Safety
in mountain flying

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Safety
in mountain flying

Techniques in behaviour and improvement

Hearty thanks to Rudolf Stüssi whose work inspired this booklet

Mountain soaring, just like mountain climbing demands a lot of humility from those who practice it

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1. INTRODUCTION.

This booklet is a technical illustrated supplement to the following document « Objectives: safe mountain gliding » published by the French Federation of Soaring, concerning the risks and threats induced by flying in the mountains. It stresses the technical points as well as the human factors.

It is not a course on mountain flying. It cannot replace a session on mountain flying with its flights in two and single seaters accompanied by briefings and debriefings, but it is complementary and a permanent reminder for the pilot. It can also serve as a backbone (or basis) for a presentation about safety in flights

The following pages include advice that have already been repeatedly expressed in books and often repeated in basic teaching.

In spite of all that, too many glider pilots, even those with a lot of experience, have been victims of accidents, for not having followed one or the other basic rules of flying techniques in mountains, the adequate preparation of the pilot or his behaviour.

Somehow, there are a few new propositions on some topics.

The main dangers are :

- Inappropriate behaviours or dangerous attitudes;
- Tiredness, stress, lack of tuition* and of training;
- Far too ambitious objectives, exceeding the level of competence;
- Entering IMC flying (flying in blind conditions);
- Flying beyond the flight envelope (of the glider);
- Losing the local airfield or flying with no alternative options;
- Misreading the changes in the weather, the meteorological traps or the wind strength;
- Outlandings;
- Ignoring the flight limitations of the glider;
- Mid-air collision with another glider, the terrain, or cables;
- Problems associated with altitude and the physiological consequences.

** an instruction guide can be found at the end of this booklet.*

2. PITCH (FLIGHT AT HIGH ANGLES OF ATTACK). STALL. SPIN. SPIRAL DIVE (INDUCED TURN).

The pilot must keep control of his attitude. In the mountains, it is visually between the panel and a horizon composed of the general environment, (peaks, valleys, limit of the tree-line, limit of the snow-line, etc.). The brain constantly « re-evaluates » this attitude. It implies a permanent and well organised visual scan.

On top of that, one must pay attention to the noise produced by the machine gliding in the air.

Silence = DANGER

Modern gliders often react in an unremarkable and stable manner when one nears the stalling speed… But that only happens in still air!

With a strong wind, in the vicinity of the ground and ridges, when one goes from a headwind to a tailwind, or when in strong turbulence provoked by thermals and wind, important variations of incidence may occur coupled with changes of airspeed, which can **instantly provoke a stalling angle** and bring the glider below the minimum flying speed.

The loss of altitude may reach 80 to 100 m (250 – 330ft).

A stall may be reached at a high indicated airspeed.

PREVENTION :
Always fly with a comfortable airspeed margin
(1,45 Vs = Best L/D speed or more)
when you are in the vicinity of mountains, in turbulent conditions. Always be ready to push the stick forward and veer towards the valley, into wind.

The sole and only safe action in such a situation is to **push hard on the stick, and keep the ailerons in the neutral position.**

In fact, one should do this as soon as one feels the controls get sloppy, long before the stall.

This action of **« stick forward »** as soon as one feels any of these warning signs of a coming stall (slow flight, nose-up attitude, sloppy controls, loss of efficiency, disappearance of airflow noise) is the **« safety action »**. It saved many lives.

Contrary to widely held opinion, modern gliders are not without treachery when flying at low speeds.

- In calm conditions, a progressive **stall** of the wing provokes a sinking of the glider, which is not always registered by the pilot. It sometimes ends in an accident, by tail first landing into the trees or onto gently sloping ground.
- One must learn to identify a stall, and in particular the sinking movement when the stick is pulled backwards, and one must understand that the stall may happen at a constant angle.
- The high-performance characteristics of these gliders produce a sharp increase in speed in a stall with nose-down attitude or when exiting a spin. The risk of exceeding the VNE, the structural limits and the limitations on the airframe, is then very important, and might provoke the rupture of the glider or a collision with the ground.
- Eventually, during exiting a stall or a spin, bring the flaps into the **zero or negative position.**
- Flying with **water ballast** increases the stalling speed. One must train progressively and regularly to fly with a high wing loading. The circling radius in the vicinity of the slope is increased, the inertia more important, so must the anticipation be.

SPINNING

If one flies at a high angle of attack (and/or at a slow speed), plus a skidding one is susceptible to enter into a spin. The loss of height will be much greater than with a stall. When this happens in the proximity of the ground, a spin is often fatal.

Risky situations: Flying in rotor, thermo-dynamic flight (meaning the utilisation of both thermal lift and ridge lift («dynamic lift») along steep slopes, improper thermalling under the crests, flight near the rocks with strong winds, flying in the lee of mountains, the turn onto finals, not only in an outlanding, but also at an airfield under stressful conditions.

Be ready to react « stick forward » at the very first sign of a potential stall.

Forget the theory of the best climb rate in a slipping attitude.

PREVENTION:

In the proximity of the ground in slope soaring as well as in thermal flight or in the landing pattern, always fly symetrically and with the appropriate speed.

In any case, do not chase the yaw string, just as you do not chase the ASI.

In turbulent conditions, it may happen that one wing stalls and drops. Do not be rash in your reaction towards the high wing, as this action may initiate a spin. A uncommanded roll « i.e. a wing-drop » may also happen in a low speed ridge flight, when passing from a calm area into a turbulent one, or entering a thermal (entering a rough thermal originating from a rocky outcrop)

Getting out of a spin [see the flight manual]: Generally **rudder opposed** to the rotation direction, **stick forward**, ailerons in the neutral position. Centralise the rudder as soon as the rotation has stopped, and smoothly return to the level flight attitude.

Eventually, bring the flaps into the neutral or negative setting.

Pay great attention to the Flight Manual. Remember the

speed limits and the g loading limits with flaps (0° and positive settings).

SPIRAL DIVE

It is a highly banked turn that is not properly controlled.

The net lift force is insufficient (speed too slow, angle of attack too small). The angle of bank is too important and does not allow a sufficient vertical component of lift to be opposed to the weight.

The increase in speed happens very fast and one may quickly exit the flight envelope, and reach the structural failure of the glider.

This situation happens quite often when the visibility is poor, when it is difficult to assess the horizon, when the pilot keeps looking at the interior of the turn, and does not control the attitude and the banking of the glider.

PREVENTION
Your visual scan must alternate frequently between the cockpit reference and the horizon references

The risky situations

- A tight turn around a point on the ground
- Circling in the proximity of the mountain or in rotor
- The loss of visibility near clouds, or **entering** into **a cloud**.

Do not fly too near clouds, especially in wave, as there is a high risk of being enveloped.

Steep banking requires training. If you feel the glider getting out of hand (banking, speed, increased roll rate, reduce the angle of bank and bring the attitude to the reference position.

Trajectory of a glider moving into wind from one wave to the other

When moving from one wave system to the other, above the cloud layer, one must be sure to have sufficient height to reach the open space of the upgoing part of the next wave.

Getting out of a spiral dive: return to **wings level and the referenced attitude.** Using the airbrakes may help contain the speed within the flight limits. In no visibility, just open the airbrakes.

3. CONTROL OF THE FLIGHT PATH. SAFETY DISTANCES. RECURRING PROBLEMS.

The pilot must always be aware of the flight path of his glider, taking into account its speed, its angle of bank, the wind, and possible strong sink. He must identify his drift and have a visual image of his trajectory when he modifies it.

A glider flying at 100km/h along a crest moves at around 30m/s. Flying in the vicinity of crests demands a sustained concentration of mind, a perfect knowledge of one's glider and its reactions, all the more if the air is turbulent.

Even the best pilots are subject to tiredness and, after a certain length of flight, they see their faculties of concentration dramatically diminish.

To reduce the risk as much as possible, stay higher than the crests.

This will provide safety and comfort.

The first pass along a slope must be done with a fair excess of speed in order to verify the turbulence and the value of the lift. One must then adapt the speed and the distance accordingly.

At the beginning, a slope is flown with out and return patterns to assess its potential; then one eventually uses «eights» in the most favourable zone.

The distance to the slope varies according to the topography, the turbulence and the value of the lift. Flying in a two seater with an instructor will set the appropriate references. It is understandable that a beginner will stay further away from the slope, while staying in the lift area.

Flying very close to the mountain is dangerous.

The height of each of these stages depends on the experience and the training of the pilot, but also on the smoothness of the air-mass and the shape of the slope.

LOSS OF ALTITUDE DURING A CIRCLE IN SUDDEN SINK.

Example for a circular turn of 24 seconds

Half a circle in the sink downwind =	12 s
Oval correction into wind =	3 s
Total :	15 s
Sink downwind:	4 m/s

4 m/s x 15 s = **60 m loss of altitude for half a circle** and 108 m for a full turn.

Do the maths again with -6, -7 m/s…

Do not circle (Cf page 11) while slope flying, unless you are an experienced pilot with sufficient training having followed appropriate instruction and if there is no other traffic. The flying must be mastered (turn radius, speed, angle of bank, balanced flight), the flight path must be properly evaluated (height margin, topography, wind, turbulence).

DO NOT CIRCLE TOO LOW!

To circle, a beginner in mountain flying, must wait until he is well above the crest (100m to 150m), and not allow himself to fly in the lee of the slope.

One must remember that the radius of a turn in the mountains is very important, and that the closing speed to the wall is higher [at an Indicated Air Speed (IAS)] than at a lower altitude.

Recommendations while slope flying.

- **The approach to a slope must be done at a converging angle of 30 to 45° at the most, the final phase must be parallel** while slowly applying a drift correction. The same technique is to be followed when making a 180° turn or during the changing of direction in an "8".

Keep a good lookout on both sides

- Some gliders have reduced aileron effectiveness, and need a certain effort on the controls. They need a lot of anticipation, and a substantial excess of speed.
- Avoid facing the ridge and turning at the last moment. An erroneous evaluation of the ground speed would force the pilot to tighten the turn with all the associated risks.
- The first time one flies a ridge, one keeps an excess of speed and of distance to the ridge.
- According to the profile of the terrain, one must maintain a certain height. Beware of the high points on gentle slopes. (cf the following drawing)
- The nearer you are to the slope, the higher the speed must be. One must avoid the small outcrops (a crest more or less perpendicular to the main ridge) by making a bend towards the valley, never by pulling on the stick.
- Follow the general direction of the mountain at an appropriate distance, without trying to follow every notch in the terrain.

- Be on the lookout, particularly in turbulent conditions, and be ready **to escape towards the valley**.
- Never fly at the minimum sink speed! Keep a 1,45 Vs (Stall velocity): best L/D speed or a little faster. This **excess of energy** allows you to escape rapidly, without stalling in the case of sudden sink or strong wind shear.
- The stronger the turbulence, the bigger the margins must be (speed, height, distance).
- Apply an appropriate **drift correction.**

Above the crest, the correct flight path allows the pilot to permanently see sideways, under the glider, the wind face of the slope.

- In a turbulent slope flight avoid using positive flaps, in order to keep adequate manoeuvrability.
- Some slopes, because of their shapes, might be particularly dangerous, causing turbulence/curl-over around escarpments and terraces. The sides of these slopes might also be dangerous.
- Do not fly into a narrow valley unless you have a sufficient margin to make a turn, and only if the slope of the valley is much steeper than the glide angle of the glider (assess this during preparation of the flight).

- Flying into the sun, in the proximity of the slope, is extremely dangerous. Keep away from the slope.

Flying down a valley in the same direction as the river flows gives more height and more time to find a plan B solution.

Thermals on the lee side of a slope:

The plus or minus 5 m/s that can be found there are the result of wind shear. They imply an imminent risk of stalling or spin!

- Exploiting thermals in that zone is to be avoided.
- It can be done, in certain cases, by flying Out and Returns or a narrow "8" with a good margin of speed.
- This technique is for very experienced and highly trained pilots only. It requires a lot of care and attention

Flying the ridge in high winds

- The turbulence is extreme in the vicinity of the slope

Decrease the angle of bank while flying into wind to obtain an oval trajectory and be sure not to find yourself in the lee of the crest.

- In Mistral conditions, sink rates of -5 to -15 m/s can be found in the lee of crests.
- Flying in the lee of crests is extremely dangerous

- If, against your will, you find yourself **in the lee of a crest, nearby its top or lower, the best solution is to flee tail wind,** towards the valley, then reach a landable area, and eventually try to climb again.

CIRCLING

If the conditions force you to circle under the crest in order to climb, one must take several precautions.

First of all, make sure there is no another solution nearby that would be easier technically, and would present less risks.

To circle, one needs:

- to check other traffic, so as not to be a problem for pilots doing O/R or "8 s";
- to have the right «feeling» of the ridge, to have «taken the temperature» of the ridge during previous O/R or "8 s";
- to have a good and precise way of flying, controlling the **attitude**, the **speed** of the glider as well as the angle of bank and **flying symetrically.**

One also has to make sure that:

- the speed applied at that precise moment offers sufficient manoeuvring ability and enough safety margin against a stall;
- the combination of bank angle and airspeed offers a **circling radius** that positively allows a circle without the risk of hitting the cliff or the vegetation, taking into account the presence of wind and a sudden sink;
- the topography and the turbulence have been correctly assessed;
- the **push** of the thermal (the increase of the load factor) is present and that the **variometer reading** is definitively **positive** when, at the latest, while at 45° to the slope, one takes the decision to keep circling;
- when flying into wind, one decreases the angle of bank, flies straight for 3 or 4 seconds and then increases the angle of bank downwind.

Once again, this technique is reserved for **experienced pilots** with a lot of training and having received proper instruction.

ALTITUDE, SPEED, RADIUS, TEMPERATURE

The true airspeed of the glider increases by 5% for each 1000 m.

At the same indicated airspeed , the converging speed of an obstacle, or another glider increases in the same proportion. The radius of a turn varies with the square of true airspeed.

For an identical indicated airspeed of 90 km/h, if the radius of the turn is 90m at Authon at an altitude of 1600 m, it will be 105 m at the Barre des Ecrins. One must take that into account. In this situation, in order to keep the same radius of turn, one should increase the angle of bank by 5°.

To avoid any risk of «flutter», some glider manufacturers may reduce the VNE at altitude. One must carefully read the flight manual, and **respect these limits.**

When the temperature gradient differs from the standard atmosphere, the altimeter that has been set on the ground is going to indicate **a higher altitude in cold weather**, and a lower one in hot conditions. Do not reset the altimeter in flight, but take these changes into account when calculating the «local» altitude, particularly in winter.

RECURRENT PROBLEMS

● False horizons

- A glider pilot might be tempted to bank his glider to keep it parallel to a «false horizon» (strata /layers in the mountain in front of him, or the general slope of the mountain…) or perpendicular to the slope, and thus veer towards the wall! Another risk would be to act on the rudder to maintain the trajectory, and start a potentially dangerous skidding flight.
- One also sees pilots that are captivated by the vicinity of the wall, who have a tendency to bank the glider towards the valley, and press on the rudder towards the mountain. This leads to crossing the controls, provoking a slip that may lead to a spin.
- Others stare at their wingtip on the mountain side, and have a tendency to bank towards the mountain, getting near to it (being fixated on the hazard fatal attraction).
- Some others frequently change the attitude of their glider, with a reduction of the speed, the nose up towards the mountain. **The consequences are fatal.** All these problems derive from a bad external visualisation.
- The pilot must create **a substitute horizon** (moving the head and the direction of sight, taking into account valleys and mountains, observing the line marking the limit of forests or of the snow… keeping an ear for the aerodynamic noises of the glider, not staring at the wingtip in a turn).
- In a turn as well as in straight flight, **setting the trim,** as soon as the attitude is constant, is important. The pilot mustn't apply any force to maintain it constant.

● Sunset

- Take note of the sunset before you take off, and remember that it takes some time to come down from a high altitude. It is the same to come back from a long distance.
- Moreover, darkness sets in earlier in the valleys than at altitude, and some areas are already in shadow when the sun hasn't set yet.
- Think ahead in good time about returning to the airfield, to be able to arrive home at sunset at the latest.
- Always have a watch, on the dashboard or on your wrist.

Wave

A wave flight gives pilots intense, unforgettable pleasures, and unequalled performances, but the associated risks are important.

The tow is sometimes very bumpy in the rotor area. Before the take-off, one must check the setting of the straps, and the absence of any loose objects. One must also think about the **possibility of a sudden/ unwanted release;** beware of CG hooks.

- High climb rates and fast transitions require that the conditions to penetrate different airspaces are well thought ahead and respected.
- The wind may cause significant drift. One «shallow» turn may cost as much as one k drift.
- Always start looking for lift upwind.
- Associated with strong sink, the wind may drive you into a cloud. IMC flying is dangerous and forbidden.
- If you are near the leading edge of clouds, position yourself upwind of them and increase your speed. If some clouds appear upwind of your position, fly rapidly into wind to overtake these forming clouds.
- Winds get stronger with altitude, so it is necessary to adapt technique and speed during the climb so as not to go backwards (fly ovals, "8 s", straight lines into wind, etc.).
- Transitions from one wave to another cost a lot of altitude, especially into wind. Very frequently, one loses between 1 000 and 2 000 m for a distance of 10 to 12 k (a 5 to 10 L/D) (cf drawing page 6).
- Heavy sink implies high speeds. However one must take care not to hit a rotor (not always visible) at a speed exceeding the Vno (max rough air speed) due to the possibility of breaking the glider.
- The «foehn hole» or «wave gap» may close rapidly. Watch carefully how the cloud cover changes when one is above the layer, especially with winds from the south-east to south-west, just before a depression. Think ahead about your descent so as not to find yourself in IMC.

On top of retreating, a downwind back-up position has to be planned, in order to climb again.

- Be cautious when landing, it is possible that rotors may rapidly change the strength and the direction of the wind.

● Thunderstorms

In the mountains thunderstorms may develop much faster than on the plains. And there will be associated phenomena.

- **Increase in wind, and windshear** will make landing patterns and landings difficult.
- **Strong turbulence and powerful vertical currents,** will provoke severe downdrafts and entering IMC.
- **Heavy rainfalls (with hail),** and lightning, will affect visibility, may risk closing an escape route or provoke damage on the glider.
- Some of these phenomena may occur at great distances from the storm (5 to 20 km).
- In the vicinity of one's airfield, if it has not been possible to land before the storm, it is sometimes safe to wait for a quietening before landing, or one may consider diverting to another less turbulent airport.

It is very important to note any risk of storms, or strong instability, during the weather forecast, and then keep a constant lookout for the evolution of the weather and obtain information on the radio.

Deciding in good time to turn round is essential.

● Meteorological traps

Each group of mountains has its own specific characteristics.

The evolution of the air masses in mountains is complex. Local phenomena, linked to the shapes of mountains, and to the interactions between winds, valley breezes, the nature of the ground, the influence of the sea, different climatic areas etc, are sometimes more important than the general meteorological situation.

This results in situations that evolve unpredictably and sometimes for the worse.

Be particularly cautious about invisible lines of downdrafts provoked by near or distant mountains, or by conflicts in air masses. In these cases, do not hesitate to radically change direction, or abandon the task.

In a «weak» climb (variometer barely positive or sometimes negative), make sure with the help of the altimeter that the climb is real, and beware of the drift. The risk is to lose height «on the spot», and in the end to lose the local airfield.

● Conclusion

As one can see, the risks are numerous and the learning process is a must.

One should therefore fly with margins and preferably penetrate new areas only in a two-seater or in a guided flight; a good preparation of the flight and the escape routes are essential before one goes «discovering».

4. BASIC RULES.

AIR LAWS.

Rules of ridge flying

- ★ *The glider having the ridge on his right has priority*
- ★ *The glider having the ridge on his left must veer to his right when he sees the other glider facing him, at a similar altitude.*
- ★ *Overtaking is always done into wind, paying great attention to the overtaken glider. This one has priority.*

To fly over FL 125, the glider must be equipped with oxygen. Pilots must use their oxygen over this flight level if they stay at this level more than 30 minutes; oxygen is absolutely compulsory over FL 145. *This rule is not enough to comply with the last medical advices (see p 31).*

SAFETY: Using common-sense rules

- The first precaution is to keep available the option to veer towards a landing area. This implies a good preparation of the flight and good navigation, the respect of rules concerning the «local to landable areas», calculations adapted to the pilot, to the glider and to the geographic area;
- Once a «retreat» has been decided, the path that one takes must be upwind of the ridges or vertically above the ridges. The average reckoning of the «local to landable areas» calculation does not take into account a systematically bad path;
- Before choosing one direction, one should have in mind one or more plan B options, or back-ups which, on top of an escape, provide a comfort that increases the safety factor of the flight;
- Always fly with a sufficient speed margin adapted to the turbulence and the proximity of the terrain;
- Maintain symmetrical, well balanced flight (yaw string in the middle);
- Never turn towards the slope, but always turn towards the valley, upwind of the slope;
- Never allow the drift take you to the lee side of the slope;
- Never approach a crest or a pass at 90°, to fly over them. And have a good excess of speed;
- When in sink fly faster, when in lift reduce your speed, but with moderate changes of attitude, and keeping a safety margin above the stall speed;
- Avoid circling in the proximity of a slope if there are other gliders; (see page 11)
- In any case, a glider flying O/R paths has the priority on gliders flying "8 s"; and glider flying "8 s" has the priority on gliders circling;
- Do not penetrate a narrow valley while ridge soaring if you are not sure that you can back-track at any moment, and if you have not checked that the descending angle of the terrain is superior to the glide angle of the glider (preparation of the flight);
- In the vicinity of airfield where gliding is practised, there are slopes used by students. It is advisable, when one is an experienced pilot, and when the conditions are favourable, to leave these students alone;
- When they exist in the vicinity of soaring centres, follow the local rules. They must be clearly explained on a billboard in the club-house or during the briefings;
- When flying in a contest, the pilots are advised to be particularly careful on these very crowded slopes, and should, if possible, choose paths avoiding these areas.

5. ANTI COLLISION.

Follow the basic rules explained previously in 4, read the CD named «supports pédagogiques» edited by the CNVV and:

● See in order to avoid, and be avoided

- Keep your eyes outside at least 95% of the time. Using a calculator, a GPS, a PDA should be done in winter, on the ground;
- Use a high quality pair of sunglasses, avoid caps with a visor;
- Install compass and PDA out of the external field of vision;
- Reduce the causes of reflection on the canopy (documents on the coaming of the instrument panel, white pictograms, light coloured trousers, white knobs in the front seat of a two-seater, etc);
- Keep the canopy clean.

● Be visible to be seen

- Install anti-collision marking devices, on the wings, on the nose and on the fin of the glider;
- A flashing device is very effective;
- Install a «Flarm» in the glider. The FFVV has made its use mandatory in mountain flying and in contests in France;
- Beware: nothing replaces vigilance. The «Flarm» helps detect potentially dangerous traffic. It has its drawbacks. Read the user guide carefully in order to use it at its best;
- Do not stay in the blind spot of another glider, in circling and in straight flight.

● Behaviour in slope soaring

- Keeping one's head and eyes very active increases the effectiveness of one's flying and the anti-collision measures;
- Beware of the high number of gliders in some areas when the weather makes conditions difficult;
- Think about the avoiding rules (rights of way when crossing paths), especially when converging;
- It might be useful to show to the other glider that you have seen him by wagging the wings, or with a change of direction to the right. This will also help him to visualise your position.

CHANGE COURSE EARLY ENOUGH!

When in converging courses

Average reaction time of a pilot =	1,5 s
Reaction time of the glider =	1,5 s
Total =	**3,0 s**
At a speed of 90 km/h (25m/s). Distance flown before the avoiding manoeuvre is performed :	
by one's own glider 3 x 25 =	75 m
by the other glider 3 x 25 =	75 m
Minimum distance of reaction =	150 m
At 110 Km/h =	185 m
At a fast converging speed, at 160 km/h, along a slope =	300 m

- Particular attention must be given to the gliders that follow you and that you will find again after the 180° turn.

While in ridge soaring, in the 3 sec time lapse reaction before a head to head crossing, one may have the following variations in height:

Glider N° 1
3 m/s climb x 3 s reaction time lapse≈ 10 m

Glider N° 2
3 m/s sink x 3 s reaction time lapse≈ 10 m

Difference in height that can be suddenly obliterated ≈ 20 m

So NEVER fly too near above or below another glider !

- When the slope has a convex shape that may partially impair the sight forward, it is necessary to follow these rules:

Slope on your left, one must widely open your path to the right to let the gliders pass.

Slope on your right, according to one's height, and to the shape and length of the slope, one has the choice **to veer towards the slope or,** on the contrary, to **open your path** early enough to have better visibility, and have more chances to avoid a possible glider.

If one discovers **a glider in front of you** at the last moment, it is advisable to **dive when one has the slope on one's right, and reduce one's speed when one has the slope on one's left** (slight nose-up attitude).

● Bend

In the mountains as well as in any other flight:

- **before one initiates a turn,** one must «sweep» the horizon, from forward to ¾ back towards the turn, then return to the visual references.

Once the turn has been initiated, sweep again inside the intended trajectory of the turn, then return to the visual references. Later on, regularly check the safety every ¼ turn.

● Thermal flight in a gaggle

The more gliders there are in a thermal, the stricter the discipline must be. The individualist who makes his own circles without bothering about the others, does not gain much, but increases the danger for all.

The extended line through the longitudinal axis of one's glider must never pass in front of or intercept the other glider.

● Collision with cables

- In the Alps, mechanised mountain agriculture and the exploitation of forests, the increase of ski-lifts, and the installation of devices provoking avalanches in ski resorts, greatly increase the risks of collision with cables.
- In an unknown area: do not fly too near the slope.
- Above ski fields, avoid flying under the summits.

Rules to be followed:

1. Fly above the crests, or intermediate summits. Keep a louk out for electric poles, telecabins, ski-lifts in order to fly over them at a safe distance.
2. Never ridge soar in the hollows of mountain sides.
3. Fly slightly to the right of the middle of narrow valleys, especially on final glides or when performing an outlanding.

6. TAKE OFF AND LANDING.

In mountains, one often finds oneself in unfriendly surroundings, which indeed provokes a high level of stress.

- Before the flight, emergency landing procedures, in case of an incident during take off, must be thought of. Do not make a 180° turn at low level.
- Behind the tow plane, when it nears the slope, one must stay in the correct position, (right behind him, at its level). The beginner in mountain flying must fight his envy to stay away from the slope.

For the landing pattern, one generally proceeds as in the flat country, applying strictly the classical PTL track.

- The differences come from the wind which sometimes is quite stronger and with gusts, from the south as well as the north, or due to thunderstorms.
- The turbulence provoked by nearby slope may be quite severe !
- One must thus take complementary precautions, on the ground and in flight, be mentally prepared and train for the necessary actions.
- A special thought must be devoted to the canopy, to the risk of ground loops while rolling, and to the minimum flying speed in the landing pattern.

Outlandings in mountains will be all the more difficult than the wind is strong, and than the wind shear near the ground will make the final tricky.

ABOVE A 25KT WIND, AN OUTLANDING IN MOUNTAINOUS SURROUNDINGS IS RISKY.

Landing in windy conditions must be practised in a two-seater, and needs training.

- Flapped gliders must be used accordingly with the flight manual. Previous training on the airfield is mandatory.
- For the landing pattern, the VOA (optimum approach speed) must be calculated in account with the strength of the wind and the possible gusts.

VOA = 1,3 Vs + ½ Wv + gusts

- One must nevertheless be careful with the upper speed limits, especially with flapped gliders.
- When landing on a slope, always land uphill, with a steeper than usual angle of approach and a majored VOA.
- In a strong wind, while on downwind, one may delay the VOA, be satisfied with 1,45 Vs, and take the VOA only during the base leg.
- The specialities of the landing area (mountain, wind, suspected sink rates),

the downwind leg may be initiated higher than usually, and one may choose a PTU in place of a PTL.

- The time length of the final leg must be respected (30 to 40 s), but its length (on the ground) will be all the shorter than the wind is strong.
- Sometimes it is advisable to wait for the wind to drop before landing. One may also choose to land on another airfield.

Never, never go from a positive setting to a negative one in final!
The consequence is a brutal drop before one obtains speed and L/D again!

● Landing in windy condition or severe turbulence

WHEN IN STRONG WINDS,

- The turbulence is important. If high angles of banking are necessary, keep an eye for height and speed.
- Moreover, one will be very cautious while turning from upwind to downwind (ZPA); one must be ready to push on the stick. Never lose sight of the field.
- Choose in advance a higher than normal downwind branch; using the airbrakes early may help to stabilise the glider
- Beware of wind gradient and of vertical and horizontal rotors;
- Wind shears may provoke 180° changes in wind direction in a few seconds (Aspres and other places).
- Landing is more bumpy. During the final, maintain the VOA till the flare, and always above 100 km/h at the ASI.
- Flaps must be at the «+1» setting until the touch down. Change the setting to 0° or negative as soon as the glider is on the ground.
- Airbrakes are all out during the flare and the touch down; this reduces the risks due to turbulences as well as the length of this delicate phase.
- Keep the stick backwards while rolling.
- Be very cautious when opening the canopy.

● Outlanding in mountainous surroundings

- Study all the outfield landings known in the area and mark them on one's map; keep the updates on the GPS and the data bases. Do not take off without an updated safety out landing zone booklet;
- As soon as possible, walk the outlanding fields, use an ULM or a power plane to check the environment and the landing pattern;
- In mountains use half the value of the L/D or the rule given by your instructor. And fly from the local of an aerodrome or an outlanding field to an other. The rule may change with the context;
- Reckon your position in comparison with a well known site, call on the radio before one is too low;

**BEWARE!
TURBULENCES
ADD STRESS.
STRESS DIMINISHES
MENTAL FACULTIES
AND NARROWS
THE FIELD OF VISION!**

The preparation of the flight, associated to instruction and training, is the best way to reduce or avoid stress

- Never use a low landing pattern, organise this one and the final leg accordingly to the rules learnt in instruction. Make a mental construction of the landing pattern starting from the point where the glider will come to a full stop;
- Try to reach and maintain the «1/2 airbrakes» glide path on final at the VOA with the present wind;
- Re-assess the wind frequently. IAS and VOA must often be controlled as well as the variometer value, the evolution of the perception of the environment (speedy arrival of the ground…);
- Move the glider out of the field as fast as possible;
- When at one's airfield, practice abnormal situations, short landings, PTUs, too high or too fast approaches/ finals. Regularly use a self-launcher to perform landings on other platforms than home;
- Get mentally prepared, consider other outlanding scenarii, imagine urgency situations (important sinks, changes in wind directions, using the flaps in place of the airbrakes, etc).

To help an eventual search in the case of an accident

before the take off, switch on the distress locator, in the position «armed» and leave the cell phone ON, preferably in a pocket

A small emergency kit, also in a pocket might be useful.

In all cases, signal on the radio your intention to land out, and give infos on the place. After the landing, inform the safe completion of the landing or the problems.

7. AERONAUTICAL MEDICINE. HYPOXY.

Read again the appropriate pages of the Pilot's manual as well as of the document «Objectives: safe mountain gliding.»

Add-ups may be found in the reports of the APSV's congresses.

Safety in mountain flying needs from the pilots a rigorous and permanent application of its rules and techniques, and a good physical condition.

To this goal, one must keep one's capacities.
One should:

- Sleep sufficiently the previous night;
- Eat properly and drink before and during the flight;
- Wear adapted clothes; temperatures may be quite cold in altitude;
- Wear good quality glasses, a cap with a small visor ad a protection of the neck (a bob);
- Breathe oxygen at 3800 m/sea-level at the latest. And keep breathing oxygen during the descent for an appropriate time. At the moment, **the best recommendation is** to use the EDS system on D5 and to use it from an altitude of 1500 m;
- Bring a bag or any other system allowing the pilot to urinate;
- Avoid any absorption of alcohol at least 12 hours before the flight (for large quantities absorbed, a duration of more than 24 hours to recover one's capacities, might be necessary!);
- Use medicine/tablets only if they are certified and compatible with flying;
- Avoid any use of drugs (especially cannabis).

And be aware that smoking lowers the level at which one suffers from hypoxia.

8. HUMAN BEHAVIOUR. HUMAN FACTORS.

DECISION-MAKING PROCESS

Decision making is right at the core of a pilot's activity. Human decisions are both extraordinarily efficient, and horrendously fragile. No decision has little importance in flight. Sometimes an innocuous event may lead to a fatal sequence of events. **One must train oneself to follow an organised, structured, and serious decision-making process.** And remember that no complex decision should take place under great urgency.

So, once again, one piece of advice: **THINK AHEAD, prepare your flights, always be ahead of your glider.** *(Student pilot's manual)*

- **Evaluate your own abilities and your flying knowledge through a comprehensive self analysis:**

- General experience in mountain soaring;
- Knowledge of the flying area and of local conditions;
- Recent training;
- Objectives of the flight and weather for the day;
- Compare one's personal level of preparation with the intended flight and the risks to be encountered.

One can partially reach this goal by following a personal check list. Following it is very important.

For example, a detailed list:

- **Préparation**

- The glider (knowledge, state, limitations, load, oxygen, other equipment,…)
- Weather-forecast, conditions during the previous days,
- Air space, NOTAMs, Supplementary Air Operating Procedures (AOP)
- Choice of task (duration, areas and waypoints)
- Preparation of the map(s)
- Escape routes
- Take-off time
- Autonomy (L/D. altitude)
- Time limit to abandon the task
- Finish
- Getting ready for landing
- Retrieve arrangements
- Documents: glider and pilot
- Food and drink
- Your physical condition
- Your state of training
- The goals you really care for
- Your equipment (see the mountain kit in «Objectives: safe mountain gliding»).

On the poster: medecine, alcool, tiredness, food and drinks and spirit balance

Even the best pilots are subject to forgetting things, to making an erroneous judgment or making an handling error.

Abandoning the flight

- When the situation gets out of hand, or when tiredness sets in, it is often better to stop flying the task and ABANDON the flight to return to the home airfield or land safely somewhere on the way.
- When the first signs of hypoxyia appear, one must start to descend.

Headache, tiredness, feeling sleepy, getting bored, a feeling of oppression, a feeling of euphoria, coughing, undefined uneasiness, sweating, getting out of breath, losing attention, difficulties in making mental calculations, difficulties in reading the map.

Above 3000 m one should make regular radio calls in order to be looked after by other pilots more able to detect your problems.

I fly within my capability limits, and I do not let myself be drawn into unknown conditions by another pilot.

Reduce one's frustration by remembering: there will be another day.

A return to friends and family = a successful flight

Dangerous attitudes

- When one wants to succeed whatever the price.
- Refusing to turn back.
- Willing to end earlier, lower and nearer to the mountain than other pilots.
- Flying beyond one's capabilities.
- Following another pilot without possessing his know how, nor his knowledge.
- Taking off unprepared in order to save time (additional stress).
- Complacency.
- Believing that one can do without briefings, debriefings, advice.

Experienced pilots should be the first ones to be suspicious about their capabilities. Their significant experience leads them to become over-confident, and carry out an incomplete decision-making process.
Factors that may lead to an accident include: disregarding one or several minor parameters; deciding on the reputedly accepted solution to a problem without the appropriate thinking; the tiredness provoked by lengthy flights; as well as ageing. **This is confirmed by statistics.** Sometimes the right solution is to stop flying alone.

- When one flies in a two-seater, the pilot in command must be clearly designated.

PILOTS FLYING SELF-LAUNCHERS

- Statistics show that for similar numbers of take-offs and flying hours, there are more frequent and more severe accidents with pilots flying self-launchers.
- It is a «must» to be present at daily briefings and listen to remarks and advice concerning safety.
- A self-launcher with its **engine out and not running becomes a very poor glider.**
- The operations to take the engine out, to start it, to stop it, to retract it, must be performed in good local flying conditions. The variation in the centre of gravity (Cg) induced by these complex operations requires precise handling and a good knowledge of the procedures. Training above the airfield is necessary.
- In a two-seater, the tasks allotted to each pilot must be well defined.
- A self-launcher requires more maintenance and extremely precise handling.

MANAGING THE FLIGHTS

The management of flights by instructors (or pilots with a lot of experience) in mountain flying, is an important safety factor.

Radio calls giving position and intentions allow pilots to be monitored, to receive advice and to be helped in their decisions in case of difficulties.

Giving one's position regularly reduces the search area in case of a missing pilot. The club, the society, the group will worry about the absence of a glider in the evening; an individualist will have fewer opportunities to be rescued.

To fly with a community of pilots will reduce the possibility of risky experiences, along with a more friendly atmosphere on the ground as well as in the air.

Experienced pilots have a tendency to limit their radio calls. Doing so, they lose a chance of getting help, while they appear in the accident statistics. Like everyone, they need training and preparation.

The instructor in mountain flying is not all-knowing. He himself must be experienced and well trained, and not take students beyond his own level of expertise.

An accompanied flight (by a generally experienced pilot in mountain flying) cannot be done unless the pilot is in practice and has a good knowledge of the know-how of his «accompanying pilot», and must pay attention to their tiredness and state of mind.

The leader must never fly higher than the follower. The best solution seems for the leader to be behind!

The incident report is important to help the whole community improve safety. One should not hesitate to share one's experience, if possible in writing.

There are report templates available at your club and on

www.isimages.com/ffvvsec

9. ESSENTIALS IN INSTRUCTION.

Main principles of pilot development in mountain flying

- Perfect control of the attitude in flight, of the flight path relative to the terrain and to other gliders, stability in turns;
- Departure from normal flight: stalling, spinning, spiral dive;
- Organisation of the visual scan;
- Basic techniques of climbing using slope/ridge lift (dynamic flight) and using ridge lift and thermals (thermodynamic flight);
- Planning the local landable fields during the flight, alternative plans, and escape routes;
- Organisation and precision in the landing pattern;
- Orientation, map reading;
- Management of the autonomy of the glider;
- Detecting the wind, drift; drift correction;
- Flying in strong winds;
- Flying near the terrain; changing from slope soaring to circling;
- Crossing over crests and passes;
- Practicing wave flights and knowing their difficulties;
- Knowledge of the glider;
- Ability to follow and to anticipate the changes in the weather;
- Ability to make the appropriate choice of areas and turn points;
- Managing the flight, organisation, anticipation, managing the priorities, study of the good solutions;
- Following the procedures, the recommendations, the rules;
- The decision making process;
- Ability to abandon the flight;
- Detection of the risks and threats;
- Capacity to analyse, self-criticism;
- Ability to judge one's psychological condition.

All the points reviewed in this booklet «Safety in mountain flying» must have been addressed in flight or during briefings.
One should go one step at a time.
For a flat land pilot, the development of skills in mountain flying must be organised in **progressive steps** so that, little by little, he widens the geographic domain of flight, through different weather conditions, alternating discovery and learning flights in a two-seater with flights in a single seater.
Going through the different steps, technical or meteorological, too rapidly, provokes the risk that, one day, the pilot is put into a situation that he cannot handle.

LEARNING THROUGH THE TRIAL-AND-ERROR PROCESS IS DANGEROUS IN FLYING. IT IS OFTEN ACCIDENT PRONE

The experience of seasoned pilots is good to share, as long as it is not showing off in the club bar.

Mountain flying is not without risks. But as one can guess by seeing the photographs, or reading everyone's reports, it also brings **intense pleasure.**

These risks, properly mastered through instruction, training, decisions adapted to the situation and pilot capability, respect of the environment (the mountains and the forces at hand), will diminish to make room for the **magic of flight.**

Flying safely in the Alps requires the greatest respect of the mountains and of the natural elements

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COMMON ABBREVIATIONS

AF = Airbrakes
APSV = Association des Professionnels de Santé Vélivoles
AR = backward, behind or Out and Return (according to the context)
AV = forward
CNVV = Centre National de Vol à Voile
CS = sun set
EDS = Electronic Delivery System
FFVV = Fédération Française de Vol à Voile
GPS = Global Position System
IMC = Instruments Meteorological Conditions
Kt = knot(s)
Km = kilomètre(s)
Km/h = kilomètres per hour
m = mètre(s)
m/s = mètre(s) per second
PDA = Personal Digital Assistant
PTL = L shaped landing pattern
PTU = U shaped landing pattern
s = second(s)
Vi = indicated speed
VMC = Visual Meteorological Conditions
Vno = Velocity Normal Operating/ Max rough air speed
Vario = variometer
VOA = Optimal Speed approach
Vp = True airspeed
Vs = Stall Velocity
Wv = Wind velocity
ZPA = Zone to lose altitude
« 8 » = eight (paths used in ridge flying or in wave)

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SUMMING UP

Flying in the mountains demands **instruction** on the ground as well as in the air.

Learning the basic techniques and complementary piloting skills as well as discovering the different meteorological conditions have to be performed in **two-seaters.** These flights, although with the purpose of tuition, leave room for **pleasure** while flying in the marvellous surroundings that can be found in the mountains.

Regular training flights in single-seaters will increase the acquisition of techniques and reinforce individual confidence.

This solo training must follow a **geographic and technical progression** adapted to the basic capabilities of the pilot.

Each club should build a pilot progression form corresponding to its region and conditions.

The mountain pilot must know how to **identify departure from normal flight: the stall, the spin and the spiral dive.** He must know how to avoid them, and how to get out of them.

Accurate control of the glider is essential for efficiency in climb as well as for safety, in slope/ridge flying, in wave or in thermodynamic flight. **Precision in landing** has to be mastered to allow a possible outlanding in difficult conditions or on a short field.

This precision implies a good **visual scan**, the **control of the attitude** of the glider and a good command of the speed. The first flights involving changes in the local landable field are possible only if precision in handling the glider is acquired.

The proximity of the terrain means that one must always have a **reserve of energy** by using a minimum speed of 1,45 Vs, though this is not the sole criteria to fly safely. Frequently turbulent conditions also require rigour in **symmetry (i.e. flying symetrically)**, and adapting the distance to the terrain appropriately.

Wind is an essential parameter in mountain flying. The pilot must always be concerned by its strength and direction, not only at that particular time during the flight at his altitude, but also on the ground, on his chosen path, particularly when nearing the terrain.

Good control of the flight requires, in all its phases, the management of changes in location, climbs and descents to stay at all times in the **proximity of a landing area.**

The risk of a **collision** exists. There again, anticipation of the flight path is paramount and the pilot must carry out a **constant visual scan for other gliders.**

Risks involved **in high altitude flying,** in tiredness and in **human factors** must be understood.

Flying in mountains is one of the flying activities that can bring the most satisfaction and pleasure to the pilot when it is performed within his area of competency, which he will widen progressively.

THANKS:

This booklet is the result of the work and experience accumulated in 70 years by the instructors of the Gliding national centre of Saint-Auban-sur-Durance (CNVV).

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Flying in mountains brings to those who practise it incomparable memories.

But, as with sports performed in a demanding environment, it demands a discipline and a knowledge that allows no room for improvisation.

This condensed booklet about safety in mountain flying is the result of the experience acquired over the years by the instructors of the national centre of Saint-Auban.

It is intended for all pilots who come to fly in the mountains, with numerous drawings, coloured photos, and sums up in an attractive way the essential techniques and precautions.

It will also be useful to experienced pilots to refresh their knowledge, and to instructors who will have a guide available for student development.

It does not replace a structured personal development and training programme, but its ambition is to improve the **level of safety** so that flying gliders in mountains remains a **pure moment of happiness.**

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