall

When any wing has flown many hours or has been over-loaded, one of the first signs of degradation is a tendency towards stable stalling. This may occur whilst exiting a high-energy or advanced manoeuvre.
When a power unit is added, a stable stall can even occur during a low airspeed take-off, usually when an over powerful engine relative to the pilot weight and wing loading is being flown. It is also most likely on the slow speed trims.

Should you ever find yourself in this situation:-

In flight *The quickest recovery is achieved by coming off the power (if any), giving a short sharp pull on the brakes in unison, followed immediately by a firm but even pull on both “A”s at once. If you are too low to brake then just do the even pull on the “A”s.*

During take-off *ALWAYS ensure that your wing is definitely flying with enough air speed, before opening the gas or pulling on any brakes during a launch. If it does happen that you have managed to leave the ground but are not fully flying, DO NOT add more power or more brakes but smoothly come off them; if the wing does not accelerate, just land. Re-assess the conditions as it may well be that you are trying to climb out through a wind gradient.*

Stalls and Spins

If a wing stalls or spins it is usually because its pilot has applied **too much brake** to both or one side. It is flying too slowly.

- A stall is when both sides of the wing have insufficient airspeed to continue flying.
- A spin is when one side only is stalled. So the wing starts to rotate around its centre axis.

The remedy is to simply ease the brakes off smoothly and come off the power in order to exit and regain flight.

Warning:- Stalling or spinning are common to all aircraft that take off or fly with insufficient air speed. In addition the thrust line on a paramotor is well below the wing, so adding power adds to the problem. Sometimes pilots panic and apply more power or more brake - this is definitely the wrong thing to do! Be aware of the dangers and study your theory of flight!

Note: Although the Revo2 is specify designed to absorb power there are always limit, so too much power to weight ratio does not help these situations.

Learn to fly the wing NOT the motor?

*All of these manoeuvres and the recoveries from them are taught on SIV (Advanced Manoeuvres Clinic) courses. Contact a local instructor or paragliding club for more information about **SIV**.*

3.5 Paramania's GOLDEN RULES!

Think Paramotoring = Wing + Motor + Pilot, 3 primary elements linked as one

Paramania's Golden Rules is a list of sensible rules to help you keep safe
Compiled by Mike Campbell-Jones

Over the last few years we have seen amazing advances in our technology – wings and motors have come a long way. Are we as pilots and our training keeping up with these advances?

- ***Always fly with at least 3 options open to you at all times. If you find yourself with fewer, search for more right away. You are at RISK! (This rule applies to the entire activity).***
- ***If you spot a problem, no matter how small, deal with it NOW!***
- ***Never rush anything, take your time, stay cool (after all you are a pilot now).***
- ***Understand the theory of flight – take the time to do this.***
- ***75% of paramotor accidents happen around propellers on the ground. Clear people away from around your propeller and ensure that they are standing in the safety zones.***
- ***Before you start your engine get in the habit of shouting "CLEAR PROP" to remind yourself and others of the necessary safety precautions.***
- ***Don't be too shy or too proud to ask for advice.***
- ***Understand the weather, (including micro-met).***
- ***Always carry out full pre-flight checks before launching.***
- ***Check, check and re-check the fuel system for leaks.***
- ***Make sure you have enough fuel to get you to your destination. Better too much than too little!***
- ***Check for any loose articles that could trail or fall into the propeller while flying and fasten them securely. Ideally wear a flying suit into which everything can be zipped in (available from the Paramania web shop).***
- ***Never place your engine downwind of your wing.***
- ***Always put on and fasten your helmet before clipping in to the harness.***
- ***Never rely on the engine - it may cut out at any moment. Always fly as if it will - so fly the wing – NOT the motor***
- ***Scan the sky at all times - know where the others are all of the time!***
- ***Don't fly into danger i.e. over water, trees, rough terrain where an engine failure will leave you in trouble (water in particular).***
- ***If you see pylons or poles, between them there will be power lines. Know where they are, especially if you are low. They are our biggest killer!***
- ***Avoid downwind low flying - it drastically reduces your options!***
- ***Try not to fly into the turbulence of your own wake or that of others, especially at low altitude.***
- ***It is unwise to fly hands-off below about 100m AGL. Especially as an engine failure will require***
- ***You to make immediate control inputs to set up a landing approach.***
- ***Be sensitive to mechanical problems early on. A noticeable change in engine tone or a new***
- ***Vibration may spell trouble. Land and check it out.***
- ***Make sure your navigation and awareness of air law are up to the job. Study your local air charts.***
- ***Remember, not everyone enjoys your engine noise.***
- ***Care must be taken when flying near livestock, (especially over pig farms or horses) and other sensitive areas.***
- ***Pay great respect to landowners and farmers, look after them, we need them!***

4 CARE AND MAINTENANCE of your wing

The safety and life-span of any aircraft, however well designed, built and flown, depend in the end on how well it is cared for. Confidence in your equipment and the quality of its maintenance is essential to good flying. Even a product as well engineered and carefully constructed as the Revo 2 can quickly deteriorate if neglected or abused. The better you look after your wing, the better it will look after you.

4.1 Basic Care

As with any paraglider, the basic rules for looking after your Paramania wing are:

Keep it Cool: Prolonged exposure to excessive heat in places like the car, the loft or the airing cupboard, as well as contact with hot engine parts can damage and significantly shorten the life of both fabric and lines.

Keep it Dry: Packing or storing a wet wing may make it mouldy, damage the coating of the fabric, corrode the metal fittings and in extreme cases rot both the fabric and the lines.
Salt water is particularly harmful (as salt crystals form an abrasive coating).
You should avoid immersing your wing in salt water if at all possible. If it does happen, rinse it thoroughly in fresh water and dry it out completely, preferably in the shade, before packing it away.

Keep it Dark: UV light degrades coatings and drastically weakens fabrics.
Never leave your wing laid out for long periods beneath holes in the ozone layer. Fold or pack it away when it's not in the air.

Keep it Clean: Some dirt can be highly corrosive. Clean off any such contamination as soon as possible using clean, fresh water. Don't use detergents, they can cause as much damage as the stains, if not more. Only use neutral soft soaps (ph7). In particular, store and transport your wing away from the motor (never in the same bag) to avoid any contact with oil or petrol.

Keep it Clear: Sharp, hard or abrasive items such as helmets, flight instruments, harness buckles and the like can accelerate fabric wear and even hole the wing. The drawstring stuff-bag provided with your wing affords a measure of protection but you should still try to ensure that you store and transport it clear of contact with anything likely to damage it.

Keep it Lonely: Insects, such as grass-hoppers and ants, will simply eat their way out if rolled up with the wing. Grazing cattle can literally lick the coatings off the fabric and mice love to make homes in it! (We suggest hanging up your wing in its bag during long term storage).

Above all, never forget, that for all its compact portability, your powerglider is an aeroplane and deserves to be treated as such!

4.2 Periodic Maintenance

Although your Revo 2 wing is designed and engineered to give you at least 400 hours of air time, regular maintenance is essential to pinpoint any problems that may arise as a result of routine wear and tear. It is especially important after any incident which may have resulted in fabric or line damage that may not show up in the course of pre-flight checks. A Paramania accredited repair centre will, for a small charge, carry out a specific programme of maintenance checks designed to keep your wing tip-top and certify its condition in a written report that will become a valuable part of its service history.
Paramania takes great pride in the quality of both its product and the service that supports it.
Feedback from periodic maintenance checks performs a vital role in its quality control procedures. They are therefore just as important to us as they are to you and you can be confident that all such checks carried out by the manufacturer are comprehensive and thorough.
We recommend that these inspections are carried out annually or after every 100 flying hours, whichever comes sooner. They are of course, an addition to rather than a substitute for, your own essential pre-flight checks.

4.3 Repairs

A basic repair kit is provided with your Revo 2 wing that allows you to carry out small-scale emergency repairs. It consists of about 1 metre of each nylon fabric of colours used in its construction, self adhesive rip-stop tape, and 4 spare suspension lines, looped at both ends and of the same length and thickness as your primary lines. These may also be used to replace primary brake lines.

VIP Note: Damage beyond the scope of this kit to deal with, and major repairs that may be necessary to the loaded parts of the wing's structure, such as seams, line attachments, ribs, risers, leading and trailing edges etc. should on ***NO*** *account be carried out by anyone other than a* ***Paramania accredited agent, these can be found on www.flyparamania.com***

Paramania can accept ***NO*** *responsibility for repairs, however minor, carried out by anyone other than a* ***Paramania accredited agent****, nor for any damage to the wing resulting from accident, neglect, negligence or abuse.*

In all such cases any statutory rights and obligations of guarantee are automatically cancelled.

4.4 Care and Maintenance of your Power Unit

This manual refers only to your Fusion wing. Any issues to do with the Power Pack you are using is beyond its remit. Refer to the relevant literature for details of care, maintenance, servicing and repair concerning your motor and harness. We can however offer advice if requested.

4.5 Care and maintenance of pilot

A pilot has a huge responsibility – and a pilot is also the most important part of a paramotor aircraft! It's a fact that most accidents happen purely through pilot error and are usually a result of several different error factors coming together.

It seems we must also check ourselves before every flight!

- *Are you in good health? Are you tired? Have you enough blood sugar/energy?*
- *Are you showing off to family, friends or camera? Is your knowledge up to scratch?*
- *Are the conditions appropriate for your pilot level?*
- *Are you taking into account your state that day – if you have not flown for a while give yourself time to ease back into it.*
- *Are you being over confident? Are you choosing to fly in dangerous areas?*
- *Are you alert enough? Are you well equipped? Have you taken adequate training?*
- *Etc… the list goes on…..*

Do you ask yourself these things?

It is an interesting fact, is that most pilots choose to fly outside the cone of safety – for instance we are relatively safe at 2-3m above the ground and after that above 300m (the minimum height to throw an emergency parachute or allow time to simply find a place to land). Sandwiched between these altitudes is our most dangerous height – as a Paramotorist, how high do you and your friends fly most of the time?

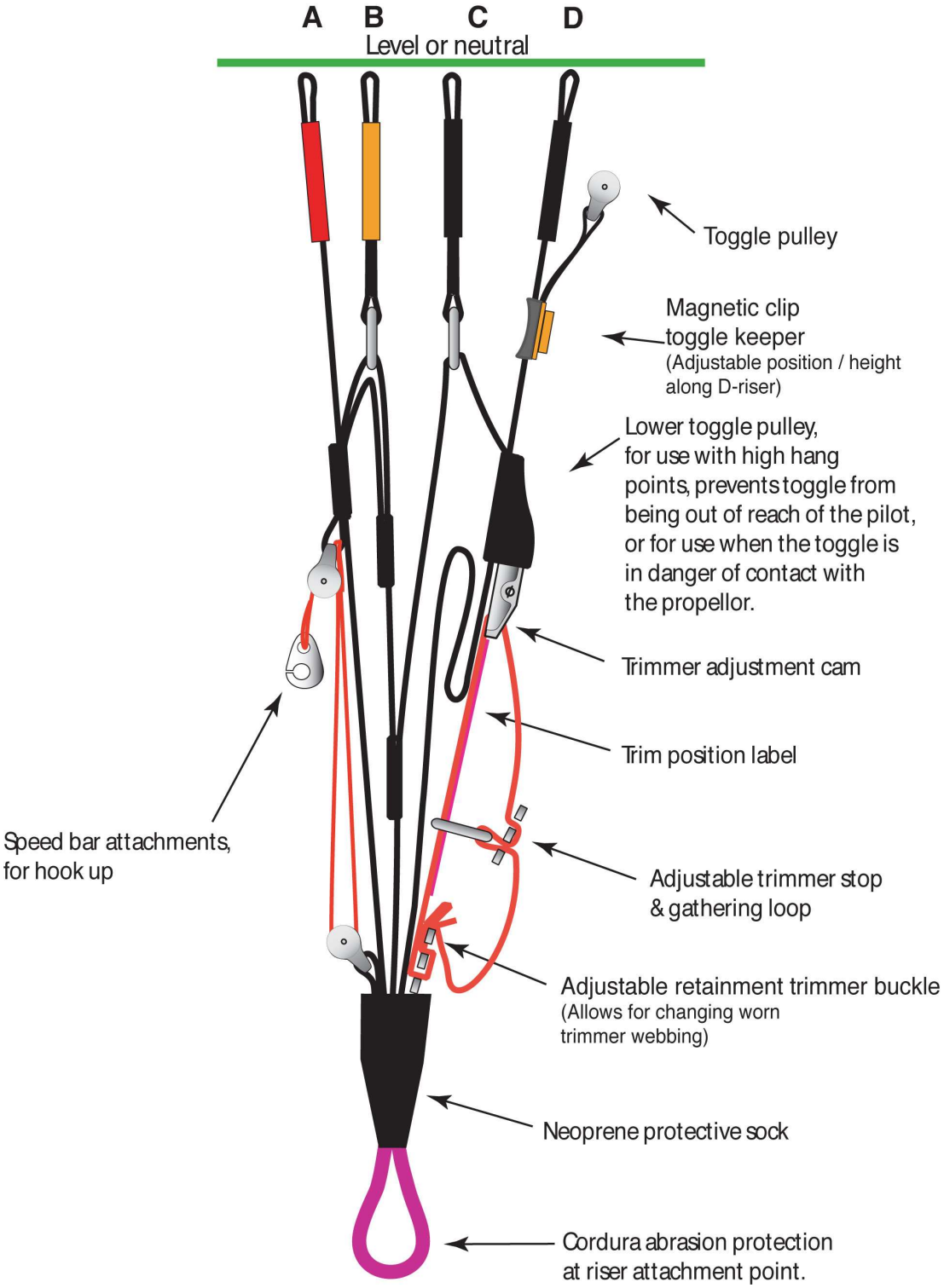
Although this is not a comprehensive flying manual it contains vital lessons from our decades of flying and useful common sense that will help you fly well and in safety.

5 Technical diagrams

5.1 Riser diagrams

Paramania Standard Risers - for Revo 2

Diagram - showing trim in position @ neutral - Reference Rev2-26-01-10



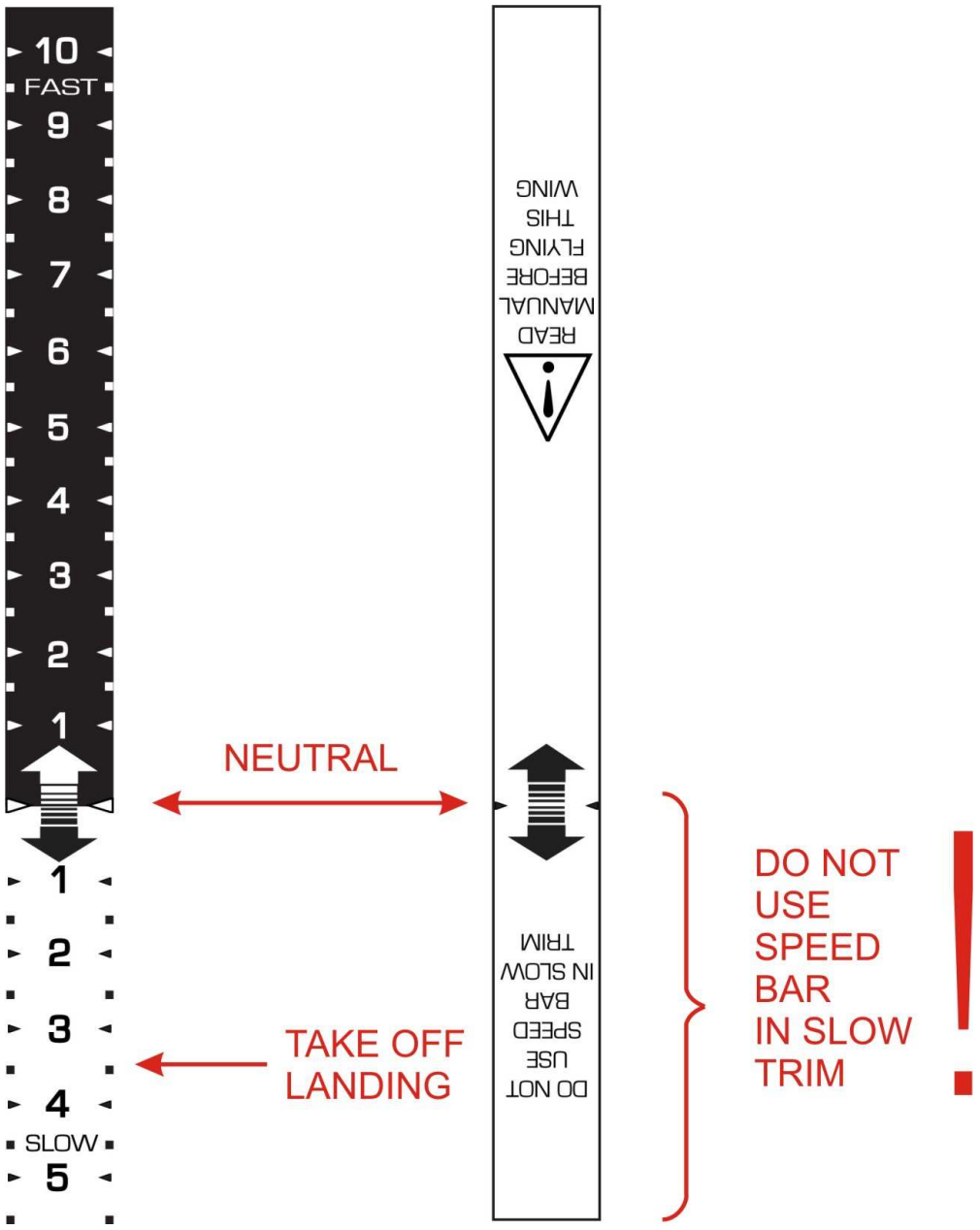
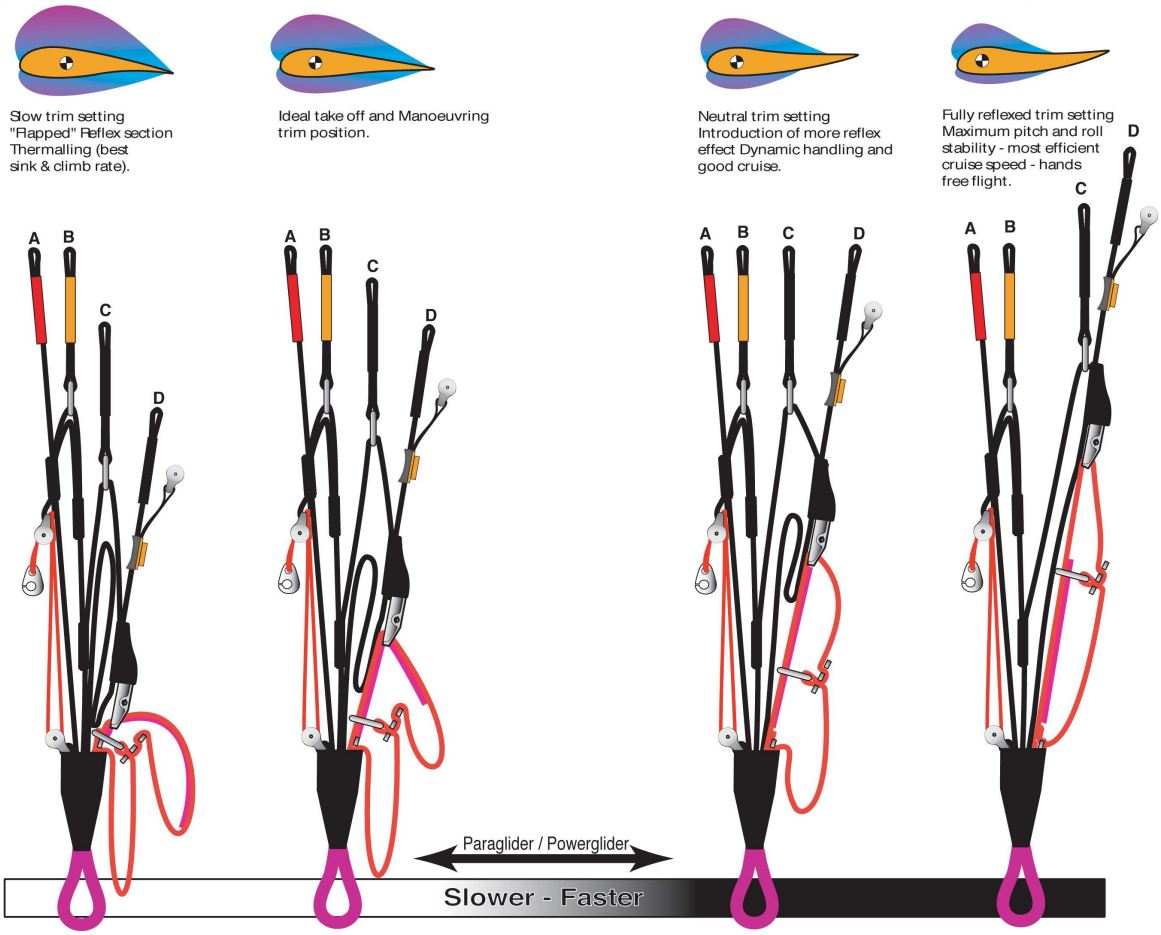
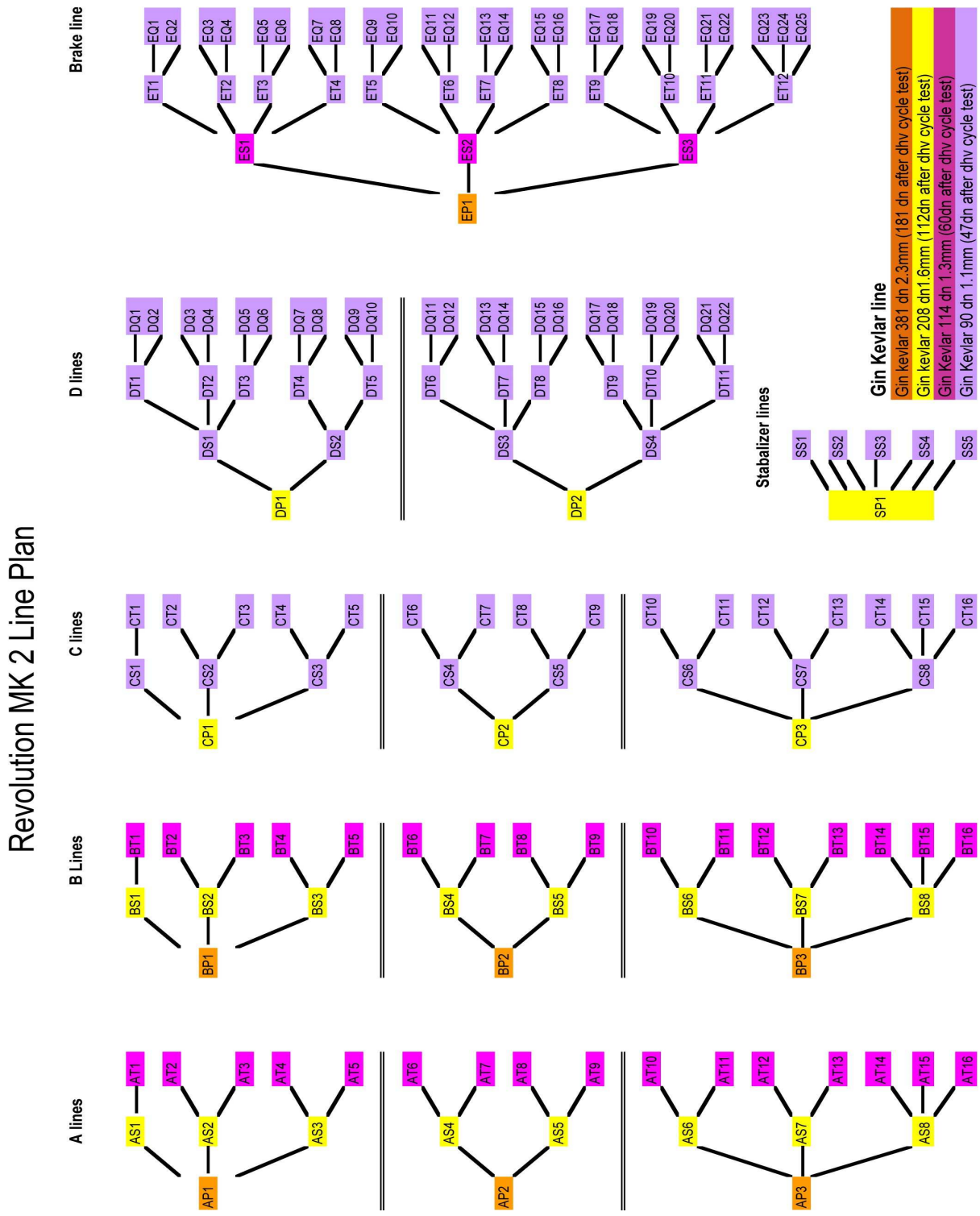

10
FAST
9
8
7
6
5
4
3
2
1
NEUTRAL
1
2
3
4
SLOW
5
TAKE OFF
LANDING
READ MANUAL BEFORE FLYING THIS WING
DO NOT USE SPEED BAR IN SLOW TRIM
DO NOT USE SPEED BAR IN SLOW TRIM
!

Diagram Revo2 -2 Showing the different trim positions and their effect on the wing section



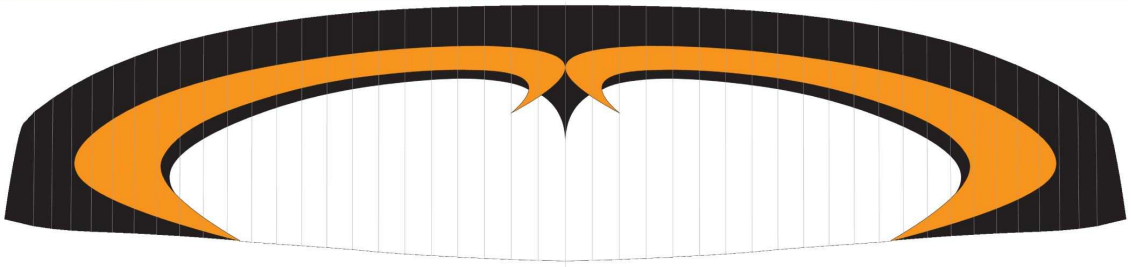
5.2 Lining Tables

Below are lining diagrams & tables. The lines are configured so that most profile changes take place in the tertiary lines, meaning that they are all different lengths. This enables the secondary and primary lines to be more standard in lengths. These are the lines most often damaged or in need of changing, particularly when a full service is carried out. Lines are numbered from the centre towards the tip. A number of spare primary lines come with your repair kit, just in case you damage some during launch. They are the strongest lines and may even be used temporarily to replace a thinner primary (like a “C” or “D” primary) or even a brake line!


Revolution MK 2 Line Plan
Brake line
D lines
C lines
B Lines
A lines
Stabalizer lines
Gin Kevlar line
Gin kevlar 381 dn 2.3mm (181 dn after dhv cycle test)
Gin kevlar 208 dn1.6mm (112dn after dhv cycle test)
Gin Kevlar 114 dn 1.3mm (60dn after dhv cycle test)
Gin Kevlar 90 dn 1.1mm (47dn after dhv cycle test)

Technical Data for Paramania Révolution 2

Technical aspects		Revolution² S	Revolution² M	Revolution² L
Number of cells		46 cells	46 cells	46 cells
Area flat		23 Sq metres	26.03 Sq metres	29.00 Sq metres
Max cord		2538 mm	2700 mm	2850 mm
Min cord		878 mm	934 mm	986 mm
mean cord		2065 mm	2196 mm	2318 mm
span		11139 mm	11849 mm	12508 mm
aspect ratio		5.40	5.40	5.40
Span projected		8862 mm	9427 mm	9951 mm
aspect ratio projected		4.02	4.02	4.02
Area projected		19.528 Sq metres	22 Sq metres	24.62 Sq metres
Pilot distance from wing		6686 mm	7109 mm	7505 mm
risers		470 mm	470 mm	470 mm
width of hang points		400 mm	400 mm	400 mm



rec weight ranges	PPG	160 Kg	185 Kg	220 Kg
	PG	70 Kg	80 Kg	90 Kg
Glide weight		100 Kg	120 Kg	140 Kg
Trimmer Travel		23 cms	23 cms	26 cms
Speed bar travel		13 cms	15 cms	16 cms
Performances in mid ranges (Approx as there are too many variables, ie Drag - motor/pilot, total weight - fuel/clothing - speed bar/trimmers etc.)				
Glide angle		8to1	8to1	8to1
Min sink	PPG	1.2 M/sec	1.2 M/sec	1.2 M/sec
Min sink no motor unit	PG	1 M/sec	1 M/sec	1 M/sec
Speeds				
Min speed	PPG	19	19	19
min trim cruise	PPG	30	30	30
neutral trim cruise	PPG	42	42	42
Max trim speed	PPG	51	51	51
max speed	PPG	65	65	65

EN certification label

When the Revo 2 was tested under the EN system, with the heaviest pilot weight possible to help simulate paramotor weights, it was awarded a “B” rating.

More in depth details through our web site www.flyparamania.com.

6 SUMMARY

We would like to stress again the points made in Section 1 of this manual.

This Paramania Revo 2 manual is subject to continuous updating - to assist us in our quest for perfection, we would appreciate any input that you the user may wish to contribute towards future versions.

Please don't hesitate to contact us with your views and suggestions.. The team wish you many hours of fun beneath your Revo 2 wing.

The Paramania Team

www.flyparamania.com
info@flyparamania.com

PARAMANIA
POWERGLIDERS