Parachute Technology Update

Misconceptions about parachutes

by Betty Pfeiffer and Bill Gargano

As a result of recent conversations and discussions during parachute repack seminars for hang glider pilots we have been able to identify several misconceptions that people have regarding parachute design, performance and standards. Current advancements in computer aided design, materials, construction techniques and testing facilities have advanced our understanding of parachutes. Many earlier beliefs no longer apply or have proven to be false.

This article we will present some short answers to very complicated questions.

Many earlier beliefs no longer apply or have proven to be false.

Fallacy

The number of gores in your parachute tells you how big it is

Background

In the early 80's we at High Energy Sports were producing several sizes of parachutes. When a customer would call and ask about his/her parachute the easiest way for them to describe it was to count the number of lines. Since each line was connected to a gore we called the parachutes HES-20, 22 and so forth. At that time, in order to make the most efficient use of the material available, most manufacturers were using a triangular gore with similar width, height, and area. By counting the number of gores you could get a rough idea of the total parachute area. Total area is an accurate method for comparison of different parachute designs, however, the more sophisticated designs have shaped or curved gores, invalidating the "gore counting" method for finding total parachute area.

Fact

The number of gores, date of manufacture and/or serial number may identify the parachute to the original manufacturer. The manufacturer can tell you the total parachute area, the nominal diameter and the shape of the parachute. The parachute design baseline, materials and construction techniques determine the shape of the gores, size of the gores, number of reinforcements, number of lines, length of lines, and all other design parameters.

More information

The parachute industry standard for measuring and comparing round parachutes is based on the *total surface area* of a parachute independent of the parachute shape.

The total surface area is symbolized by the term *So*. Nominal Diameter, symbolized by the term *Do,* is the diameter of the total surface area. The nominal diameter is expressed by multiplying 1.1284 times the square root of the total surface area (1.1284 x **So*).

This, coupled with the drag coefficient of the particular parachute, allows for the comparison of the performance of any and all round parachute designs.

Fallacy

All parachutes of the same "size" are equal.

Fact

Parachute design is like hang glider design each one has its own unique flight characteristics. Some designs are inherently more efficient than others, but may or may not be good for a specific application.

More Information

Parachute designs must be approached with a clear design goal and an understanding of performance tradeoffs associated with each design decision. For example, strength requirements must be considered when choosing lightweight construction techniques. Designing a parachute for fast openings may affect stability. Choices made regarding the design can result in radically different performance characteristics in parachutes of the same size.

Fallacy

You should not fly alone with a tandem chute if you are a light weight. Your parachute could be too big for you.

Fact

This fallacy is founded in the belief that parachute opening distance is affected by suspended weight. The real factors are (1) the acceleration of the pilot, which is related to weight, and (2) the length and volume of the parachute system. Heavier pilots will accelerate faster than lighter pilots, thereby slightly shortening opening time, but the opening distance remains the same.

More Information

The distance that it takes for a parachute to open is related to "fill volume", i.e. the volume of air entrapped by the open parachute. The time it takes to open is related to the velocity or acceleration of the pilot. A more important consideration related to size is whether or not the size of the parachute is large enough to slow your descent for a safe landing.

Fallacy

A 22 gore parachute is fine for tandem flight

Fact

Parachute area and performance characteristics are the important factors in determining the suitability of a parachute for a particular function. A 22 gore parachute may be fine for tandem as long as it has a large enough area and the flight characteristics you need. A different 22 gore canopy may be very small and not capable of withstanding the stresses of opening with 500 pounds suspended weight. Even if it did open without incident, the rate of descent may be very fast if that particular design was meant for a single person A different design may even have fewer lines but be constructed specifically for the stresses of tandem deployment and descent. Once again, you cannot tell the performance of your parachute just by counting lines.

More information

One PDA with 22 gores has a <u>surface area of 302 square feet</u>, therefore a <u>nominal diameter of 19.6 feet</u>. A tandem flight could be considered to have a suspended weight of approximately <u>450 pounds</u>. With no coincidental drag (that drag contributed by whatever is left of your glider) this system will have a descent rate of <u>32 to 34 feet per second</u>. **This landing would probably be tough to walk away from.**

Fallacy

The longer the parachute bridle the better.

Fact

A hand thrown canopy deploys in this sequence: full bridle extension, full line extension, full canopy extension. A rocket or air deployment system uses just the reverse order of extension. The longer you construct any part of that sequence the further you will have to fall before you will get full canopy inflation.

More information

There continues to be disagreement on the optimum length of bridles. If your bridle is too short (under 20 feet) you may have a problem clearing the glider on deployment. An extra long bridle will take that much longer in distance and therefore time to gain full line and canopy extension.

Fallacy

Your parachute must have V-tabs

Fact

V-tabs are used to direct the peeling forces from the suspension line on the outside of the radial seam to the inside. They also help to distribute the load at the line attachment There are other construction techniques which can do the same thing without using the conventional V approach.. If you have any question as to the need for V tabs on your parachute consult the manufacturer.

Fallacy

Two parachutes are better than one

Fact

The deployment of two parachutes always runs the risk of entanglement, thereby compromising your rate of descent. It's better to keep the single parachute if the combination of your disabled hang glider and one parachute is stable and controlled. A radically spinning or unstable situation may be helped by the deployment of a second parachute.

More information

If the first one doesn't work, maybe the second one will. Or the third if you carry three. But some days nothing goes right.

Fallacy

Your parachute will bring you down slower if your glider is broken

Fact

If you have deployed your parachute and then found that your glider is still intact, you should under no circumstances try to break your glider. Instead, try to fly the glider down. If this is not working, try to fly by climbing into the control bar and steering with your legs. When preparing to land, flex your knees and give a good flare.

More Information

With a given system weight, parachute drag is consistent whether it is traveling horizontally, vertically or any other direction. The direction and velocity of the system weight is what dictates the direction of the parachute. The parachute will always be behind the system weight. If the hang glider is intact, the parachute will be behind the system weight at an angle equal to the complete system angle-of-incident. The drag of the parachute reduces the flight envelope of the hang glider, but does not stop the hang glider from flying. The lift from the flying hang glider compliments the parachutes drag and therefore provides a slower rate-of-descent and shallower angle-of-incidence than if the hang glider was not flying. If the hang glider is broken in such a way that it is not providing any lift, the parachute will bring the complete system straight down and at a higher rate-of-descent. An important parameter when selecting a parachute is a suitable rate-of-descent for your total system weight.

Fallacy

You can always get your chute out.

Fact

If you cannot deploy your parachute you do not have an emergency reserve system. There have been several incidents where the pilot either waited too long to deploy his chute or could not get his chute out.

More Information

We believe that practicing parachute deployments in a simulated environment and NOT in flight is the best way to assure that you can get your parachute out. A good mental image of your emergency procedures, rehearsed internally on a routine basis, can be invaluable when things really go bad, and you have no time to think about what to do and how to do it. Every flight you should physically practice looking for your parachute handle and practice grabbing it with either hand. A quality parachute seminar/symposium will provide you with a chance to practice deployments in a simulator, as well as an opportunity to have your equipment checked and repacked.

Fallacy

A hang gliding parachute with a short bridle is fine for paragliding

Fact

A paraglider pilot should have a larger parachute than a hang glider pilot of the same weight. The conditions in which a parachute is needed are different for paragliding and hang gliding. In hang gliding you have the extra drag of the broken glider. In paragliding you may not. In hang gliding you have the frame of the broken glider to help absorb the impact of landing. In paragliding you do not. Paraglider pilots need a canopy that will open very fast at very slow speeds yet bring them down slowly enough to land with minimal injuries.

More Information

One of the most hazardous aspects of landing under a paragliding canopy is that the pilot is being directed to a seated position. Hitting the ground in a seated position can lead to serious back injuries. Hitting the ground in a seated position at speeds over 15 feet per second can easily lead to compression fractures or other injuries. It is for this reason that we believe the paraglider pilots need substantially larger parachutes.

With the use of advanced CAD programs, the availability of better materials and alternative construction techniques, parachute designers can now more easily focus in on the special needs of the flying community.

THE BIGGEST FALLACY OF ALL

I AM ABSOLUTELY SAFE BECAUSE I HAVE A PARACHUTE

Fact

A parachute is like an insurance policy with a large exclusion clause. Even if your parachute is properly designed, properly constructed, properly maintained and correctly deployed it still may not work.

Consider the following true stories:

- At 500 feet over the ridge a pilot is showing off for the crowd when he stalls during a loop attempt. The hang glider tumbles and the pilot cannot locate his parachute handle. He is very lucky that day because his leading edge hit the ground first and absorbed much of the impact. The pilot comes out of it with a totalled glider and sprained wrist.

• A pilot breaks his hang glider doing aerobatics. He throws his parachute. As the parachute reaches full inflation the bridle gets severed by his side wire were he had removed the cable coating for less drag. He tumbles/spins to the ground and is in a coma for 2 weeks.

• Pilot deploys his parachute which falls in an arc and swings below him. As he descends into the unopened parachute he reels the parachute in to throw it again. The parachute gets hooked on the wreckage and never fully inflates. The pilot is sore and bruised but lives to fly again.

• A pilot is convinced that the future of hang gliding is sustained inverted flight. He sets up his ridged wing hang glider with a cable base tube and traps his harness into the wires so he will not fall into the keel when flying upside down. He inverts, something on his glider snaps and he throws his parachute. During the incident a cable gets looped around his neck and the parachute gets tangled in the wreckage. Had the parachute deployed the pilot would probably have been decapitated by the cable.

• A pilot breaks his wing during an aerobatics contest. He is in a spin and throws his parachute. The parachute does not open. He throws his second pulled down apex chute. That parachute does not open either. Upon further examination of the video, it is evident that he is spinning in such a way that the hang glider is producing lift, not allowing him to get the needed speed for his 'chutes to inflate. He walks away dizzy with a sprained ankle.

• It is smooth laminar air at *Cape Kiwanda* and a pilot is doing dolphins (diving, then pulling up) to see how close he can come to the sandy dunes. He scrapes the sand with his harness (no safety locks). His parachute container opens and his canopy accidentally deploys. He is lowered to the sand, but as he picks the glider up the hang glider begins to fly in the ridge lift. As the hang glider begins to fly, the parachute yanks on the attachment point at the carabiner and slams the nose back into the sand. The nose comes up, the hang glider starts to fly, and the parachute yanks. The pilot is fighting the whole time—wishing he had a hook knife.

• Pilot is test flying a hang glider. Hang glider breaks and he throws his parachute. The bridle is only 15 feet long and the lines get crossed on the wreckage. The canopy streamers. The pilot fractures his hip.

• Pilot is doing wing overs and stalls. The hang glider tumbles, the pilot pulls out his deployment bag and it drops from his hand. As the glider tumbles the bridle line gets wrapped around the joint of the base tube and control bar. As he rotates, the parachute bridles continue to wrap up in the wreckage and the pilot has an alternating partial inflation. This repeats until impact. Pilot miraculously only breaks 3 ribs.

• *Plowshear* Pilot gets into an inverted dive. Due to extreme G force he can't get to his parachute handle. He spins in and suffers a broken arm and cut chin.

• The trailing edge of the sail rips in extremely windy conditions. Pilot throws his parachute and descends to the ground. When he hits the ground he is dragged through rocky terrain. He does not have an accessible hook knife. Afterwards, he states that he was more beaten up *after* landing than he was during the whole accident.

• In 1986, a pilot deploys his parachute at 2000 feet above the ground after having blown an aerobatics maneuver. His parachute bridle and lines wrap up as his glider spins. He stabilized and the canopy unwraps, then his glider spins and wraps up the lines. The sequence repeats itself. After several phases he hits the ground while in the middle of unwrapping and brakes both legs.

• *Brazil* A French pilot racing to goal is 200 feet short. He pulls up from a steep dive and simultaneously releases his VG. The cross bar comes out of column and breaks. He throws his parachute at 100 feet off the deck. It opens just as he hits the bleachers in a head down position. He comes out with facial injuries but doesn't achieve the goal.

• *Milan, Italy 1988* 12 pilots are sucked up into a cloud as cloudbase unexpectedly drops very rapidly. One pilot deploys his parachute but is gusted into the side of the mountains. It is presumed that he was killed on impact. Five pilots die in that gust front.

Conclusion

The number of hang glider pilots that have survived catastrophic situations with the help of a parachute is quite amazing. It is equally remarkable that the times when the parachutes did not function as expected, most pilots (through the grace of God and good Karma) have survived. Doug Hildreth estimates that in the US alone we average 20 emergency deployments a year.

The moral of the story is fly safely. Do not take unnecessary risks.

Even though you may have the hottest newest parachute or deployment system available there are no guarantees that it will work.

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