Pilot Manual

1- Equipment

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Association of Paragliding Pilots and Instructors

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1.1 - Component parts of the paraglider

The canopy, which consists of the upper and lower part of the sail, forms a semi-rigid airfoil inflated forward by a flow of air through cell openings. The contoured shape of the canopy is achieved through cell walls and intercellular walls. The more there are the more the **surface** of the paraglider will approach the shape of the desired profile.

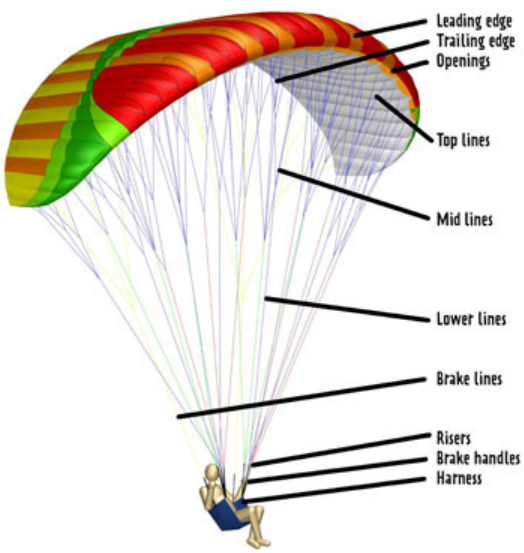
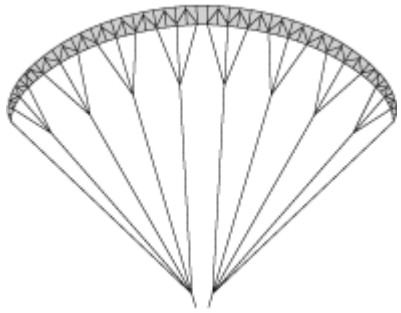


Figure 1-1: The most important parts of a paraglider are the canopy, the suspension lines and the risers.

The cell-bearing walls divide the canopy into cells and intercellular non-bearing walls divide these cells into cell boxes. The cell walls are mainly used to give a regular distribution of the load of the lines to the upper surface. The largest load is at the forward half of the wing at the point of attachment of the suspension lines. At this point one tries to prevent the deformation of cell walls by the construction of reinforcements called 'Flares'. In flight, these partitions are mostly required during a spiral dive.

Openings in the cell and intercellular walls ('evens') allow a balance of pressures between the cells and the boxes and ensure a homogeneous distribution of the pressure within the entire surface of the glider. They also perform an important function, namely the inflation of closed cells at the wing tip during takeoff or flight. The lateral stabilizers reduce the loss of lift at the wing tip and stabilize the glider in slow flight.

Figure 1-2: Front view of paraglider.
The wing and the pilot are connected one to another by a harness. Numerous and fine lines are attached to cell walls and evenly distribute the load on the canopy, these lead down to webbed risers which are connected to the harness by carabiners or maillons. Many line branches help maintain the profile of the wing. On the other hand, a large number of suspension lines means greater air resistance and poorer vision during sorting before take off.



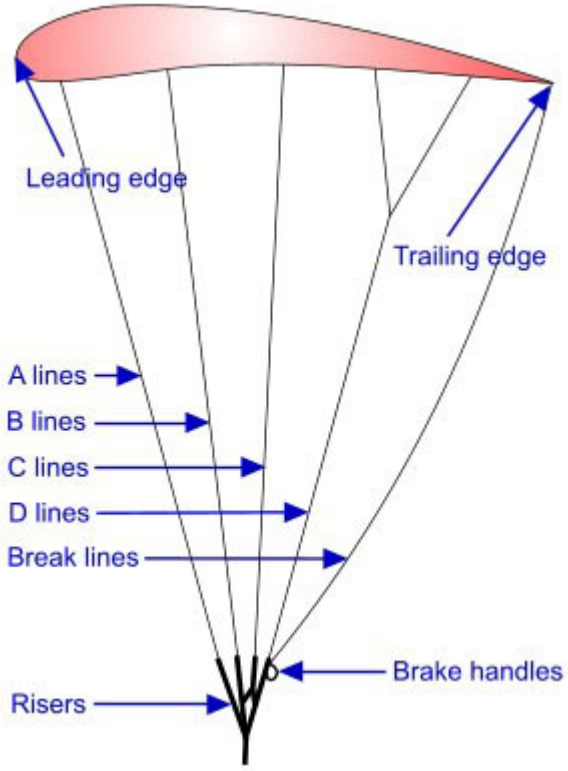


Figure 1-3: Side view of the canopy of a paraglider.
The first row of front lines (A lines) and the second row (B lines) bear together about 80% of the load. It is for this reason that on certain models of paragliders, these lines are thicker than the lines C and D. The A lines are connected to the front risers and the B lines to the risers of the second row through quick links. The lines C and D and possibly even a fifth series of lines (E), are either assembled in a rear riser, or distributed on each side to a third and fourth riser. Unlike those of old, modern gliders have at least three risers on each side.

They thus offer, compared to the models with two elevators, two main advantages: it allows paragliders to perform certain important flight maneuvers such as the B-stall or big ears; besides, the installation of a system of acceleration is possible (see later in this chapter). On the upper part of the rear risers the brake handles are fixed with the aid of pressure or Velcro bandages. From these handles the brake line passes through a grommet or a pulley (to reduce friction) and branches into several lines that fix onto the trailing edge of the canopy.

Figure 1-4: ***Leading edge****.*
The openings of the cells are located on the lower part of the profile.

1.2 - Concepts and definitions

1.2.1 Real and projected surface

Real surface F is measured from the canopy extended on the ground. It is always bigger than the projected surface which one measures from a parallel projection of the inflated paraglider on a horizontal plan.

1.2.2 The span

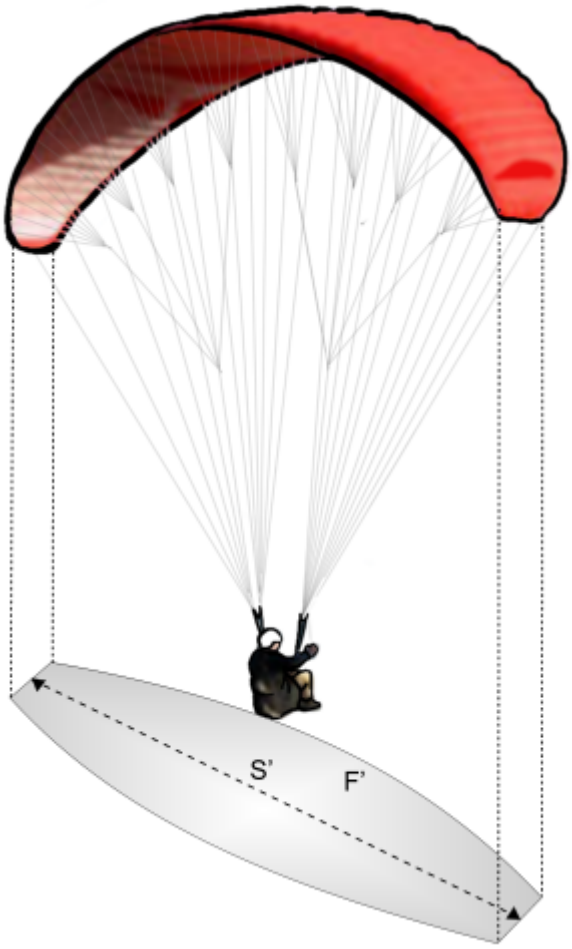


Figure 1-4: The projected surface and the span (also projected).
The **span** S' is the distance between the ends of the paraglider on the transverse axis. One can also measure the span of a paraglider on the ground or in projection.

1.2.3 The drag ratio g (finesse)

The **drag ratio** also known as glide ratio g gives a characteristic of the aircraft flight performance. It indicates at what maximum distance per unit of height, a glider in smooth air can fly.

$$\text{Drag ratio} = \frac{\text{horizontal distance}}{\text{vertical distance}}$$

1.2.4 The load

The load is obtained when adding to the weight of the pilot, the total weight of all its equipment, including the weight of the paraglider.

Load	
Paraglider	5 kg
Harness	3 kg
Rescue	2 kg
Helmet	0.5 kg
Instruments	0.5 kg
Clothing	3.5 kg
Shoes	1.5 kg
Accessories, wallet...	0.5 kg
Equipment	16.5 kg
Pilot	65 kg
Total load	81.5 kg

Every ratified paraglider has a manufacturer placard providing both maximum and minimum load allowed. This should be on the canopy normally sewn into the centre cells or at the wing tip.
The weight and volume of a folded paraglider plays an important role in alpine use. The economy of weight is achieved mainly by using finer fabrics but this makes the life of the wing shorter.

1.2.5 The total weight of flight

The weight of a paraglider and the total suspended load gives the total weight of flight P.

1.2.6 The wing load

$$\text{Wing load} = \frac{\text{total weight in flight P}}{\text{projected area F}}$$

The burden of a paraglider in relation to its surface is an important criterion when selecting a wing. The wing load influences the flight characteristics and represents a compromise between conflicting demands. It oscillates in modern paragliders from 2, 5 to 4 kg/m^2 and may vary from one type to another. The flight performance is only slightly influenced by wing load. However to fly certified you must be within the manufactures wing loading specification and too light or to heavy a load generally have a negative influence on drag ratio and on wing behaviour.

Light wing loading	**Wing load**	Heavy wing loading
lower	**Speed**	higher
softer	**Handling**	more direct

lower	**Stability (to the closure)**	higher
higher	**Tendency to parachuting and starts to spin**	smaller
lower	**Sink rate**	higher
more cushioned	**Response when closing**	more sudden
slower	**Loss of altitude**	faster

1.2.7 The Chord

Is the measurement of distance between the leading edge and trailing edge.

1.2.8 The aspect ratio

The span divided by the mean (average) chord gives the aspect ratio or the square of the span divided by the surface. It is a measure of the aerodynamic qualities of a wing.

$$\text{Aspect ratio} = \frac{\text{span} * \text{span}}{\text{surface}} = \frac{\text{span}}{\text{mean chord}}$$

1.3 - The camber

By camber one means the adjustment of the **inclination** of the paraglider (line profile) with the relative wind rather the trajectory (angle of attack).

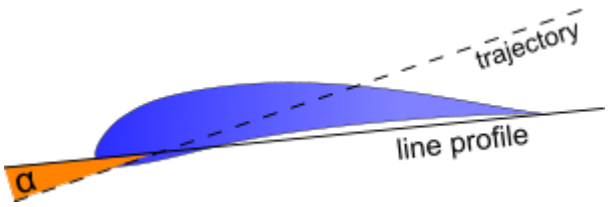


Figure 1-5: Angle of attack (incidence)

The length of the suspension lines on this subject is crucial. They determine the radius of curvature of the canopy and affect flight behavior. This is known as the trim of the wing through time and use the gliders trim can change due to shrinkage on the outer sheathing of a line. This for instance can make the c or d lines shorter in relation to the other lines making the wing hang back at takeoff and giving a high angle of attack making the wing more liable to stall at a higher brake position. Which is one of the reasons it is very important to get an annual check of your wing as well as a strength test for lines and materials. Check the trim of your glider compared to the manufactures line lengths if the glider starts to behave differently.

short lines (about 5-6m)	long lines (about 7-8m)
strongly curved arc	less curved arc
position of center of gravity high	position of center of gravity low
small pendulum oscillations during high banked left and right turns	large pendulum oscillationsduring high banked left and right turns

The camber is an integral part of the design of a paraglider and the wings trim should only be modified by specialists. Changes of as little as one cm have an effect on flight behavior.

shortening the lines A or lengthening the lines D	**lengthening the lines A or shortening the lines D**
smaller angle of attack	larger angle of attack
profile and behavior in flight changing	
rise of the wing on takeoff easier	rise of the wing on takeoff harder
more frequent front closures	less frequent front closures
reduced tendency to parachuting	increased tendency to parachuting
higher speed	slower speed

A correctly trimmed paraglider, without the use of brakes in a nil wind glide can reach speeds of approx 50 km/h. Each

glider is different and the speed range of your paraglider can be found in your manual.

the glider flying too slowly	the glider flying too fast
the danger of parachuting and stalling increases	higher speed during takeoff and landing
reserve of speed too little headwind	increased rate of falling

In flight the different rows of suspension lines are charged in different ways. The pulling force on the front lines (lines A and B) is four times greater than the one on the rear lines (lines D) which are, themselves, lightly charged. For this reason, and by a process of lengthening and shortening of both sides, the camber may change over time. We can identify these changes by the appearance of new folds in the canopy or flight behavior.

If the wing is reluctant to launch and is hanging back the D line sheathing may have shrunk. Gently and consistently re stretching the D lines between two people can improve the launching characteristics.

We can also check the length of one side against the other. For instance hold the two A lines together and compare.

If in doubt the paraglider should be controlled by the manufacturer and, if necessary, a new 'trimming' should be made by putting loops around the maillon of the A lines or the glider may need totally re-lined. Knots are never tied in the lines as each knot will weaken the line by 50%.

1.3.1 Adjustment of brake lines

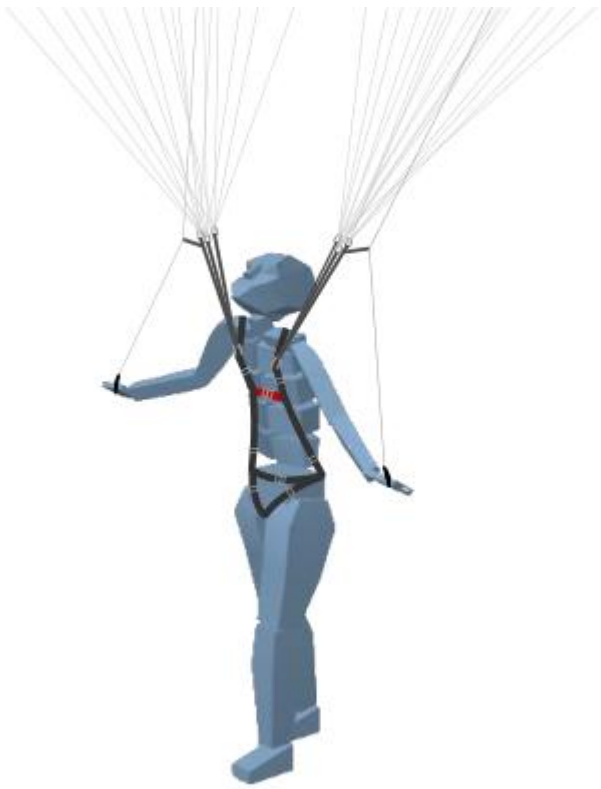


Figure 1-6: Setting the brake lines

The main brake line lengths of a paraglider are the same as on the sample that has been used for the certification test flights. These line lengths have been fine tuned by test pilots, and it should not be necessary to adjust them.

In soaring flight, it is common to fly with your hands through the brake handles with a half a wrap on the brakes. However, care should be taken to release the wraps fully in any extreme situation. If you do need to make adjustments to suit your harness, body and flying style, we strongly recommend that you test fly the glider with every 2cm of adjustment. There should be a minimum of 10cm of free brake travel when the glider is flown hands-off. This prevents the brakes being applied unintentionally when the speed system is fully engaged. After any adjustment

Caution: If the brakes have too tight a setting, the paraglider is flying too slowly. The result is a **greater risk of stalling or going parachutul**, and you are unable to fly at full speed into a head wind. Too short brake lines can effect the wings recovery from incidents in flight.

Check brake lines for twists and if necessary untwist them by holding the brake lines and letting the lines untwist. These twists are caused by the pilot taking a turn with his hands whilst flying. There have been incidents where twists in the brake lines have led to accidents by preventing the wing from recovering properly after a collapse and entering a spin. You can also purchase swivels to put on the brake lines which help to prevent these.

Too long brake lines can make you feel you can't stop the glider on take off or fully flare. This can be hard when landing in the sense that one can not sufficiently slow down the paraglider. On the other hand, during flight in turbulent air, a big displacement of the brake control is necessary to **prevent or correct the closure of the sail**. If your brakes are long you can take a wrap of the brake line around your hands for the final flare if needed in light winds.

We recommend a double fishermans or a bowline knot for the brake handle attachment.

1.4 - Acceleration system and trims

Varying the flight speed, by changing the geometry of suspension lines which adjusts the camber of the wing.

IMPORTANT: Using the accelerator decreases the angle of attack and can make the glider more prone to collapse. If it does collapse it will turn a lot more violently when accelerated. If you get a collapse whilst on speed bar then release the speed bar and weightshift and look ahead to maintain a safe course. Do not use the accelerator near the ground or in turbulence.

Figure 1-7: Modifying the shape of the profile by pulling on hte A and B lines and lengthening the C and D lines.

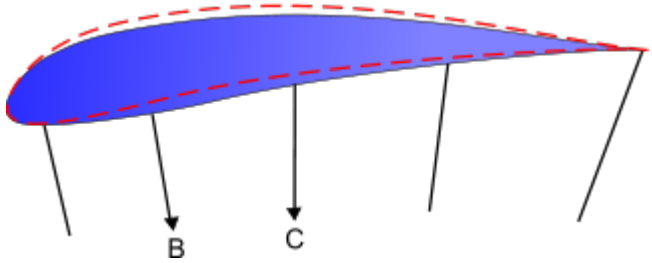
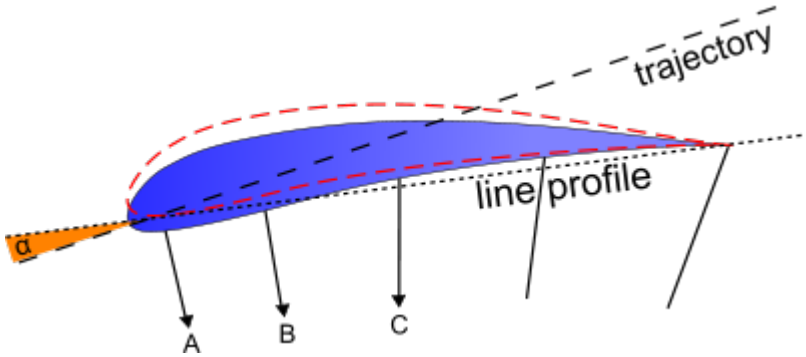


Figure 1-8: Decrease the angle of attack.



Tip: Modern paragliders are usually adjusted to ensure the best possible glide without using brakes though you should always keep contact with the paraglider and fly actively. However, despite a loss of performance, an increase in flight speed can be helpful in certain situations. Thus in upwind flight or strong sink one can improve overall performance by accelerating the glider.

1.4.1 The risers

The risers are an integral part of the construction of a paraglider. Some gliders have trim tabs on the risers, normally neatral trim is with all the maillons set evenly. Read your paraglider manual to find out how they operate with your wing.

You can also steer with the rear risers if you have a problem with the brakes or whilst you are operating your speed system.

Use weight shift first then gently pull the rear riser back (not down) between 2cm to 5 cm to assist with steering, If you are landing then flare lower and less than with brakes be careful not to pull them too much whilst flying as you could induce a stall.

1.4.2 Foot accelerator

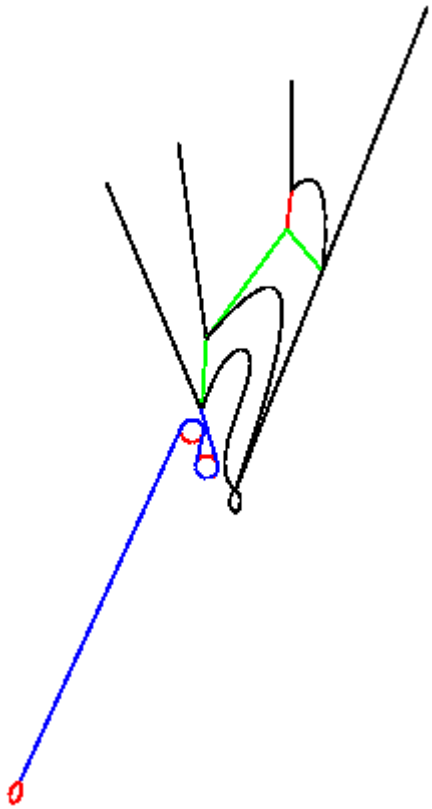


Image from Wikipedia.
With an acceleration system on foot, the pilot, by pressing an accelerator connected to the risers A and B, can increase the speed by 10 km/h. Usually the B lines are drawn and cause a flattening of the profile and a decrease in air resistance. Simultaneously the tendency to frontal closures increases.
The speed system increases the maximum speed by lowering the angle of attack with a pulley guided,
foot-operated system.

1.4.2 Setting up your Foot Accelerator

It is important to have your accelerator system correctly routed through your harness and attached to the risers with the supplied Brummel hooks. The length of the speed bar should be initially adjusted while on the ground, sitting in the harness so that the legs are fully extended at the point of full accelerator travel. It is helpful to have an assistant hold the risers taut while making this adjustment. If in doubt about this procedure, consult your instructor or dealer.

	Trim tabs on Risers	Accelerator
Actuation	by hand	with the feet
Attitude of the pilot	independent of the posture of the driver: can be used for a long time with low energy expenditure	request an elongated body position: prolonged use can become very physical
Speed range	reduced	adjustable speed very gradually within a wide range
Disabling the risers	active: briefly interfere the control	passive: no obstacle the piloting
Restrictions		can not be used with skis

Once set up, test the full range of the accelerator in calm flying conditions: ensure that both risers are pulled evenly during operation. Check that when your speed system is pressed fully that there is still slack in your brakes. If your brakes are too short they may be pulled when the speed system is pressed.

Fine-tuning can be completed when you are back on the ground.

1.4.3 Operating the speed system

Figure 1-9: Operation of an accelerator system in action with the feet.

When operating the speed system smoothly and slowly press the bar. Allow the paraglider to gain speed, don't pull the brakes whilst pressing the speed bar. You can keep in contact with the glider by resting your hands on the back risers. Smoothly and slowly release the bar to avoid the wing pitching backwards. If the air is turbulant or you get a collapse then release the bar.

1.4.4 Trim tabs

The trim tabs are an integral part of most Tandem, Paramotor and Competition paragliders. Good knowledge of the system is essential for safe handling. Read your paraglider manual.

Paramotor paragliding use the trim to compensate the motor rotation which will create a turn to the right by adjusting one trim slightly more than the other so you can maintain straight flight with hands up. The risers have trim tabs to adjust cruise speed during powered flight.

Risers pulled	slow flight	wide angle of attack - behind the profile is curved downward shorter displacement of controls - low tendency to frontal closures increased tendency to parachuting and stalling
Risers released	fast flight	small angle of attack - the rear profile is curved upwards longer displacement of controls - strong tendency to frontal closures lower tendency to parachuting and stalling
Left risers released, right risers pulled		the glider turns right
Right risers released, left risers pulled		the glider turns left

1.5 - The paraglider

The considerable number of types of gliders may be classified into three distinct categories:

- the paragliders for school and beginners,
- the intermediate-performance gliders,
- the high performance of competition gliders.

1.5.1 The paragliders school and beginners

The beginner needs a sound wing in any situation which must be easy to maneuver. The characteristics of takeoff, flight and landing are important and relegate performance to second place. Modern beginner wings now have good performance and allow you to explore the sky and start to go cross country. If you plan to be or you become a low airtime pilot (30 or less hours a year) you are best to fly a beginner level wing as flying with confidence is the fastest and safest way to increase your ability as a pilot.

You are better to fly 90 to 100% of the gliders performance and then move up a level. When you are learning you inevitably occasionally find yourself in the wrong part of the sky dealing with turbulence or rotor and you will be glad to have a glider with forgiving characteristics.

1.5.2 The intermediate-performance gliders

From the beginner to the experienced thermal pilot, the class of intermediate paragliders ranges widely with high end performance requiring very active piloting to low end more forgiving intermediate gliders requiring less piloting skills. Gliders in this class meet most pilots requirements of free flight. These paragliders offer a safe and normally trouble free use in normal flight and have, at the same time, good performances. They require pilots to fly 30+hours a year read the manufactures recommendations and get an instructors opinion as to which wing is suitable for your existing skill level. (You don't grow into a glider a lot of people are put off the sport by getting to high a performance paraglider which they can't fly properly and scare themselves)

A minimum sink rate of 1.1 to 1.3 meters per second and a glide ratio of 6-7, make distant flights possible. Anyone who flies with an intermediate wing should fly regularly and master the style of active flight (see chap. 5).

1.5.3 The high performance of competition gliders

Paragliders of high performance and competition should be reserved for very experienced pilots who fly frequently.

Even if, thanks to several years of development, the 'performance' gliders have a large reserve of safety, one must not forget that they require, as before, more demanding steering than paragliders of intermediate category.

A drag ratio of 8 or more, a minimum sink rate of about 1m/s has no interest but in competition or for ambitious long distance flights.

> **Caution:** A beginner or occasional pilot flying a high performance or competition glider is taking a high risk as he does not have the necessary skills to react correctly without over reacting during turbulent conditions

1.5.4 Choice of paraglider

> A paraglider whatever the level of performance to which it belongs, must first provide enjoyment. That is why it must be adapted to the capabilities of the pilot.

Although gliders of beginner category have a potential performance which one could not dare dream about a few years ago, too many pilots are exceeded by such a highly capable wing. The following example illustrates and puts into perspective the notion of drag ratio and sink rate.

- If you fly in a straight line a distance of 1 km with a paraglider of drag ratio 6, you lose 22m in height compared to a glider of drag 7 and 19m more compared to a glider of drag ratio 8.
- In the center of an average thermal column in the Alps, the air mass rises with a speed of 5m/s. How does it act on the rate of ascent of an intermediate paraglider with a sinking rate of about 1.2 m/s, compared to a high performance glider of sink rate 1.0 m/s?
  A performance paraglider rises up about 5% faster. Instead of taking 4 min. 23 sec. it takes 13 sec. less, which means a time of 4 min. 10 sec.

What is highlighted by this difference of time is mainly the fact that a good control of thermal balance helps further in obtaining a good rate of climb no matter what high-performance paraglider.

1.5.5 The certification tests

Warning the Certification means security not performance !!!

The certification test is an optional control of the flight ability of a type of paraglider. The framework of requirements for a wing to be approved by , is fixed by the APPI itself. With the exception of Germany with DHV, all European countries have developed certification tests for common emergency parachutes and gliders. The gliders are submitted by European standards (CEN) to three tests:

- *Test shock*: the paraglider is accelerated to 60km/h by a vehicle and is then suddenly catapulted in to the air, which corresponds to a load of 600 kg. If it resists this abuse without damage, the test is successful.
- *Test scalability*: The glider is gradually accelerated by a car until the pull on suspension lines is eight times more than the value of the maximum load placed on the manufacturer wafer. If no damage has been suffered by the glider, the test is successful.
- *Flight test*: There are 4 different categories: A, B ,C et D or 1, 1-2, 2 and 3 with DHV
  - *Class Standard*A: includes beginner and intermediate wings. It's in this class that the requirements are more rigorous. 17 flight configurations (eg. spin) are tested from takeoff to landing. During these flight figures and also after provoked incidents, the glider must find itself a normal flight situation. The test is successful if after the 17 flight configurations, the requirements, clearly defined, are met.
  - *Class Performance*B: includes the top of the intermediate class wings and the wings of the high class performance. The requirements for the flight behavior and flight patterns are less stringent than in standard class.
  - *Class Competition*C: In this category, one only tests the conduct in a tuck, an asymmetrical stall or a spin.

Manufacturers must test their wing in a class that they themselves have chosen. If the glider meets the criteria, it will be certified, otherwise the approval will be refused.

One recognizes a certified paraglider by the store approval pasted on a sticker in the midle of the glider or in the edge.

An exhaustive list of all currently approved types of gliders can be obtained at:

All the glider certify EN is by independent center :

- Academy (site web)
- Air Turquoise (site web)
- Aerotest (FFVL)
- DHV

The approval gives to a new model of paraglider an information on its behavior in flight and ensures that it has been built according to the standards. (Glider Manual must be read before flight)

It is mandatory to fly during an APPI examination with a certified wing, and in other cases this is strongly recommended. Concerning the flight behavior and the load allowed, the unapproved gliders can deviate significantly from the certification requirements.

If we can have DHV1 class A competition glider then I take it, but commercially nobody will buy it !!!
Company have to create DHV1-2 for commercial purpose as pilot do not want to buy School Glider !
Class 1 or DHV1

The new generation of basic glider have great and excellent performance.

APPI pilot should fly CEN class A or DHV1 glider

The best glider is the glider making you feeling good .

APPI Advanced Pilot can fly CEN class B or DHV2 Glider

APPI Advanced pilot with Performance or Acro training certification can use CEN class C glider

APPI tandem pilot have to fly with Approved glider

The life time of a paraglider is normally around 5 r 6 years depending how well it is maintained and what conditions it is flown in. Ultraviolet sunlight degrades a glider fabric quickly so does getting it wet! Read your manual. Depending on the glider it should be checked annually after the first 2 years or 200 hours. The trim can change on a glider and will also need checked. Even a brand new paraglider will degrade just sitting in a cupboard as it is made of a plastic material that degrades through time. You need to have a load test on the lines and fabric to make sure it is airworthy before flying.

1.6 - The harness

As well as paragliders, harnesses have been under considerable development. _ The light harnesses, which were widely used in the beginning of the sport, are coming back into style with a lot of convertible lightweight rucksack / harness designs to choose from or very light weight ones available for climbing and mountaineering. Similarly, the pure seat steering harnesses, which allow the pilot, from his position, to act directly on the canopy, have almost disappeared.
Nowadays harnesses often have the possibility of manual adjustment from the lying or sitting position, are on the market today. There are also many pod harnesses which create a more aerodynamic shape if they are adjusted properly. They are not suitable for beginners or low airtime pilots as they require more effort to get into than a simple harness and are a cause of distraction at take off and landing.

Modern paraglider harnesses allow comfortable flight for several hours. When buying a harness you need to decide what kind of flying you plan to do and what level a pilot you are at the moment. If you are walking up the mountain then weight is a high priority, if you are taking a chair lift or driving weight is not so high on your agenda (until you have to pay for extra baggage on a aeroplane flight!)

Here are some characteristics to consider when choosing a harness:

- An anatomical board deep enough so that the thighs are fully supported with out it digging in at your knees.
- An easy adjustment from sitting to lying position and vice versa.
- Accessories (eg. pulleys) provided for accelerating system.
- A suitable system for the installation of a reserve parachute possibly a parachute container under the harness with clover

leaf closure or in the lower back part.

- A storage area with sufficient space for a backpack, etc.
- A pocket provided for back protection or the airbag.
- T-bar No forget line (Obligation for tandem Passenger)

Some characteristics of the construction of a harness play an important role in the flight behavior and the paragliding safety: height of suspension; seat board; width of suspension; amount of weightshift.

	Instability	Stability
Suspension height	low (25-35 cm)	high (40 cm)
Board	large	tight
Suspension width	long distance	small distance
Triangulation	no triangulation or triangulation with a flat geometry	triangulation with a tilted geometry

The nature and the adjustment of these four characteristics determine whether a harness will be stable or unstable.

Old harnesses: Harnesses wear out as they are made of plastic which degrades over time. Some old designs of harness have higher hang points, some are too tightly crossbraced preventing proper weightshift and are now considered dangerous. The buckles can stop working and the webbing can get worn.

Check under the seatboard of a harness to see if the leg strap webbing is getting frayed or cut. This can even happen on new harnesses where lightweight carbon kevlar seatboards may need covered with ductape to prevent them cutting the leg strap webbing.

1.6.1 Adjustment and setting of the harness

It is important to have a correctly fitting harness , too big and you will be falling from side to side and feel unstable. Too small and the seatboard will be digging into the back of your legs when you fly. It is good to try different manufactures on a harness simulator. This is also important for adjusting your harness and for practising getting in and out of it.

The width of the waist belt setting is very important as it can effect the canopy in flight. It should be set at what the manufacturer for your glider tested your size of wing with, this information is often written on the placard on the paraglider or can be found in the manual or test report. Too wide an adjustment makes the glider be more affected by weight shift and can result in an increased turn rate in an asyymetric collapse.

	Distance between the points of attachment too small	Distance between the points of attachment to big
Danger of twist	bigger	lower
Turbulences	less noticeable	highly noticeable

Figure1-4: ***Extended position*** *in the harness. This position delays the rotation of the pilot around the vertical axis:* ***attention during a quick turn!***

The danger of twist also comes from a lying position in the harness. The high torque is opposed to the rotation. In addition, in this position, the vision is obscured. If you experience turbulence or a collapse in a pod harness there is a yaw effect caused by the legs moving sideways due to the centrifulgal force. The unfortunate result that may happen is a vertical twisting of risers and suspension lines (Twists). So if you are in turbulence bend your knees and sit up whilst flying.

The distance between the seat board and the point of attachment of the harness to the risers affects flight behavior.

	High attachment points	Low attachment points
Turbulences	less noticeable	more noticeable
Acceleration on takeoff leaning forward	more difficult	less difficult

Adjusting the thigh straps correctly helps you to get seated in the harness straight away after takeoff, if they are too loose the seat board can move too high and you may find it harder to sit.

Caution: Releasing the brake controls close to the ground may, in case of closures, have fatal consequences (see also Chap. 4).

1.6.2 APPI points

- T safety line obligory for passengers (tandem flight).
- Check your buckles are secure every flight especially in snowy or sandy areas.
- Respect the 5 point APPI preflight check process before every take off.
- In case of ventral rescue (buckle your harness before attaching the rescue), the rescue has to be fixed via webbing to the shoulders of the harness).
- Control the webbing under the seatboard of your harness, possibility of friction with your seat (specially carbon seat).
- Carbon seat has to be protected with tape or any soft material.
- APPI does not accept side rescue pocket(In a spiral dive there is a risk to remain in the spiral due to the extra weight) and shoulder mounted rescue pocket with handle to the front. (very difficult to deploy)
- Back and under seat rescue pocket with a clover leaf release are recommended .

Caution: APPI do not accept Under pocket closed style rescue as there have been accidents where the reserve has been trapped if the seatboard snaps.

In case of under seat rescue the Acceleration and stirrup have to come back to the seat if not in use, (elastic or security clip attached to the rescue).

APPI recommend in ventral Rescue only Light rescue.

APPI do not accept knots in the webbing connection between harness and rescue (direct connection or carabiner).

APPI give a maximum 10 year life for any harness and for a reserve.

1.7 - Building Materials

Paragliders are essentially submitted to tensile forces. The tensile strength is therefore one of the most important criteria for the construction of a glider. Generally, it is admitted on this subject that when loads go up to the limit of stretch, or rather to the maximum tensile strength, the materials will no longer return to their exact original condition.

1.7.1 The wing

The paraglider wing is woven with polyamide fibers or polyester. Its weight is between 30-80 g/m2. The resistance to tearing in both tissues decreases slightly with use but with configuration loads of normal flight, the wing remains quite suitable after 250 to 300 flight hours. The main source of weakening, especially for polyamide fabrics, is due primarily to harmful UV radiation.

When damaged, it’s the spread resistance to tearing that comes into play. Although the Rip-Stop weaving technique is used on the paraglider fabric, the spread resistance to tearing is considerably smaller than the primer resistance to tearing. It is by inserting, at regular spaces, a thicker wire that the spread resistance to tearing is improved. The weaving Rip-Stop is recognized by the characteristic squared fabric. It is in the bias direction (diagonally) that the acting loads more easily distort the weaving structure. These same forces act on the walls between cells and can cause a change in the profile. For this reason, the extended performances of extreme flight maneuvers are not recommended.

To ensure that paragliders’ fabrics are the most impermeable to air and water and mechanically resistant, they are

impregnated with additional synthetic resin (eg. Silicone, Mylar). In addition, we can reduce by a specific impregnation the UV sensitivity and the elasticity. For some parts of the canopy, which especially should not undergo deformation, manufacturers use items made of Mylar (Flares, intercellular partitions). The polyamide fabric, being smoother, is better to absorb the impregnation than the polyester fabric. But the mechanical stress causes tiredness to both materials equally.

Tips: Gently and appropriate treatment can significantly increase the lifetime of a glider. In this context, we do not unnecessarily expose a glider in the light of the sun, as UV rays strongly tired polyamide tissues in particular. The impregnation is damaged mainly by:

- Rubbing and scraping
- Storage in a wet state
- Cleaning with harsh detergents
- UV (sunlight)
- Do not drag the canopy on the ground. The seams also wear out very quickly. Wherever possible, unfold its wings on a soft surface.

It's not just the loss of tissue resistance to aging that appears to be a problem but also the increase of the tissue porosity (air permeability). We can control this phenomenon ourselves by performing a mouth suction on the upper surface in the largest profile area.

Tips: A permeable to air cap shows a change in flight behavior, for example a greater tendency to parachuting and a smaller speed range.

1.7.2 The suspension lines

In order to obtain an optimal distribution of the load on the canopy, in the modern construction of paragliders, suspension equipment with a total length of 200-500m is used. With such a length of suspension, the thickness of the lines has a considerable influence on the drag. It is the core wrapped construction that best meets the requirements of a large load resistance, a small diameter and low elasticity. Most of the time, a core of woven aramid (Kevlar) or polyethylene (Dyneema) is surrounded by a coat of polyester to protect it from light and mechanical stress. The disadvantage of this core wrapped construction is the fact that any nucleus lesion can be hidden under a intact sheath. This is called white rents, and they can occur because of a too thin sheath or as a result of humidity and frost exposure.
The breaking strength of new suspension lines of 1-2 mm in diameter which are currently used, is around 60 to 130 daN (kp). In the modern construction of paragliding, different thicknesses of lines are used in the same model. 3-4 basic lines of 1.5 - 2 mm thick and 5-7m in length which branch into a large number of shorter and finer lines that are attached to the canopy. The greatest resistance to the air of the thick lines is compensated by their smaller number. On the other hand, thicker lines are less likely to tangle and are, on the ground, much more pleasant to order and sort out than the thin ones.
If the atmospheric factors (humidity, cold, UV radiation) cause relatively little injury to the breaking force, bending and especially crushing enormously weaken the lines. At this point, the lines Dyneema are better than Kevlar lines. On the other hand, the aramid lines (Kevlar), when heavily loaded, almost do not stretch. The polyethylene lines (Dyneema), by contrast, may grow 0.5% to 1% depending on the load exerted.

Tips: In daily use you should observe the following:

- The Dyneema lines are identified by their white core. Their melting point is below 200 ° C. They are less susceptible to bending and to UV radiation than the Kevlar lines but they are more elastic.
- The aramid lines have a brown-yellow core. The melting point of Kevlar is above 500 ° C. They are very sensitive to bending but they resist to elongation.
- The suspension can be permanently damaged by crashes. That is why one should never pull on the hangers. The suspension lines can also get seriously damaged on stony ground.
- When unfolding the wing one should check that no suspension will remain hanging during the inflation of the wing. Never pull the wing suddenly.
- The sheathed core manufacturing, due to the differences in the core (Kevlar, Dyneema) and sheath (polyethylene) materials, are submitted to a lengthening and shortening phenomenon.
  Variable loads that act on the different rows of the lines can therefore change the trim. So it is the length of the lines that one checks first as the behavior changes with aging (eg difficult inflation, slow gliding, deep stall tendency).
- Use only original pieces to replace suspension lines. Loop attachments make it easier when changing the lines.

1.7.3 The harness

Straps of polyester or polyamide are used for harnesses and risers. They have a very great resistance, but their weakness lies at the seams.

1.7.4 Closures, carabiners and connectors

The connection between the harness and risers is done either through steel carabiners or aluminum connectors. One uses carabiners if you want to fix permanently the harness and risers; on the other hand aluminum connectors allow rapid separation of the harness after the flight.

	Connectors	Aluminum carabiners
Using	Permanently attaching	Fixing the time of flight
Benefits	When checking the harness, either both risers are correct either no	The canopy may be extended regardless of the harness. It is possible to attach just before takeoff
Disadvantages	Just before takeoff when the wing is disturbed by a gust of wind, the harness has to be removed	The risk of having a twist of lines and a turn of the harness is higher

One must make sure that the binding of risers and connectors occurs across the full width of the latter. The loops of the harness are also made of steel or aluminum.

1.8 - Care and Maintenance

1.8.1 Inspection and repairs

The glider and the harness should be subject to regular monitoring of their condition (most manufacturers recommend a control plant each year):

- **The wing**
  - Check the air porosity. The most loaded part in flight is on the upper surface of the edge. The experienced pilot recognizes the wing signs of aging (especially an increase in porosity) by changes in flight behavior: the paraglider is inclined to drop, the air flow picks up sooner and speed range becomes smaller.
  - Small lacerations can be repaired by sticking self-adhesive tape Rip-Stop on both sides, taking care to round the corners. Large lacerations should be repaired by the manufacturer.
- **The sewing**
  - Check the seams of the canopy, the risers and the harness.
  - The defective seams can be repaired with nylon thread.
    Note: Too tight points perforate the fabric and make it lose its strength!
- **The Suspension lines**
  - Measure the length of the base lines. A change in the length of suspension lines of more than 1 cm exceeds the tolerance allowed and can cause both a change of profile and of flight behavior. They should therefore be changed.
  - Replace the lines when snagged or torn apart.
- **Carabiners**: Periodically check the thread. One screws on a carabiner by hand and ends with a one quarter turn of key.
- **The risers**: Replace faulty elevators.
- **The harness**: Only specialists should repair defective harnesses.
  Check the friction point with the Seat (specially carbon one) and the Harness principal strap

Example of slotted carabiner.

1.8.2 Cleaning

Gliders should only be cleaned if it is essential. The dirt goes away with use. Very dirty wings should be washed with warm water and possibly with a very mild detergent.
Warning: The harsh chemicals can damage the fabric or dissolve the impregnation.
If a glider has been in contact with dirty water or sea water, rinse immediately with fresh water and put it to dry.

1.8.3 Storage

Store paragliding gear only when completely dry and in a dry place. It takes several days to completely dry the harness and the suspension lines.

> **Caution:** Do not dry in direct sun light! Dry equipment can remain stored for several months in its bag. When storing or transporting in the trunk of a car, make sure the equipment is not in contact with oil, benzene, strong detergents or antifreeze products and that it is not subjected to excessive heat (Specially riser in Dynema).

1.9 - Instruments

1.9.1 The variometer

The current variation instruments are multifunctional and have a very modern electronic instrumentation. Its most important function is the visual and audible indication of the rate of ascent or descent and altitude. This calculation is based on the physical principle of the loss of air pressure with increasing altitude. The measurement of atmospheric pressure is via an aneroid capsule. This flat metal box and vacuum air registers the tiniest variations in pressure and instantly transcribes them at high altitude. However the signs of altitude are perpetually subject to variations as the pressure of the air varies not only with altitude but also with temperature and with weather conditions.
So during the day, with the warming of the soil due to sunlight or approaching an area of low pressure, the air pressure drops.

	Volume of the aneroid capsule	Air pressure	The altimeter

	Volume of the aneroid capsule	Air pressure	The altimeter
⇒ Descent ⇒ cooling ⇒ approaching a high pressure zone	decreases	increases	drops (the indicated altitude is too low)
⇒ Ascent ⇒ warming ⇒ approaching a zone of low pressure	increases	decreases	rises (the indicated altitude is too high)

An altimeter is characterized by the following features:

- An unbreakable and moisture resistant case.
- Easy to handle even with gloves.
- Easily readable data at first glance, too much information on a small space can lead to confusion.
- A clear acoustic tone of ascent which is easily recognizable.
- A temperature compensation, which means the large changes in the pressure sensor due to changes in temperature, must be compensated by the correction values.
- A mechanical stabilization (eg. a threshold reaction of 100cm means that changes in altitude of less than 100cm will not be marked) prevents a too shaky operation in case of choppy conditions.
- Adequate and safe body fixings.

The barographs record and trace graphically the chronological progression of the static pressure during a flight. The barograms are used as authentication for flights (to record flights).

1.9.2 The anemometer

The anemometer is used to measure the wind speed on the ground. The same instrument can be used in flight to measure its own speed relative to the surrounding air mass. Care must be taken to position the propeller a sufficient distance from the body or other accessories and in the exact direction of movement, otherwise the results obtained will be false due to turbulence.

1.10 - Personal equipment

1.10.1 Clothing

It is advisable to wear sturdy clothes and to cover the whole body which might, in case of failed takeoff or emergency landing, protect small wounds.
The same goes for gloves.
For longer flights, it is essential to have gloves and warm windproof clothes.

1.10.2 The shoes

In paragliding, sprains and torn ligaments in the ankle are by far the most frequent injuries. The best way to prevent that is to wear strong shoes with ankle support.

1.10.3 The helmet

The helmet should be certified for airsports use normally EN 966. The helemt is designed for high impact to offer some protection to the head in the event of a fall and on takeoff and landing.
You should were your helmet even when you are ground handling and any time you are clipped into your paraglider.
It should protect the head and have a good resistance on impact.
However it should not interfere with movement, vision or hearing. The lightweight helmets meet these requirements.
_Some helmets are certified for air and snow sports.
Heavy helmets can be dangerous for the neck in Acro training and are not recommended.
_Motorbike helmets are not suitable as they are too heavy and you can’t hear properly
_Large chin guards can be dangerous as they can twist the neck.
Helmets with back profile are not recommended as they do not increase performance and can push your helmet over your face in case of rescue use or again may twist your neck.
Full face helmets do offer your face more protection in the event of a crash and are good for cold air but they affect your vision and wind sensitivity. So in some ways it is safer to fly with an open face helmet as you have clearer open vision and more information about your airspeed whilst flying.

1.11 - Rescue

1.11.1 The reserve

The reserve parachute is a highly recommended piece of equipment as it may give you a last chance and save your life in the event of a disaster. To fly on some flying sites it is mandatory to have a reserve.
The reserve should be no more than 10 years old as they are a man made fabric and degrade through time, they need to be strong enough to take a shock loading. It should be repacked every 6 months otherwise static and compression can make the fabric stick together and delay or prevent opening. It must be repacked following the manufactures recommended packing methods exactly.
Use: The rescue system operates if the situation, in relation to altitude, proves to be uncontrollable in a relatively short period of time. This applies primarily to collisions between aircraft. They represent the greatest danger in the air and require immediate throwing of the reserve parachute.
When to throw your reserve?
• Mid Air collisions
• Lines are 'twisted' as a result of a spin
• Locked into spiral dive and can't recover
• Equipment failure
• Too low to recover from a large collapse.
Assess your altitude and assess the problem with your glider. If you have height and there is a chance to get the wing flying again then try to recover it whilst constantly monitoring your altitude. Don't wait to long. Look where the wind will drift you and decide the best altitude to throw your reserve. If you are suffering from G force or risk free fall then throw the reserve immediately. If you are in a SAT or strong spiral you are best to stall the wing and put both brakes in one hand before throwing the reserve. Practise finding the route to your reserve handle so you can find it automatically.
How to throw your reserve?
Look at the handle, grasp your handle twist your hand and pull hard releasing the reserve pod. Throw to clear air in such a way as to try to prevent it getting caught in the lines of your paraglider and to try and get it to catch the airflow. **Let go of the handle!** The reserve should go to the end of its lines and open if it doesn't then give it a shake. As soon as it does open and you feel its tug now is your chance to control your main glider and stop it from flying. Either wrap the brakes a couple of times to stall the glider or grasp the B lines, or back risers firmly and stop the wing from flying.
Mirror Effect.
If the reserve and the main wing are both flying then they will start to pull against each other and cause a strong downplaning effect that is basically flying you downwards at highspeed - Very dangerous! If this starts to happen then stall your paraglider.
Systems: The reserve parachutes with a round canopy represent are the most popular. There are also rogallo steerable, double surface and square reserves now on the market, they all have pros and cons. Normally paraglider reserves are not designed to be a "Cut-away" system but can be operated at low altitude above the ground. Acro pilots often carry 2 reserves.

Accidental deployment 1 in 3 reserve deployments are accidental! A proper pre flight check is needed on every flight to check that the reserve pin and handle is in place. If you have a bad takeoff or landing check it is secure.

Certification: Buying a parachute that is clearly marked as conforming to the CEN standard EN12491 is strongly recommended. Such parachutes will havepassed rigorous speed of opening tests, descent rate tests (max. 5.5m/s), stability tests and strength tests. In the strength test the manufacturer has the choice of two test speeds, and the successfully certified parachutes therefore carry on the certification label the warning: 'not suitable for speeds in excess of 32m/s (115km/h)' OR 'not suitable for speeds in excess of 49m/s (176km/h)'. check that it is available in a size suitable for your total weight in flight this figure includes the weight of your glider, harness and the reserve.

Construction: The most used models are the parachutes with a round canopy with a middle string. Using one or more central suspension lines, the central peak of the canopy is pulled down. This type of construction offers the advantage, when compared to a traditional round canopy, of having a lower sink rate but however a poorer stability against tilting. The double canopies have a shorter opening time compared to single ones. The reserve parachutes are folded and compressed according to a very precise scheme in a container (pod). This container protects the suspension lines from possible snags and the whole of it must be thrown laterally when the reserve parachute is released. With traction on the lines, the parachute opens gradually.

Connectors: You should use 7mm Square Stainless Steel Maillon Rapide for attaching single point reserves to bridlesto connect the bridle of the reserve to the Y bridle that leads to your shoulders. You should connect the webbing from the Y bridle to the shoulders using 6mm Stainless Steel Trapezoidal Maillon Rapide suitable for attaching reserve Y-bridles to the shoulder attachment points on your paragliding harness. and put elastic bands around them to prevent them twisting and side loading.

Check the pins and that the velcro handle is secure, check that the velcro doesn't hold too tightly through time. Check the handle connection to the reserve handle is attached and of the right length so that the the handle deploys the reserve properly. You must do a test deployment.

Materials: The reserve parachutes are subjected to high demands in the matter of solidity. Unlike paragliders, here the material must offer some elasticity. For the construction of emergency parachutes the same materials are used as for paragliders: nylon for the canopy and polyester or polyamide in some cases for the lines. These materials are mostly sensitive to UV and moisture. After landing in water, the reserve parachute should be spread out to dry for at least 72 hours as it is mainly the lines that take a long time to dry. Due to the high frequency of flights at low altitude, in addition to the reliability, the speed of opening of a reserve parachute is a very important criterion. The opening time of current emergency parachutes is about 1 sec. There are several factors that affect the opening time. Thus a small area and a high speed at the opening, has a positive influence as well as a low porosity of the fabric and a frequent periodic folding.

Size: The reserve parachute should be neither too large nor too small. An open reserve parachute should have a sink rate of around 5-6m/sec. A higher sink rate increases the risk of injuries at landing; a lower sink rate increases the opening time. A speed of 5-6m/sec. is obtained by jumping from a wall 1.8m high.

Fixing: Body position during ground impact greatly determines, during a crash landing with a reserve parachute, the risk of injury. Stand up in your harness with your legs together and slightly bent with arms tucked in clenched. Bend your knees and tuck your chin in, twist to the side and roll on impact. (see 4.9.3 parachute landing fall technique). The reserve is fitted with bridles that attach to the shoulders of your harness in a symmetrical way as high as possible. This is to ensure a straightened position of the body.

Location on the harness: It is essential that the handle to release the reserve parachute is in the pilot's visual field and is easily accessible. The four locations that are used all have advantages and disadvantages.

	Advantages			**Disavantages**
Lap fixing	Release handle in the visual field	Can be drawn with both hands	Possible impetus while throwing	Complicated placing of the harnes
Side fixing	Release handle in the visual field	The reserve parachute can be easily dismantled	Possible impetus while throwing	Can only be drawn with one hand (left or right)
Fixing under seat board	The reserve parachute does not interfere	The reserve parachute acts as shock absorber cushion	The release handle is not immediately in the visual field	Can only be drawn with one hand (left or right)
Back fixing	The reserve parachute does not interfere, all is well placed	The release handle is not immediately in the visual field	Can only be drawn with one hand (left or right)	Less impetus at the start due to the long bond handle-container
	Advantages	**Disavantages**		

Folding: Even when not in use, the emergency parachutes are exposed to changes in temperature and humidity. It may happen with time that the thin material of the canopy sticks and slows considerably the opening or even makes it impossible to open. Therefore it is strongly recommended to regularly ventilate and fold up again the reserve parachute at intervals of about six months (the recommendation of APPI is every 6 months). The folding of the emergency parachute may be executed by any certified rescue packer.