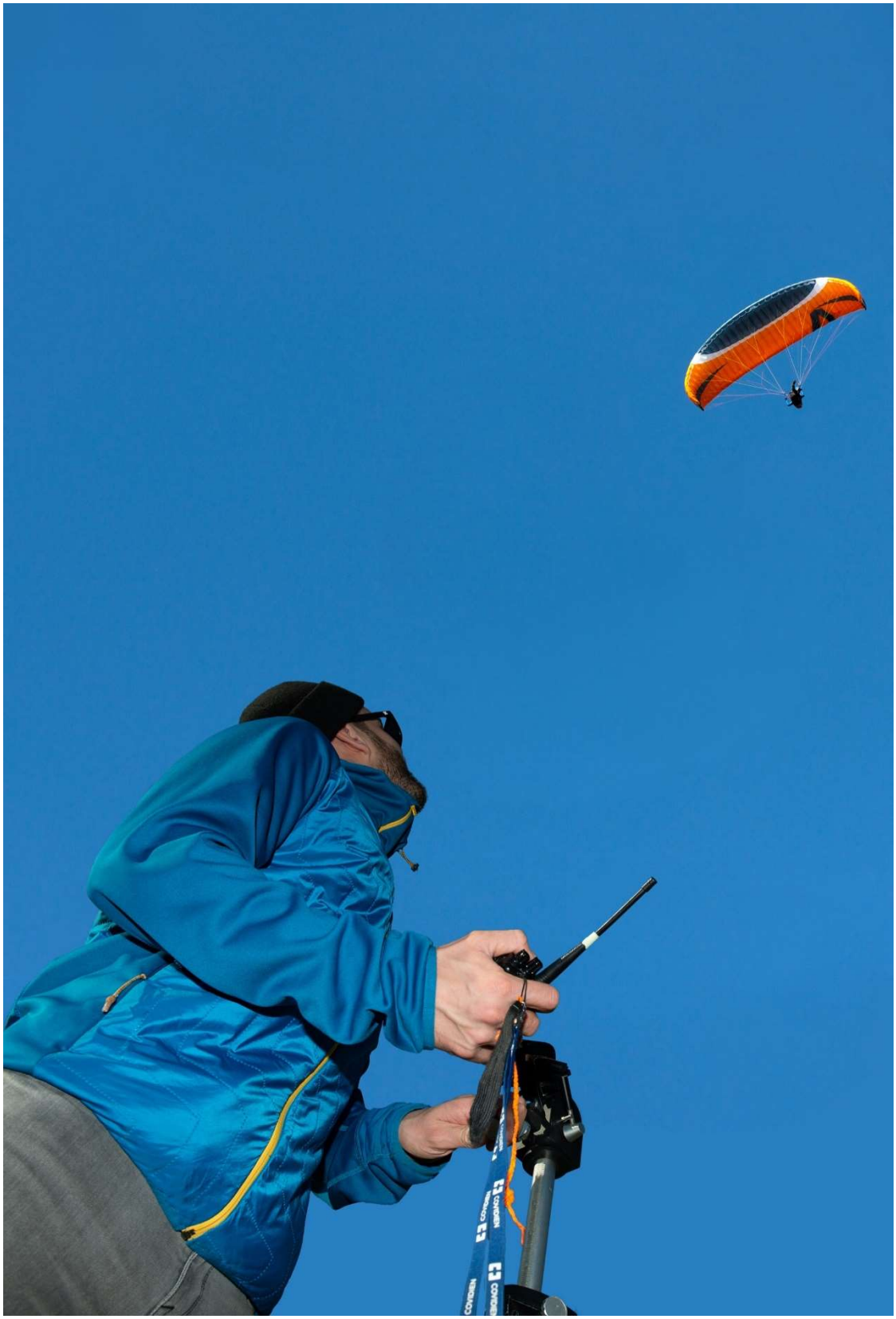
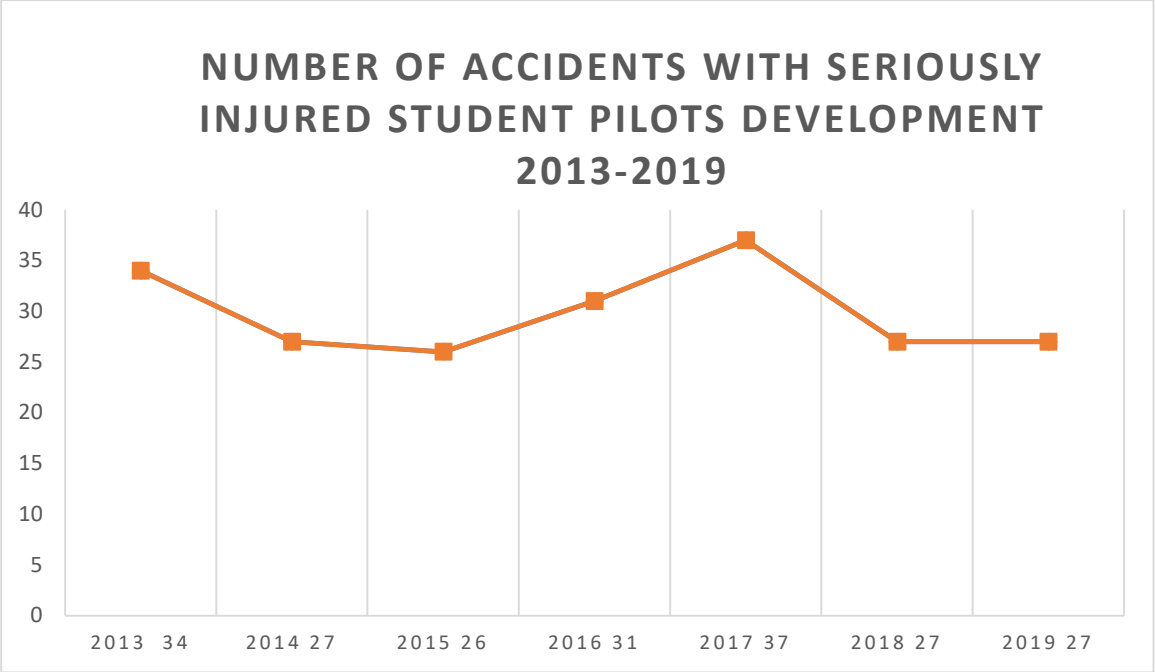
Analysis training accidents paraglider 2013 to 2019

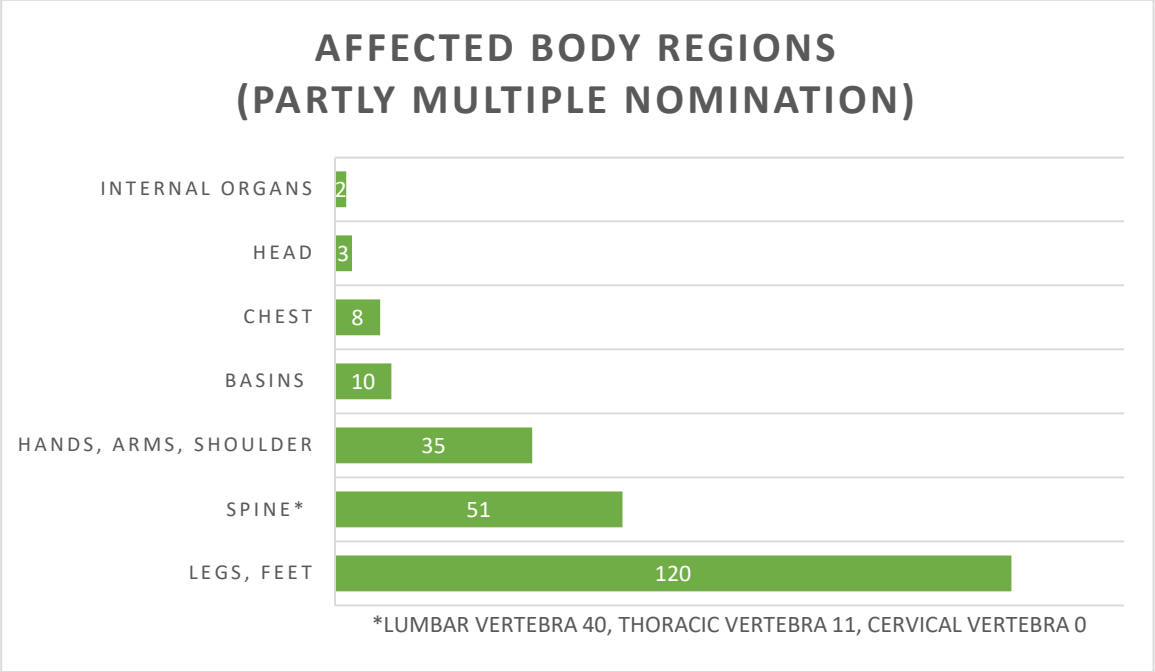


An initiative of the DHV within the "EASA's European Plan for Aviation Safety (EPAS) 2019-2023

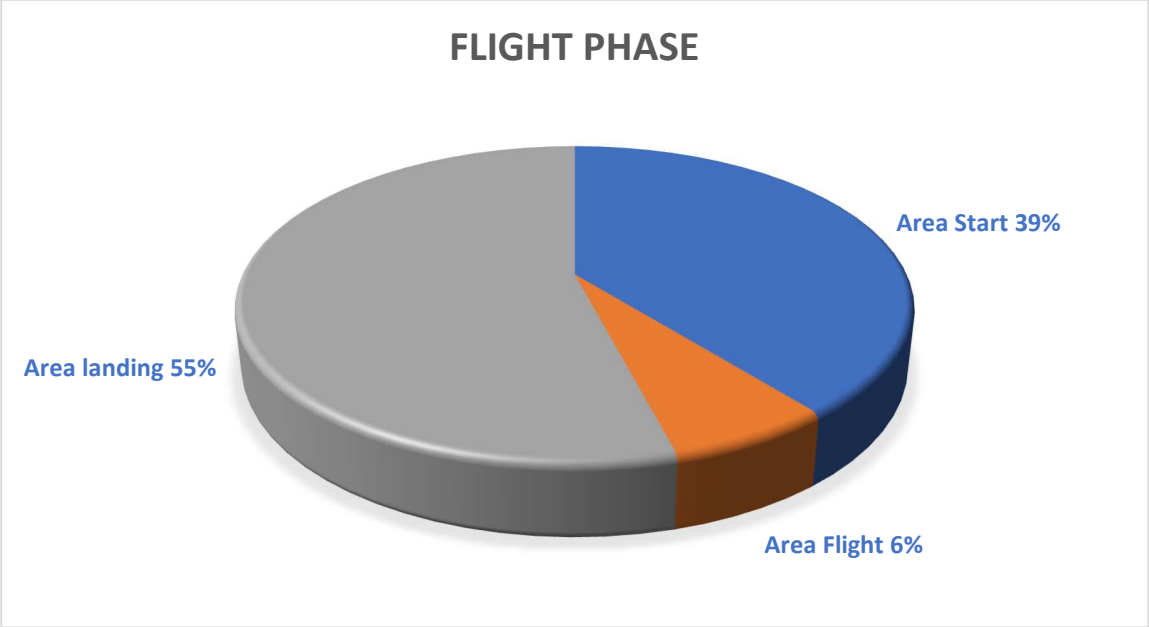
A closer look was taken at 209 accidents at German paragliding flight schools with seriously injured students between 2013 and 2019, all figures taken from the DHV accident database (EHPU-Incident- and Accident-Database).



As a first fact it can be stated that between 25 and about 35 accidents with seriously injured students are reported every year. The range of serious injuries (according to BfU definition) ranges from torn ligaments to polytrauma. The number of unreported cases is likely to be low (see next paragraph). Statistically, the following calculation can be made. In German flight schools, approx. 200,000 to 250,000 flights are performed annually for A-licence training. With an average of 30 accidents with serious injuries, one can calculate that about 7500 training flights result in one serious injury.

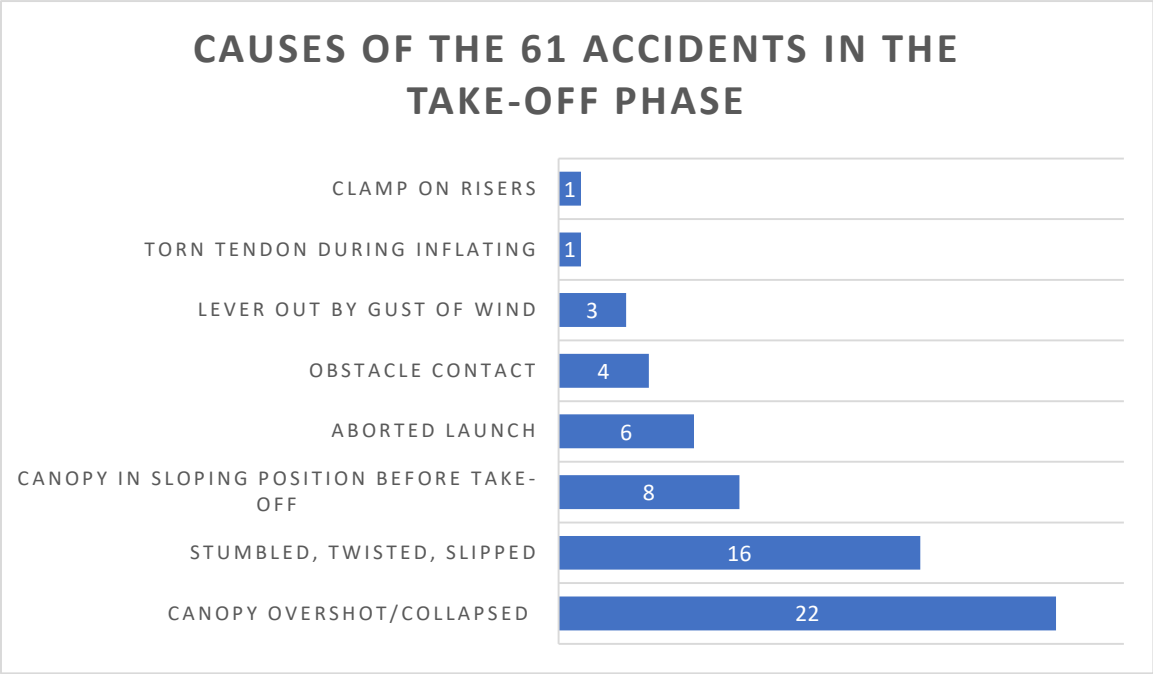


It is noticeable that the proportion of spinal column injuries in training accidents is relatively low at 25%. In comparison: Proportion of reported (severe) spinal column injuries in all accidents reported to the DHV in the same period: 65%. It is a fact that less serious accidents tend not to be reported by pilots. However, the flight schools do, also for insurance reasons. For example, the proportion of injuries to legs and feet among the reports from pilots is 38%, among the reports from flight schools almost 60%.



Start area

Almost 40% of the accidents occurred in the take-off phase, about a quarter of them after leaving the ground (take-off).



The emphasis of the accident is clearly visible when overshooting the canopy, usually followed by a collapse. The student pilots then fall at often already high running speed and with corresponding energy. Or, worse, the glider lifts off despite the collapse and the pilot is thrown into the slope in a turning movement. The causes of overshooting/collapsing are different. Often it is a combination of several factors.

- With the **old school starting technique** (dynamic inflation with active leading of the canopy up to above the pilot, stabilisation by strong braking, pilot is slow in the control phase) the problem is that you have to start accelerating with deep brakes. The necessary releasing of the brakes to accelerate is demanding; too little and the canopy cannot keep up with the pilot who is getting faster, it nods backwards. Releasing too much accelerates the canopy too much and can lead to a collapse.

- New School technique can also have its pitfalls here. Because of them (dynamics only in the first part of the inflation, early release of the hands from the raisers) the tendency increases that the canopy is still behind the pilot after inflation. In the take-off run the pilot first runs away from the glider. Often the canopy comes forward quickly, e.g. when the pilot runs into a steeper slope. Now the pilot has to adjust the brakes to prevent overshooting, as the take-off run is already demanding in terms of movement. In six cases the collapse occurred because the students released the brakes too far/too fast during the take-off run. Again, adequate pitch control (by pulling or releasing the brakes) in the take-off run is probably too demanding for the level A certificate training.

What can a flight instructor do to prevent such accidents?

Steering technique
The student pilots should never go from the control phase to the acceleration phase with an extreme braking position. This means that the brakes should not be pulled very hard or applied very high up. If you watch the relevant videos, the steering lines are usually rigidly set at the height to which the

steering lines were pulled during stabilisation. Students should therefore not be forced to change the brake position during the take-off run. Depending on the steepness of the take-off area, a brake position between minimum sink (rather flat take-off area) and karabiner height (rather steep take-off area) can be used as a reference point. In view of the knowledge that student pilots are probably overtaxed with the regulation of the pitch control in the take-off run, there is also a safety tip: If the student has to brake very hard before the start of the take-off run to stabilize the canopy or keep the brakes up because the canopy is hanging - the launch should be aborted. In these cases there are no favourable conditions for a safe launch.

Take-off run

The analysis result, that for flight students the pitch control over the steering lines is difficult, clearly puts the focus of accident prevention on the correct running technique.

During inflation, after the initial impulse, the running speed must be reduced immediately, otherwise the whole following procedure becomes too dynamic and hectic. The flight instructor must immediately intervene with the radio instruction "slower", if this does not help, stop the inflation. Only when the canopy is stable and vertical above the pilot with moderate control line pull (between upper and lower accelerator pulleys, maximum karabiner height) may the take-off run begin. The flight instructor must pay particular attention to gradually increasing the running speed. This must be the focus of training, if necessary for dry runs. If the pilot runs away from the glider (canopy in the back) or behind it (canopy in the front), the take-off must be aborted. Otherwise a dangerous pendulum start cannot be prevented for beginners.

Take-off run pilot position

The aim here is to give the student pilot the simplest possible idea of movement, which makes the take-off run stable and allows him to get up in the air safely. The best way is a moderate forward position of the whole upright body with the centre of gravity in front of the suspension. This puts pressure on the ground (can accelerate well) and keeps you upright and ready to run in the air. The arms are held approximately parallel to the risers, and a slight outward angle stabilises the shoulder joint. A completely free guidance of the arms is not ideal, it tempts the student to "row".

If the instructor observes that a student is bending the upper body strongly, he should check the harness adjustment. This problem often occurs with students with a belly. It will bump on the front harness and prevent the student from taking a moderate forward position. Alternatively, the pilot will then kink the upper body. It has been shown that some harness models are not well suited for pilots with a big belly. In this case an individual selection of the harness is important.

When starting the take off run with the upper body kinked, the pilot must stretch the arms backwards. This is usually not a problem in the take-off run itself, but there is a risk that the pilot will tip backwards during take-off. For stabilization, the hands are then often taken down in a support reflex, which leads to uncoordinated brake/steering. For this reason, a pronounced kinked upper body and strongly backward stretched arms should be avoided.

Occasionally, one observes take-off runs in a completely upright body position without a forward lean. These pilots accelerate in a restrained manner and often row with their arms stretched out to the side or forward. They do not put pressure on the ground and are often lifted (and lowered) at too low a speed. Or overtaken by the canopy (dangerous). The instructor should advise to do these exercises with the harness on but without the canopy. The instructor pulls on the back of the harness and simulates the force of the glider. He asks the student to lean forward all over his body during the run.

Radio instructions

The flight instructor should support the speed increase of the take-off run with appropriate radio instructions, in such a way that the voice indicates the increase.

The second most common cause of accidents is any kind of **stumbling, slipping, kicking a hole**, twisting, etc. Interesting: In the majority of cases the wind was very light to non-existent, often on the first flight in the morning with (multiple quotes) "morning zero wind conditions". In general, some of the other categories, such as aborted take-off or obstacle contact, are also often mentioned in connection with zero wind conditions (on closer examination). Logically, with a zero wind start run,

the errors happen with much higher running speed and thus the risk of injury increases. Also in the case of an aborted start. The section "Canopy in sloping position before take-off" contains another interesting fact. This happens most often when it is necessary to underrun the canopy to the front, usually in a lateral wind component. The glider is already sloping when it is being inflated, and the instructor will instruct you to run under the glider forwards, but this does not provide the desired stabilisation until the acceleration phase. The student is often overwhelmed by the situation, because his "workload" is simply too high. In the end, the take-off is unstable with pendulum or a take-off abort with already high speed.

What can a flight instructor do to prevent such accidents?

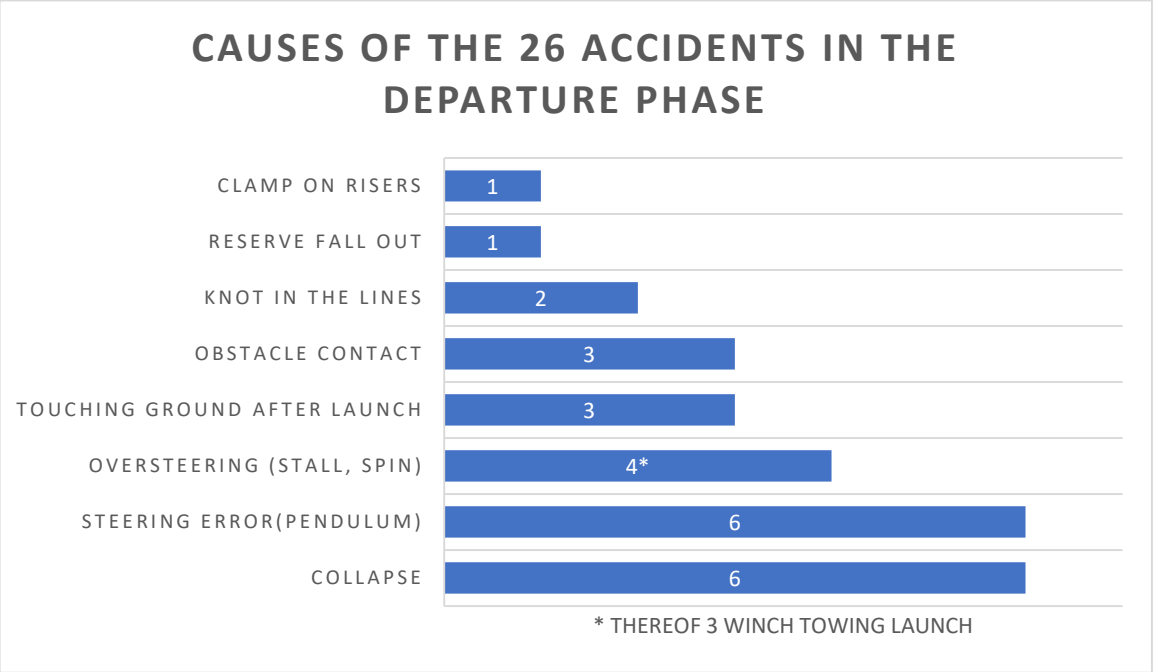
There are really bad take-off areas with terrain edges, depressions, holes, nasty lateral slopes, etc., which almost provoke accidents from this category. You should do everything in your power to defuse such traps.
Like on a camping site, there are premium and standard pitches at every starting point. It would also be a measure to ensure that the weaker students do not catch the most difficult take-off sites.
To take into account the supporting effect of the wind is another important factor. Just think about yourself; how much easier is a start at 5 km/h wind from the front compared to a "zero wind from the back" start.
However, it must not blow so strongly that it causes the student pilots to be levered out and dragged into the air, or that they are torn to the rear while being pulled up (accident category "levered out by gust").
All in all, wind speeds at the launch site, which make it necessary to take more than 2-3 steps towards the canopy during inflation, are borderline for the A certificate training. Groundhandling in flat terrain is basically essential to prepare for the inflation and launch behaviour in stronger winds, and should be preceded whenever possible. The glider's reactions to control inputs, changes in angle of attack, the need to release pressure by counter-attacking, going deep to apply pressure, all these things make one or more ground handling sessions the most valuable lesson a student pilot can enjoy. The control handles should be in the right hand from the beginning.

Many subsequent problems could be avoided, as simple as they are effective, simply by laying out the canopy in an orderly manner in the shape of the canopy's arch and by adopting a symmetrical basic pilot position.
If the adjustment of an inclined glider is not done at the latest in the control phase, i.e. before the launch decision, the launch should definitely be aborted. If the student starts with the canopy in sloping position, the danger of a crash is high. In crosswind conditions, students should not be subjected to too much stress. To have to compensate the crosswind during the take-off run by active steering is usually too much for the student pilots. The control view to the canopy is important but should not be a dogma. Under normal conditions a control look should be carried out in any case. However, if it is clear that a meaningful control view cannot be made (e.g. zero wind + unfavourable take-off conditions, + motorically less talented student pilot...), the student should leave it out. The control must then be performed by the flight instructor. A control look can do more harm than good here, because it makes the movement patterns during take-off much more complex and error-prone. Flight students should learn that an alibi control view is useless. Instead, they should make a very precise check of the lines and canopy during launch preparations. And perform the launch without a control look, just focusing on sensing the correct launch configuration in the control phase and abort at the slightest indication: "Feels strange".
There are clear indications that severely overweight and unfit flight students require stricter safety measures than fit, sporty people. Quite simply because the probability of a crash (due to poorer motoric skills) is always significantly higher. And because the risk of injury is always greater in the event of a crash for heavyweight pilots. This is especially true at the start. Here, special attention must be paid to favourable conditions for this group of people.

The accident analysis also made it clear that students should not fly training gliders close to the upper weight limit. Many EN-A gliders also lose a lot of roll damping and become too sensitive and dynamic. Take-off and landing speeds increase, the collapse behaviour becomes more demanding, sometimes even significant. Therefore the range of 50-70% of the weight range is usually correct for student pilots. For very heavy weight students there is only the option of a (small) two-seater.
The combination of harness-glider should also be considered. For example, for students who need more practice or who are less fit in terms of motorics/sport, more damped combinations should be chosen. Manoeuvrable gliders (direct steering line handling, low roll damping) + manoeuvrable harnesses (cross-belt grips late) should be avoided.

Oh, yes, the shoes. We generally recommend stable trekking boots that are as high as a stove to prevent injuries. But there are also advocates of low trekking shoes (so-called access shoes) for paragliding. While the high boot certainly offers better protection when twisting, the low boot (at least for sporty persons) allows a more sensitive feeling of bumps and a corresponding reaction before twisting occurs. However, students with such shoes should be advised of the limited protection against injury when twisting. Clearly not acceptable are thin leisure shoes without profile (sneakers..).

A firm recommendation for full-face helmets with a chinguard does not make the relatively low number of accidents with head injuries absolutely necessary. Half-shell helmets have undeniable advantages in terms of weight, field of vision and reduced hearing loss. Nevertheless, there are occasional accidents in which the chin guard of a full-face helmet has prevented really serious facial injuries. No accident has been reported in which the leverage of the chin bar has caused a neck spine injury - a common argument against full-face helmets. There is no question that only aviation sports helmets with EN 966 should be used, if only for reasons of liability.



In no other phase of flight are overreacting students reported in accident reports as frequently as during departure, shortly after getting airborne. Especially when directional corrections are required shortly after take-off, such control errors occur. Flight instructors report strong swinging or abrupt pulling of a control line up to the wingover. There was a very nasty crash when it came to ground contact in the strong oscillation. "I instructed the student pilot to steer to the left because the wind was drifting her towards a row of trees. She initiated such a narrow steep turn that the glider went

nose down and she hit an embankment". This is one of the typical phrases used in accidents of this kind. Another type of control error is when the student pilots do nothing, do not follow any control command given by radio.

What can a flight instructor do to prevent such accidents?

These kinds of incidents will probably always happen - you can't look inside people. But if in the previous training of a student pilot a tendency to either hectic overreactions or to "freezing", i.e. not reacting anymore, has already been shown, one has to be appropriately careful. It would then be ideal if such a student pilot prefers to fly under the most favourable conditions and has the full attention of the flight instructor.

In the event of uncoordinated control inputs by the student pilot in flight, a clear, simple radio instruction must be given (e.g. "both hands at shoulder height - look in flight direction .... WEIGHT slightly to the .... side and hold"). Uncoordinated steering inputs often result from an intuitive support and holding reflex over the hands and therefore over the steering lines. For example, when the pilot is levered from the harness into a sitting position or when accelerating, the hands move strongly with the pilot. Static, stretched arm-positions also lead to delayed but then powerful turns. Isolated partial exercises are recommended for students who show such behaviour. Also on the ground or in a simulator.
In this context the reference to a judgement of a higher regional court. A flight student (basic training) had a severe movement error, he pulled and released the brakes during the flight again and again without comprehensible reason. This error played a role in the accident. And also in the judgement. The flight instructor should have worked on the correction of the movement error before the student pilot got into a situation where this mistake could have become risky. This means that flight instructors must take preventive action when they detect potentially dangerous behaviour on the part of the student pilot (e.g. uncoordinated control inputs, seating in the middle of the take-off run, no reaction to radio instructions...). This may also mean that the training must be aborted if the behaviour cannot be controlled.

Collapses caused by turbulence or incorrect steering technique are equally involved in accidents in the take-off area. In 3 of the 4 collapses caused by turbulence, the students were flying into a strong thermal. Due to the lack of active flying, the gliders had pitched forward and collapsed during the excursion out of the updraft, always to the surprise of the instructors. They had not expected collapses in this situation. There is still a common belief that the glider has to pitch very far forward to collapse in such a situation. This is not true! As many Youtube videos have shown, collapses usually occur when the pitching movement (actually the pitch angle speed) of the canopy is the fastest. And this is the case when the forward pitching (with the momentum of the previous deployment of the canopy) just starts. This situation actually takes place according to a recurring pattern:
- The canopy and the pilot are in a rapid vertical movement upwards.
- The climb ends abruptly.
- The canopy begins to pitch forward and collapses aggressively at a very low pitch angle.
By studying relevant videos on Youtube several times
(e.g. https://www.youtube.com/watch?v=OvYORWG-SpU) one can keep an eye on this situation and thus be prepared for it as an instructor in practice. The correct reaction would then be to announce the brake application via radio already at the zenith of the pitching motion. After applying the brakes, the radio command must be given with hands up to prevent a stall.

The other student pilot had entered a crosswind turbulence area during take-off. Two others had provoked the collapses themselves by suddenly releasing the brakes, which had been pulled relatively hard during take-off, and the subsequent forward pitching resulted in a collapse.

What can a flight instructor do to prevent such accidents?

Collapse accidents in training are not only serious because of the potential injury consequences for the student pilot. Also because the flight instructor can be blamed for having trained in dangerous weather conditions. And then the liability insurance can cause problems. It can therefore only be recommended to stop training if the turbulence noticeably increases from slight to moderate, so that active flying is necessary to compensate for stronger changes in angle of attack or to prevent disturbances. A student pilot is not sufficiently trained for this.
In this situation (i.e. when the flight instructor notices that the turbulence level of the student pilot who has just taken off) the student pilot should be guided closely with radio instructions so that he can react very quickly in case of a disturbance. Special attention is required from the flight instructor when his student flies into a strong updraft, as described above.

3 of the 4 stalls during take-off occurred during winch towing, namely during the radio controlled counteraction of a drift from the towing direction (lock-out). Another student pilot had leaned on the brakes during a slope take-off so that the glider went into a deep stall and crashed into the slope.
As already described during the take-off run, caution must be exercised in zero wind conditions. 2 of the 3 student pilots who had an accident by touching down again did so because at the end of a zero wind take-off run they thought the glider was already carrying them and sat down. In each case there was a spectacular rollover caused by the harness/feet getting caught in the terrain. Obstacle contact during take-off occurred mainly when the take-off direction was left during the take-off run (crosswind).
Line knots caused 2 accidents with serious injuries. In one case a turning movement back into the slope occurred immediately after take-off. In the second case, after the correction (instructed by radio), a one-sided stall occurred due to excessive counter-steering. In a third case, a flight instructor decided to let the student release the reserve parachute over a wooded area. The glider was difficult to control, the instructor felt that the risk of making a landing approach with the student in this configuration was too high. Correct decision! The student was only slightly injured during the rescue landing.

What can a flight instructor do to prevent such accidents?

As the analysis shows, problems with stalls are comparatively rare in this phase of flight, with the exception of the take-off phase during winch towing. The flight instructor should make sure that the brake position during take-off is normally not above the lowest sink rate and not significantly below the height of the karabiners. If the brakes are pulled low, a soft release must be instructed by radio to prevent the canopy from pitching forward strongly.
During winch towing starts it is important that the glider is not braked during towing.
In order to compensate for stalls during winch towing, it is essential to use the indirect control technique (outside brake release) when correcting direction. A paraglider reacts only slowly to the steering lines at high angles of attack, as during towing. In this case it is advisable to do more training in the simulator to train the student before the first flights, how it feels when the glider leaves the towing direction. Special feature here: The pilot is towed in the direction of the wind. But the glider itself has already bdrifted away. This is difficult for beginners to notice.
If the glider is drifting away from the towing direction, the instructor has the task of giving instructions quickly and correctly via radio to the winch operator and student pilots. E.g. "Winch pilot! Reduce pull, student pilots (name)! steer right..."

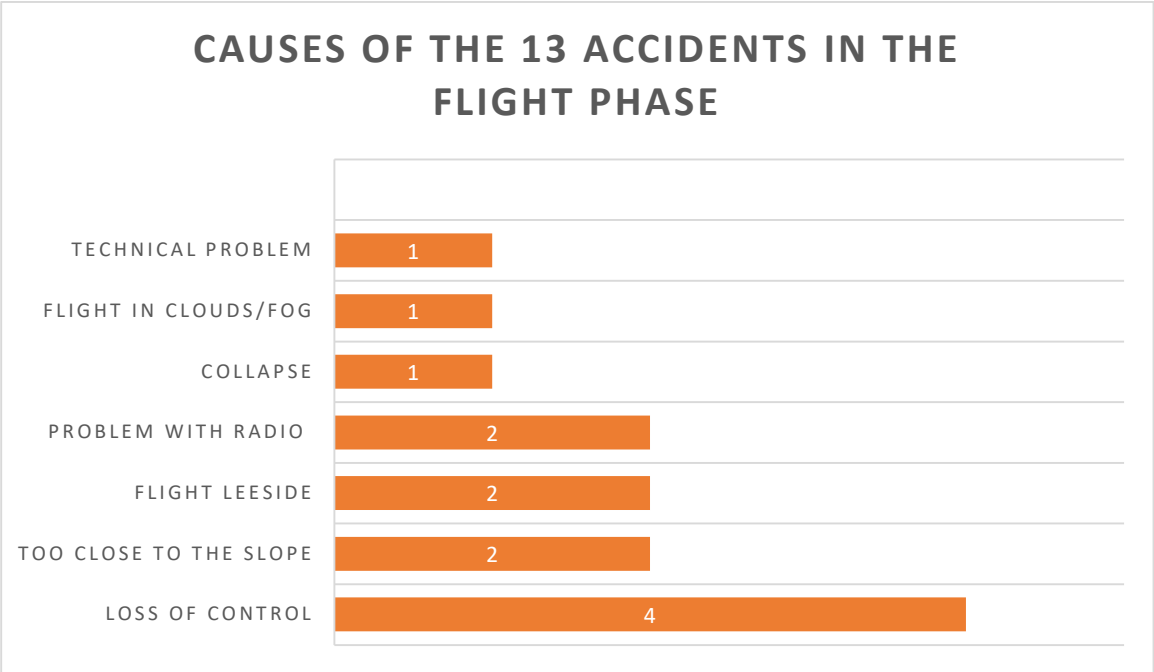
The problem of sitting in the harness too early can be countered with exercises on the harness simulator and a corresponding harness adjustment (technical article on harness adjustment: www.dhv.de/fileadmin/user_upload/files/2015/Artikel_Sicherheit/Geraetetechnik/2015_193_gurtzeug.pdf

www.dhv.de/fileadmin/user_upload/files/2018/sicherheit/artikel_pdfs/2018_213_aushebeln.pdf

It is well known that harnesses with a Get-Up-System are less suitable for staying upright during take-off than those with T-Lock-System. This is particularly noticeable with corpulent pilots. Their "stem" prevents them from actively maintaining their forward position and causes them to tip backwards into the harness after losing ground contact. It has also been shown that seatboard-less harnesses are also unfavourable in this respect. It is very important to maintain an upright and ready to run position for a safe landing. For this reason, flight instructors are requested to be very conscientious in the selection and adjustment of student pilots' harnesses.
Student pilots whose steps do not become larger when accelerating, but only increase the step frequency (tipplers), are particularly at risk of being put in too early. As an important accident prevention measure, running exercises without a glider and appropriate radio support in the take-off run are strongly recommended.
If a line knot is only detected during take-off, the instructor must take command immediately. Weight shifting against the rotation, light counter-braking, looking in the direction of flight and moderate use of the speed bar are the recommended measures. Also the option "release the reserve" should always be kept in mind with strong line knots. (Flight practice video on this topic by Simon Winkler):
https://www.youtube.com/watch?v=zlYZDHppoGs&list=PLqnmbqFjp5-Rqj9qfR5djCcVPxQgqDmjf&index=12&t=4s

Flight phase

In the period under investigation, a total of 13 training accidents with serious injuries occurring during the flight phase were reported. These accidents are therefore rather rare and practically in every single case unusual, unlucky or the result of a clear crossing of boundaries.



Most often a training manoeuvre got out of control. Twice the glider was stalled during the pitching manoeuvre, each time a dramatic crash occurred. A student pilot had fallen into the canopy and the reserve was released literally in the last second < 50 m GND. There was also a very critical reaction during rolling. The glider had been swung up too high and collapsed on the outer wing. Cravat, spiral dive, reserve released but did not open completely, seriously injured student pilot. The manoeuvre had been flown well below 100 m GND. A student pilot had pulled the wrong lines when he put big

ears, which resulted in a stall, shooting forward, collapses, cravat, spiral dive. Despite repeated instructions to release the reserve, this did not happen. The student pilot hit a steep slope and fortunately survived. During radio-assisted thermal flying / soaring in the high-altitude flight training, the student pilots briefly escaped the control of the instructor four times. Two of them flew leeside where they crashed, and two others crashed because they were too close during the soaring.
A classic: student pilots refer to radio instructions that were intended for someone else. This caused two serious accidents, because the affected students hit the slope during straight flight or flew leeside. One student pilot flew into a surprisingly fast closing cloud cover and lost her orientation. She crashed into the mountain in a curve. A student pilot (with a flight assignment) had not properly attached a riser to the karabiner. During the soaring, the riser detached from the carabiner but was still hanging on the speed bar rope. Crashed into the forest with serious injuries.

What can a flight instructor do to prevent such accidents?

*The risk potential of the pitching and rolling manoeuvres should never be underestimated. They require thorough instruction in the simulator (harness suspension) and an absolutely attentive flight instructor during their execution. Carabiner height should be considered the absolute maximum of braking when **pitching**. After intercepting (stopping the glider advancing, the actual methodical aim of the exercise), do not forget to release the brakes again. During the nodding manoeuvre, you oftenwork on the perfect rhythm of the amplitude - forgetting that this swaying of the glider is only a preliminary exercise towards the actual goal, namely the timely interception of an advancing movement.*
First exercises to stop the forward pitching canopy can be done without any previous swaying. By slowing the glider down to the height of the karabiners by slow braking. Wait until the system is stationary and only then release the steering lines very quickly. The following pitching movements should be perceived by the student. This way the timing can be precisely defined and even the stopping of small pitching movements can be trained. Only then the amplitude is increased step by step. The flight instructor must know that the pitching motion becomes more pronounced when thebraking and releasing is done with impulse and the brakes are only released when the canopy is above the pilot. This technique requires relatively little control travel, but precise timing. Therefore, at the beginning, instruct braking rather slowly and release rather early (canopy behind the pilot).
This technique also gives the student pilot more time to prepare for the final interception. Thismethod significantly reduces the pitch intensity, but should not tempt the student to use morecontrol travel for amplification.
*When **rolling,** the instructor must pay close attention to the timing of the student pilot. To practise timing, only rolling and stabilising with body weight control should be done at the beginning. Only then use the steering lines. If the amplitude becomes too high, the glider may collapse without supporting the outside. The inner side may fold if the student changes sides too early. A collapse on the inside can result in a too strongly braked outer wing stalling. These dangers suggest that constantradio guidance and complete observation by the instructor is also required when rolling.*

*When **putting on your ears,** a briefing on the equipment (which lines I have to use) and a radio check("check if you have the right lines") is also important. Before this, you should have mastered the roll and stabilisation manoeuvre with your body weight to compensate for the usually lower roll dampingwith your ears on.*
*During the **"Fast Eight"** no accident with seriously injured student pilots has been reported. But problems do occur relatively often. The most important is the one-sided stall during turn changes. If there is the slightest indication that the student wants to make the turn change in an unfavourable configuration (canopy behind the pilot, both hands up, so that release of the outer brake is not possible), the manoeuvre must be aborted **before the change is made** - with a clear, previously agreed radio instruction. With a little practice, the flight instructor will see already in*

the last third of a too dynamic first circle of eight that the transition will not function safely and can abort in time andwithout danger. (Video Tutorial with radio instructions): https://www.youtube.com/watch?v=9aNowEfvf4E&list=PLqnmbqFjp5-Rqj9qfR5djCcVPxQqqDmjf&index=18

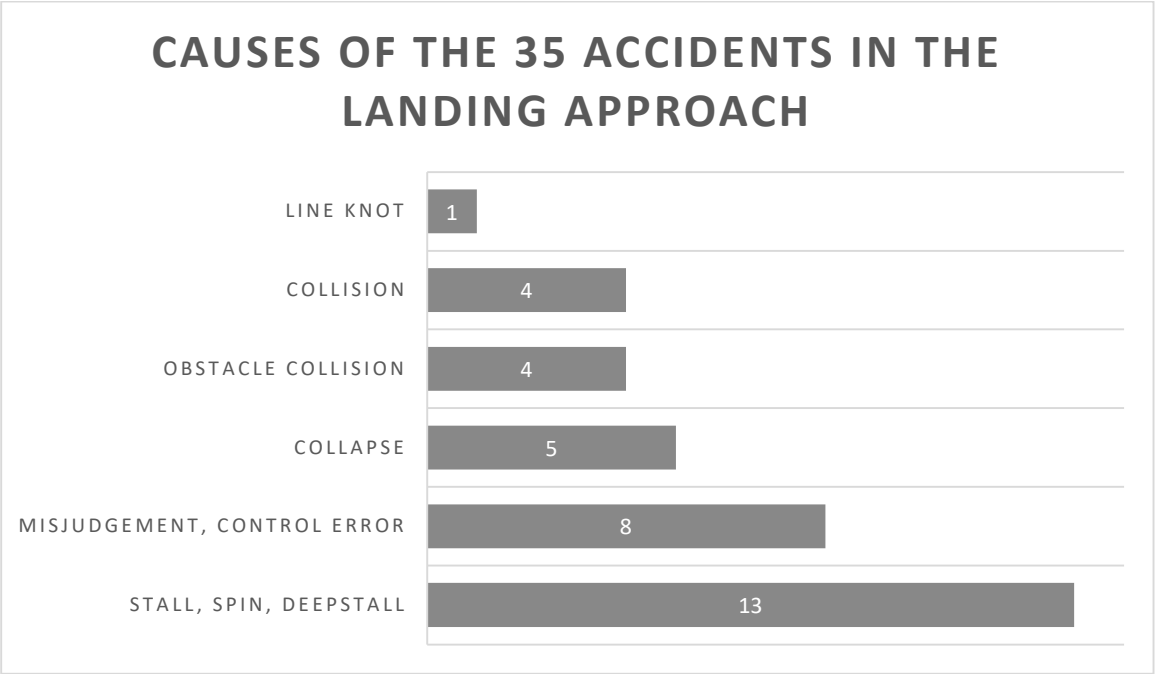
*If a **manoeuvre is out of control, it** must not be delayed for a long time, but the instruction for rescue must be given quickly. For the successful opening of the rescuer sufficient height is required. The manoeuvres Rolling, pitching, fast figure of eight, ear contact, collapse should not be flown below 150 m GND. This is matched with the minimum safety altitude of 150 m GND as defined by law. Two (injury-free) incidents make it clear how important it is to carry out **the prescribed "rescue deployment and throwing exercises"** with every student pilot **before the first high altitude flight.** In both cases the gliders were out of control during the first or second high altitude flight (collision and line knot). Both flight students triggered the rescue on radio instruction and said afterwards that theycould only react in such a targeted way because the deployment had been trained before the high altitude flights.*

*If the flight instructor always addresses the student, to whom he gives an instruction, by name, **radio command mix-ups** cannot actually occur. Make sure that the name is not swallowed up by the "**first word is gone" phenomenon.** Anyway, it is better to choose something like "ok", "good", "now"... as the first word of each new radio command and then to give the name first. Here a second radio on standby helps to put next to it. In this way you can check whether you are swallowing words, whether there is interference on thefrequency and whether the battery of the operating radio is running low.*

In general, inexperienced flight instructors should keep their workload as low as possible and onlysupervise a few students at a time!

*There are few more effective lessons for student pilots than **radio-assisted thermal or soaring flights**. As a flight instructor, however, you will soon discover that these flights require full attention and constant observation and conducting. Especially regarding slope distance, attention to lee areas,necessary corrections when circling and in thermal turbulence. To accompany a student in thermals from the launch site in addition to the regular training is almost impossible without compromising safety. It is better to create the space which allows you to concentrate exclusively on the thermal pilot. E.g. in the time gap until the next student arrives by cable car or bus.*

Landing approach



Stalls, on one or both sides, are by far the most common cause of accidents in the landing area. Very serious injuries often occur because high energy and corresponding impact forces are generated in the pendulum of the advancing glider. A one-sided tear-off occurs most frequently when circling in position (4 cases), when turning into the next approach section (4 times) and when correcting the direction of a heavily braked glider in the final approach (2 cases). The stalls on both sides were only the result of too much braking in the final approach (too high) and in one case clearly caused by a strong wind gradient.
Because a stall near the ground is always life-threatening, prevention must be done with great seriousness. It is particularly important to teach flight students that the choice of airspeed and the control technique are crucial for safety. When circling in position, it is noticeable that the reported stalls occurred in the last circle. As one (especially as a student pilot) is actually always unsure whether or not to make another circle, this is often done more hectically, faster and with more brake application. Then there is the danger of stalling. Even if no compensation of the wind drift (opening the circle in the headwind part) is made in the position circle, hecticness will occur. The pilot then wants to circle tight and fast in order not to drift any further. Here too, danger of stall.

What can a flight instructor do to prevent such accidents?

The students should be informed that, in case of doubt, they should decide against a last position circle and prefer to fly a little higher into the downwind approach. From the beginning, students should learn that they have to fly fixed position circles and therefore have to ***compensate for wind*** *in the position circle. This is easy to do when they understand that the position is a fixed point on the ground which you fly over at the beginning and end of the circle. The flight instructor should take the time to do a radio-coached position circle training with the student pilot.*
"Flight student was low on the downwind approach and steered into the base approach with an abrupt pull of the steering lines, which caused a stall on the inside of the turn". The transition from the opposite approach to the cross approach is the most common "scene of crime" for one-sided

stalls. Especially if the counter approach with the tailwind is a bit faster, unprepared students become impatient or panicky because their glider does not react fast enough to the control command. First of all it should be explained in more detail that the turn radius increases when the tailwind and crosswind components are added.
And here also one of the main problems during the whole landing approach becomes clear. Too low or too far away, it gets tight, it has to go fast! This is dangerous. Therefore, the flight instructor must always make sure that the extension of the landing approach gives the student pilot enough time to implement radio and control commands without rushing. At least 10, better 15 seconds time per approach section (i.e. at least 100 -120 m flight distance) should be sufficient.

What always has to be considered is the nervousness of the student pilots. The ground is approaching quickly and now precise action under time pressure is required. Taking bearings, estimating, deciding, flying curves, observing airspace, observing obstacles, straightening up...
This takes enormously capacities. And reduces the attention for stall-proof control, which is so important, however, especially during landing approach. Intuitively, the opposite of what is required is often done. Quickly around the turn when you are too low. Brake hard if you are too high.
The flight instructor should therefore take great care that the whole landing approach is not flown at too slow a speed. The initial position (approximately height upper speed bar roll)) is the standard position of the steering lines for the whole landing approach. When turning into the next part of the landing approach, the emphasis is on a flat, pendulum-free turn - and always remember to release the (soft) outer brake. In final approach the bearing point only has the function of determining the landing direction. A 5-10 m long "landing bar" fulfils this function even better. It makes no difference whether the student lands 30 m in front of it or 30 m behind it. In the basic position the final approach is flown straight and calm. A stronger braking to worsen the glide angle (which is only theory with the lowest lift anyway) should only be applied if necessary, because obstacles are imminent.
A student pilot who lands 60 m outward with a safe final glide has done much less wrong than his colleague who is 30 m closer to the bearing point with a strongly braked final glide. It is important to communicate this! (Video Tutorial Avoiding Stall):
https://www.youtube.com/watch?v=RQTxHVSzc9U&list=PLqnmbqFjp5-Rqj9qfR5djCcVPxQgqDmjf&index=4&t=60s
In this context, a particularly sensitive issue needs to be addressed. How should the instructor react to a stall? Is "hands up" really the right radio instruction? The answer is not easy, because a wrong instruction in this situation endangers the life of the student pilot. If the instructor notices the stall in the first approach, the "Hands up" command is correct, except in the immediate vicinity of the ground, < 5 m GND. However, in a fully developed stall this instruction will always result in a very strong forward thrust of the canopy. "Hands up" should only be given if there is enough height to stabilize the glider before the pilot reaches the ground. This cannot be assumed if the GND is below approx. 15 m (i.e., in the last part of the cross glide and in the final glide). At this altitude the pilot would crash into the ground with full acceleration (swinging). Fatal accidents occur again and again in this way, and two student pilots have also died in this way during training. It is clear that such an extreme situation near the ground is never without consequences. So it is a matter of damage limitation. And the damage is usually less if the pilot does not hit the ground in an accelerated forward pendulum movement, but in a backward movement or vertically on the protector. The radio instruction in this situation (and in the case of ruptures in the approach close to the ground) should therefore be "grasp, hold" or "grab the risers".
If during a landing approach of a student pilot it somehow looks like "flying too slow", "steering too aggressively or with deep brakes" (or if there is a clear wind gradient), the instructor must react immediately and devote himself entirely to that pilot. Do not look away and hope that everything goes well!

Of course there are also cases in the landing approach where students do not follow the radio instructions and fly "somewhere". Often there is contact with obstacles or an uncontrolled

outlanding. By far the most common **control error** is too steep a turn with high banking/pre-noddingof the canopy and crash on the ground in the pendulum.
Several times accidents have been reported where the student pilot has **incorrectly** executed a **radio instruction** - stupidly in situations where precise following would have been important.
Instead of turning 90° to the left into the final glide, the direction was only changed by 45°, which ledto contact with the tree and crash from the tree. Instead of turning 180° (because it carried a lot in the cross approach), a 270° turn was flown, which caused a crash into the slope with tailwind. These and similar are the accident descriptions here.

What can a flight instructor do to prevent such accidents?

The student pilot must be familiar with the control technique for flat turns. It is best if he has already learned this in the simulator before the first higher flights.
Flat turns from the starting position (direct steering): Look + moderate weight shift + outside brake only on pull, possibly release slightly + steering line soft to the inside. After initiating the turn, apply outer brake slightly, at the end of the turn, both brakes in home position
*Flat turn from slower airspeed (indirect steering): View + moderate weight shift to the inside, release outer brake gently, inner brake remains. After initiating the turn, apply outside brake slightly, at the end of the turn, both brakes in home position - leave weight on the inside of the turn to prevent rolling. (DHV video tutorial on https://www.youtube.com/watch?v=BXTitaewb7E&list=PLqnmbqFjp5-Rqj9qfR5djCcVPxQqqDmjf&index=17)The instructor should make sure that all students know what a change of flight direction by 45°, 90°, 180° means. Infact, problems have arisen here because students have believed that 180° means a full circle. So let's clarify this in advance. And very important: Especially in stressful situations the direction is important. So don't just "turn 180°", but "turn 180° to the left, again into the cross approach", etc. Never before has anyone become a sovereign lander who has not really mastered **the angular bearing method.** This takes time and requires a lot of consistency, even from the flight instructor, who has to demand direction finding from his students again and again.*

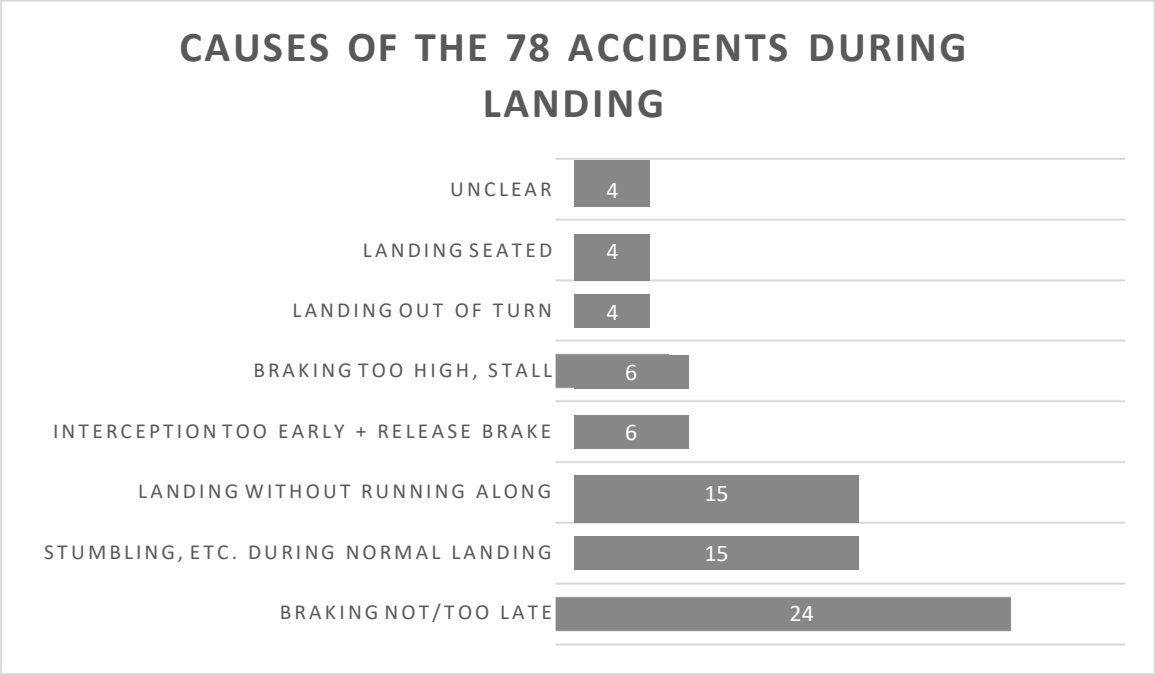
Collisions during landing approach are super-critical. The colliding gliders usually get completely out of control. The danger of serious or fatal injuries is high. The landing approach is the center of gravity in collisions. Sure, everyone in the air has to go there at some point.

What can a flight instructor do to prevent such accidents?

Consistent training of landing procedures with the flight students is the most important preventive measure here. Because the standardized landing procedure is prescribed precisely for this purpose - collision avoidance.
There's a pattern to the landing collision accidents. For one thing, there was always a lot going on. Not without reason Bassano is the hot spot in this respect. ***If there are 50-60-70 pilots in the air, of which 5-10 always approach the landing site, a safe training operation cannot be carried out****.*

Secondly: The flight instructors had several students in the air. Therefore they were not able to take care of the student pilots in the landing section all the time. Above flying student pilots demanded part of their attention. Creating the time to continuously observe and guide each student in the landing pattern and during landing is therefore a particularly important safety measure when other pilots are in the airspace. Ideally, a second student pilot is still in the air under the control of the instructor at the take-off site until the first student pilot has landed safely. This should apply in any case for beginner students, i.e. for the first approx. 25 high altitude flights (up to the training level Flight Mission). ***Student-flight tapes*** *(included with every DHV training certificate) should always be used when other pilots are in the air.*

Landing



The actual landing is calculated in this analysis from the last part of the final approach. The individual accident scenarios are often mixed up here. Clear accident focus: The final braking, or braking through, does not occur or occurs too late (after touching the ground). Consequence; too high landing speed with crash and mostly an injury of the legs/feet. The category "Landing without running" can also be partially attributed to insufficient braking / through-braking. The result is that about half of the direct landing accidents with severely injured persons can be attributed to faulty landing technique with excessive speeds.
The most common cause for such a bad landing is a too short final approach, which does not give the student (and the teacher) enough time to prepare for the landing.

What can a flight instructor do to prevent such accidents?

To get to the bottom of this question, a whole series of accident videos were analysed. In addition, many videos from the DHV flight instructor courses, where landing training and radio instruction of student landings are a main focus.
Result 1: With a sufficiently long (say at least 100 m/12 seconds), straight final approach, with timely "landing configuration", landing problems occur much less frequently.
Result 2: The characteristics and timing of interception - glide - through-braking often do not work properly. Especially the final glide brakes are often not applied.
If the interception is too deep and/or too slow, the glider will not, or too late, enter a ground parallel glide, but will continue to sink. The ground comes surprisingly fast and the braking is too late. Contact with the ground is made with still high airspeed and almost unbroken sink rate. If the flight instructor realizes that the interception is too deep (or hesitantly implemented), he must immediately instruct full braking.
If the interception is too high and/or too strong, the opposite happens. The glider glides parallel to the ground (or even rises), but too high. At the end of the glide phase the canopy wants to pick up speed again and nod forward. Now, even if the student is a bit too high, an energetic radio command to brake (through braking) must come. If this does not happen, the student pilot will descend with the canopy nodding forward in the pendulum. Great danger of injury.

The analysis of student pilots' videos shows that a 7-A landing (straightening up, approaching, looking away from the bearing, intercepting, gliding, braking, running out, dropping), consistently guided by the instructor, usually works well. If the student has to land alone, it often goes wrong. The complex procedure of the 7-A landing seems to overtax many flight students. This is due to the fact that both the intensity of the interception impulse and the duration of the glide phase differ each time, depending on the terrain (flat, hanging, rising) and the wind (much, little, carries well or badly). The student must reassess each landing when he/she has to brake or brake through, depending on the nature of the glide phase. This requires a lot of training and a thorough instructor radio supervision. It seems to make sense that in the first part of the training the focus should be on slowing/braking through, because this is where most problems are encountered in practice.
A sensible methodical approach to the 7-A landing technique is to simplify the timing of the interception-braking:

- *from the straight, stable final approach*
- *from a control position which corresponds approximately to that of the slightest sink*
- *with the feet approx. 1 m above the ground*
- *brake the glider in two directly successive steps (1. to the karabiner - 2. all the way through) to a speed which can be reached without any problems.*

In the further course of the training the landing technique should be refined step by step (especially the interception) and the simplified technique should be turned into a clean 7-A landing by the time you are ready for the exam.

When asked whether a student should release the brakes during braked final approach to generate energy for interception, the answer for safety reasons should be "no". Again the observation that this only works quite well under direct instructor guidance. A student pilot should be instructed that the glider should be kept steady, stable and pendulum-free in the final glide.

Stalls in final approach are very dangerous even from a low height of 1.5 or 2 m. The 6 reported accidents were the result of over-braking on too high an approach. In 3 cases, everything would havegone well if the students had not still flown a turn with deep brakes. On an accident video the effect of a pronounced wind gradient was impressively shown. The student pilot (without instructor on the radio) brakes slowly more and more to about a hand's breadth below karabiner height and holds thesteering lines there. The glider will sink into the strongly decreasing headwind and suddenly tip backwards into a full stall.

What can a flight instructor do to prevent such accidents?

***Above all, do not leave** a student pilot who is clearly too high for the final approach **alone.** This student needs full attention and support, because a dangerous situation can quickly develop. If the take-off from the cross glide is already too high or if the first part of the final glide carries/rises strongly, the instructor should instruct a double cross glide - if the air traffic at the landing area allows this without danger. This is actually a no-go. But it is safer than to act as a much too high student pilot in the middle of the landing field surrounded by obstacles. But this must not be used as a permanent solution. If this occurs twice in a row during the training from the instructor's point of view, more height must be reduced beforehand by stretching.*

The flight instructor should always have an idea in advance of what to do in such a case, i.e. know thelongest runway (usually the landing strip diagonal) and the least critical obstacle areas. This is where the student pilot is guided. Always initiate turns from slow flight by accelerating the outer wing (release outer brake).

Sitting landings, often from the too low curve into the final approach, often have no further consequences. The analysis shows that the protectors cope quite well with the forces that occur (which usually have a predominantly horizontal component). The situation becomes critical when a foot gets stuck somewhere on the ground and is turned back under the seat board or sideways. In the cases listed above, this results primarily in fractures of the ankle joint or fractures of the lower leg when the leg gets under the seat board.

What can a flight instructor do to prevent such accidents?

Of course, set up in such a way that there are no hard landings on the protector. If a quick "seat landing" becomes apparent, the student pilot should be instructed to lift his legs and "slip out". In this case an exercise in the simulator is also recommended. In addition to the "legs up", the upper body must also be laid backwards. Otherwise the pilot will straighten up around the pivot point of the main suspension.

Summary + priorities

Avoid starting accidents by ensuring that the take-off decision is only made when favourable conditions exist for the take-off run. If not, abort take-off consistently. Pay particular attention to teaching a running technique that does not run after the glider, but also does not run away. And a simplification of the procedures, especially if the conditions are not optimal. Make sure that weaker flight students take their turn when conditions are generally favourable. Correct incorrect take-off run postures through exercises.
A good ground handling training is extremely important!

Prevent accidents during take-off by ensuring that there are no excessive conditions (strong or

sideways wind, gusts, wind shear, excessive thermals, etc.). counter overreactions by timely, calm and anticipatory radio instructions.

Prevent accidents in flight by discussing manoeuvres to be flown sufficiently in advance, training them in the simulator and having them attentively accompanied in flight by the flight instructor. Build up the manoeuvres methodically, start in a simplified way, increase slowly. Address the student pilots consistently with their names, so that there is no false reaction due to mix-ups. If the manoeuvres get out of control, do not hesitate to release the rescue. Thermal flights in training require a lot of attention and radio guidance from the flight instructor and should not be supervised just as a sideline.

Accidents during the landing approach thereby prevent stress and time pressure from being minimized by a rather large-scale landing schedule. Careful attention and, if necessary, correction of airspeed and turning techniques can best prevent stalls. Do not brake from both sides lower than the karabiner height. Also, because of rapid intervention in the event of a risk of collision, the landing approach of less experienced students should be observed by the instructor as far as possible.

Prevent accidents during landing by giving the student pilot sufficient time to prepare for landing during a long and stable final approach. Gradually introduce student pilots to the technique of "flown out landing", initially with a simplified version. Pay particular attention to the correct timing for final braking.

General:
The training must be terminated before the meteorological conditions become too demanding for flight students. The flight instructor must not wait until the first student pilot takes off in conditions that are too severe, but must notice this development beforehand and react. Do

not make training flights at the upper weight limit of the paraglider.
Adjust the size and setting of the harness to suit the individual student.
Pay attention to weaker motor skills and greater susceptibility to injury in very unathletic, overweight persons.
Wording of the radio instructions, especially the directional instructions, communicate in advance.

Gmund, February 2020
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