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WORLDWIDE PARAGLIDING AND PARAMOTORING MAGAZINE. FOR FREE.

FRONTALS

ON A PARAGLIDER AND A PARAMOTOR

Photo: Gudrun öchsl/www.profly.org

As with all the induced SIV manoeuvres, this type of frontal isn't necessarily the same as a collapse in real life. Here the pilot will have no doubt pulled down on only the inner A lines

Photo : Gédrun Ichlis/www.pentlay.de

Front collapses are, as a general rule, benign incidents. However with modern wings, certain unexpected behaviour can occur…

By Sascha Burkhardt, with the help of Lucian Haas (http://lu-glidz.blogspot.fr/) and the DHV.
Translation by Ruth Jessop

The frontal - don't touch the brakes?
The frontal - academic reactions from the DHV

In a previous edition of **free.aero** we saw that a frontal is the consequence of an angle of attack that is too low, which occurs most of the time at high speed whilst accelerating. It isn't necessarily a bad reaction of the wing; quite the opposite: By collapsing the profile protects the wing from going too fast which, in other more solid aircraft could cause structural damage due to resonance. But also, a collapse can be beneficial if it stops a wing which is in the middle of diving, coming out of a stall for example. A profile which is solid as a rock can fall further under the pilot than another more fragile profile which can play the role of a kind of fuse by collapsing at an earlier stage.

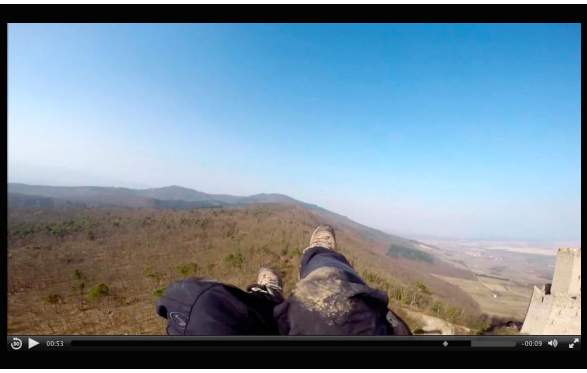
THE PROBLEMS START…

A frontal which opens quickly and symmetrically isn't normally a big problem as long as the pilot is high enough to sustain a loss of altitude of a minimum of 20 metres, or even double that, before recovering normal stable flight.

A FRONTAL AT TAKE OFF

During an underpowered take off, the wing dives to recover air speed. During the surge, it goes past the critical angle of attack and has a front collapse.

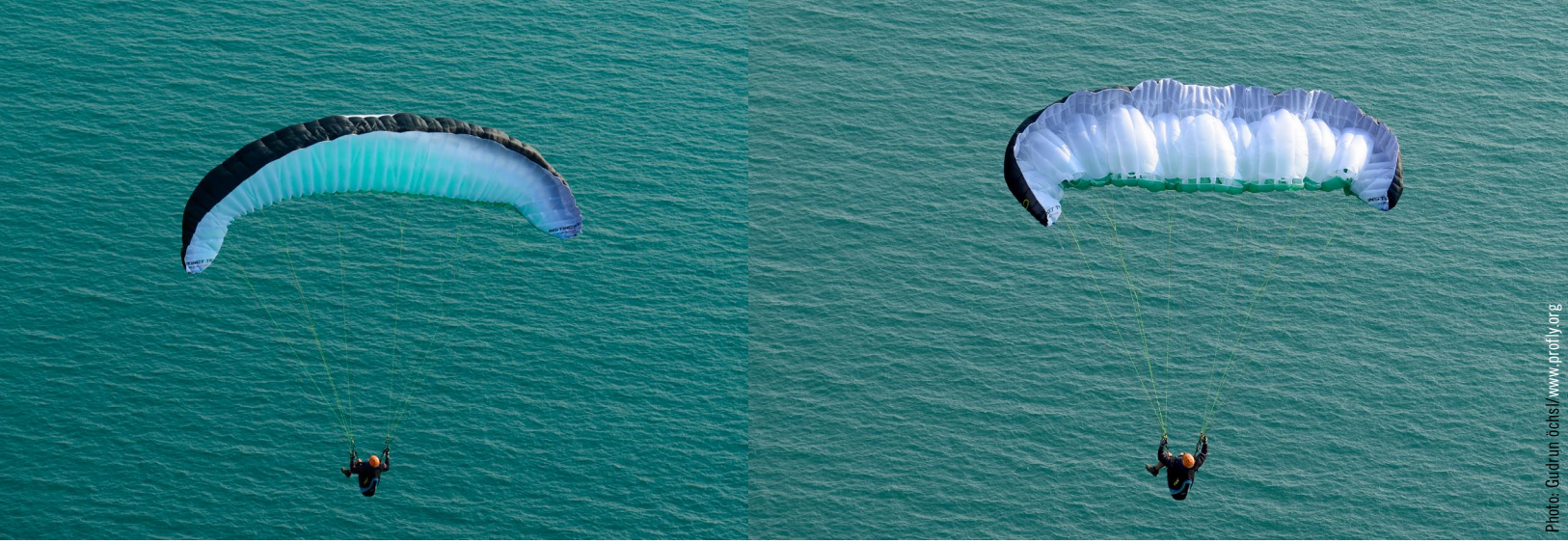
https://www.youtube.com watch?v=JMid1Y03rto



A QUICK FRONTAL ON A PARAMOTOR

A frontal can happen unexpectedly in a clear sky. In these conditions, in the majority of cases, it reopens very quickly.

https://www.youtube.com/watch?v=qkBBcIWM45M



A full on frontal.

Yet, during SIV courses, instructors are noticing that more and more modern wings don't open straight away... The leading edge remains caught under the lower surface, the wing fights itself whilst falling vertically in a type of parachutal and sometimes, to cap it all, the wing goes into a front horseshoe (the wing tips join in front of the wing) or more rarely in a rear horseshoe (the wing tips meet behind the wing). Certain wings can even perform one or the other figures, depending on its mood and the way the frontal happened. In any case, every frontal is different.

The airflow pushes on the folded under leading edge and some cells become tangled in the lines which are more and more spread out in modern wings: An additional factor which contributes to delayed reopening.

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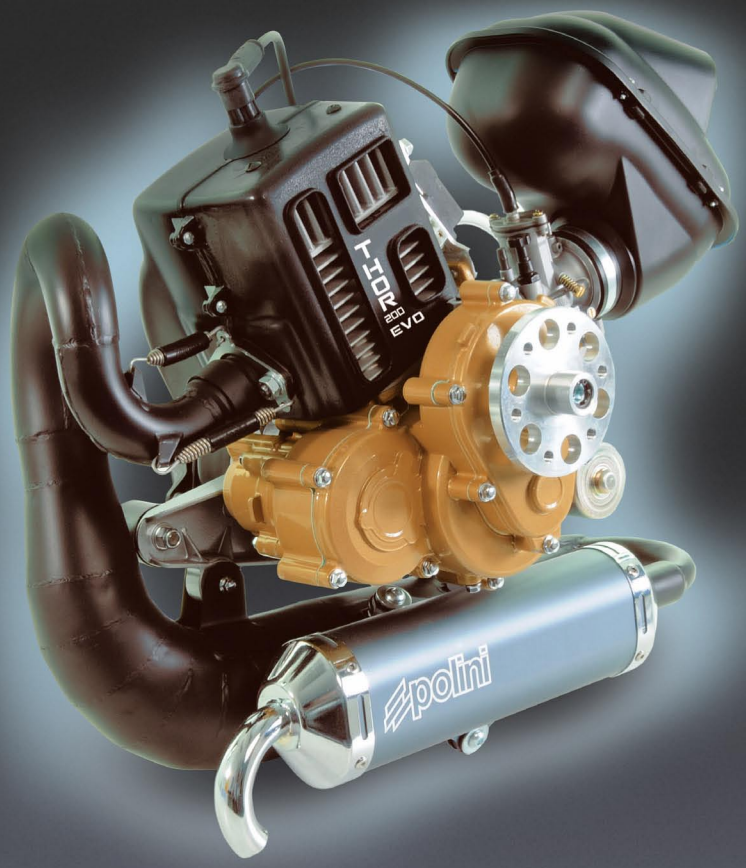

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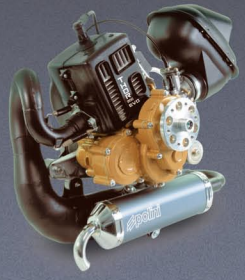

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When they are induced they are already different from those caused by turbulent air, and their form and size depends on the fashion that the pilot pulls on the A lines, or indeed on the folding lines if they are used. But it is, above all, the geometry and construction of the wing which determines its behaviour once it has collapsed.

With recent wings equipped with leading edge rods, combined with set back attachment points for the As, collapses are often bigger and more stable, and, in the end, need a reaction from the pilot to encourage reopening. This could be due to the fact that the point around which the leading edge folds is further back in these modern wings equipped with leading edge rods, SharkNose profiles and set-back A lines. The leading edge is thus more easily trapped under the lower surface by the air flow. But of course, stable front stalls can also happen on older wings that don't feature this technology. So even if the causes aren't fully understood, there must be other factors which increase the likelihood of these incidents occurring.

RUSSELL OGDEN'S ADVICE

"I wouldn't necessarily blame long plastics and SharkNose for stable frontals though, the problem existed long before that - we have plenty of protos with neither that can also remain in stable frontals; conversely we have SharkNose and long plastics that we cannot make trap. It is more complex. The truth is we do not fully understand this characteristic. What we do know is that it is due to airflow - in a normal frontal that recovers from the middle to the tips, air flushes from the back to the front on the under surface forcing the nose to open. In collapses that trap, this does not occur, instead the airflow pushes the leading edge against the under surface trapping it into a stable position.

Brake input should be used on every frontal that remains stable or has the tendency to forward or rearward horseshoe – it is vital to keep the tips from touching to avoid potential cravats."

A STABLE FRONTAL

During a failed attempt to stall (or to fly at low speed) the pilot puts his hands back up, the wing dives and produces a big collapse which turns out to be stable.

https ://www.youtube.com/watch?v=EPM0YogVP60

A FRONTAL AFTER GOING INTO THE WAKE OF ANOTHER PARAMOTOR

A frontal in calm air no doubt provoked by turbulence from the wake of another paramotor…

https://www.youtube.com/watch?v=yvWFZWBEWXc

Flytec realizes flying dreams!

Jörg Ewald is an experienced engineer, passionate paraglider pilot and the new head of Flytec. As an active competition, cross-country and tandem pilot, he has high expectations of a variometer:

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For the future, Flytec aims to make the joy of free flight more accessible by taking the technical support for free flying pilots to new levels. Peter Joder and Lorenz Camenzind, who established and grew Flytec for 31 years through high precision technology and ground breaking innovations, have laid the foundations. Jörg Ewald and his team will transport their legacy into a new era, where Flytec supports all pilots to realize their flying dreams.

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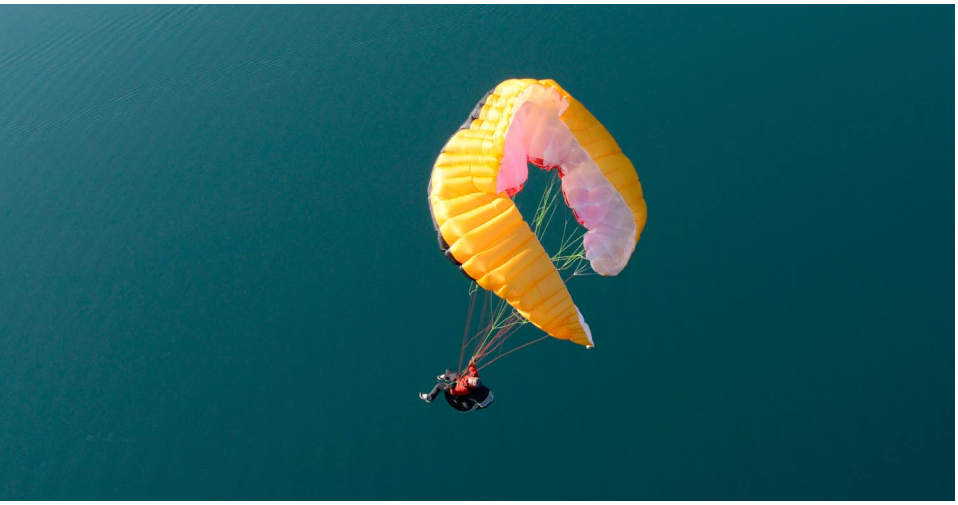


After a collapse, this wing goes into a rear horseshoe. By keeping the brakes up at the stoppers, this wing reopens normally. This isn't always the case with all wings in all configurations…

Photo: Gudrun öchsl/www.proflyo.org

This frontal stability is theoretically equally true for paramotor wings with a strong reflex profile. It's true that they are almost impossible to collapse but, as with all flexible profiles, that isn't guaranteed in every situation. It is very possible that, if a frontal collapse happens in this type of wing, a large part of the leading edge could get caught under the lower surface and stay there. One could even imagine the scenario where the reflex would end up operating in the wrong way, opposing a quick re-inflation. Fortunately, in practice, that seems rare…

The reduction of the number of lines on the new generation of paragliding wings plays an equally important role and could potentially delay opening. The air flow forces parts of the leading edge through the lines which are more and more spread out on our modern wings. This additional factor delays reopening and indeed, prevents self reopening…

The wing therefore ends up in a parachutal stall and, the higher the aspect ratio, the greater the chances are that the wing will twist or spin, adding asymmetric movements to this stage in the flight. Certain top of the range EN B wings with aspect ratios of around 5.5 are more affected than more compact EN A paragliders.

A FRONTAL ON A REFLEX PRAMOTOR WING

One of the best known videos showing a scene with a reflex paramotor wing going through a frontal collapse. It's worth noting that in this eight year old clip, the pilot did exactly what the instruction manual specifically says not to do: Press on the speed bar prior to having released the reflex of the wing with the trimmers. A strict no-no on this type of wing.

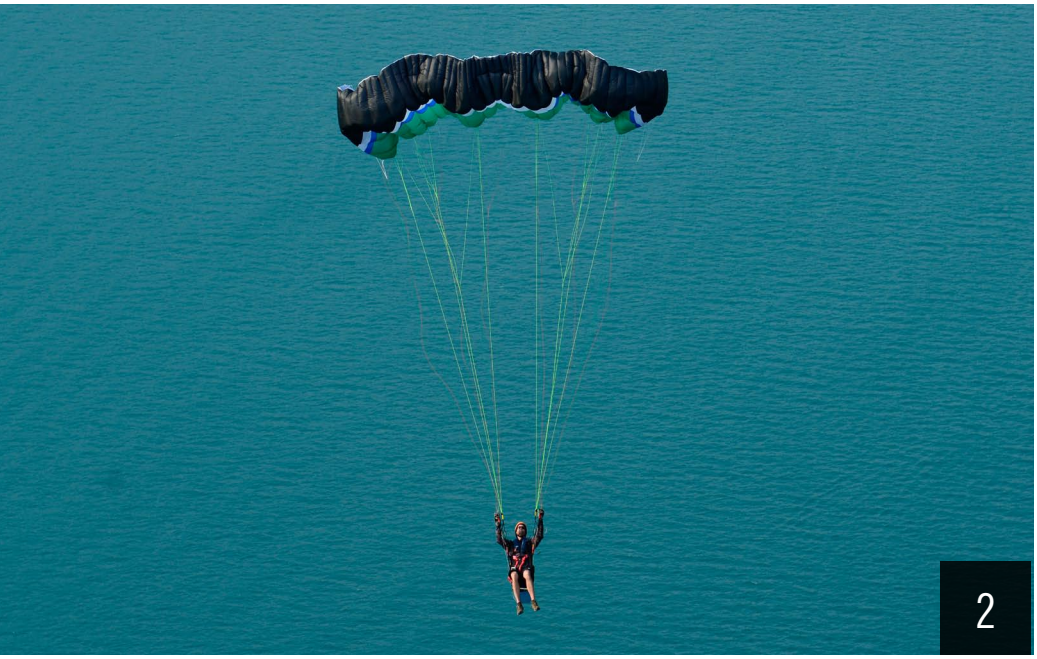
https://www.youtube.com/watch?v=TbNwk4BDnrQ

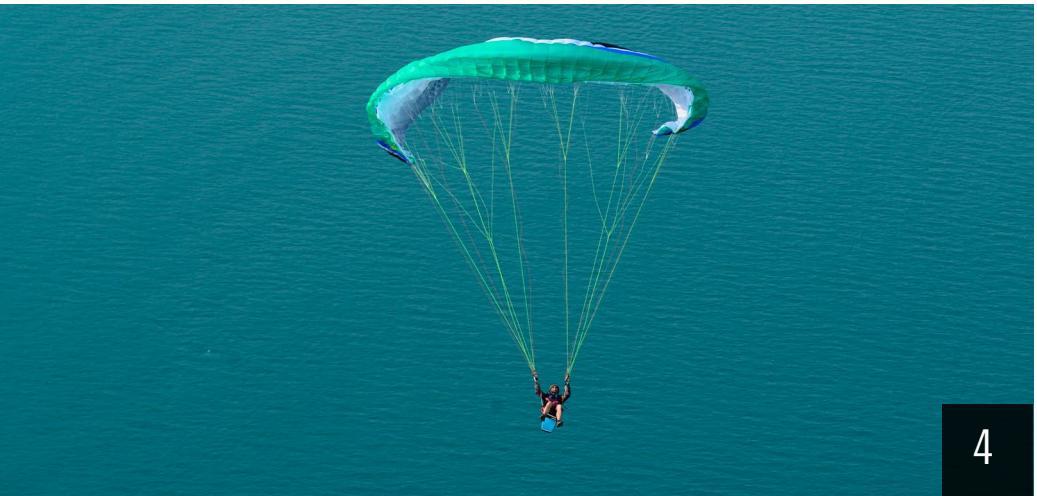
AN INCONSEQUENTIAL LITTLE FRONTAL

An inconsequential frontal on a paraglider during final glide. Another example showing that a symmetric frontal, in the majority of cases, is benign.

https://www.youtube.comwatch?v=MzbQj2o0TqA

Photo : Gudrun öchsl/www.profly.org





After the frontal this wing reopens almost normally along its whole span. A fraction of a second later, the centre will also be open.

The pilot watches his wing throughout the whole sequence. Even on this subject opinions diverge. If numerous instructors advise you to keep your eyes glued to your trajectory, other professionals like Russell Ogden advocate keeping a regular eye on your wing. 'It's up there where everything happens, it's the wing which looks after my life,' he says.

'It's up there where everything happens, it's the wing which looks after my life'.

THE REACTION

As far as the appropriate reaction to a frontal is concerned, most instructors advaise not braking the wing right at that moment. Because **before** the collapse, a bit of brake could have avoided it, but **after** the collapse has occurred you risk creating new problems. The wing will be in a type of parachutal, close to a stall, and braking could make it stall completely.

But there are those who advaise the opposite: Certain pilots like Philipp Medicus and Russell Ogden advocate a very short sharp pull on the brakes to speed up reopening.

In a video Philipp Medicus clearly demonstrates that his wing went back to stable flight much more quickly thanks to this method.

COMPARISON: BRAKING AFTER THE FRONTAL VERSUS THE PASSIVE PILOT

Phillip Medicus, test pilot and Nova designer explained (unfortunately in German, but still understandable) his technique for reacting to a frontal. He showed that a short but sufficient pull on the brakes can speed up reopening. But you need to be aware that it's a dangerous game, played near to a stall!

https://www.youtube.com/watch?v=UCJ23zLaME8

SOME ADVICE FROM RUSSELL OGDEN

An interesting 45 minute long video. During the 2012 Open Distance Nationals in Sun Valley, Ozone's Russell Ogden explained his personal vision of good flying techniques. He also spoke about his technique for managing frontals…

https://www.youtube.com/watch?v=_YVbdaLc1jk

When the German federation, the DHV, retested several wings which were already certified, pushing, amongst other things, frontal collapses further than required in the EN tests, they noticed rather long recoveries on certain top of the range EN B paragliders with large aspect ratios. But in that case, they were applying the dogma, 'at the start of a collapse, hands off the brakes'. It's a defensible position, given the risk of stalling if the pilot interferes with the controls, and it seemed to establish that by using Philipp and Russell's method, the frontal would be over sooner.

It's a dilemma that there isn't a universal solution for. So much of the progression of the manoeuvre depends on the amount of brake used, the feeling and experience of the pilot, the configuration of the frontal and the type of wing.

If in doubt, it is best initially not to touch the brakes and to follow advice as taught in DHV affiliated schools. These procedures seemed of sufficient interest for us to publish them here. ■

PARAWORDS

The rear horseshoe
The wing tips join behind the wing. This is often the case after a classic stall, i.e. leaving the flight envelope due to low speed, but can also happen after a front collapse.

The shrimp or front horseshoe
The wing tips join in front of the wing. In the 90s, when the first wings with sufficient aspect ratio made their appearance, this manoeuvre was regularly done as a minor acro move.

A cravat
This happens mainly after an asymmetric collapse. The wing tip stays caught in the lines and prevents it from reopening. A possible reaction from the pilot is to pull on the stabilo line on the cravatted side until the ear is released.

Kiss of death
After a pronounced front horseshoe on a wing with a high aspect ratio, the wing tips which are joined together can get so tangled that they create an even more serious incident. In this case both stabilos are mutually cravatted…

Photo : Gudrun öchsl/www.profly.org

DIFFERENT FRONTALS

The different forms of frontal collapse require different reactions…

By Simon Winkler, SIV instructor and DHV test pilot (www.dhv.de)
Photos: Simon Winkler, Eki Maute, Pascal Purin

A frontal opening asymmetrically

Reopening from the centre

Reopening from the wing tips

A front horseshoe

A rear horseshoe

A frontal often makes a rustling noise and the pilot feels as if he is being pulled backwards by the braces. He looks up and the wing is already re-flying peacefully. It's an advantage of paragliding: A phase in the flight where the aircraft returns in a fraction of a second from total destruction to flying normally.

Where it is difficult is if the wing doesn't return to normal flight by itself, and the pilot has to intervene. Several years ago, we only had category C wings which could become stuck in a stable frontal collapse. Since then we find that on high performance category B wings as well.

FRONTAL ACCIDENTS

In the accident statistics, asymmetric collapses are ahead of frontals. Yet in strong turbulence the frontal happens just as often.

According to our statistics 10% of accidents are due to frontals. The principal danger is having a frontal close to the ground. Following that are the cases where the pilots find themselves with a stable frontal and don't know how to react.

THE NATURE OF THE FRONTAL

A frontal happens when the angle of attack goes below a critical level. The leading edge becomes stuck under the rear of the lower surface, and the cells become empty of air. The wing stops abruptly, the pilot pendulums forwards and feels as if he is being pulled backwards by the braces. When the pilot comes back under the wing, the rear lines are once again loaded and the wing reopens all by itself… normally. From then on, the airflow around the profile is re-established and the wing reflies.

A normal re-inflation, symmetric and along the whole leading edge

A frontal collapse sequence with slightly retarded wing tips…

Very important: You must not brake the forward pitching movement because, at that moment, the paraglider is about to 'bite the air', but the angle of attack is still very high. It is only if the wing starts to really dive that you must stop it with a short sharp pull on both controls.

WHY A FRONTAL?

POSSIBLE CAUSES OF A FRONTAL

- Turbulence, especially in the lee of relief. In this case it is difficult for the pilot to avoid a collapse by active piloting.
- Strong dive of the wing, for example after a manoeuvre that has gone wrong, or by reacting wrongly when coming out of a strong thermal.
- Wake turbulence from another paraglider or paramotor, or indeed encountering your own vortex after doing a 360°, whether on a paraglider or a paramotor.

A typical error due to a lack of stability; as a result of sitting in a bad position, the pilot tries to support himself with his hands.

Having your legs and body in a good position allows active and accurate piloting.

Feet under the seat increases the stability of the pilot and will increase the quality of piloting.

A good upright posture with knees apart.

- Using the brakes whilst on speed bar: When the pilot uses the brakes whilst pressing fully on the speed bar, the increase in lift at the trailing edge can cause the glider to pitch forwards even though the angle of attack is already at the limit, and can provoke a front collapse. (It is a particularly well known phenomenon on full reflex paramotor wings - editor's comment). During certification tests, this point will, from now on, be checked, limiting new cases of wings susceptible to this behaviour.

DIFFERENCES IN OPENING

There are lots of differences in wings' behaviour when reopening. In addition, an induced collapse is never the same as an unprovoked collapse. In the first case the pilot pulls on the As, and in the second case, turbulence pushes from above.

Other factors have a big influence on the behaviour of the wing; its design, the position of the brakes at the time of the collapse and the position of the pilot in the harness. So it is not really possible to generalize about the behaviour of the paraglider during a frontal.

On the other hand, it is important that the pilot correctly identifies the type of collapse and the reaction of the wing so that he can react accordingly.

ACTIONS AND REACTIONS...

The ground rule: To react well the pilot must pilot actively and keep his body tensioned. Being an active pilot is a skill acquired amongst other things by ground handling sessions...

The importance of keeping the body tensioned for efficient piloting is often under estimated. A prerequisite is a correctly adjusted harness. The pilot must be in as vertical a position as possible, without constricting the abdominals. Feet should be kept under the seat, with the knees pushed outwards. The pilots' body is thus in a stable position, and he won't be tempted to look elsewhere to hold on (an often harmful reflex).

In addition, the pilot will be able to feel what the wing is doing much better, and the piloting will be much more precise because the controls can be used along the risers. The brake application must follow the rule: As much as necessary, as little as possible.

A stable front collapse…

Using the brakes…

Reopening…

Hands up!

PARACHUTAL

It is important to recognise a parachutal stall that the wing could enter just after re-inflation. The signs of a parachutal stall: The noise of the wind is less, and the lower surface often bulges towards the interior. Sometimes the rows of lines are closer together. If the wing doesn't exit the parachutal stall by itself, the pilot can pull towards the front on the As and use the speed bar to help the paraglider return to normal flight.

Crédit photo: Michel Farrugia -PL Molbert

SPONTANEOUS SYMMETRIC OPENING

WHAT HAPPENS

The pilot pendulums forward and the wing re-opens, either behind the pilot, or at the point when the pilot repasses under the wing. The loss of altitude is often very minor and the collapse sometimes barely noticeable.

PILOT INPUT

It is important to put the brakes back up to the stopper to allow the wing to start flying again after a short parachutal phase. No braking is necessary.

ASYMMETRIC OPENING

WHAT HAPPENS

For various reasons the wing doesn't open symmetrically. The wing undergoes a zig zag movement and rolls towards the side which remains closed.

PILOT INPUT

Stabilise the trajectory by using weight shift towards the open side and light braking on the same side.

OPENING OF THE CENTRAL PART OF THE WING, BEFORE THE WING TIPS

WHAT HAPPENS

The wing tips stay caught under the lower surface, their considerable drag preventing the wing from reflying. The wing stays parachutal as long as it isn't completely open.

PILOT INPUT

The best thing is to put your hands up: The wing will open progressively and will be able to pick up speed. An experienced pilot could speed up the opening by skilfully using both brakes briefly and alternately. But be careful: If there is too much brake or they are held on too long, the wing can spin or stall. The best advice is to practice this method during an SIV course.

WING TIPS OPENING FIRST

WHAT HAPPENS

If the wing tips reopen before the central part, they can go forward and provoke a front horseshoe.

PILOT INPUT

Once again it is best to keep the brakes at the stoppers. But if a front horseshoe starts, the pilot can intervene by giving a brief symmetric pull on the brakes.

THE WING STAYS IN A STABLE FRONTAL

WHAT HAPPENS

The wing forms a pocket between the lines and the rear of the profile folds upwards and so it lacks the necessary pressure to reopen. The wing won't open spontaneously. If the pilot doesn't react, the situation can get worse and twists and cravats can follow.

PILOT INPUT

In this case the pilot must react rapidly and brake symmetrically, immediately. Often a small pull is enough. It is important that the movement is very brief and not more than 50% of the brake travel.

IN SUMMARY

When a frontal happens, it is necessary to do the following:

- Keep your body tensioned
- Keep looking in the direction of flight
- Hands up
- Pilot pendulums under the wing
- Visual check of the state of the wing
- Spontaneous opening of the wing → no action required by the pilot
- Asymmetric opening → correct the trajectory
- Opening with a front horseshoe → brake the wing tips
- Opening with a rear horseshoe → wait, possibly give short pulls on the brakes alternately left and right.
- Wing doesn't open → short pull on the brakes up to 50% of travel, then put your hands back up.
- Look in the direction of flight
- Last visual check of the state of the wing

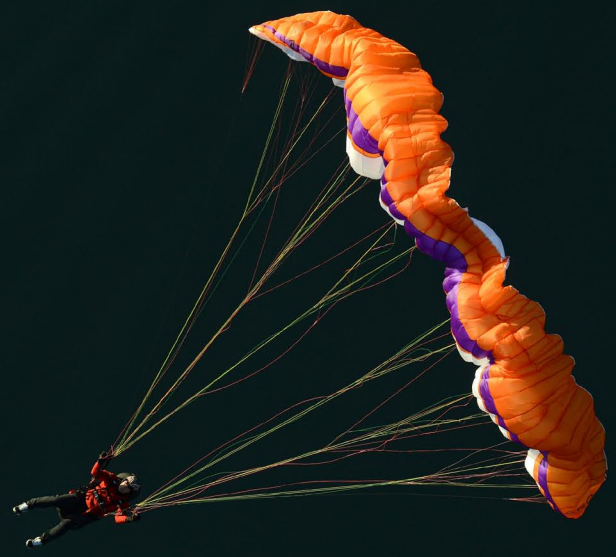
With every change of paraglider an SIV course is particularly recommended in order to get to know the precise characteristics of your wing and its behaviour...

WORK AT THE BACK AND AT THE ACCELERATOR

Frontals often happen during accelerated flight. But as it is rarely advisable to pull on the brakes in this situation, active piloting is limited.

There are two solutions possible:
Experienced pilots often help by piloting via the back risers.
Holding onto the risers gives the pilot feedback directly from the wing, enabling him to react immediately.
Another possibility is to actively use the speed bar. When the wing pitches forward, you partially release the bar, and when the wing pitches backwards, you push harder.
This technique can be practiced in calm air. By pushing on, and then releasing the speed bar, the pilot provokes pitching movements. Then he can neutralize them with the same technique.

A nice sequence above a lake…
The pilot wisely keeps his hands high whilst waiting to pendulum back under the wing and to start flying normally again.



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