# THE SIV MANEOUVRES EXPLAINED

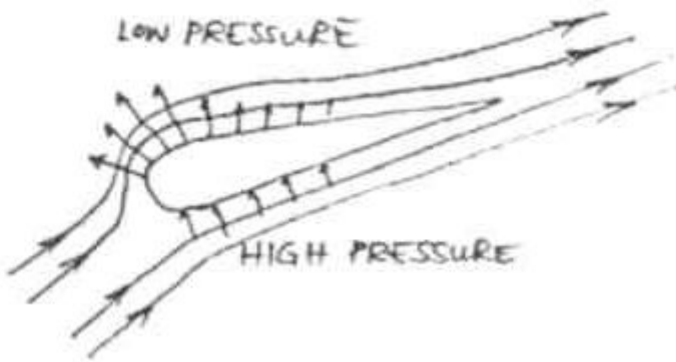
Inducing the following maneouvres on your paraglider increases your immediate flying risk. The ideal is to let an experienced instructor guide you through these maneouvres during an SIV Course, over water, under radio instruction, with a freshly packed reserve parachute, which you know how to deploy.

It is my belief that practicing SIV maneouvres is essential to your longevity. By honing the skills to recognise and recover from extreme situations, you dramatically reduce your long-term risk of injury. So it is a trade-off : increase your momentary flying risk, to decrease your long-term risk in the sport. I believe it is a trade-off which leaves you far richer. I advocate the regular practicing of aerobatics to all pilots. It can be loads of fun once you know what you're doing.

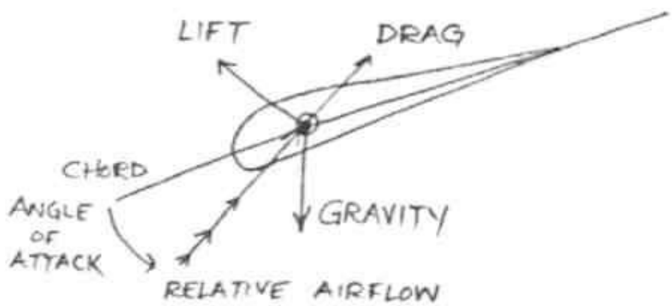
It is in this spirit that I have provided my Instability notes. They are not intended as a 'Do it yourself' SIV Course. But the theory may be invaluable to you one day, and sometimes SIV Courses are too expensive, or simply not available. Here follows my knowledge of extreme flight maneouvres.

**Firstly, some basic aerodynamics which I'll refer to later.**

What enables a glider to fly?




The aerofoil shape of the canopy, based on the wing of an aeroplane, is designed to have minimal resistance with maximum lift capabilities (Diagram). Gliders, having no engine, rely on gravity and a downward tilted wing to provide forward movement. The canopy of the paraglider, when inflated by the air flowing into the open leading edge cells, produces an aerofoil.



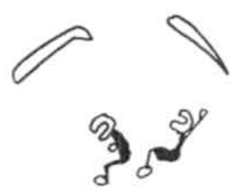

The airflow in and around the canopy is such that as the air molecules meet the leading edge of the canopy they are dispersed. Some go over the top of the canopy, some underneath and others through the cell openings. The molecules travelling over the curved top surface have a longer distance to travel than the other molecules travelling along the bottom of the canopy at the same point in time. The upper airflow is also speeded up by the venturi effect, similar to the compression zone on the crest of a hill. This causes a Low Pressure on the top and a High Pressure underneath. Air flows from a HP to a LP and thus an upward lift is maintained in the canopy. The upward lift is not even, however, but greater over the curved, first third of the canopy. The length of the arrows in the diagram illustrate this. Familiarise yourself with the terms used in the diagram, as they will be referred to often during the course.

**What maneouvres are discussed?**

The paraglider is a wonderful aircraft, both flexible and stable, a remarkeable feat of aerodynamic design. All of the following are possible : Pitch Control, Speed bar, Symmetric Collapses, Asymmetric Collapse, Front Tuck, Full Stall, Parachutal Stall, B-line Stall\, Asymmetric Stall, Negative Spin, Wingovers, Spirals, Spiral Dive, Cravattes.

# PITCH CONTROL

**Dampening out the dive**



When the glider pitches behind you, you will feel a loss of airspeed. The angle of attack will be increased, and the glider close to stall. As the glider pitches forwards and begins to dive in front of you, there will be an increase in airspeed (and wind in your face). The angle of attack will then be reduced, and the glider close to front tuck.

**Why would you do this?** Flying in thermic conditions or turbulence, the glider will pitch behind you as you enter a sudden updraught or sudden increase in windspeed. This is likely as you enter a thermal, or fly from a sheltered area into clean airflow. The glider will pitch in front of you as it encounters sinking air or sudden reduction in prevailing wind. This is likely as one exits a thermal, encounters turbulence or flies into wind shadow behind obstacles which are placed upwind of you.

**Recommended recovery** : It is recommended that you always fly actively, striving to guide the glider to a stable position directly overhead as soon as possible. The glider is less likely to collapse in this position, and your flight path will be easier to control. As the glider falls behind you and you pendulum forwards, come off the brakes. As the glider pitches forwards and begins to dive in front of you, pull half brakes to dampen out the dive. Resume quarter brakes to stabilise the glider.

**Careful!** Bear in mind that your inputs should be smooth and moderate, allowing the glider some room to recover by itself - you are guiding, not forcing the glider to remain overhead. Pulling the brakes at the incorrect time will worsen the pendulum effect - when the glider is behind you, out of sight, do not pull the brakes.

## SPEEDBAR

**or pulling down on the A+B risers**


Increase in speed because of decreased angle of attack (+4km/h). Glider has changed its trim. Glider more susceptible to frontal collapse, so don't use in this in heavy turbulence

**Why would you do this?** When you become nervous about the strength of the prevailing wind and your lack of positive groundspeed, use the speedbar to move ahead to a safer area, where you can descend. If your speedbar is not connected or brakes, you can hang on the A+B risers to simulate the same effect. This is a very strenuous exercise, and after two minutes of hanging the average pilot will be weakened and unable to continue.

**Recommended recovery** : Release the speedbar gently and smoothly. The wing slows and the pilot swings forwards slightly, resulting in a high angle of attack.

**Careful!** Wait for a few seconds so that the glider can adjust to its new (reduced) speed before initiating any turns, because a hasty turn could cause a negative spin.

## SYMMETRIC COLLAPSES/ BIG-EARS

**Sharp pull on outer A-lines**

Increase in sink rate because of smaller glider area (-3 m/s resultant)

Higher cell pressure due to increased wingloading

Slight decrease in forward speed on most gliders

Increased angle of attack due to steeper glide angle

Closer to stall point

**Why would you do this?** To lose height in an area where it is essential to maintain some forward speed. Being lifted up over a mountain in ridge lift, or being sucked upwards into a cloud close to the mountain are just two examples of likely scenarios. You retain almost full control of your glider, as you can use weight-shift to turn.

**Recommended recovery** Firstly, release the lines which you pulled to induce the collapses. On some gliders, the tips will re-inflate by themselves. If they remain tucked, one smooth, firm pump on both brakes simultaneously should re-inflate them.

**Careful!** Be very careful of inducing a parachutal stall at this point - the glider already has a high angle of attack with the tips tucked, and now you are pumping the brakes, further increasing the angle of attack.

## ASYMMETRIC COLLAPSE

**Sharply pulling the A-lines on one side**

Tucked wing creates drag, inducing a turn

Loss of support on collapsed wing results in pilot weight-shift, which worsens the turn towards the collapsed wing

Increased cell pressure on remaining wing can help to re-inflate collapse

**Why would you do this?** This simulates a very common collapse induced by flying into any reasonably strong turbulence. Expect asymmetric collapses when flying in thermic conditions, downwind of any obstacles to the airflow, or when passing through wind shear layers. They are your aerial equivalent of potholes in a gravel road.

**Recommended recovery** : There are three vital steps to an effective collapse recovery

1. AVOID OBSTACLES Pilot your craft away from obstacles such as the mountain slope and other gliders. A rapid check to see what has

happened to your glider should be done, but watch where you are going immediately thereafter.

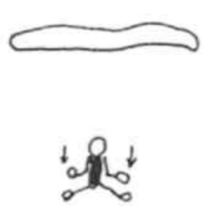
2. COUNTERSTEER The glider will want to turn you towards the side which is collapsed. Shift your weight in the harness to the opposite side, away from the collapse. Use gentle brake input on the wing which is still flying if necessary.

PUMP OUT THE COLLAPSE A firm, deep pull on the brake of the collapsed wing will aid the re-inflation of the glider. It is neither a "flapping" motion, nor a pull held indefinitely. It is a long, slow pump to full extension, taking two seconds to complete. If the wing does not re-inflate immediately, wait for two seconds, then pump again.

**Careful!** The glider has been slowed by the drag of the collapsed wing, and the angle of attack has increased due to the steeper descent. By counter-steering too deeply, it is possible to stall the wing that is still flying. It may be better to alow the glider to turn slightly, building up speed and cell pressure over the wing if you have the space and height clearance. If the collapse is not countersteered early enough, the glider may be turned into a spiral dive.

## FRONT TUCK

**Pulling down sharply on both A-risers**



Leading edge is tucked under, resulting in an immediate loss of lift

Glider pitches back due to increased drag

Pilot's momentum continues forwards and downwards, which tensions the rear risers and increases the angle of attack

Glider reinflates rapidly, then pitches overhead and dives in front, trying to regain vital airspeed

**Why would you do this?** Similar to the asymmetric collapse, the front tuck will occur if you fly into strong downdraught, for example when exiting a thermal or flying into rotor turbulence behind an obstacle. Typically this occurs on a cliff-launch, which is why they are so treacherous.

**Recommended recovery** : Most gliders recover instantly from a front-tuck, as the glider has air trapped inside it, and keeps its shape. A short, sharp pump simultaneously on both brakes will aid the reinflation by forcing the trapped air towards the leading edge and the cell openings.

**Careful!** The glider will pitch back in a big front tuck, and if you pump too hard and long on the brakes, you will induce a stall. If a short pump does not reinflate the glider, wait until you drop back underneath the glider before executing a strong, deep pump of two seconds. The glider will surge forwards to recover its aispeed, allow it to do so but dampen the dive with the brakes.

## PARACHUTAL STALL

**Deep brakes to stall point, then 1/2 brakes held on**


Glider has stalled due to high angle of attack

Airflow is completely broken over aerofoil, no lift generated

Sink rate -6m/s

Glider remains inflated due to vertical decent and resultant airflow into the cell openings

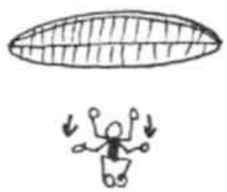
**Why would you do this?** Flying slowly in thermic conditions can often result in a parachutal stall - as you enter the thermal, a stall which is sometimes referred to as a gust stall is experienced. Exiting from a B-line Stall with a gentle release of the B-risers can also result in a parachutal stall. Trying to slow the glider down as you pass into a wind-shadow. Landing on 'big-ears' and passing through turbulence close to landing. Executing a 'butterfly landing' where the brakes are pumped to reduce speed almost to stall point.

**Recommended recovery** : As soon as brakes are released, the glider should dive forwards to regain vital airspeed. Some gliders need to be encouraged with the speedbar to recover. Alternatively, the A+B risers can be pulled down, or the trim tabs released.

**Careful!** Any asymmetric input on the brakes will result in a spin

## B-LINE STALL

**Pulling far down with both B-risers**



High sink rate (- 6 m/s resultant)

Glider is reasonably stable

No forward speed, so don't use this maneouvre in ridge lift or where forward speed is needed Why would you do this? To escape from strong cloud-suck under a building cumulus cloud. To get down in a hurry, when it is safe to drift back with the wind as you sink.

**Recommended recovery** : Let the B-lines go. They will shoot out of your hands, and the canopy will pop open. This gives the glider a jolt, and encourages the surge forwards to regain airspeed. The dive is usually mild, and does not need damping.

**Careful!** If the B-lines are released gently and slowly, then the glider could remain in a parachutal stall. The glider may take some time to recover, and may even need encouragement with the speedbar.

## NEGATIVE SPIN

**Deep brakes to stall point, then full brake on one side, zero on the other**

Glider spins on yaw axis, one wing flying forwards, one backwards

Loss of properly functioning aerofoil means sink rate of -5m/s

Lines can become twisted between pilot and glider, locking up the brakes

Rapid spin can be disorientating

**Why would you do this?** Trying to core a small, strong thermal, there is a temptation to slow the glider down. This would make it easier to stay within the thermal, but increases the risk of spinning - as you bank hard to turn in the core, the inside wing stalls due to lack of airspeed, and the glider begins to spin.

**Recommended recovery** : As soon as you feel the wing slipping instead of turning, release the brakes. The glider should pitch forwards and recover.

**Careful!** The negative spin can become extremely violent and disorientating. If the spin is released when the glider is off to one side of the pilot, it will dive and collapse asymmetrically, often forming a cravatte, which could lead to a spiral dive. Rapid spins can twist the lines together, locking the brakes up and continuing the spin. Trying to slow the outside wing (the one which is not stalled and is flying forwards) can often result in reversing the direction of spin, which lengthens the recovery time.

## ASYMMETRIC STALL

**Normal flying speed, then full brake on one side only, held for 4 seconds**

Glider spins on yaw axis: one wing flying forwards, the other wing is stalled and flies backwards.

Loss of properly functioning aerofoil means sink rate of -5m/s

Pilot is swung out due to momentum on entry

Disorientation of negative spin is increased by oscillating motion of glider

**Recommended recovery** : As per negative spin, hands up immediately. If you have the presence of mind, it is better to release the brake when the glider has dived in front of you. If the glider has swung behind you, hold on until you see it again.

## WINGOVERS

**Rhythmic reversal of turning direction**

Glider banks, and pilot is swung outwards on each turn

If properly executed, the wing will have a solid feel and will not collapse

If mistimed, the wing will collapse asymmetrically as the pilot becomes weightless at the top of each turn

**Why would you do this?** Controlling the rolling motion of a paraglider is a very useful skill to develop, increasing your awareness of the wing and improving your turning ability. Well executed wingovers feel wonderful, and can be quite safe if done high up. The trick is to maintain speed over the wing, using weight shift as the primary means to bank the glider. The brake is used to turn the glider just 90degrees near the high point of the wingover. No more than half-brake is needed, as the wingover is created by the body not the brakes

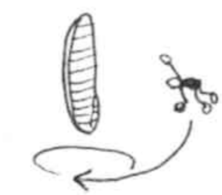
**Recommended recovery** : To exit from a series of wingovers it is essential to disperse the energy that has been built up through the swinging motion. The easiest and smoothest method is to execute one final turn, just as if it was another wingover in sequence, but using only gentle weight shift and coming on to quarter brakes near the end of the turn. This should result in a smooth carving turn and gentle climb-out, without any pitching or subsequent rolling of the glider.

**Careful!** Hot-doggers like to wow the crowds by doing this technique close to the ground. The danger is the speed of the pendulum - as you swing under the glider between wing-overs. If you misjudge your height and the consistency of the air, you may well swing into the ground. As with all aerobatics, do it high up in the gaseous safety of altitude.

Heavy brake input to induce bigger wingovers is unnecessary and likely to cause problems. Firstly, the glider is slowed, so there is a likelihood of spinning the inside wing. Secondly, there is a loss of cell pressure and reduced G-force, which usually results in the outside (upper) wingtip collapsing. Thirdly, the pilot will experience a weightless point on the top of the turns now, and at this point the lower wing sometimes collapses as well, leaving the pilot with a right mess to fix.

## SPIRAL

**Moderate brake and weight shift to one side only**



Sink rate around -5m/s

Glider stable with a large bank

Mild G-force, disorientation, dizziness

No forward movement through the airmass, only downwards.

Therefore as with B-line stall, can't used in ridge lift or if penetration is \tab needed. Can lead to a spiral dive if excessive brake is used.

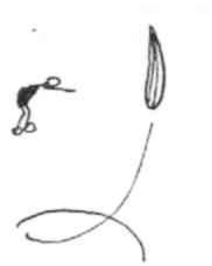
**Why would you do this?** To familiarise yourself with the sensation of higher G-forces and disorientation, which prepares you to handle extreme collapse sequences and the spiral dive. A gentle spiral is not an effective way of losing height, as a B-line can result in a similar sink-rate with less discomfort and disorientation, and has an easier exit on most gliders.

**Recommended recovery** : Ease off the initiating brake, but keep your weight shifted into the spiral. This should result in a smooth, carving turn which continues in the direction of the spiral, an exit which is as smooth as the entry.

**Careful!** Being too enthusiastic with the initiating brake and weight-shift could put you into a spiral dive, which becomes an extreme maneouvre after one full rotation. Increasing the amount of brake on the inside wing once in the spiral could result in spinning that wing, if the spiral is slow and flat. Exiting straight out of a spiral without the turn at the end, will result in a large climb out, then the glider will pitch forwards overhead and dive. Dampen out the dive with half-brakes.

# SPIRAL DIVE

**Hard initiating turn with big weight shift, held in**



Sink rate up to -20m/s

Leading edge is parallel with the horizon

Incredibly high G forces can result in disorientation, dizziness and finally blackout.

Airspeed increases to close on 100km/h, but no forward penetration into the prevailing wind results as the motion is downward. Huge momentum built up, so exit must be expertly managed.

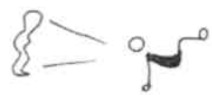
**Why would you do this?** The most effective method for rapid height loss, a spiral dive is an extreme maneouvre for extreme circumstances - the dark, black-bottomed cumulus cloud which sucks you up at 10m/s warrants a healthy spiral dive.

**Recommended recovery** : While in the spiral, be careful of a rapid acceleration in G-forces which can become too severe. Keep your eyes on your glider, the inside wingtip. Looking at the ground or moving your head to look at the upper wingtip will result in nausea. If you see your field of vision narrowing and fear blackout, clench your stomach muscles to force blood back up to your head. Ease off the inside brake, and allow the glider to exit the spiral dive. It is vital that you continue the turn for at least one full 360 degrees, to work off the energy built up during the dive. If you reverse the turn direction, or come out straight and do nothing to harness the energy, you will experience a massive climb-out. Then your glider will pitch and dive far in front of you, possibly even below the horizon where dampening the dive with brakes is essential.

**Careful!** Some gliders are stable in a spiral dive, and require a small amount of weight-shift to break out of the turn. The G-force of the spiral will help you to lean out of the turn, but you may have to initiate it yourself. A spiral dive can make a reserve deployment extremely difficult. Pilots have struggled against powerful G-forces to get their grasping hands on the reserve handle.

# FULL STALL

**Both brakes held below the seatboard, indefinitely**



Sink rate in excess of - 15m/s

Do not attempt this maneouvre unless under expert instruction.

Glider is extremely unstable and unpredictable, thrashes about, trying to re-inflate and dive in front of the pilot.

**Why would you do this?** When the glider is deformed by a cravatte or similar rigging problem, a full stall is sometimes your only option to get it out. It requires a good amount of height to execute a full stall and recover safely. If you find the spiral dive exerts too much G-Force on your body, and desperately need to descend, the full stall is the last item in your bag of tricks. Use it prudently, for it can be wild. As you pull the brakes down to full brake position simultaneously on both sides, the angle of attack will increase dramatically. The wing will slow down, reducing the lift generated and further increasing the angle of attack, until the wing stalls. First the wingtips soften and bend backwards, then the whole glider will be yanked backwards into the vortex of the stall. To the pilot, the wing vanishes from view, dropping far back behind the pilot. A second later the pilot will drop, and fall beneath the wing. The brakes will resist the pilot's input violently, as the glider strains to fly again. If the brakes are held in, the full stall will be maintained, and the glider will thrash about above the pilot's head as they plummet earthwards.

**Recommended recovery** : The glider will appear to pulse overhead like a jellyfish. It dives forward trying to fly, but then is pulled back by the brakes, dives forwards again, is pulled back again. When it is forwards of the pilot or directly overhead, release the brakes smoothly to zero. The glider should dive forwards as the wing bites into the air, and the pilot must dampen out the dive.

**Careful!** If the dive is dampened too strongly, then the glider will stall once again. Let the glider dive far forwards, allow it to build up airspeed, but dampen out the dive so as to avoid a front tuck. If the brakes are released when the glider is behind the pilot in the stall, then the wing will inflate and pitch violently overhead, diving way in front of the pilot (possibly so far that it flies underneath the pilot). This early release is most likely just as you enter the full stall, for the pressure on the brakes is extremely high. Wait for the glider to stabilise overhead before exiting from the full stall. The exit from the full stall can be unpredictable, and can lead into a cascade of events (eg. release, asymmetric pitch, cravatte, asymmetric spiral dive).

## CRAVATTE

**Collapsed wingtip trapped by lines**

Glider is slowed dramatically by cravatte, and turns to that side

Rapidly enters a spiral dive if unchecked

**Why would you do this?** This is a mistake, caused by not dampening out the dive, and exiting asymmetrically from a spin or stall, or pushing wingovers too far. Essentially the glider has been allowed to dive asymmetrically, collapse when the lines were slack, and now the wingtip is trapped in the lines.

**Recommended recovery** : The glider will immediatly begin to turn to the cravatted side. Countersteer and lean away from the cravatte. Try 'plucking' some of the trapping lines. Next try short, sharp pumps on the brake of the cravatted side. Then induce a bigger asymmetric collapse on the cravatted side, and pump it out. If that doesn't work, pull on both brakes to slow the wing to stall point, and release as the stall point is reached. The final resort is to full stall the glider, hold it in until the wingtip has thrashed itself free of the entrapping lines, then exit from the full stall.

**Careful!** If a cravatte is left unchecked, it can induce a severe spiral dive, which becomes progressively difficult to counter. Two hands may be needed on the outside brake to steer away from the cravatte once you are in the mature stage of a severe spiral dive. If the force is becoming too great to counter, and you are not exiting from the spiral dive, induce a hefty front tuck, a full stall, or throw your reserve.