Learning from the Mistakes of Others
Skydive Arizona Accident Review, 1991 – 2011
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Since our opening in 1991, Skydive Arizona has experienced a number of fatal accidents and, of course, a lot of non-fatal ones and near misses. The rate of fatal accidents at Skydive Arizona is almost exactly one per 100,000 jumps. Since USPA and the IPC estimate the average skydiving fatality rate to be about one per 85,000, Skydive Arizona is actually doing fairly well. I attribute this to our fairly strict landing rules and the fact that out landings are fairly low risk due to the extensive open land around the DZ.

Obviously if we know what causes accidents, we can work towards reducing the frequency. Skydive Arizona's general trends parallel the National ones pretty closely. Low turns lead our fatalities, followed by pattern altitude collisions, and then by deployment collisions. Other fatalities with an apparently functional parachute add two more. These elements have caused 73%, and if we use only the past ten years, deaths under perfectly good canopies are 75% of the casualties. This matches the USPA numbers very closely. No matter how you massage the numbers, about three quarters of all skydiving fatalities in the 21st century do not involve any equipment malfunctions.

In addition to fatal accidents, we can learn a lot from non-fatal accidents and from incidents that do not result in injury, but could have. In a way this latter category is the most useful, because it is easy to de-brief someone who is not injured. By learning what process got them into a dangerous situation we can come to conclusions about how to avoid those situations in the future. In this review I will examine fatalities, then see what non-fatal accidents and incidents add to our knowledge about what might be done to reduce risks.

Intentional low turns: 24% of fatalities. Of these, four were a simple miscalculation of the high performance landing. Three involved additional problems. In one case the jumper was landing out in an area with many obstacles, but he opted for his usual high performance landing anyway and did not execute it successfully. Another jumper had his vision obscured moments before the flare point when his slider, stowed under his chin, came lose. The third was deep into a 360 plus landing, in heavy traffic, when he did an emergency turn to avoid a collision.

I think it is significant that this cause of death is, in our case, unique to males. Although women have "hooked it in" they are not represented in proportion to their numbers in the sport (roughly 25%). Ironically the two women I know personally who have died elsewhere from intentional low turns were both taking competition swoop instruction at the time. I think this goes to show that even in a highly controlled environment with education and expert supervision, intentional low turns still carry a lot of risk.

Low collisions in the landing pattern: 21%. Some of these did not occur in the way one might expect. In one case, two jumpers landing off on a long spot collided. One died, the other was severely injured. They may have had visibility problems as they turned to land

directly into the setting sun. A double fatality occurred when two very low time jumpers collided, one of them (14 jumps, in a visiting student program) spiraled into the military jumper below him, who was also fairly inexperienced. They were the last ones down from the load and the only two jumpers in the air.

The other three fatal collisions all involved heavy traffic, experienced jumpers, and one jumper turning into another's path. Of those three collisions, one involved a very experienced jumper who made an "S" turn maneuver into another jumper. It caused one side of his canopy to collapse but luckily he did not entangle with the other jumper. However, his half-collapsed canopy spun into the ground in a steep dive. A second collision appeared to be caused by two jumpers not seeing one another as they set up to land. The canopies entangled and spun down, separating just before impact but not re-inflating. The survivor was seriously injured. In the third approach collision the canopies entangled and then separated at about 100 feet. One re-inflated and the jumper landed safely, but only by good luck because his canopy recovered flying towards an open spot instead of any of the many obstacles near the landing area. The second jumper, who had caused the collision by turning into the survivor who was established on a straight final, landed under a collapsed canopy and died.

It should be noted that the collision count could have been *much* worse, with dozens of near misses and several non-fatal collisions. Of eleven landing pattern collisions when one or both canopies collapsed and/or entangled, very few people got away cleanly. It breaks down like this:

- 2 helicoptered out. High jumper hook turned into lower jumper.
- 1 heli, one ambulance. One jumper landed downwind, opposite the pattern, and collided head on with the other at about fifty feet up. Both canopies collapsed.
- 1 heli, one ambulance. Two members of the same team collided when one had to abort a low hook turn due to insufficient altitude and landed across the pattern at 90 degrees to his team-mate. They collided mere feet off the ground but at a high rate of speed.
- One dead, one heli. Two jumpers landing out failed to see each other.
- 2 heli. Two local jumpers collided at about fifty feet in heavy traffic. At least one was just coming out of a low turn onto final.
- 2 heli. Two international caliber competitors on rival teams collided about 150 feet up as they approached the landing area. Both teams had landing styles that involved lots of toggle turns to set up their landing. Both teams had been warned of the risk created by these styles. Both landed under partially collapsed canopies.
- 1 dead, one heli. Two jumpers collided in heavy traffic while maneuvering to set up their landing. One may have been executing a 270 to final.
- 1 dead, one unharmed. A jumper making a 90 turn to final did not see another skydiver already on final and turned into him. I observed the collision and believe the dead jumper was focused on the landing area, to his right, instead of incoming traffic to his left.
- 2 dead. One relatively inexperienced jumper spiraling under canopy to lose altitude in the pattern overtook a second jumper from above.

- 1 dead, one unharmed. Two experienced jumpers on a 100-way collided when one S turned on final.
- One heli, one OK. The jumpers collided fairly high, perhaps 300 - 400 feet. One canopy did not fully re-inflate and the jumper suffered a broken femur and other injuries.

I think most skydivers greatly underestimate just how dangerous canopy collisions are, especially how little it takes to cause a wrap or collapse a canopy. In our collisions, only three of 22 people (14%) involved escaped unharmed, and that was simply dumb luck. **86% of people involved in low collisions where one or both canopies collapsed or entangled died or received severe injuries. Six of 22, or 27%, died.**

We have many near misses for every hit. Clearly two conclusions can be reached. One, ***any*** turn in traffic significantly increases the chance of a collision. Two, never assume you know where all the traffic is. Beyond the fact that target fixation may have prevented some of these jumpers from spotting the person they collided with, a skydiver has a very large blind spot below and behind, which is where they are going in any turn over 90. They also have a very large blind spot above and behind, which is where people in steep descents will be coming from. In any situation when two parachutes are in the air, the only good strategy for collision avoidance is to minimize turns, keep descent rates fairly neutral, and fly only in a logical, easily understood landing pattern.

High collisions at break-off: 14%. Two jumpers were killed on a competition CRW jump. The last jumper out opened with a 180 and collided body to body with the third person to exit. Both lost consciousness when they collided and descended under uncontrolled canopies. A second fatal collision was on a two-way where neither person tracked adequately. Again, both lost consciousness in the collision. The survivor landed unconscious and had severe injuries. The third fatal collision was a camera man who, instead of deploying in the center at break-off, followed a skydiver down into the break-off from an incomplete larger formation, about a twelve way if I recall. He collided with a deploying parachute and was killed when his head struck (and amputated) the leg of the skydiver below him. This could easily have killed the second jumper, who landed unconscious from blood loss.

There have been several non-fatal collisions at break off and several freefall collisions that resulted in injuries. Again, it is just dumb luck that our numbers are not higher. There does not seem to be a direct correlation with the size of the group and the rate of collisions. We have had break-off collisions on a 2-way, a 6-way, 4-ways, and on 100-ways. We have had them between members of the same, highly experienced team. We have had them between cameramen and their teams. Although high wing loading was not a factor in the fatal collisions, I believe the speeds modern canopies open at, and fly at with brakes still set, is a contributing risk. Add to that the propensity of many modern designs to open off-heading and you have a fairly dangerous situation whenever two jumpers open less than a hundred yards apart.

Malfunctions: 14%: One skydiver jumping fairly obsolete gear with a closing loop that was too long apparently experienced a horseshoe with her main and deployed her round reserve into the main. They entangled and she landed with no inflated canopies. Another experienced a spinning malfunction, which he did not resolve immediately. He cut away and deployed his reserve too low for it to inflate. A third had the misfortune of having a suspension line catch on a poorly set grommet on a main closing flap. The main was cut away but remained tied to the rig. He attempted to deploy his reserve but it entangled with the main and he died after impacting under the tangled canopies. Another was a military jumper landing under a two canopy situation. It turned into a down-plane a few seconds before impact, the jumper struck a cinder block wall, and he died later from the injuries.

Of these four, only one falls into the almost unavoidable bad luck category, that in which the faulty grommet caught a line. However, even that could have been prevented had his equipment been thoroughly inspected in time to catch the problem before it happened. In a very similar, non-fatal instance, an experienced jumper with well maintained modern equipment had a suspension line half-hitch itself around his right main closing flap, catching on fabric below the plastic stiffening plate. Unable to free his main after cutting away, he deployed his reserve. It inflated but the main obstructed the nose. The reserve descended in a nearly stalled configuration but the jumper survived with two broken legs.

The last incident illustrates that sometimes there really is an element of bad luck – in less than five percent of all high-risk incidents. That leaves 95 or more percent of accidents preventable.

It is interesting to note that although we log over one hundred malfunctions annually, one every 900 jumps on average, very few of these result in injuries of any kind, let alone serious ones. I attribute this to the fact that in the last two decades equipment has become very standardized, and so have emergency procedures. Thus what was once a major risk a generation ago has become almost a non-event. While I would never suggest that we reduce the amount of time spent on malfunction procedures, I will suggest that if we applied the same standardization of procedures to flying our perfectly good parachutes we might see a similar reduction in risk.

Incidentally, our numbers show that malfunction rates go up geometrically with wing loading. It is very uncommon now for malfunctions to be the result of structural problems such as broken lines or torn panels. The most common by far is spinning malfunctions caused by line twists or brake releases during opening. Of the malfunctions experienced by non-student jumpers in 2009, 46 of 112 were spinning malfunctions and/or line twists, and another 11 were due to brake problems, six premature releases and five unreleasable. The incidence of brake problems seems to have gone up significantly with the advent of velcroless toggle systems.

In 2010, non-student malfunctions numbered 117. 54 were spinning malfunctions and/or line twists, 20 involved brake problems.

Both years posted 11 total malfunctions, mainly due to error in packing or deploying the pilot chute.

Anyone who wishes to avoid malfunctions can do so through two simple actions. One, stay under a 1.4 wing loading. Just under one third of our malfunctions in the past two years were at 2.0 or higher loading. About six percent of our jumpers are at this wing loading. I am certain they do not make one third of all jumps.

Half were on wing loadings above 1.7, which represents a little less than 20% of our jumpers. Two thirds of the malfunctions were at 1.4 or higher. Yet according to our boogie records, two thirds of all our jumpers are *under* a 1.4 wing loading. Without knowing just how many jumps are made at which wing loadings, we cannot make an exact conclusion, but the correlation is still pretty obvious.

Two, learn exactly how all of your gear works and maintain it carefully.

Landing problems not involving low turns: 7%. One never flared, apparently distracted by traffic, and suffered severe head and neck injuries. The other entered an apparently unintentional turn at a couple hundred feet and did not recover. The equipment revealed nothing unusual but the suspected problem was that her steering line may have somehow locked in a turn position because her slider was down at the steering line guide ring. In other words, the eye of the brake setting somehow interacted with the slider grommet and steering line guide ring to trap the line in a half-brake position. This event is thought to have caused another fatality elsewhere. Jumpers should be trained to know exactly how their risers, slider, steering lines, and toggles work and interact, and use them as the manufacturer intended.

We have had several serious injuries in this category, from simple and obvious causes such as flying into obstacles, to more subtle dangers such as accidentally dropping a toggle at flare altitude. In addition, dust devils have caused three serious injury accidents and several minor ones.

No pull/low pull: 1, or 3%. This skydiver released her pilot chute a moment before impact while freestyle skydiving. The group she was with reported that she had altitude awareness issues in the past. Her camera flyer nearly went in with her, getting open at probably well under 200 feet. This was before AADs were common. Since audible altimeters and AADs have become common, we have had few close calls of this type.

On the subject of low/no pulls and AADs, we have had numerous AAD fires but nearly all were due to loss of altitude awareness and occurred after the main deployment was initiated. This is compounded by the fact that CYPRES AADs are known to fire as high as 1200 feet if the jumper is in a stand-up position under a sniveling main.

This two-canopy out situation has happened dozens of times but miraculously has not resulted in many injuries and only one fatality.

We have had three saves by AAD that are legitimate. In one case, the jumper hit his head on the Skyvan deck at exit and remained unconscious through the freefall and the reserve ride. The CYPRES performed as designed and undoubtedly prevented his death. Luckily he was under a large reserve and it landed in an open area. (In a similar instance at a boogie away, a jumper performed a “gainer” style exit out of one of our Otters and hit his head on the deck. He remained unconscious until impact, without an AAD to save him.)

The second save occurred on a large formation (200-way.) The jumper did not properly secure his leg strap and on deployment he experienced a spinning malfunction under a highly loaded canopy. The harness shifted because of the loose leg strap, which probably also caused the spinning malfunction. He was able to cut away at a low altitude but could not find the reserve handle. Again, the CYPRES did its job.

In the third incident, the jumper broke off from a head-down jump and tracked away, still facing the center, without clearing the space behind him. He tracked into another jumper and hit the back of his head and neck against the legs and hips of the other jumper. The impact temporarily paralyzed him. Although he did not lose consciousness he said he could not move his arms to pull. The CYPRES fired as designed and he landed hard under his reserve, unable to flare. Luckily the landing was in an open field and his helmet protected his head from further injury.

Our AAD saves are one per 860,000 jumps. The fact that there have been many other AAD fires as the main was deployed suggests that had those jumpers been less aware, they too might have been saved by AADs. While 15% of our jumpers have made the calculation that an AAD is unnecessary or might actually increase risk in some scenarios, the field record suggests that AADs are probably a good idea for anyone who can afford them.

Low pulls have become increasingly rare as audible altimeters have become more common. In addition, AADs, and perhaps to some extent modern canopy designs and freeflying, have induced jumpers to pull higher than they did 20 years ago.

Finally we have some deaths that do not lend themselves to classification very well. These are events so unlikely that most skydivers will never confront them and could not very well prepare for. Each claimed one life.

A very experienced jumper made a successful FS jump with several others and showed no indications of a problem throughout the jump. She tracked off at the correct altitude and deployed. Both toggles were released, and immediately afterward she must have lost consciousness. One hand remained in a toggle, putting the canopy in a steady spiral all the way to the ground. It is unclear from the medical examination if she died under canopy from a medical problem, or from impact.

A skydiver using a PISA Pintail experienced a total collapse of the canopy a couple hundred feet above the ground. There was no sign that it was caused by a dust devil, wake turbulence, or other exterior causes, nor was he performing extreme maneuvers as

shown by two different videos. The canopy collapsed from the center of the leading edge outward and essentially flew over its own nose which presented the leading top skin to the wind. The Pintail was considered a radical design and may have been fundamentally prone to collapse.

A representative of a well known canopy manufacturer was jumping a 40 square foot version of the company's high performance model. The canopy had been jumped several times by directly deploying from the plane, then cutting away at a normal deployment altitude leaving the jumper with a complete rig, main and reserve. On this jump the canopy went into a hard spin on deployment. It is speculated that the G forces from the turn rate would have made it impossible for the jumper to cut away and caused him to black out after a few seconds. He rode the spinning malfunction all the way to the ground with no sign of consciousness.

It is important to acknowledge that many more skydivers might have died at Skydive Arizona, and no doubt around the world, were it not for luck. Similarly, many of the skydivers evacuated by helicopter after collisions could well have died if the response had been slower or the trauma centers less capable. We are very fortunate that Eloy Fire Department is close by and very capable in their emergency response.

To emphasize this point, we have sent several skydivers away by helicopter who were barely alive and remained in comas for several days. Some are still suffering deficits from the injuries. We have had one near fatal break-off collision and eleven helicopter evacuations due to pattern collisions. A collision avoidance turn at flare altitude resulted in permanent brain damage. Low turns, intentional or not, have generated several more helivacs, as has one canopy collapse and one dust devil causing a canopy to dive into the ground. Had things gone more badly in any of these accidents our fatality rate would be significantly higher than it is. In at least a dozen cases it could have gone either way, but the skydiver lived.

The Local Knowledge Factor

A fascinating footnote to these numbers is that an estimated 40% of the jumps made at SDAZ are by locals: 20% through the school and another 20% from experienced jumpers in the Phoenix and Tucson areas. Only 9% of our fatal accidents happened to locals.

Visiting jumpers are 5.1 times more likely to die on any given jump at Skydive Arizona than local jumpers.

Locals, 1 every 346,667. This is a fourth of the national and global average.

Visiting, 1 every 67,829. This is 20% worse than the national average. I attribute some of this to "boogie fever." People arriving here like to go big, many bite off more than they can chew, planning is sometimes poor, and some may be at less than peak condition due to fatigue. But many are also simply poorly prepared, and a weak skill set that might

not kill them at a small drop zone can certainly kill them at a big one.

What do our locals know that visitors do not? Home-grown jumpers are taught from the start to be acutely aware of ground speed and exit separation, master tracking, use modern pattern techniques, and so on. There is heavy peer pressure to use caution when downsizing (especially in consideration of our density altitude issues) and to fly an intelligible pattern. Finally, besides education and peer pressure, we have an active intervention policy when jumpers exhibit unsafe behavior. We insist that our rules be followed. If Skydive Arizona is doing something right, it means that the death rate in the sport could potentially be reduced by a factor of four if other drop zones would show similar initiative.

Incidentally, all three of our local fatalities were low turns, two of them intentional.

Clearly, visiting jumpers are at much higher risk, 5.1 times more likely to die than local jumpers. Why? Reviewing the causes shows the common denominator is poor training. In fact of all our fatalities only three suicides (not counted as accidents and therefore not counted in this study) and the medical problem seem to be unavoidable, although I grant that some of the others involved an element of bad luck as well as bad judgment. The death from two canopies out is an example. He didn't really do the wrong thing, but he didn't do the right thing either.

Low turn or no flare:7. I'm placing the guy whose slider went over his face in the gear category.

Low collision: 6

Selection, maintenance, or improper use of gear: 5.

High collision: 4

Low pull or low cutaway: 2

Inability to resolve two canopies out: 1

It seems obvious that almost all of these could have been prevented by better training. Altitude awareness, adequate separation at break-off, pattern work to manage traffic, solid canopy skills, and clear understanding of exactly how equipment works are – or should be - fundamental elements of training. They are obviously not emphasized sufficiently by some instructors and drop zone managers. Why?

Non-fatal Trends

The accident pattern holds for non-fatal accidents and is especially apparent in another data set we keep: safety briefings. The vast majority of these briefings, like our injuries and fatalities, are to visiting jumpers. A safety briefing is done when a safety officer observes behavior that could have resulted in an accident but did not and speaks to the

jumper about it. Most are canopy flying issues, and probably only one infraction in five receives a briefing since we are simply too busy to address them all.

For the years 2009 and 2010, the list of main safety briefing topics looks like this:

- Landing opposite the traffic pattern – 99 incidents
- Low turns – 80 incidents. I would estimate that most, perhaps as many as two thirds, are unintentional. We will refine our methods to determine this.
- Flying at an angle across the pattern, usually due to chasing the wind indicators but sometimes pulling out of a turn too low to make the final pattern – 59
- Turns in excess of those allowed in our landing areas – 45
- Crossing the centerline – 44 (A left pattern to the right side of the landing area, or vice versa)
- S turns – 37

In addition, I do preemptive briefings about overshooting to the west whenever the winds are light and variable since this is a common mistake at our dz. With the additional 52 assorted briefings on other canopy piloting issues, the two year total comes to 416. Assuming my rough guess that less than one in five infractions gets a briefing, we are looking at over 2,000 dangerous canopy piloting errors in two years, any of which could have resulted in an injury or death. That works out to about one in a thousand jumps, but the reality is that it is far higher. It's just dumb luck that keeps most jumpers out of the hospital or morgue. And again - it is not our local jumpers that need most of the discipline and attention. It is visiting jumpers. Skydive Arizona just can't give every jumper a thorough canopy flying course. But that *can* be done at their home drop zone, before they ever come to ours! And it should be.

At the heart of it, I believe that complacency is rampant, and canopy skills are probably the most glaring example. Many instructors don't even know that what they teach is obsolete if not downright wrong. S turns and spiraling in the pattern are classic examples of things that new skydivers should be taught to avoid at all costs, but many "expert" skydivers still employ these dangerous tools regularly and teach them. In fact in the 27 pages out of 243 in the Skydiver's Information Manual that address canopy skills, they are *never* recommended. Category A and B explicitly warn against S turns. That's first jump course material! The modern SIM also makes it a point to de-emphasize landing into the wind from the very first jump course and gives excellent reasons why, yet many skydivers are still taught that landing into the wind is of fundamental importance.

The SIM actually has very good, current suggestions about safe canopy flight, yet they are being ignored by a significant number of instructors and coaches.

Another area where complacency is implicated is in equipment maintenance and operation. From debriefing many incidents, it is clear that a lot of skydivers do not have a clear understanding of how every element of their equipment works. I would suggest that every time a jumper gets a new piece of gear, they also get a detailed inspection and review of all the components, not just the new one. Once a year during a reserve re-pack

would be another good time to go over every inch of the main and container with the rigger before having the reserve done.

Root Causes of the Canopy Problem
The most common problems seen in the briefings are a direct result of poor pattern planning. Landing opposite traffic means they misread the situation and set up in a position that did not allow them to safely enter the pattern. Low turns are sometimes intentional, but most are unintentional as the jumper attempts to adapt to the pattern too low once they realize they have set up the wrong way. Most of the other problems also stem from being out of position in the pattern. This in turn leads to the two most common causes of fatal and non-fatal accidents, low turns and collisions at pattern altitude.

Our prevailing weather condition, light and variable wind, is definitely a contributor. In many cases they think landing in their primary target (the grass) is more important than landing safely, so even if a viable out landing is possible, they do not always use it. Although the SIM explicitly states that in such conditions a pattern is more important than landing into the wind, this is not the emphasis that the average skydiver is getting. ***In fact, when the SIM reviews the top four safe landing priorities, landing into the wind is not even mentioned.*** I agree with that position.

High performance turns, S turns, crossing the centerline, and chasing the wind indicators are typical of people who were taught to fly as though there was no one else in the air.

Moving Towards a New Paradigm
Altitude awareness, adequate separation at break-off, better pattern work to manage traffic, and better canopy handling skills are fundamental elements of training. USPA has done a great job with the training materials, emphasizing safe canopy flight from Category A on. But this material is not adequately emphasized by many instructors and drop zone managers. Why?

Part of it is that many “expert” skydivers apparently train new jumpers to their environment. In other words, if they jump at a drop zone with limited lift capacity, very limited traffic, and a huge landing area, novices may not be given a strong enough emphasis on break-off skills or how to fly a canopy into an area with lots of traffic and/or few outs. These trusting, low time jumpers do not even know how weak their skill set is until they come to a drop zone where the opposite conditions prevail – lots of people in the air, all the time, and a limited landing area. They find themselves without the right tools to deal with these challenges.

How do we get instructors to realize that *how* you land is much more important than *where* you land? Setting up the final approach too close, too high, or in disregard to other traffic are fundamental mistakes that obviously date back to the day when precision accuracy was a priority and there were few if any other jumpers in the air. On a modern drop zone these are tactics that are causing the low turns and the collisions. Jumpers are still taught to solve their landing problems on final, whereas they really should be taught that the major adjustments take place on the entry leg, the fine tuning is on the base leg,

and the final is *always* straight unless a collision with an obstacle or canopy is unavoidable otherwise.

At the other end are the instructors at high wing loadings busting out huge turns, often in traffic. *Both* are major factors in the national body count, and both are routine at many drop zones. Our canopy collisions have included two people with less than 30 jumps, and very current skydivers with thousands of jumps. To emphasize how pervasive this problem is, just hold a Safety Day seminar about canopy traffic. The swoopers will blame the old school jumpers for the traffic issues, and the old school jumpers blame the swoopers.

In other words, instructors and other "expert" jumpers at some drop zones are setting their students up for disaster and don't even know it. Not only that, USPA's review* of experience levels for these accidents reveals that clearly a lot of "expert" jumpers also do not have the skill set to step out of their standard jump environment, whether it be landing out at their home dz or creating a collision situation when they go elsewhere. The mean jump numbers for these fatalities is over 1,000! To me that indicates that countless hundreds or even thousands of skydivers are essentially time bombs – or maybe "air mines" would be a better term – waiting until just the wrong set of circumstances combines to create a situation where they simply lack the skill and judgment to escape alive.

Concrete Steps to Reduce Accidents

When we combine the nature of the accidents at Skydive Arizona with the fact that most of them occur to non-locals, the obvious conclusion is to take aggressive steps to educate visiting skydivers, and ideally to have them take home better safety practices than they came with.

- Make sure every jumper has a clear understanding of exit order and separation, including the importance of ground speed. As a back-up to freefall separation, jumpers leaving early on multiple group loads should carefully check up the line of flight before turning towards the drop zone.
- Teach flat tracking skills and increase attention to break-off. Dives with a weak plan or a low likelihood of success will contribute to disorder at break-off. Skydivers should focus on carefully planning a dive with a high chance of success and stick to the plan. Of our fatal break-off collisions, two (half) took place on "garbage loads."
- Unintentional low turns and pattern altitude collisions can be greatly reduced by more attention to a distinct pattern that is designed to ensure the jumper has a clear runway that will not require low maneuvers to avoid obstacles or other jumpers.
- Intentional low turns can be reduced by increasing awareness of just how dangerous this maneuver can be, especially as jumpers downsize.

- Few if any skydivers are injured by too much parachute overhead. The culture of downsizing needs to be de-emphasized.
- An apparently insignificant gear problem, such as a badly set grommet or closing loop that is worn or too long, can kill you. It should go without saying that your life support should receive very careful attention. As with canopy flight, complacency seems to be the problem.

Of all the things skydivers can do to reduce accidents, I can not emphasize enough that ***every turn you make, for any reason, increases your odds of an accident.*** Spiraling in the pattern and playing under canopy at any altitude is dangerous. S turns in the pattern are also high-risk. Furthermore, "the more you turn, the less you learn." Turns create a constantly changing descent rate and picture of the pattern, making assessment of the environment a challenge. Canopy maneuvers should be discouraged except on solo jumps or with attention to separating jumpers in time and space.

***Statistical Background - National**

The following paragraph is copied directly from the USPA web site.

Background—Of the 300 fatalities from 1999 to the present, 158 (53%) were canopy-related. That is, 158 fatalities were due to accidents that involved a fatal landing while flying a fully inflated parachute during some (in the case of a collision), or all of the canopy descent. Additionally, the low cutaway/low reserve deployment category is also included in these figures, because many of those fatalities occurred after a jumper lost a large amount of altitude in a short time due to a spinning malfunction, under a highly loaded main canopy. The types of canopy-related fatal accidents are broken out below into five categories. Presented within each category are two types of averages (the mean and the median) of the number of jumps of each involved jumper. The mean is what most of us think of as the "average;" the median is the actual middle value in the list of jump numbers.

- Intentional Low Turns—43 fatalities, typically jumpers with several hundred jumps or more trying to swoop. Number of jumps: Mean is 1,489. Median: 1,000
- Canopy Collisions—38 fatalities, some caused by being too close on deployment but most are collisions at pattern altitudes. High-performance approaches resulting in striking slower-flying canopies are on the rise. Number of jumps: Mean is 1,490. Median: 850
- Unintentional Low Turns—32 fatalities, typically trying to turn into the wind or avoid an obstacle. Number of jumps: Mean is 706. Median: 200
- Landing Problems—32 fatalities, mostly striking obstacles and bad landings, many are related to off-field landings. Number of jumps: Mean is 1,419. Median: 450
- Low cutaway/low reserve deployment—13 fatalities, many of the low-cutaway fatalities involved higher wing-loaded canopies where a great deal of altitude was lost in a short time under a spinning main canopy. Number of jumps: Mean is 922. Median: 96

Currently, canopy-related fatalities are 76% of total fatalities in 2010.